

Evolution of Diagnostic Laboratory

The Diagnostic, Cables and capacitors Division (DCC Division) formerly known as Cables and Capacitors Laboratory (CC Laboratory) during 1970's was mainly involved in testing of low voltage (LV) and medium voltage (MV) cables, LV capacitors and heat run testing of bus bars/ducts, panels as per National/International Standards. During 1980's with the induction of young engineers and scientists the laboratory initiated R&D projects related to the functional evaluation of insulation systems of power cables, power capacitors, rotating machines, traction motors and the like. The decade 1990 was remarkable from the point of view of diagnostic on-site testing and Remaining Life Assessment (RLA) studies on power plant electrical equipment. As there was no established diagnostic testing method for condition assessment of power cables, DCC Division introduced for the first time in the country Very Low Frequency (VLF) tan delta testing for diagnostic testing of XLPE power cables. The DCC Division conducted the VLF tan delta testing on 33kV class XLPE cables at Rourkela Steel Plant in 2007 and detected the manufacturing defects in the cables.

The Diagnostic Laboratory of the Diagnostic, Cables and Capacitors Division (DCC Division) is fully equipped with the facilities for conducting Diagnostic testing and condition assessment/life evaluation of High Voltage Power Equipment like Power Transformers, Hydro & Turbo Generators, Power Cables, Large AC Motors, Current Transformers (CTs), Capacitance Voltage Transformers (CVTs), Circuit breakers, Lightning arrestors etc. in service. The Laboratory has adequate experience and expertise in conducting Diagnostic testing and Condition Assessment Studies on High Voltage Substation and Power Plant Electrical Equipment in service. Diagnostic Laboratory is an accredited laboratory as per ISO 9001–2000 quality management system for undertaking field engineering services and consultancy for various utilities.

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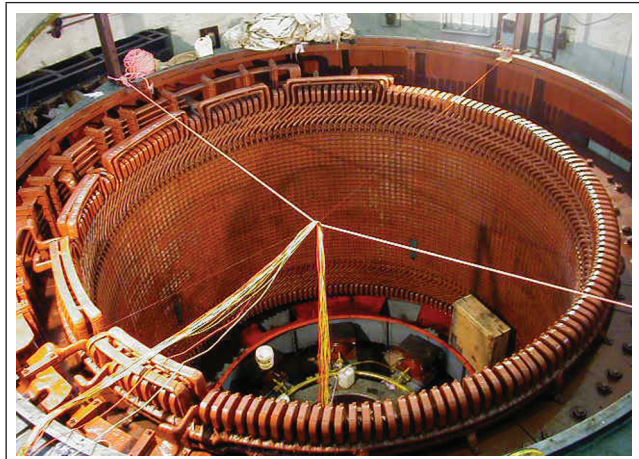
young engineers and scientists the laboratory initiated R&D projects related to the functional evaluation of insulation systems of power cables, power capacitors, rotating machines, traction motors and the like. Analysis of the functional evaluation data enhanced the knowledge base of the engineers and scientists in understanding the behavior of various high voltage insulation systems under operating stresses. Several research papers on the outcome of the projects were published in National and International conferences [1–9]. Incidentally, Karnataka Power Corporation Limited (KPCL) Karnataka was erecting 135 MW hydro generator units at



GENERATOR INSPECTION OF IDUKKI UNIT 1



VISUAL GENERATOR INSPECTION OF SABARAGIRI UNIT 4



A VIEW OF ELCID/WEDGE MAPPING TEST ON HYDRO GENERATOR

Nagjhari Power House (NPH), Ambikanagar. KPCL sought CPRI help in conducting dielectric loss angle and partial discharge tests on the stator bars of the generator units to weed out unhealthy/defective bars before inserting into the stator. The CC Laboratory readily came forward and deputed senior engineers to NPH and systematically conducted the quality assurance tests on the stator bars and contributed to a great extent in maintaining high quality in the constructing, erecting and commissioning of the generator units at NPH, Ambikanagar. KPCL supported the testing and R&D efforts of CPRI and provided an opportunity for on-site testing of stator bars and subsequently the stator windings of hydro generators. KPCL is the first organization to support and promote CPRI in the field of on-site testing and R&D.

The experience gained both in the Laboratory and at site boosted the confidence level and morale of the engineers and scientists in taking up on-site testing assignments for utilities, power stations and industries. On the basis of the field testing experience the officers of the CC Laboratory presented several technical papers at National conferences such as CBIP, ELROMA and International conferences such as COMDEM, CBIP, ICPDM and like [10–23].

Participation of the Officers at the National/International conferences, seminars and workshops provided wide publicity of the CPRI capability in evaluation and condition

assessment of power apparatus insulation systems among the utilities and industries. As a consequence, two petrochemical industries namely Zuari Agrochemicals Ltd (presently Zuari Industries Ltd) Goa and Gujarat State Fertilizers Company (GSFC) came forward to avail the on-site testing services of CPRI for diagnostic testing and condition assessment of HV motors, power transformers and power cables in service. The Laboratory seized all the opportunities and extended diagnostic field testing services to the satisfaction of the customers. Even now M/s. Zuari industries is the esteemed customers of CPRI availing diagnostic field engineering and consultancy



A VIEW OF ELCID TEST ON TERBO GENERATOR IN PROGRESS



A VIEW OF ELCID TEST ON HYDRO GENERATOR IN PROGRESS

Encouraged by the increased demand and to enhance awareness among the utilities regarding importance of the diagnostic field testing and health assessment of the high voltage equipment the CC Laboratory successfully arranged the first National Seminar on “Diagnostic testing and condition monitoring of high voltage equipment in operation” in 1990. The conference was a grand success with the participation of 130 delegates from utilities, electricity boards and industries.

services of DCCD, CPRI. Subsequently IPCL Baroda, IOCL Bijwasan, TAPS Tarapur, RAPS Anu-shakti-nagar, SFC Kota, MCF Mangalore, Coromandel Fertilizers Vizag, Texmaco Cements Ltd Pedatur in Andhra Pradesh, etc. joined the list of esteemed customers of CPRI.

In 1989 the CC Laboratory received the NRDC-1989 Independence Day Award for Innovation from National Research and Development Corporation, (NRDC) Govt. of India for having designed and developed the test method for testing of metallized polypropylene film power capacitors.

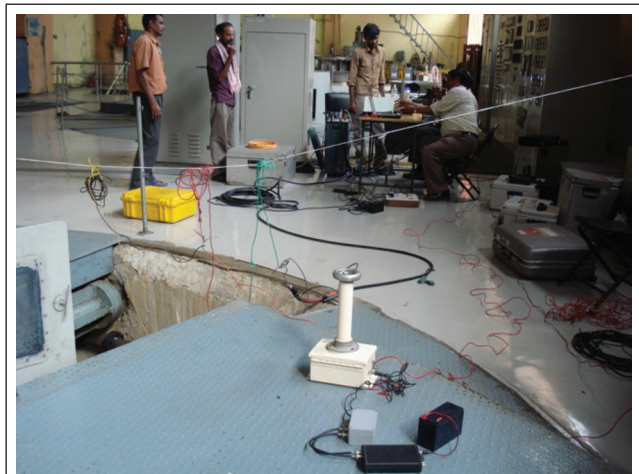


A VIEW OF WEDGE MAPPING TEST IN PROGRESS

The decade 1990 was remarkable from the point of view of diagnostic on-site testing and Remaining Life Assessment (RLA) studies on power plant electrical equipment. In 1995 for the first time the CC Lab in association with



A VIEW OF WEDGE MAPPING TEST ON GENERATOR IN PROGRESS



A VIEW OF PARTIAL DISCHARGE TEST ON HYDRO GENERATOR STATOR IN PROGRESS



A VIEW OF RSO TEST ON GENERATOR ROTOR IN PROGRESS

M/s. Sholin, Canada successfully conducted the RLA studies on the 11 kV, 155 MVA hydro generators at Idukki underground Power Station, KSEB, Kerala.

By 1998 the Power Finance Corporation, Govt. of India recognized CPRI as the vendor for undertaking the RLA studies on Thermal Power Plants in the country. The Cables and



A VIEW OF TAN- δ TEST ON CTs IN PROGRESS

Capacitors Laboratory in association with TRC, CPRI Nagpur successfully conducted the RLA studies on electrical and mechanical equipment at Hardwaganj Thermal Power Station (on 07 Nos of generator units) UPSEB, Guru Nanak Dev Thermal Power Station (02 Nos of Units) Bathinda, Tau Devi Lal Thermal Power Station Panipat, Indraprastha Thermal Power Station Delhi, Bhusawal Thermal Power Station MSEB Bhusawal and Ramagundam Thermal Power Station APGENCO Ramagundam.

The Diagnostic testing group received the Best Technical paper Awards twice from Central Board of Irrigation and Power New Delhi (CBI&P) at Kolkata Conference in 1994 and at Diamond Jubilee R&D session in 1996.

With the rich experience in undertaking RLA studies on Power Plants, the CC Laboratory added new test facilities to gear up to meet variety of problems associated with the power plant electrical equipment. With the advent of these new facilities the DCC is fully geared up for undertaking comprehensive diagnostic testing of power station electrical equipment and high voltage substation equipment.

As there was no established diagnostic testing method for condition assessment of power cables, DCC Division introduced for the first time in the country Very Low Frequency (VLF) tan delta testing for diagnostic testing of XLPE power cables. The DCC Division conducted the VLF



A VIEW OF MOBILE FIELD CT/PT TESTING VAN



A VIEW OF CONTROL PANEL OF MOBILE FIELD CT/PT TESTING



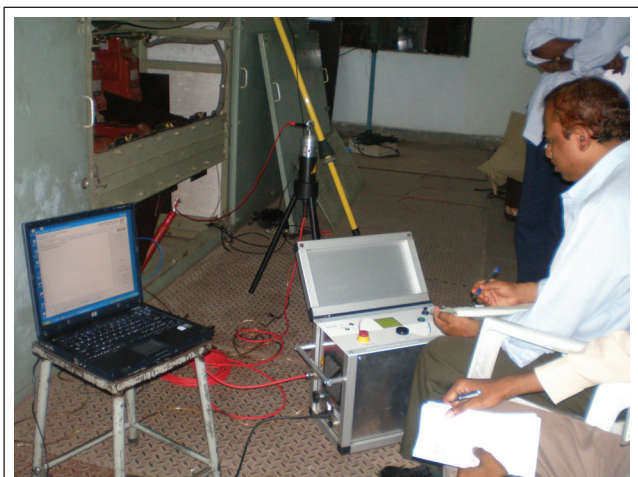
A VIEW OF ARRANGEMENT FOR TESTS ON POWER CABLES IN PROGRESS

tan delta testing on 33 kV class XLPE cables at Rourkela Steel Plant in 2007 and detected the manufacturing defects in the cables. The VLF tan δ was conducted on the 11 kV class cables for petrochemical plants also. With the advent of the rich experience gained DCCD presented a technical paper at the CIGRE-2008 Conference, Paris in 2008 [24].

Recognizing the importance of asset management in Generation, Transmission and Distribution network, DCC Division provided a common platform for all the stake holders, policy makers, power utilities, manufacturers and technologists an unique opportunity for sharing of knowledge and best practices in asset management by organizing a two day International Conference on “Condition Monitoring and Diagnostic Engineering Management of Substation/Power Plant Electrical Equipment” during November 20–21, 2008 at CPRI Bangalore. The conference was successful in enriching the Indian Power sector with the latest knowledge on diagnostic testing, O&M practices, condition monitoring and life extension of substation/power plant electrical equipment.



A VIEW OF TAN- δ TEST ON TRANSFORMER IN PROGRESS



A VIEW OF VLF TAN- δ TEST ON POWER CABLES IN PROGRESS



A VIEW OF CIRCUIT BREAKERS

In the present context of optimum utilization of the existing T&D assets in our country, there is a tremendous scope for condition assessment and Life Cycle Management/Life Extension studies on the existing Generating and T&D equipment. Recognizing the importance of life cycle management in power sector DCC Division proposed the project “Setting up of Centre for Life Cycle Management and Condition Assessment of High Voltage Substation and Power Plant Electrical equipment” under Govt. of India XI plan. As a result of these efforts, a full fledged Diagnostic Laboratory is coming up in CPRI Bangalore campus at a cost of Rs. 12 Crores.

In this era of open access to electricity markets, accurate measurement of power flow in the transmission network is of vital importance to all the stake holders. Any error or inaccuracy in the measurement of quantum of power flow can result in heavy financial losses either to the producer or to the consumer. Recognizing the importance of accurate measurement of power flow in the transmission network, CPRI, Bangalore has established the unique Mobile Test Laboratory for on-site accuracy testing of EHV class instrument transformers at a cost of ₹. 5 Crores under the Govt. of India XI plan.

With these added facilities the Diagnostic Laboratory is fully geared up to meet the demand of the power sector in the country for the next 15 years.



A VIEW OF LIGHTNING ARRESTER

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