PRDC
विज्ञानेन जातानि जीवन्ति

MiPower™
Empowering Power System Engineers
Power Transmission and Distribution System Analysis Software Suite

Quarterly Newsletter

# PRDC NEWS

October - December, 2011

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## From MD's Desk

## Inside This Issue



## Editorial Board



Dear Friends,

I am happy to share with the readers that we had received overwhelming response to the PRDC inaugural issue of the newsletter. Encouraging feedbacks have been received towards the overall content of the newsletter. The second issue of the PRDC newsletter is in your hands and I thank all who have contributed directly or indirectly to this issue. During the launch of the PRDC newsletter, members from the press were eager to know the financial healthiness of the distribution companies. I thought of sharing my views here.

It is well known fact that maximum cash outflow of any distribution company is in the power purchase. About 85% of the annual expenses of the distribution company are towards the power purchase, while the balance is for other charges like establishment (salary/wages), administrative & general expenses, O&M, depreciation & interest charges. The distribution companies should plan their long term energy requirement through proper load forecasting techniques and lineup with the generation companies to meet this demand to reduce their power purchase cost. At least 95% of the energy requirement should be met by long term power purchase agreements. To account for the un-certainties in the load forecast and shortfall due to un-expected breakdown in the power plants, balance 5% of the energy can be bought through short term purchases. Let us understand the problem through an illustration. As we all know, the street vegetable vendor borrows say, Rs. 100 in the morning from the money lender and ends up paying Rs. 110 at the end of the day, the whooping interest rate of 3650% per annum!!!. A petty shop owner borrows say, Rs. 100 in the beginning of the month and ends up paying Rs. 110 at the end of the month. Interest rate works out to 120% per annum. A shrewd businessman borrows say, Rs. 100 in the beginning of the year and ends up paying Rs. 110 at the year end, an acceptable interest rate of 10% per annum. This clearly illustrates that the short term power purchase is always expensive. Proper demand forecasting and planning the energy requirement is lacking in most of the distribution companies in India. This results in short term power purchase at higher rates or installation of expensive diesel or barge mounted generator sets. Some of the steps to be taken up by the distribution companies to improve the financial healthiness are:

- Conducting load forecasting studies to determine the peak power and the energy requirement of the company, year on year for next 10 years.
- To determine the demand and supply gap year on year, based on committed power purchase agreements and to fill the gap with the help of long term power purchases.
- To prepare the business plan in line with the demand requirement which includes the system augmentation plan and the capital investment to meet the increasing demand.
- To arrive at short term and long term network improvement schemes and prioritizing the investment based on techno-economic feasibility studies.

PRDC has already extended its services to distribution companies in these aspects and further would like to associate as and when required.

I wish all the readers, their families and friends season's greetings and happy and prosperous New Year 2012.

**Dr. R. Nagaraja**
**Managing Director**

# Consultancy Services Rendered

## UG cabling project at world famous tourist place: Puri city in the state of Odisha

Puri is one of the international tourist places in India. Lakhs of pilgrims across the country and abroad visit Puri every day. The inflow to Puri city is increasing day by day, consequently load demand is also increasing. During Rathyatra and Sunabesa more than 10 Lakhs people assemble on Grand Road to witness the occasion. The existing OH system of power supply in Grand Road and surrounding the temple is unsafe and also aesthetically not appealing. Power supply to Grand Road and its vicinity is unreliable due to frequent breakdown of conductors due to saline climatic condition and old network. In order to feed a reliable power supply to these important areas, M/S PRDC is entrusted to prepare a detailed project report and supervise the work for replacement of the existing OH system by UG cable system.

### Puri - Few facts

The City is located at 19°48′N 85°51′E19.8°N 85.85°E. It has an average elevation of 0 meters (0 feet). As of 2001 India census, Puri had a population of 1, 57,610.

Lord Jagannath Temple

Puri city, on the east coast of India, in the state of Odisha is a holy pilgrimage center, enshrining Lord Jagannath, colossal temple. Puri is the forerunner of the Jagannath cult in Odisha. The vast Lord Jagannath temple complex occupies an area of over 4, 00, 000 square feet and is bounded by a 20 feet high fortified wall.

This complex contains about 120 temples and shrines. The shikhara of the Jagannath temple towers to a height of 192 feet. Structurally the temple has four chambers. In the first phase, Government of Odisha is planning to replace the existing OH lines along both sides of the Grand Road and temple surrounding for smooth movement of chariots during world famous Rathyatra and Sunabesa.

### Proposed system

To convert the overhead primary 11 kV & secondary LT Distribution system to Under Ground Cabling system and to achieve the above objectives, PRDC has proposed to form a ring among three existing primary Sub-Stations through 10 no's of RMUs, 24 no's of 750 kVA CSS replacing existing small DTCs. The existing total capacity of 192 DTCs is 19,974 KVA and the total capacity of 76 DTCs (44 retained + 32 proposed DTCs in the new UG Cable Feeders) will be 26426 kVA. The entire network will be connected through SCADA system which will be controlled remotely from a Primary Sub-Station.

Special care has been taken considering all aspects to make this project as a model one in Odisha. A detailed survey was conducted for the existing and proposed system by our experts Er. Jagannath Gupta and Er. Gurusripad M.V for preparation of the DPR. The scheme was presented before the Honorable Chief Minister of Odisha and was highly appreciated. The project cost is estimated to be around eighteen crores which would be invested jointly by CESU and Govt. of Odisha. The project is expected to be completed before December-2012.

Grand Road - Puri

## Power System Studies: Qatar Petroleum Projects, QATAR

PRDC team successfully completed TWO overseas projects for Qatar Petroleum (QP), Qatar.

1. Engineering Consultancy for 33kV Network QP, Dukhan.
2. Front End Engineering Design (FEED) for Power Factor Correction for 33 kV Network, QP, Dukhan.

**The QP project-1** i.e. "Engineering Consultancy Services for 33 kV Network, QP, Dukhan" focused on the protection and relay co-ordination for existing network in depth and to analyze all the fault incidents and failure cases to find out the exact nature of problems and to provide techno-economical solutions to them.

Based on the detailed analysis, it is observed that there were few mal-operations and relay setting were revised along with recommendation for automatic generation control of DPS generation through PLC/SCADA scheme. Further, in view of changes in the network in the future operating conditions including planned decommissioning of some of the generation, short term solution is also recommended with the stage-wise operation. PRDC has undertaken protection requirement of largest petroleum company and it has passed many test including third party validation.

**The QP project-2** i.e. "Front End Engineering Design for Power Factor Correction for 33 kV Network, QP, Dukhan" focused on harmonic study and analysis, proposal and design of capacitor banks for the proposed QP network for power factor improvement. The overvoltage studies were carried out for the sizing of capacitor banks considering various combinations and operating conditions to arrive at the highest rated capacitor bank to be proposed in the QP electrical network. Further studies were performed to verify the occurrence of ferroresonance.

Based on studies conducted for different possible operating conditions, it was observed that there could be a chance of occurrence of ferroresonance, hence it was recommended to ensure minimum loading on secondary of transformer to damp out the ferroresonance oscillations.

## Power System Analysis of 10 MTPA, Tata Steel Jamshedpur Plant

Power system studies provide information that allows to understand the root of present or future power system problems and to make correct decisions in planning upgrades or extensions in an industrial plant, which lead to reduced operating costs, increased availability and minimized equipment or system failure.

PRDC has successfully taken up several consultancy projects for many steel plants in India. One such study was carried out for Tata Steel plant in Jamshedpur. Tata Steel is the largest iron and steel producing plant in India, as well as the oldest. Initially the Tata steel was producing 5.0 MTPA crude steel. Tata Steel's existing plant at Jamshedpur has plans for the expansion of from 5 million tonnes per annum to 6.8 million tonnes per annum and then further expansion to 10 MTPA crude steel. The main sources of power for TATA STEEL 10 MTPA plant are Jojobera power plant of Tata Power Company Limited (TPCL) and in-plant generators of captive power plants PH-3, PH-4, PH-5 & PH-6 supplemented by utility grid viz. Damodar Valley Corporation (DVC). The study is aimed to carry out the power system analysis for the 10 MTPA expansion project.

PRDC has successfully completed the assignment by carrying out detailed analysis of load flow, short circuit, stability, relay co-ordination for various stages of expansion. The studies were carried out for various operating conditions of the plant to ensure stable and reliable operation of the system.

Further the important factor in any steel plant study is the harmonic measurement and detailed analysis was carried out. It is observed that the voltage Total Harmonic Distortion is within the limits for the considering operating condition.

The highlights of the study was

- The reactive power support required in the form of capacitor bank for the plant was identified in order to minimize the penalty likely to be imposed by utilities as well as to minimize system losses.
- Considering various operating conditions, grid islanding studies were carried out and the detailed load shedding scheme were identified for stable operation in the worst case operation.
- Critical clearing time at different voltage levels was identified in order to clear faults so as to avoid system going out of step under various system conditions.
- Suggested to change to modern relays.

## Discussion Paper on Long Term Demand Forecast

**By: Dr. K. Balaraman**

If quality is defined by what the customers want, one way to measure the success of an Electric power distribution system is to deliver reliable & quality electric power to customers spread throughout utility's service territory. In order to achieve the objective, it is required to judiciously plan the infrastructure development in generation, transmission and distribution well in advance giving the long gestation period for the same coupled with a better operational facility. The basic requirement for better planning and operation is to have accurate forecasting facilitates in the operating area for various time horizon.

The various time horizons for the Load forecast in utilities can be short term from one hour to one week, medium term from a week to a year and long term forecasting which are longer than a year. Short-term forecasting is motivated by a need to reach a decision, for an optimal plan for utilizing available resources to meet the demand at an optimal cost. ***(Contd…)***

The short term demand projection is the basis for scheduling the generation, optimum operational planning of generation facilities vis-à-vis import, maintenance programs, load control etc.

The medium term demand forecasting is used for generation outage program, tying up for short gestation period generations, distribution system reinforcement etc. The long term demand forecasting is used for capacity planning, strengthening of the T & D network, tying up for fuel linkages etc. It is a universally accepted business practice among utilities across the world to carry out demand estimations for the future.

There are two major approaches for long term demand forecasting viz.

I. Top down approach
II. Bottom up approach

The top down approach focuses on the macro parameters like GDP, population, per-capita income, prices for forecasting of demand. The bottom up approach focuses on micro parameters like growth centers/areas, change in load profile, load density, number of consumers, step loads etc. As prudence practice utilities always find it necessary to consider both the approaches and finalize the demand for the future.

The top down approach is the most popular in the sense that most of the utilities are following this methodology. In this approach, the macro socioeconomic parameters are considered in the regression model and the relation is formed for forecasting the future demand. This method works well for large geographical area wherein the aggregated socioeconomic data is available and sensitivity of demand with respect to change in any of the variable can be accurately determined. Most of the econometric methods and trending methods fall in this approach.

The econometric method is the most popular top down approach which determines energy demand by considering the influence of socioeconomic independent variables, such as population, income, economic growth, cost, industrial & commercial activity and also other socioeconomic variables. Econometric models are estimate equations that relate electricity demand to external factors.

An important problem to solve in econometric method is the selection of the correct independent variables. Initially an extensive list of possible combination exists, and the problems arise in choosing the appropriate variables and in estimating how many of them should be included in the final model. The final model should incorporate all the important explanatory variables. In addition, it should be simple in order to make it easier to use and interpret.

The multi-variable regression analysis is used to establish the correlation between selected socioeconomic energy variables and energy consumption data using the past sample data. The relation obtained is then used to estimate the energy consumption data for the future years using the trend/modified trend values for the regression variables for the future years. The main advantage of this type of model is that it explicitly measures the effect of underlying causes of trends and patterns along with statistical evaluation of forecast uncertainty. This method combines well with economic and demographic information on service territory. However, the disadvantage of this method is that it requires skill and experience in econometrics and programming along with the extensive data required for detailed disaggregated model.

The bottom up approach is gaining its popularity in the demand forecast, particularly where the geographical area is small and end use techniques can be applied easily. This approach finds it extensive use in the distribution system planning. The most popular technique in this approach is end use methodology. This methodology started at the supply point of the customer and end use load profiles are used to determine the expected loads on feeders and sub - stations. Here the forecast identified areas with high, moderate, low and no growth. The end use load profiles are divided into classes to group the different load profiles in classes that are more homogeneous.

The bottom up approach of load forecasting addresses not only the question of how much & when demand would occur but also where the demand is likely to take place. Geographical maps are used to indicate the location (where) of the expected loads or increase in new supply points. The service territory is divided into smaller area and these smaller areas can be small square areas or irregularly shaped & sized to determine the expected loads on feeders.

In this approach, the load growth is considered to occur due to:

I. New customers connected or existing customers increasing their supply.
II. New uses of electricity, existing customers may add new appliances or replace existing equipment with improved devices which may require more or less power.
III. Change in the customer profile from residential to commercial or industrial or vice versa.

Based on the above factors, these two load forecast techniques are generally adopted. Trending involves extrapolating past load growth into the future or simulation which involves modeling the process of load growth itself. The simulation process works well for high spatial resolution – when the region studied is divided into very small areas. Trending is most suited to large area forecasting.

The simulation process starts by distinguishing customers by class like residential, commercial and industrial or sub classes. Simulation attempts to reproduce the process of load growth to forecast where, when and how the load will develop and the reasons behind the load growth.

Most of the techniques in the bottom up approach revolve around spatial load forecasting.

# Events

## IEEE Bangalore Section 20th Annual Symposium on "Emerging Applications of ICT in Utilities"

PRDC was actively involved in organizing The 20th Annual Symposium on **"Emerging Application of ICT in Utilities"** conducted by IEEE Bangalore Section at Bangalore on 4th & 5th November 2011. The Symposium was inaugurated by Sri. Bharat Lal Meena, Commissioner, Bangalore Development Authority who gave factual information about how the human errors are reduced and billing process was improved by introducing ICTs in utilities.

Dr. R. Nagaraja, MD, PRDC and Symposium Chair, in his introductory remarks stressed on the importance of ICT applications to make the utilities clean, green and smart. The two day symposium was attended by around 70 delegates. The participants were from POWERGRID, SRLDC, KPTCL, Infosys, PRDC, CPRI and various engineering institutes. 13 papers were presented by the respective authors in different sessions. The symposium was divided into five sessions on different topics. Each session was chaired by an expert in that field related to the session topic. Invited technical talks were also arranged by eminent personalities in the field. The session on 'ICT Infrastructure' was chaired by Dr. R. Nagaraja, MD, PRDC. On the opening day, Mr. Babu Narayanan, CTA, PRDC delivered an invited talk on 'BESCOM Pilot Project on Smart Grid' which was well received by the participants.


**Dr. R. Nagaraja, MD, PRDC addressing inaugural function**

## EEE Programme - feedback from students

PRDC is dedicated to encouraging talent and strengthening industry - academic relation. In this regard, every year PRDC identifies bright young minds from various institutes for "*PRDC EEE Student Assistance ship program*". Selected students are given assignments on a regular basis, take part in joint R&D projects, seminars and symposia which allows them to know trends in the sector and enhance technical knowledge. Here is what some of them have stated about the programme…….

"I am pleased to inform you that being a part of PRDC EEE student assistanceship program I learnt many skills and I am very proud to be the part of this program at your concern. While going through all the assignments, I inculcate various new skills. The most prestigious thing for me is to work with the most prestigious company which is working for developing new ideas in the field of electrical and electronics.

I hope you will be helping me to develop as a skillful electrical engineer. Thank you for giving me the opportunity to learn at your concern."

**Gopi Raman, (Electrical and Electronics dept.), GGITM, Bhopal**

"I'm one of the few privileged students of Electrical & Electronics Dept., Sir MVIT, and Bangalore to have been given the ASSISTANCESHIP PROGRAM by PRDC. We were specially picked by PRDC after a set of short listing and interviews in our 3rd semester. We've done various types of assignments like coding on power electronics and math problems, collecting IEEE papers on SVC and making a presentation out of it, etc. The assignments were very interesting and helped us know a lot of things. Side by side we were always guided by PRDC to spread the word about the scope and importance of power systems among our peers and juniors which we tried our best to do. PRDC had been kind enough to let us do our final year project with them and we wish to make the most of this opportunity in all dimensions".
!!! THANK YOU PRDC!!!

**Aafreen Shaik, Sir MVIT, Bangalore**

# Technical Paper

## Line Trap – Fundamentals and Design Considerations

By: Faraz Zafar Khan

**Abstract**—This paper highlights the fundamentals and design consideration of line trap. Line traps are the key component in Power Line Carrier (PLC) system used for remote control signals, voice communication, remote metering and control between substations in the electrical transmission and distribution network. The paper explains construction, basic types and important design features of line trap in detail.

Keywords - Power Line Carrier (PLC); Line Trap.

### I. FUNDAMENTALS OF LINE TRAP

Power line carrier (PLC) systems are employed due to high reliability of the transmission path, ease of right of way and low terminal equipment cost. Line traps are the basic component in PLC system. Line traps are connected in series to the transmission line and is designed to withstand rated power frequency current and the short circuit current to which the lines are subjected. Line traps are used to prevent transmission of high frequency signals entering into the substation without loss of energy at power frequency. The general assembly of line trap along with its related accessories is shown in Figure 1.

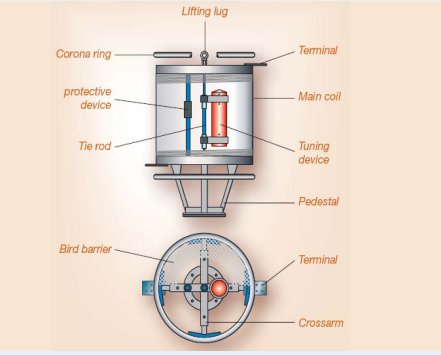



**Figure1. Line trap assembly**

Three major components of line trap are as follows:

- Main coil
- Tuning device
- Protective device

#### A. Main coil

Main coil of line trap is in the form of inductor which carries the power frequency current of the transmission line and is designed to withstand the maximum short circuit current. It has small inherent capacitance which varies based on size of line trap and provides high self-resonance frequency making it suitable for high frequency applications. The standard ratings accordance with IEC 60353 is furnished in Table 1.

**Table 1. Standard ratings for main coil of line trap**

| Rated continuous current (A) | Rated short-time current (kA/1sec) Series 1 | Rated short-time current (kA/1sec) Series 2 | Rated Inductance of the main coil (mH) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 100 | 2.5 | 5 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 200 | 5 | 10 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 400 | 10 | 16 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 630 | 16 | 20 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 800 | 20 | 25 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 1000 | 25 | 31.5 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 1250 | 31.5 | 40 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 1600 | 40 | 50 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 2000 | 40 | 50 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 2500 | 40 | 50 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 3150 | 40 | 50 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |
| 4000 | 63 | 80 | 0.2 | 0.25 | 0.315 | 0.4 | 0.5 | 1.0 | 2.0 |

#### B. Tuning device

The tuning device is connected in parallel with the main coil and the protective device. It provides a defined blocking impedance or blocking resistance over a specified frequency range for power line carrier (PLC) channel. Depending on the type of tuning required the tuning device consists of combination of resistor, inductors and capacitors. The tuning device is installed inside the main coil. To meet the changing PLC frequency requirements the tuning device shall be easily accessible for replacement or field adjustment if required.

Different types of tuning device can be developed from various combinations of resistor, inductors and capacitors arrangement. The two most common types of tuning device used in practice for line traps are single frequency tuned and wide band tuned.

**Single frequency tuned**

If narrow blocking bands are required single frequency tuning is simplest and economical type of tuning available. When capacitor is connected in parallel to a relatively low inductance, the result is a resonant circuit with high impedance at the resonance frequency. This tuning device offers a very low resistive component of impedance at frequency bandwidth limit but in turn, provides very high blocking impedance at the resonance frequency. The desired minimum resistive component of impedance can be obtained by damping parallel LC circuit by adding a resistor in series with the tuning capacitor. The schematic diagram and blocking characteristics of single tuned device are shown in figures 2 and 3 respectively.

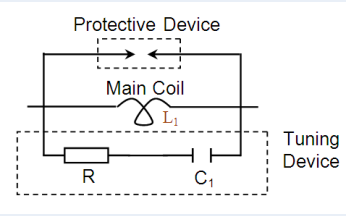



**Figure 2. Schematic of single frequency tuned line trap**

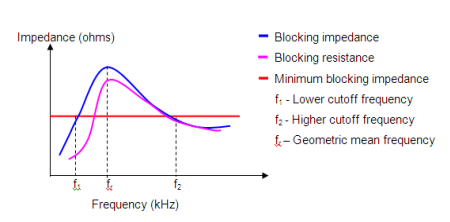



**Figure 3. Characteristics of single frequency tuned line trap**

**Wide band tuned**

Wide band tuning is the most common type of tuning as it efficiently utilizes the main coil inductance. Wide band tuned line traps are suitable for multi channel applications, since relatively constant impedance is obtained over a broad

frequency range. This type of tuning provides high bandwidth flexibility for future changes or expansion of PLC frequencies.

Schematic and characteristics of typical wide band tuned line trap are shown in figures 4 and 5 respectively.

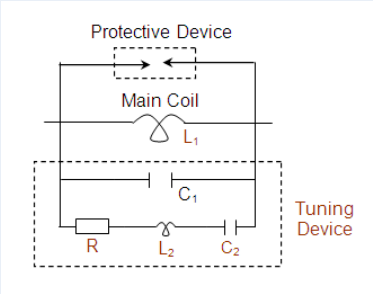



**Figure 4. Schematic of wide band tuned line trap**

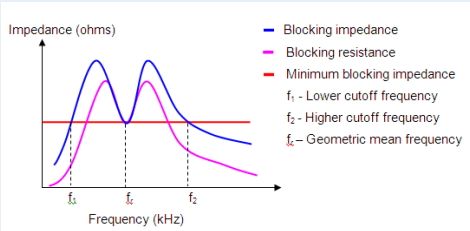



**Figure 5. Characteristics of wide band tuned line trap**

### Protective device

The protective device is connected across the main coil and tuning device which prevents the line trap from being damaged by transient over-voltages. Its rating is chosen to respond to high transient over-voltages, but it will not operate as a result of the power frequency voltage developed across line trap by the rated short circuit current, nor will it remain in operation after the response to transient over-voltage developed across the line trap by the rated short time current. It is recommended that non-linear resistor type arresters for a.c system should be used in accordance with IEC publication 99 or equivalent standard. The nominal discharge current should be equal to or greater than that of station arrester installed behind the line traps. In no case this current shall be less than 5 kA.

## II. DESIGN CONSIDERATION

The purpose of the line trap is to block specific frequency bands within the frequency range from 30 kHz to 500 kHz. Blocking impedance/resistance, tapping loss and blocking attenuation are some of the important parameters which need to be taken care during the design of line trap.

### Blocking impedance/resistance

Blocking impedance is defined as the complex impedance of complete line trap within a specified carrier frequency range. Mainly resistive component is used as a basis for evaluation as this value indicates the lowest line trap impedance under any operating condition, including the presence of a full or partial series resonance. A sufficiently high resistance component is kept in tuning device to avoid the problem of series resonance in carrier transmissions. Typically blocking resistance is 1.41 times the characteristic impedance of the line.

### Tapping loss and blocking attenuation

Efficiency evaluation of line traps are based on tapping loss and blocking attenuation. Tapping loss is defined as the ratio of signal voltages across impedance equal to the characteristic impedance of transmission line with and without the shunt connection of line trap. Maximum tapping loss of 2.6 dB is allowed as per IEC 60353. Both tapping loss and blocking attenuation values are derived from a voltage ratio and are expressed in decibels and can be obtained from the following formulae:

$$A_t = 20 * \log\left[1 + \frac{Z_L}{2 * Z_b}\right]$$

$$A_b = 20 * \log\left[1 + \frac{Z_b}{Z_L}\right]$$

*where,* $A_t = Tapping\ loss\ (dB)$
$A_b = Blocking\ attenuation\ (dB)$
$Z_L = Characteristic\ impedance\ (ohm)$
$Z_b = Blocking\ impedance\ (ohm)$

## III. CASE STUDY

A case study for designing wide band frequency line trap has been performed for frequency range of 65 kHz to 500 kHz. Here, transmission line characteristic impedance is assumed as 400 ohms. The designed values for inductor and capacitor are furnished in Table 2.

**Table 2: Design values for wide band line trap**

| | | | | |
|---|---|---|---|---|
| 1 | Main coil | | | |
| | | Inductance ( L1 ) | 0.001 | Henry |
| 2 | Tuning Circuit | | | |
| | | Resistance ( R ) | 600 | ohms |
| | | Capacitance ( C1 ) | 7.794E-10 | Farad |
| | | Inductance ( L2 ) | 0.0002927 | Henry |
| | | Capacitance ( C2 ) | 2.662E-09 | Farad |
| 3 | Tapping loss | | | |
| | | for blocking impedance (Atz) | 1.8382768 | Decibel |
| | | for blocking resistance (Atr) | 2.4987747 | Decibel |
| 4 | Blocking attenuation | | | |
| | | for blocking impedance (Abz) | 9.8867669 | Decibel |
| | | for blocking resistance (Abr) | 7.9588002 | Decibel |
| 5 | Impedance | | | |
| | | At Power frequency | 0.3141593 | ohms |
| 6 | Voltage across line trap | | | |
| | | at rated continuous current | 628.31853 | Volts |
| | | at rated short time current | 12566.371 | Volts |

## IV. CONCLUSIONS

This paper highlights the basic features of line trap along with its design considerations. Line trap is a key component of PLC and its designing requires special attention to avoid any nuisance in the system due to resonance of circuit parameters.

## V. REFERENCES

[1] IEC standard 60353 on “Line traps for AC power system”
[2] Leaflet on “ABB line traps type DLTC - a reliable component for PLC communication”.
[3] Manual on “Line Trap design” by Areva T&D.
[4] Manual on “Line Trap” by Trench group.

# Events and Achievements

## Tutorial on Power System Reliability

**Organized By:**

**IEEE Bangalore Section & IEEE PES Bangalore Chapter**

The IEEE Bangalore Section in association with IEEE PES, Bangalore Chapter, organized a half day tutorial program on **"Power System Reliability"** at Power Research & Development Consultants Pvt. Ltd. on 30th November 2011.

Dr. Lalit Kumar Goel, an IEEE R-10 Regional Representative, Nanyang Technological University, Singapore was the speaker.

In his welcome address, Dr. R. Nagaraja, MD, PRDC & Tutorial Coordinator stressed on the importance of reliability studies.

Dr. Goel gave an excellent review about the generation reliability analysis, composite power system analysis and distribution system analysis and cost worth analysis.

He also discussed in detail about the applicability of various reliability indices like LOLP, LOLE, and ENS etc. in real power system scenario. Generation modeling, load forecast modeling and sample case studies and also the detailed procedure like recursive algorithm were also discussed with reliability indices. The participants were from academia, industry, Utilities and research institutions.


**Dr. R. Nagaraja, MD, PRDC welcomes Dr. Lalit Goel**

## Achievements

- PRDC has been selected as a **"Partner Training Institute"** for Govt. of India's R-APDRP programme for providing training in Distribution Equipment – Technology & Applications, General Management in Power Distribution, Revenue Management & Loss Reduction, Performance benchmarking and quality of supply and service.
- Fiji Electricity Authority has made PRDC as its Consultant for providing services towards Grid Code Review of Fiji.
- Considering its expertise in the area of power system simulation, PRDC has bagged an order for developing **"Transmission Line Simulator with Automation"** for Indian Institute of Technology (IIT), Guwahati.
- PRDC has demonstrated a first-of-a-kind mile stone in integrating the power system application capability with the GIS solution to work on the WEB platform. PRDC has successfully integrated and delivered the MiPDAP software integrated with ESRI GIS on the WEB platform for distribution studies under R-APDRP scheme for 8 states. Administration privileged operations along with functionalities are supported through client-server application integrated with GIS on the desktop. MiPDAP integrated with GIS is delivered with ESRI GIS 9.3.1,JAVA/J2EE/JSF/.Net/C++/MFC, supporting databases like Oracle 10/11G, DB-2, MS SQL Server.

# Our Expertise in Training

## Upcoming Events

At PRDC, we conduct various training programmes throughout the year. The duration of the training programme varies from one to four weeks.

### One Week Training

We conduct one week training programme on MiPower. It's a Standard Course.

**MiPower Training Level 1**

Level 1 is a training programme on basic theory & simple problems (hands-on).

**Level 1 Batch:**

1. 16th Jan 2012 to 20th Jan 2012
2. 12th Mar 2012 to 16th Mar 2012

**MiPower Training Level 2**

Level 2 is a training programme which consists of only hands-on and solving own system problems, sorting out issues and clarifications.

**Level 2 Batch:**

1. 6th Feb 2012 to 10th Feb 2012

### Short Term Training /Workshop

In addition to the above said programme PRDC is also conducting short term training program and workshops to impart knowledge and practical approach on specific topics, which are of relevance to power engineers in day-to-day works. Such training not only enhances their knowledge but also helps to implement in their regular routine works.

For short term and special trainings please contact our marketing team:
***marketingteam@prdcinfotech.com***

## Training Calendar - 2012

Training Schedule of PRDC Training Centre For the Year 2012

| Month / Days | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | |
| February | | | | | S | M | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | x | x |
| March | | | | S | M | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | | |
| April | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | x |
| May | | | | | | S | M | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | |
| June | | | S | M | | | | | S | M | | | | | | S | M | | | | | | | S | M | | | | | | x |
| July | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | |
| August | | | | | S | M | | | | | S | M | | | | | | S | M | | | | | | | S | M | | | | |
| September | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | x |
| October | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | | |
| November | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | x |
| December | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M | | | | | | S | M |

L1 MiPower Training Level 1: Basic Theory & Simple problems (hands on)*

L2 MiPower Training Level 2: Only hands on and solving own system problems & sorting out issues and clarifications*.

* Participants are requested to choose the training as per their need i.e. Level 1 or Level 2

S Sunday | Saturday | Holiday | M Monday

## Workshop Participation


PRDC conducted a training programme on **"Emerging Trends in Power Systems & MiPower Applications" ETPMA'11** at Mar Baselios College of Engineering and Technology, Trivandrum during 21-25, November 2011.

# Release of PRDC Newsletter


Release function of 'PRDC News'


PRDC MD Dr. R. Nagaraja addresses the gathering

# Our Products

**MiPower™**

*Empowering Power System Engineers*

Power Transmission and Distribution System Analysis Software Suite

## Transmission Line Simulator

## Buchholz Relay

# PDU – Phase Detection Unit

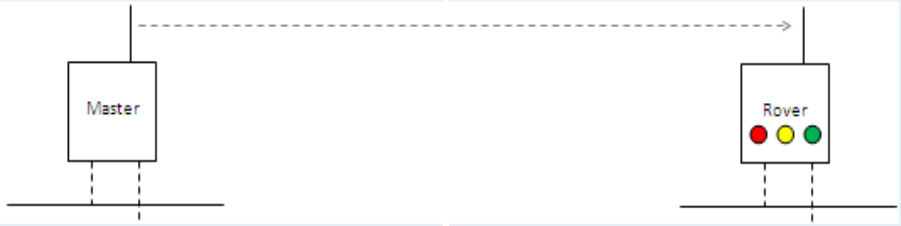
## Need for Phase Detection

This is the first product of its kind. This device is used for determining any unknown phase in the 3 phase electrical system. This device is of great help to local electricity companies and survey groups.

This device when connected to the incoming supply line of any consumer, can determine whether the consumer is in R-Phase, Y-Phase or B-Phase. This helps the utility companies to balance the loads for each of the 3 phases for effective utilization of power.

## Principle of Operation

The device works on RF technology working in the ISM Band and does not require a license. The Master Device sends the phase angle data of the reference phase to the rover in digital form. The rover receives the data through the RF channel, decodes it and compares with the phase angle data of the phase under test. The result of comparison gives the identification of the phase under test. The device works only when the rover is within the RF range of the master, otherwise it switches of all the LEDs in the indication panel.




This product has got an overwhelming response throughout the industry. The surveyors appointed for the R-APDRP project by Ministry of Power, Govt. of India have been using this product successfully for their projects.

Under R-APDRP project, consumer survey is a part. Consumer survey was faced by a criticality in determining the phase of a single phase consumer.

This unit solves the criticality by providing an easy solution to determine the unknown phase. The portable device can be just plugged to any consumer's outlet and instant indication about the phase can be seen through the 3 coloured LEDs on the user friendly front panel.

The rover unit works while within the RF range of the master device which can be connected to any known phase either at the transformer or even at any consumer whose phase has been already determined.

The similar products available in the market are bulky and much higher in terms of cost which gives our product an edge over all other similar products.

Basically the similar products available in the international market use GPS technology which requires clear sky for satellite communication and hence does not work in closed areas such as basements or inside the building. But in Indian scenario most of the meter terminals are located in confined areas. In these conditions our equipment works efficiently, thanks to the latest RF technology.

This unit can be used in various configurations. Only one master can provide information to maximum of 8 rovers. This makes parallel surveying of different consumers thus saving time.

Our devices are being used throughout India successfully. We are also in a process of upgrading the system with memory, display and keypad. This will reduce the manual entry of data and thus reducing errors. The new system can store the meter number or the consumer number and when the phase is checked, automatically it can store the phase data of the respective meter identified by its number.

## Features

- Phase detection time: within 1500 ms.
- Microprocessor based design for improved efficiency.
- Separate LED indication for R, Y and B Phases.
- Inbuilt consistency functions for error free operation.
- Programmable reference selector.
- No external power supply required.
- Single key menu function.
- Compact and portable design.
- Long Range: Up to 500m coverage.
- Easy to use and user friendly operation.
- CAT III Probes ensuring better insulation and safety.
- Light weight polycarbonate body for safety from shocking hazards.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