

Mechanical Engineering Division - Vibration Laboratory

The Vibration Laboratory and Wake Simulation Laboratory are very oldest and unique in its nature, were established in Mechanical Engineering Division in the eighties. These two laboratories were come into existence under the leadership of Shri T.V. Gopalan who headed the Mechanical Engineering Division nearly more than a decade. It would not have been possible to have such a wonderful laboratory as stood up-front today than as it was seen before was probably with able guidance and support from Shri C.S. Sreenivasan, who served the Institute as Director from 1980–1983.

The Vibration lab was first established in the year 1980, while the Wake Simulation Laboratory was subsequently came into existence after few years. Special thanks and credit goes to Shri T.V. Gopalan, as Head of Mechanical Engineering Division for having constructed the WSL at very low expenditure by using tested tower parts and employing the in house welders. As on today and as things stand on, we are quite confident of offering our high ended services in terms of product development, Research and testing not only limited to power sector but also to others.

1.0 AN OVERVIEW

The Vibration Laboratory and Wake Simulation Laboratory are very oldest and unique in its nature, were established in Mechanical Engineering Division in the eighties. These two laboratories were come into existence under the leadership of Shri T.V. Gopalan who headed the Mechanical Engineering Division nearly more than a decade. It would not have been possible to have such a wonderful laboratory as stood up-front today than as it was seen before was probably with able guidance and support from C.S. Sreenivasan, who served the Institute as Director from 1980–1983.

These laboratories potentially considered to have ‘state of the art’ facilities and infrastructure with vibration test rigs each spanning to 40 meters and 80 meters in length for Vibration Laboratory (VBL) and Wake Simulation Laboratory (WSL) respectively and no such facility is available anywhere in India. These labs have progressed steadily over the years and made significant contribution to Power sector and others in terms of Research, Testing and Consultancy for about more than Three decades. These Labs had come

across many mile stones and bottle necks and as seen today moulded as one of the best of its kind in the world which would have been extremely impossible without the effort of our great predecessors/leaders/heads/Engineers/Scientists and Technicians/Labourers who had worked and created history as a team with dedication, Sincerity and Integrity. Among the technocrats, Dr. M. Ramamoorthy who took a prominent place in the history of CPRI, as had served for the longest duration of about Ten years since 1985 brought up CPRI to an eminent class particularly in R&D. The latest consultancy status of VBL and WSL had been very closer to ₹ 200 lakhs shows a very remarkable achievement which manifolds into 40 times compared to the revenue of initial year of inception.

It had strived for excellence all along and earned not only the revenue but also developed and maintained a Customer-Friendly relationship with about 180 strong Customers base across India from all Utilities, Public Sector Units, Electricity Companies/Corporations/Boards, Private Companies, Manufacturers including Academia and kept overwhelming reputation with about 18 Overseas Customers viz., USA, France, Japan,

China, Switzerland, Brazil, Jordan, Malaysia, Saudi Arabia, Srilanka and Bangladesh.

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As on today and as things stand on, we are quite confident of offering our high ended services in terms of product development, Research and testing not only limited to power sector but also to others.

2.0 BACKGROUND

The overall performance of any transmission line is dependent on various factors. The mechanical reliability of any line component is as important as its electrical reliability. Testing of any product as such is mandatory to evaluate its quality and performance and avoid any chance/risk of (premature) failures and all subsequent losses.

The major factor which affects the mechanical performance of any transmission line is the natural wind. These type of vibration can't be eliminated fully but can be controlled within the acceptable safe limits as per IEEE guide lines.

During 80s, the search for knowledge find a beginning on the simulation and evaluation procedures and testing standards as because of the non existence of computers. The Socio-economical changes, Technological advances



VIBRATION LABORATORY



WAKE SIMULATION LABORATORY

and Environmental impacts over the time played a major role in posing many risks and challenges to the working Transmission Line Engineers and Scientists. The exploration of computer era at the beginning of 90s had made revolution in the field of Science and Technology. And today the availability of abundant tools and instruments made extremely ease to the extent that any Engineer just need apply a common sense to select the same to serve the purpose intended.

Apart from the Research and Consultancy service, all kind of line components are regularly tested and evaluated in these laboratories for its mechanical performance as per National/International Standards and Customer requirements.

3.0 INFRASTRUCTURE

The Vibration Laboratory has 40 m test span used for testing of Vibration dampers/Spacer dampers / conductors / cables / insulators and associated hard ware. The Electro-Hydraulic shaker system of 150 Pounds capacity was installed in the year 1980 catered for testing of (single) conductors and Vibration dampers. The same was replaced with similar system of 300 Pounds during 2007. It also housed with 20 Ton capacity Hydraulic loading device for testing of line components and other hardware. Recently new hydraulic loading equipment of 60 Ton capacity was also installed in the same lab. The type test facility like Tensile testing machine, Torsion machine, Resistance measurement facility including galvanizing test

were established during 2006. The facilities are at a glance below.



40 METRES TEST SPAN AT VIBRATION LABORATORY



60 TON HYDRAULIC SYSTEM 80 m TEST RIG ELECTRO MECHANICAL 10 kN SERVO HYDRAULICSHAKER SYSTEM



ELECTRO DYNAMIC SHAKER SYSTEM



TYPE TEST FACILITY

The Wake Simulation laboratory as shown just above was established around the year 1984. In this 80 m test span, the vibration testing of Assembly insulator string with multiple conductor configuration up to 765 kV HVAC and 800 kV HVDC are normally tested for ten million vibration cycles which evaluates the fatigue behavior of conductors and associated hardware.

Continued effort and expertise gained over the years had made it possible for us to diversify our activities and gave birth to establish Earthquake Engineering and Vibration Research Centre (EVRC) which was originated from the vibration laboratory, which is one of the unique system in the country catered to important major projects

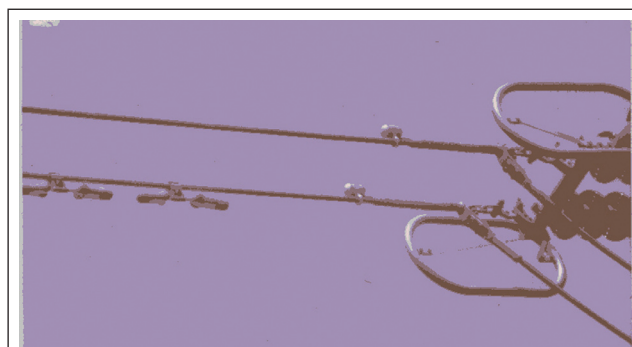
from Defense, Atomic, Power plant sectors for Seismic Qualification testing, etc.

4.0 RESEARCH AND DEVELOPMENT

The experience gained over the years, helped us brood over research for knowledge and benefit to the industry. The research activity gained momentum at the end of 80s. Many collaborative and sponsored research projects were taken up with the Utilities/Manufacturers. Limited knowledge was available on the vibration aspects of our transmission lines in India.

At the beginning of 90s, it had brought up several publications/Research papers/Technical reports in the area of mechanical vibration of transmission lines. We offered many solutions/suggestions that were accepted and used towards redesign, product development and cost effective measures.

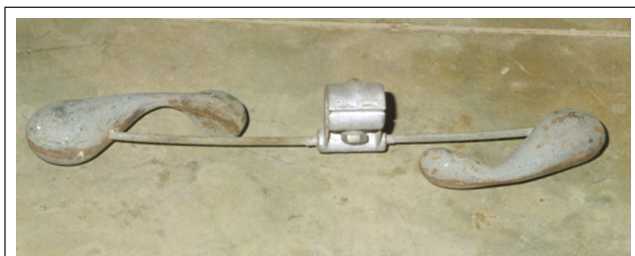
Many field research workson transmission lines were also conducted along with the utilities. The field vibration recorders were procured under the sponsored project was used for monitoring the severity of line vibration that is caused due to natural wind. A typical recorder installed on the line is shown below.

VIBRATION RECORDERS MOUNTED ON THE LINE
FIELD VIBRATION RECORDER

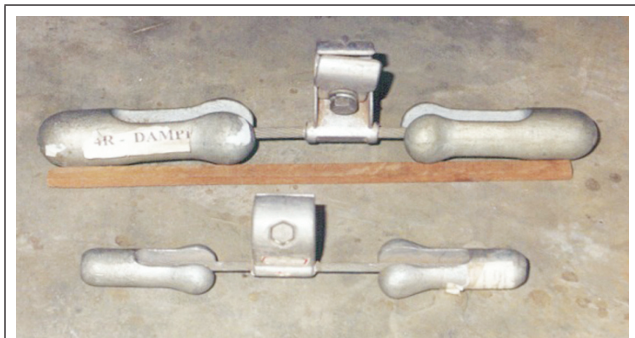
Exhaustive in-house vibration studies carried out on the insulator string and associated hardware up to 765 kV class. Strain gauge technology were abundantly used to obtain the variation of dynamic stress levels including the mode

shapes were established which are very much used by the utilities/designers so as to redesign/ modification leading to optimized performance of the line components.

The research studies on conductor and dampers were also carried out. The self damping capacity of the conductors were evaluated. The development of Six Resonance damper were made between 1993–1995 which had additional features and many advantages over the existing Four Resonance damper. Atypical Six Resonance damper along with Four Resonance damper respectively is shown in the photo below



6 R - VIBRATION DAMPER



4 R - VIBRATION DAMPER

Many attempts were made around 2004, to the extent possible of using the existing infrastructure for carrying out temperature sag of ACSR/AAAC conductors in the Wake simulation laboratory. The temperature of the outer surface of the conductor was raised around 120°C to a length of 7 m with the help of loading electrical coils available in the Diagnostic Cables and Capacitors Laboratory. The mechanical load (tensile) was applied simultaneously to see the sagging behavior of the conductor. The experimental set up is as shown below



SAG – TEMPERATURE STUDY ON AAAC CONDUCTOR

5.0 TESTING - CERTIFICATION AND CONSULTANCY

Various line products and accessories including components from different sectors were test qualified and certified. These labs were catered to testing relevant to National/International Standards including Customer requirement. It had attained the status of NABL Accredited during 1994. The quality and work of excellence gained over the years had attracted huge Customers in India and abroad.

About 1200 tests were conducted successfully. It also catered to the needs of Utilities like M/s KPTCL, Bangalore for Third Party Inspection of about more than Two Km of ACSR/AAAC conductors during 1998–2000.

Many Engineers from these labs had been representing various bodies like IEEE, BIS made

significant contribution towards test methods and standardization.

6.0 QUALITY ASSURANCE

Quality was given prime importance and built a good rapport and healthy relationship with all Customers in India and abroad. As an off shoot, we could attain ISO 17025 status in the first go during 2005. Over the years we had gained the reputation from the Customers across the country as well as many more customers from abroad because of our quality and world class excellence services.

The number of increase in the test requirements of Indian Customers and Overseas Customers are getting increased day by day as because of the high quality awareness and globalization and matching of any product to international class as expected and envisaged by the Utilities and User community.

7.0 CAPABILITIES AND ACHIEVEMENTS

A strong vibration team had been built to undertake any kind of challenges in terms of mechanical testing, Research and Consultancy and product development. We had successfully tested many challenging test assignments. We are geared up to meet any kind of mechanical testing not only to power sector but also to others in general. M/s NGK Insulators, Japan had been utilized our lab for fatigue/ vibration testing of their ± 800 kV HVDC insulator string with SIX bundle conductor which got tested for the first time in India. A 'Certificate of excellence' letter was given by NGK, Japan in this regard. The 'Unit substation assembly' was tested successfully for M/s Mohammed Al-Ojaimi Factory, Saudi Arabia for the first time in India.

A glimpse of few tests that are conducted at these labs are shown below



± 800 kV HVDC SINGLE 'Y' ± 800 kV HVDC TRIPLE TENSION SUSPENSION INSULATOR STRING WITH SIX BUNDLE CONDUCTOR CONFIGURATION. TESTED FOR NGK, JAPAN



UNIT SUBSTATION ASSEMBLY (13.8 kV/231 kVA TRANSFORMER, HV COMPARTMENT AND LV PANEL CABIN AND ASSOCIATED HARDWARE) TESTED FOR M/S MOHAMMED AL-OJAIMI FACTORY, SAUDI ARABIA

8.0 MISCELLANEOUS AND OTHERS

We had supported many Customers outside the power sector in meeting their test requirements. We had carried out various mechanical tests on miscellaneous products. Some of typical tests are shown as below



PC WORK STATION TABLE UNDER TEST AND MATERIAL HANDLING FRAME UNDER TEST

9.0 FUTURE PLANS

Owing to the unlimited growing of power demand and change in the environmental issues and technological advances including the entrant of new materials, we are very well prepared to take up any challenges ahead and support the power sector in a greater way in terms of Research, Product testing and evaluation.

Foreseeing the developments and future requirements, we had made a few proposals/projects that are planned to find a unique and state of the art of the system in CPRI in the near future. They are

- Establishment of New Vibration test facility for 800 kV HVDC and 1200 kV HVAC insulator strings
- Development of vibration damper and Spacer damper
- Performance evaluation of High temperature conductors
- Evaluation of creep characteristics of transmission line conductors
- Field vibration testing station for performance evaluation of transmission line and its components

CONCLUSION

We shall remain thankful and respectable to those who had contributed directly or indirectly to CPRI as what we see today which would not have been possible without their valuable support and dedication. We strive hard and proceed further the way our predecessors had shown and followed to improve our best professional services in upbringing CPRI to greater heights.

It is our sincere duty to thank all our esteemed Customers, Utilities, and Manufacturers who had supported all along with sustained effort and co operation towards building and growing as one of the best premier Research organization in the world. Our survival lies in their existence.

We are extremely thankful to our present Director General, Shri N. Murugesan for having shown overwhelming support and incredible dedication with clear vision in up bringing up CPRI as a premier Organization.

ACKNOWLEDGEMENT

The author (Shri M.D. Anantha Babu, Joint Director) whole heartedly wish to thank the

predecessors namely Shri T.V. Gopalan, Shri R. Susendran, Shri P. Muniyappa, Shri P. Krishnamurthy, Dr. N.S. Parthasarathy, Dr. R. Ramesh Babu and Shri M.N. Gundu Rao who were equally responsible in bringing these two laboratories to the highest level of excellence as what we see today.