R.N.I No. KARENG/2013/51589

PRDC®

विज्ञानेन जातानि जीवन्ति

POWER RESEARCH AND DEVELOPMENT CONSULTANTS NEWSLETTER

Quarterly Newsletter
January - March, 2015
Issue - 1
Volume - 5

Inside This Issue

Editorial Board

From MD's Desk

Dear Friends,

We are all about to conclude the financial year 2014-15 and anticipating a great year ahead for 2015-16. I thought it is worthwhile to appreciate and discuss the difference between **'spending'** and **'utilization',** which would eventually result in having better financial commitment in all our projects.

Look at the 100 rupee currency note. It can be considered as hundred one rupee notes and each one rupee note as 100 paisa. Suffice to say that each small denomination of rupee has its own value. On a philosophical note, the entire human life span of say, 100 years, can be further divided into months, days, hours, minutes and even seconds. Each time division has its own value. Merely spending our full life time is not important but, how we lived and set example to others is more important.

Each and every organization, every departmental setup and the State and Central governments do perform rigorous exercise during the fag-end of the financial year to prepare the annual budget and allocate the fund and resources to various projects to be initiated next year. However, one has to understand that there exists a big difference between **"Spending the Budgetary Amount"** and **"Utilizing the Budgetary Amount".** Mere spending may not bring any value addition to the system while utilization definitely brings about value addition to the system, similar to the distinction made between having just lived one's life span and having lived for others and made a lasting contribution.

With reference to the power sector, we all understand that most of the projects are capital intensive. Generally on an average, about Rs. 4 to 7 Cr. investment per MW is needed in the generation sector, which would vary depending upon the type of generation (about Rs. 4 Cr. per MW for thermal, Rs. 6 Cr. per MW for hydro and nuclear, Rs. 5.5 Cr. per MW for wind and Rs. 7 Cr. per MW for solar). On an average, about Rs. 5 Cr. per MW of generation can be taken as a thumb rule.The corresponding investment required in the transmission sector will be about 50% of the generation sector and a matching amount (50%) would be needed in the distribution sector as well. Hence, in the Indian context, to give quality power to the end consumer with reliability and security as per the grid code, we need to spend Rs. 10 Cr. per MW. If we plan to cater to an additional demand of about 1,00,000 MW in a five year span, the investment required will be around Rs. 10 lakh Cr., or an average of Rs. 2 lakh Cr. per annum. Part of this investment, generally the investment towards generation schemes, comes from the private sector engagement and rest has to be invested by the Government-run power utilities. Having identified the fund requirement to be spent, depending on the financial health of various utilities, borrowing capability etc., it would be quite easy to work out the financing requirements of the various projects. Once the macro level fund requirement is worked out, the decision for spending of Rs. 2 lakh Cr. per annum is announced and claimed at various forums. Even though not much options are left out in the generation sector in terms of optimization of the investment decisions, spending of Rs. 1 lakh Cr. per annum in the transmission and distribution (T&D) sector can certainly be optimized through the process of system studies and detailed project report (DPR) preparation. Having closely worked with the Indian power sector and also in projects funded by the ADB and the World Bank and with experience of having interacted with several best-run utilities worldwide, I find that most of the DPRs in T&D sectors in India are prepared without spending adequate time and effort for optimization of the electrical network through system studies.

If one looks at the ADB or World Bank funded projects, various milestones involved in the project life cycle are *a) identifying the key areas of investment and the strategy to invest, b) preparation of the investment feasibility report, c) fund approval d) project implementation and e) project closure with completion and evaluation report preparation.* For the utility transmission and distribution projects, the timeline for the EOI and the appointment of consultant for the system studies and DPR preparation is around 6 months. After the award of the contract, timeline for the system study and arriving at the project high level costing for a typical Indian State power utility is about 10 to 12 months. Based on the system study report, the project monitoring consultants are appointed who would assist the utility for the entire duration of the project implementation to ensure quality and timelines of the contract. Project closure evaluation report is prepared within 1-2 years after implementation. If the steps listed above are judiciously followed, the fund is better utilized, not just spent. However, in most of the projects being implemented in India, all stakeholders appear to be in a hurry and go into the implementation phase rather in haste, without spending requisite quality time and money for the system studies and DPR preparation which would result in optimizing the spending for better utilization of the project fund. I do hope that the budgetary plan for the spending in the financial year 2016-17 and beyond starts now itself, so that the funds to be allocated in those financial years get properly utilized.

I thank all those who have contributed to this issue of PRDC Newsletter through their technical articles. I wish all the readers, their business associates a prosperous financial year 2015-16.

Dr. R. Nagaraja
Managing Director

Technical Article

Comparative Analysis of PMU and DPR data

Faraz Zafar Khan

I. Introduction

Fault analysis is a complicated task requiring experience and understanding of the complete power system. Accurate fault analysis can render assistance to maintenance engineers and support system operators to take better decisions. Digital Protective Relays (DPR) are widely spread devices over the power network. Conventionally, data obtained from DPR is mostly used as the basic input for fault analysis [1, 2]. Recently, applications based on Phasor Measurement Unit (PMU) also gained popularity. PMUs are considered as the powerful measuring devices to analyze system dynamics. Many protection based applications are also proposed using the PMU data [3, 4].

The valuable piece of information regarding faulted event can be of great assistance to the power system operators. Operators can take appropriate actions and organize their work in a better way to maintain system in healthy condition. At present, DPR output required for fault analysis is collected manually from the affected stations and then provided at control center for detailed analysis. This process takes around a day or two, which provides little scope for operator to take swift actions. However, if fault analysis is possible using real time data as obtained from PMUs, it can surely improve the efficacy of operator decision. Thus, in order to understand the applications possibilities and scope of fault analysis, it is essential to compare the basic data obtained from PMU and Relay.

II. Phasor Measurement Unit (PMU)

PMU is considered as one of the important measuring devices in the future of power systems. The distinction comes from its unique ability to time stamp, record, derive quantities and store the phasor measurements of power system events. A typical PMU as shown in Fig. 1 collects its basic inputs from instrument transformers and uses analog to digital (A/D) converter to sample the signals. It estimates a phasor equivalent using microprocessor and time reference from GPS receiver, which is further recorded or reported through communication port as per the requirement.

Thus, basic requirements for any PMU installation are access to signals to be measured, a timing signal to synchronize the measurement and data communication Modern relays are flexible enough to develop protective functions as per the system requirements and also provide the recorded data during its triggered instance.

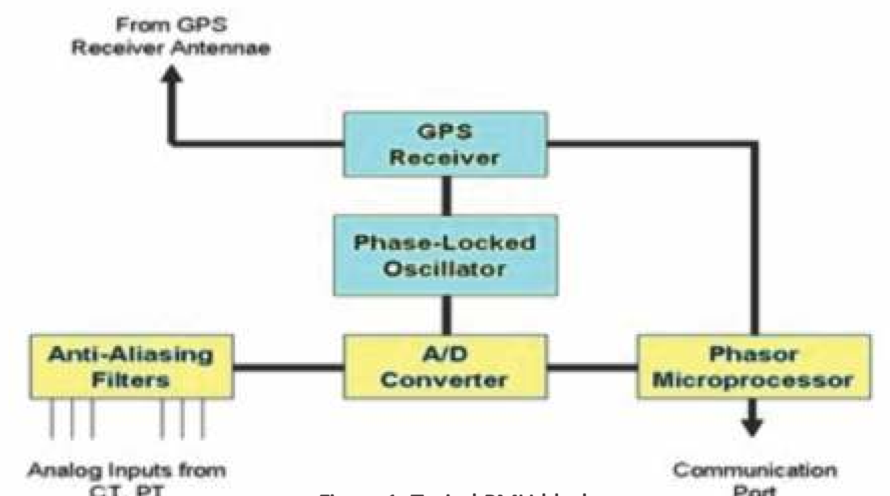


Figure 1: Typical PMU block

Its basic block consists of input module, anti-aliasing filters, A/D converter and microprocessor with communication facilities. These blocks are very similar to typical PMU blocks highlighted in yellow as shown in Fig. 1. Though, basic building blocks are same their operational requirements and performance are altogether different for PMU and DPR.

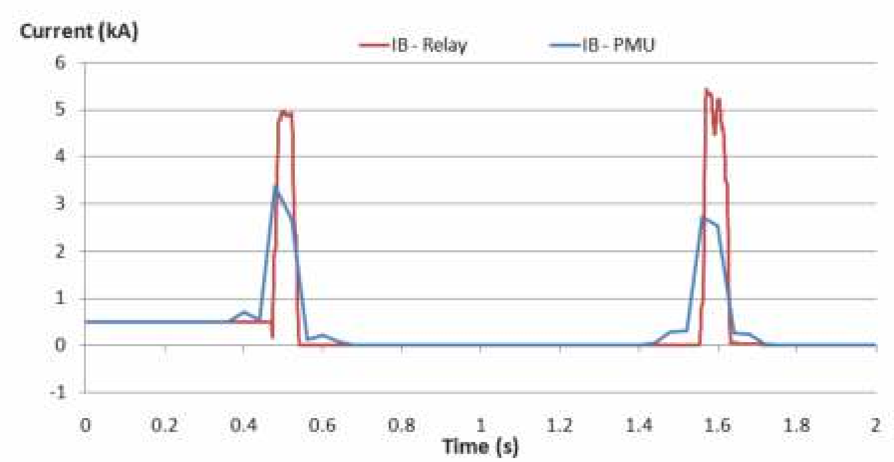


Figure 2: Fault current for PMU and Relay

A. Comparison

In order to understand the operation of two different devices for fault analysis their output data are compared. Disturbance record collected from PMU and DPR monitoring the same feeder for the same event are considered. Relay data is available at every 1ms while PMU data every 40ms. A single phase fault in B-phase with unsuccessful auto-reclosure is analyzed and the corresponding fault current waveforms are shown in Fig. 2.

During steady state, the current value matches for both the devices though deviations in the values are observed during disturbance. Details of fault analysis results compared for PMU and Relay data is given in Table 1. Fault current reported by the PMU is lesser than the fault current reported by the relay. This may occur due to data reporting rate of PMU which is slower as compared with the Relay. However, both the devices detect the correct fault type and auto-reclosure operation. Time difference computed for fault initiation, fault clearing and auto-reclosure dead time is also within 40 ms, which implies the correctness of results considering the data reporting rate.

Table 1: Comparison of PMU and Relay data

Details	PMU	Relay	Difference
Maximum Fault current (kA)	3.378	4.970	1.592
Fault Type	B phase to Ground	B phase to Ground	---
Fault Initiation Time from File Start (s)	0.48	0.469	0.011
Fault Clearing Time (s)	0.08	0.047	0.033
Auto-reclosure Status	Unsuccessful	Unsuccessful	---

For the given case, value of maximum fault current does not match for both the devices. Analysis such as relay operation, fault location, etc., will get affected, if such values are utilized. Thus, PMU data should be carefully utilized for protection related analysis, as it may mislead engineer with improper results.

IV. Conclusion

Real time data obtained from PMU can be utilized for power system applications. It is also utilized for some of the protection applications which are performed conventionally by relays. The article highlights that all the data obtained by PMU will not be the same as that of a relay. Thus, PMU data should be applied carefully for fault analysis considering both its strength and weakness.

V. References

[1] B.J. Mann, and I. F. Morrison, "Relaying a Three Phase Transmission Line with a Digital Computer", IEEE Transactions on Power Apparatus and Systems, Vol.PAS-90, No.2, Mar 1971, pp.742-750.

[2] Luo, X. and Kezunovic, M. "Fault Analysis Based on Integration of Digital Relay and DFR data ", Power Engineering Society General Meeting, IEEE, Vol. 1, 12-16 June 2005, pp.746 – 751.

[3] Horowitz, S.H., Phadke, A.G., and Thorp, J. S., "Adaptive transmission system relaying", IEEE Transactions Power Delivery, Vol. 3, No. 4, October 1988, pp. 1436–1445.

[4] Faraz Z. Khan, G. Raghavendra, R. Nagaraja and H. P. Khincha, "Enhanced Transmission Line Protection Using PMUs", 4th International Exhibition and Conference, GRIDTECH 2013, 3rd to 5th April 2013.

[5] Bogdan Kasztenny and Mark Adamiak, "Implementation and Performance of Synchrophasor Function within Microprocessor Based Relays", Protection and Control Journal, 2007, pp. 35-45.

[6] M. G. Adamiak, A. P. Apostolov, M. M. Begovic and et al., "Wide Area Protection-Technology and Infrastructures", IEEE Transactions on Power Delivery, Vol. 21, No.2, Apr 2006, pp.601-609.

Technical Article

Evaluation of TRV across Circuit Breaker for Transmission Line Fault Application

Rashmiranjan Rout

I. Introduction

Being one of the important components of power system, circuit breakers are generally selected by evaluating their device duty – rated continuous current, rated peak withstand current, rated short circuit breaking current, % of DC breaking current, short circuit thermal withstand current etc. - with steady state and short circuit current characteristics of the network. Apart from these, transient recovery voltage (TRV) generated during interruption of current by circuit breaker is also one among the crucial parameters that needs proper evaluation while selecting the circuit breaker for any application. In power system, TRV persists for a very short duration of time and assumes very high magnitude; this causes deleterious effects on the circuit breaker and the system as well. High amplitudes of TRV can stress the insulation in the system and also causes restrike/re-ignition in circuit breaker and eventual failure of circuit breaker. Presently, many EHV substations (AIS and GIS) are following switching schemes like one main bus scheme, two main bus scheme etc. which do not in general consider contingency for circuit breaker failure; any failure in circuit breaker in these types of substations could negatively affect the reliability and availability of the overall system.

One of the most frequent fault conditions is observed on overhead transmission lines. A transmission line fault, located at few kilometers' distance from the circuit breaker, is considered to be most onerous. In the present article, the transient recovery voltage that develops across the circuit breaker during interruption of fault on the transmission line is discussed.

II. Characteristics of Transient Recovery Voltage for Fault on Transmission Line

After interruption of the current, the stored energy in line is dissipated by means of voltage wave travelling on the line, resulting in high frequency voltage transients as shown in Figure 1. The peak voltage and frequency of the line side transient voltage are functions of distance of fault from the terminal of circuit breaker. The circuit breaker is subjected to a total transient recovery voltage which is equal to the vector difference of source side transient recovery voltage and line side transient recovery voltage.

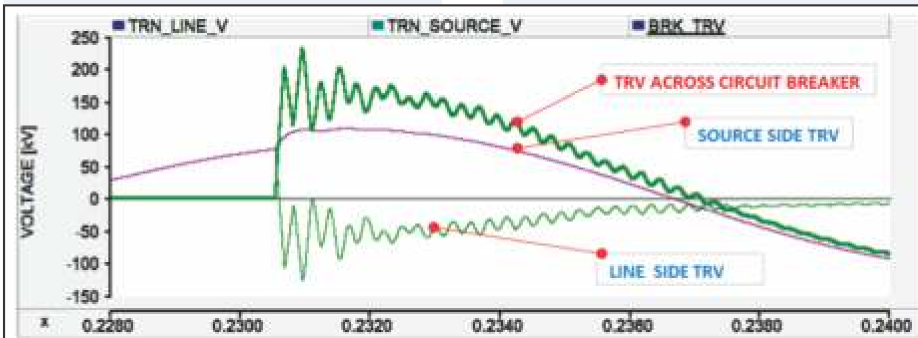


Figure 1: Transient recovery voltage for transmission line fault [1st pole clearence]

The first peak of Transient Recovery Voltage (TRV) on line side (u_L^*) can be expressed as per the following formula:

$$u_L^* = Z\frac{di}{dt} \times \frac{2\lambda}{v}$$

The Rate of Rise of Recover Voltage (RRRV) on the line side can be expressed as:

$$\text{RRRV} = Z\frac{di}{dt}$$

Where,

Z = Surge impedance of transmission line

i = Current in the line prior to interruption

λ = Distance between the fault location on the transmission line and circuit breaker

v = Velocity of surge in the transmission line (close to speed of light).

A case study has been conducted in order to comprehend the effect of distance between circuit breaker and location of fault on the characteristics of TRV. The system under the study comprises a 132 kV source with a three phase fault level of 30 kA with X/R ratio of 14.3, a typical 132 kV double circuit transmission line having circuit distance of 40 kM and a SF6 circuit breaker. Simulation was carried out using PSCAD/EMTDC™ software for the three phase faults at different locations on the transmission line and repeated for fault at each interval of 1 kM.

Figure 2 depicts the magnitude of fault current versus the distance of fault location on the transmission line from the circuit breaker. Figure 3 depicts the trend of TRV with respect to the distance of fault on the transmission line from the circuit breaker. Figure 4 illustrates the Rate of Rise of Recovery Voltage (RRRV) versus the distance of fault location on the transmission line from the circuit breaker.

When a fault on the transmission line is interrupted, it results in triangular TRV on line side of circuit breaker. Short line faults (SLF) are characterized by comparatively higher short circuit current and higher RRRV. A sharp increase in magnitude of RRRV is observed for faults located within few kilometers of transmission line. The magnitude of TRV varies for different fault location on transmission line as shown in Figure 3.

For selecting a circuit breaker that is suitable for transmission line, the TRV and RRRV values need to be evaluated for faults at different locations on the transmission line. These parameters are compared with the circuit breaker test duties like T10, T30, T60, T100, L90, L75, L60, out of phase etc. as outlined in applicable IEC and IEEE standards [1,2,3,4]. Special attention must be given for selecting circuit breakers for the system, where a transmission line is associated with series/shunt reactor, by means of which, the effective surge impedance of the system alters, and hence the TRV and RRRV characteristics vary from the respective assumed values for the transmission line while standardizing the circuit breaker. Use of grading capacitors, CR suppressor, surge arresters etc. is generally considered as protective measure to control the characteristics of TRV.

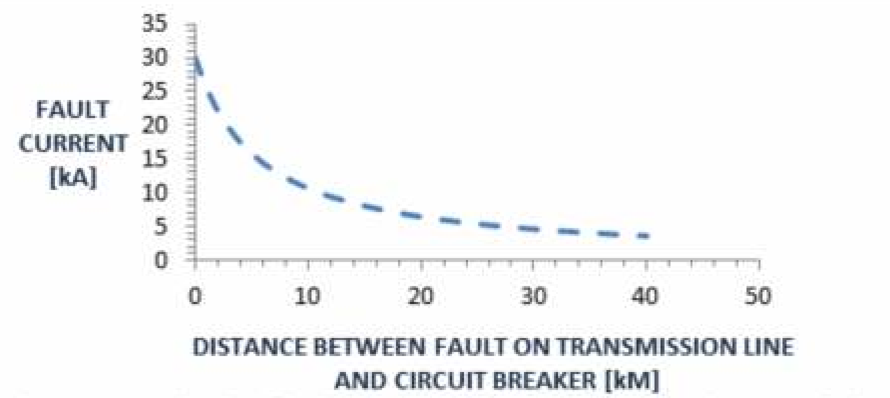


Figure 2: Magnitude of fault current vs. Location of fault on the transmission line

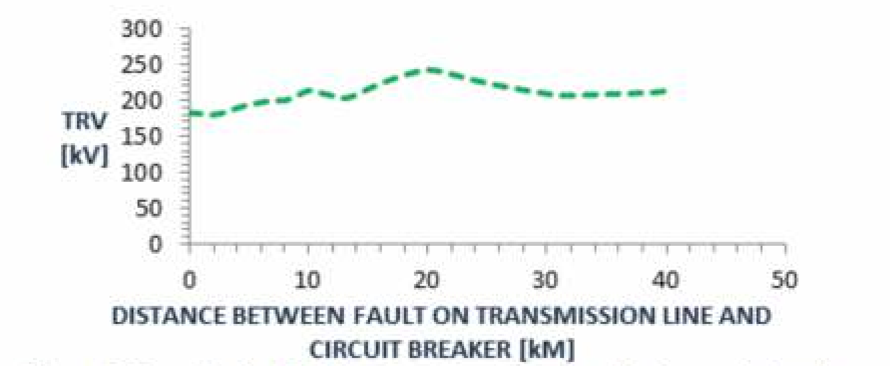


Figure 3: Magnitude of TRV vs. Location of fault on the transmission line

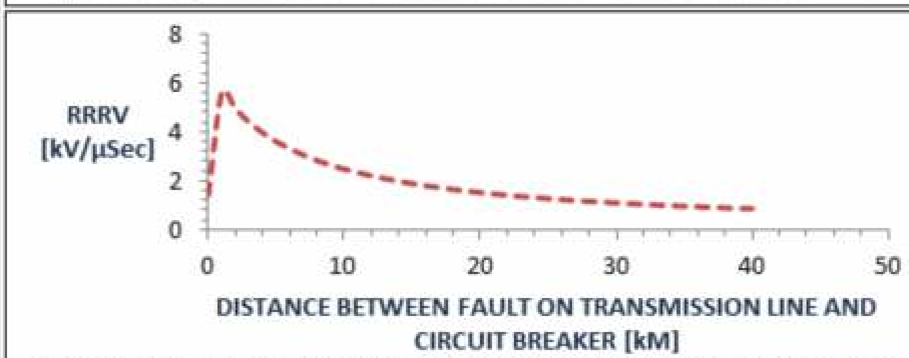


Figure 4: Magnitude of RRRV vs. Location of fault on the transmission line

III. Conclusion

In this article, the characteristic of transient recover voltage that develops across the circuit breaker during interruption of transmission line faults is discussed. Considering high reliability and maximum availability as the two essential parameters while designing today's power system, selection of circuit breaker by evaluating TRV and corresponding RRRV is one of the essential tasks that need to be performed during system design engineering to avoid possibilities of catastrophic failures in circuit breakers caused by either high magnitude of TRV or RRRV.

IV. References

1. IEC 62271-100: High-voltage switchgear and control gear – Part 100, Alternating-current circuit-breakers

2. IEEE Std C37.04: IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers

3. ANSI C37.06: AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis— Preferred Ratings and Related Required Capabilities

4. CIGRE guide for application of IEC 62271-100 and IEC 62271-1 (Part 2 making and breaking tests)

Consultancy Services Rendered

Electromagnetic switching transients and insulation coordination study

There is a proposal for developing upstream production facilities and infrastructure to meet a target of 1.2MMBOPD of production in an oil field in Southern Iraq. In this regard, front- end engineering design (FEED) phase is being carried for the development of the project.

As part of the FEED development project, insulation coordination study was executed by PRDC, Bengaluru for two substations – 132 kV main substation and 132 kV WP substation – to specify the rated insulation level of corresponding substation equipment and the location and rating of the surge arresters. Fast front overvoltage study was carried out to assess the risk of equipment failure and to select required lightning impulse withstand level of substation equipment in relation to surge protective device configuration and to evaluate system performance against lightning overvoltage. A typical waveform for fast-front overvoltage at GIS bus caused by incidence of lightning stroke on one of the phase conductors of transmission line is illustrated in Figure 1. For 145 kV gas insulated switchgear (GIS), very fast front overvoltage study was carried out to evaluate the internal and external transients generated during operation of disconnectors inside GIS.

Study of transients during switching of transmission line was carried out for validation of selected insulation level with respect to slow front overvoltage phenomenon. Transformer energization study was performed to determine the required minimum fault level at connected bus by analyzing the voltage profile during energization of the transformer feeder; the minimum number of generator units required to energize the transformers was finalized. Further, transients caused by de-energization of MV motor through vacuum circuit breaker (VCB) were studied to determine the magnitude and effect of maximum transient overvoltage generated during de-energization of the motor feeder and subsequent single/multiple re-strike phenomenon inside the VCB for unstable arc at chopping current. A typical waveform for

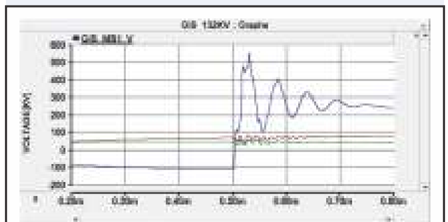


Figure 1: Typical waveform for fast-front overvoltage at GIS bus

inrush current during energization of transformer with 80% residual flux in one of the limb of the transformer core prior to energization is presented in Figure-2.Performance of 132 kV, SF6

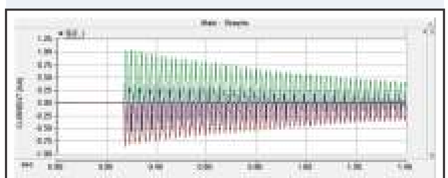


Figure 2: Typical waveform for inrush current during energization of transformer with 80% residual flux

breakers for transmission line feeder and transformer feeder was validated with respect to specified test duties as mentioned in IEC 62271-100 by evaluating the characteristics of transient recovery voltage (TRV) caused during de-energization of respective feeders under faulted conditions.

The aforementioned studies were performed in accordance with relevant IEC, IEEE and CIGRE standards and references, with a focus on reliability of electrical system insulation that is expected to withstand the transient over voltages during system operation for the expected life cycle. In addition to this, the feasibility of energization of transformers in the presence of minimum number of generation units in circuit was analyzed.

Transmission Line Parameter Calculation for KPLC Kenya

Transmission line parameters will help in determining the performance of the conductors with respect to the losses in the conductor, leakage currents, corona losses etc. Hence, detailed modeling of the transmission lines plays an important role in studying the performance of the power systems.

M/s Tata Projects Ltd is executing 132kV S/C Transmission Line for Kenya Power & Light Company (KPLC), Kenya which is a local utility company. In order to set up proper protection system and facilitate analysis, the utility required relevant parameters like positive & zero sequence resistances & reactances and line ampacity. M/s Power Research and Development Consultants Pvt Ltd. (PRDC) have carried out this consultancy. Calculations were done using MiPowerTM software for different routes having different tower configurations and even transpositions in some cases.

Consultancy Services Rendered

Study of Dynamic interactions of Wind Turbine Generators with the Grid

PRDC has been assigned to assess the reason for frequent tripping of wind turbine generator (WTG) at one of the wind farm sites in Maharashtra and propose remedial measures for the newly installed WTGs coming up in the same pooling sub-station at 132kV level. The objective was to study the behavior of WTGs for the faults at grid side by conducting dynamic studies and assess whether the turbine would satisfy the low voltage ride through (LVRT) characteristics as mandated by Central Electrical Authority (CEA) connectivity regulations. In case the probability of tripping is high even after enabling LVRT characteristics, it is required to analyze the requirement of dynamic compensation device such as STATCOM to mitigate the issue.

As per CEA guidelines for wind projects, any wind farm connected at voltage level of 66 kV and above shall remain connected to the grid when voltage at the interconnection point on any or all phases dips up to the levels depicted by the thick lines in the curve shown in figure 1 (where, V_T / V_n is the ratio of the actual voltage to the nominal system voltage at the interconnection point), provided that during the voltage dip, the individual wind generating units in the generating station shall generate active power in proportion to the retained voltage. Also provided further that during the voltage dip, the generating station shall maximize supply of reactive current till the time voltage starts recovering or for 300 ms, which ever time is lower.

In order to meet the objective, the following Studies were carried out:

✓ Steady state load flow Analysis:

As a first step in the analysis, load flow studies have been carried out considering various wind generation and demand profile. Typical voltage profile at tail end of WTG is given in figure 2. Of the total of about 21 operating conditions, few severe operating conditions have been identified for the transient stability studies.

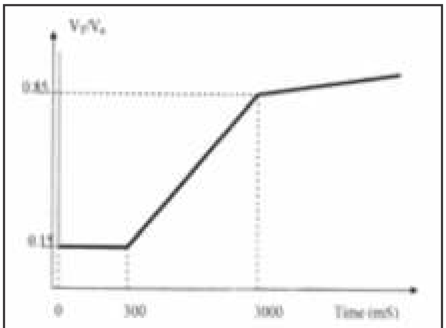


Figure 1 : LVRT characteristics

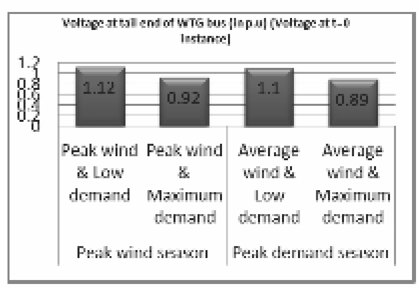


Figure 2: Voltage details

✓ Transient stability studies:

Considering the results of worst cases identified in steady state analysis as initial condition, transient stability studies have been conducted for both three-phase-to-ground and single-line-to-ground faults at various locations which would be critical for the studies. These include:

- fault near to 132/33kV wind farm pooling S/S (on 132kV side)
- fault at 50% distance from wind farm pooling S/S (on 132kV side)
- fault near to 220/132/33kV grid S/S (on 132kV side)
- fault near to 132/33kV grid S/S (on 33kV side)

For three-phase-to-ground faults on 132kV side, the dip in terminal voltage at wind turbine generator buses is very severe and the protection relays are expected to operate and clear the fault. Therefore during the analysis, three- phase-to-ground fault case studies have been carried out considering a fault clearing time of 160ms as per the CEA guidelines.

Terminal voltage of WTG bus for this case is shown in figure 3.

Transient stability studies have also been carried out for single line-to-ground fault (SLG) at the above mentioned locations. Compared to three-phase-to-ground faults, the SLG faults are less severe as expected, although their frequency of occurrence is very high. Usually the clearing time for such faults would be higher. For the study, the fault clearing time has been taken as 800ms for SLG fault cases on 132kV and for the fault on 33kV side, the clearing time has been taken as 1000ms. Terminal voltage of WTG during SLG fault is given in figure 4.

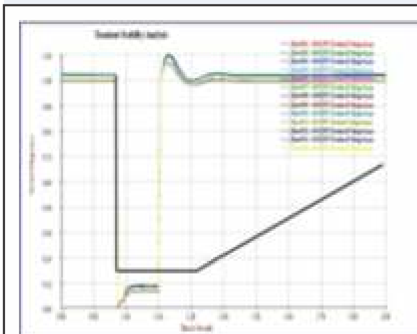


Figure 3: Terminal voltage of WTG buses during 3-phase to ground fault

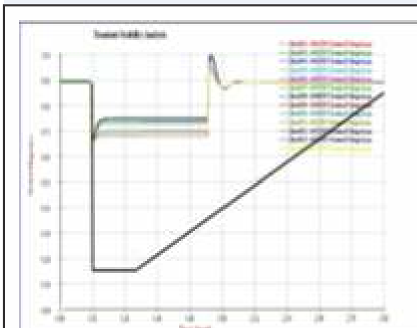


Figure 4: Terminal voltage of WTG buses during single line to ground fault

Based on the analysis it was observed that, if LVRT settings are enabled as per CEA criteria, the wind turbine generators would be able to ride through the fault and would not trip on account of these faults on the grid side.

Events & Achievements

Seminars / Workshops

1. PRDC conducted two day workshop on "Power System Analysis and Protection using MiPower" at Visvesvaraya National Institute of Technology, Nagpur on 1st and 2nd January 2015. The event was primarily focused on various aspects of the power systems and dedicated to teaching faculties of various Engineering colleges and Utility engineers.

2. JNTU Hyderabad conducted a three-day work shop on 'Computer Applications in Power System' using MiPower™ during 18-20, March 2015. Participants were Faculty, research scholars and M. Tech students from different colleges.

Dr. R. Nagaraja, MD, PRDC delivering lecture at JNTU, Hyderabad workshop

Achievements

- PRDC has been awarded consultancy services for undertaking power evacuation studies by Essar Power Generation Ltd.(EPGL). EPGL is intending to upscale the existing installed capacity from 1200 MW (Phase-I) to 3240 MW with an addition of 2640MW; 4 X 660 MW (Imported Coal based, envisaged as Phase-II) & 4x150MW (Petcoke based, envisaged as Phase-III).

- M/s SunEdison Solar Power India Pvt. Ltd. awarded consultancy services to PRDC for conducting feasibility studies for conversion of Irrigation pump sets into solar PV integrated IP sets in Karnataka. This study will assess the existing network infrastructure, grid preparedness, system analysis, bottlenecks and make suitable recommendations.

POWER SYSTEM PROTECTION SUITE

PRDC received an order to supply Power System Protection Suite for Maharashtra State Electricity Transmission Co. Ltd (MSETCL).

In this project, PRDC will supply Power System protection Software Suites for testing and communication circles at Aurangabad, Nagpur and Vashi. PRDC will also provide a training to MSETCL engineers.

Many electrical utilities (more than 20) in India and also in countries like Sudan, Fiji are using our software for their power system studies due to its superior technical capabilities, user-friendliness and excellent technical support from PRDC

HARMONIZATION OF GRID CODES IN SOUTH ASIA REGION – USAID FUNDED CONSULTANCY

PRDC is currently conducting the study on "Harmonization of Grid Codes, Operating procedures and standards to facilitate/promote Cross Border Electricity Trade in the South Asia region" from Integrated Research & Action for Development (IRADe). This is a USAID funded project in which PRDC will be reviewing the grid codes of the respective south Asian nations covering procedures/ codes/ standards such as Power system operating procedures, protection code, metering code, connection code, planning code, system security, demand estimation systems, outage planning and recovery procedures. PRDC shall also suggest possible measures to facilitate/promote optimal and economic "cross border electricity trade" in the South Asia region.

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 is a standard course.

MiPower Training Level 1

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

Level 1 Batch:

11th May to 15th May 2015.

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.

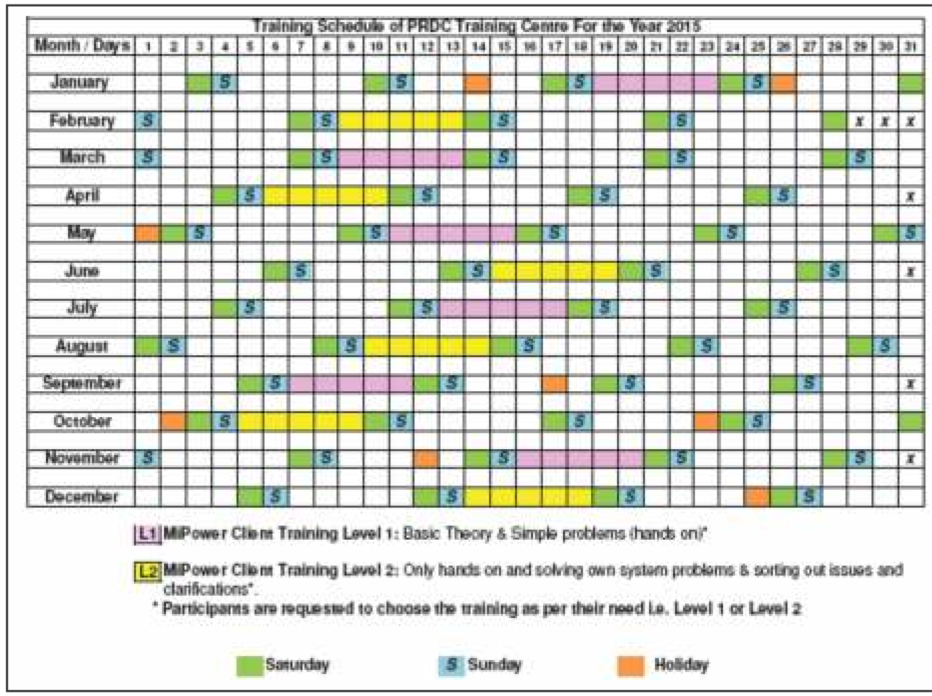
Level 2 Batch:

- 6th April to 10th April 2015.
- 15th June to 19th June 2015.

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 these techniques in their routine works. For short term and special training programme, please contact our marketing team at the following address:

marketingteam@prdcinfotech.com



FORM IV

(See Rule 8 of Press and regulations of Book Act)

1	Title of the Newspaper	Power Research & Development Consultants Newsletter
2	Registration No.	KARENG/2013/51589
3	Place of Publication	Bangalore
4	Periodicity of its Publication	Quarterly
5	Publisher	Dr. R. Nagaraja
	Nationality	Indian
	Address	#5, 11th Cross, 2nd Stage, West of Chord Road, Bangalore - 560086
6	Printed at	M/s. Art Print 719/A, Dr. Modi Main, W.O.C. Road, Mahalakshmipuram, Bangalore - 86.
7	Owner's Name	Power Research & Development Consultants Pvt. Ltd.

I, Dr. R. Nagaraja, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Bangalore

Date: 31st March 2015

sd/-

Name: Dr. R. Nagaraja

Signature of Editor, Publisher & Printer

Indian Power Sector Highlights

❖ Redesigned Websites of Power Ministries

Inspired by Prime Minister's vision of "Digital India", Ministries of Power, Coal & New & Renewable Energy have re-designed their websites to make them user-friendly, mobile/tablet responsive and engaging. The URLs are as follows:

- Ministry of Power: http://www.powermin.nic.in
- Ministry of Coal: http://www.coal.nic.in
- Ministry of New & Renewable Energy: http://www.mnre.nic.in

Source: PIB, Jan 20 2015

❖ Establishment of Solar Power Plants

The Government of India has launched various schemes to set up grid-connected solar power plants and requested all states to identify land for establishment of Solar Parks.

- Setting up of 25 Solar Parks and Ultra Mega Solar Power Projects of aggregate capacity of 20,000 MW in various States.
- Pilot-cum-Demonstration Project of capacity 100 MW for Development of Grid Connected Solar PV Power Plants on Canal Banks and Canal Tops.
- Grid-Connected Solar PV Power Projects by Defence Establishments under Ministry of Defence and Para Military Forces - 300 MW (with Domestic Content Requirement).
- Scheme for setting up 1000 MW of Grid-Connected Solar PV Power Projects by Central Public Sector Undertakings (CPSUs) under various Central/State Schemes with Viability Gap Funding (VGF) under Batch-V of Phase-II of JNNSM.
- Grid Connected Solar PV Power Projects with VGF (750 MW).
- Grid Connected Solar PV Power Projects (3300 MW) by NTPC and other PSUs.

Source: PIB, Mar 2 2015

❖ Renewable-Roadmap 2030

The "Report India's Renewable Electricity Roadmap 2030—Toward Accelerated Renewable Electricity Deployment" was released at the Renewable Energy Global Investors Meet & Expo (RE-INVEST 2015). The report was brought out by NITI Aayog with support of CII, Shakti Sustainable Energy Foundation and RAP (Regulatory Assistance Project), a global non-profit group, talks about the current scenario of renewable energy in India and what needs to be done for its accelerated deployment to address energy security concerns.

Source: PIB, Feb 17 2015

❖ Highlights of Union Budget 2015-16 on Power Sector

- Each house in the country should have basic facilities of 24-hour power supply, clean drinking water, a toilet, and be connected to a road.
- Electrification, by 2020, of the remaining 20,000 villages in the country, including by off-grid solar power generation
- Government proposes to set up 5 new Ultra Mega Power Projects, each of 4000 MWs in the plug-and-play mode. All clearances and linkages will be in place before the project is awarded by a transparent auction system. This should unlock investments to the extent of ₹ 1 lakh crore.
- Second unit of Kudankulam Nuclear Power Station will be commissioned in 2015-16
- Energising the country: Brought rapid growth in power sector inspite of uncertainty on the coal front and launched ambitious programmes for new and renewable energy;
- The Ministry of New Renewable Energy revises its target of renewable energy capacity to 1,75,000 MW till 2022, comprising 100,000 MW Solar, 60,000 MW Wind, 10,000 MW Biomass and 5000 MW Small Hydro.

Source: PIB, Feb 28 2015

R.N.I No. KARENG/2013/51589

Power Research & Development Consultants Pvt. Ltd.
5, 11th Cross, 2nd Stage, West of Chord Road,
Bangalore - 560086. INDIA. Phone : (080) 4245 5555 / 2319 2209
Website : www.prdcinfotech.com

For feedback and subscription, please reach us at **newsletter@prdcinfotech.com**

Printed & Published by : Dr. R. Nagaraja on behalf of Power Research & Development Consultants Pvt. Ltd.
Printed at : M/s. Art Print, Dr. Modi Hospital Main, WOC Road, Bangalore - 560 086. Cell : 98452 33516. Editor : M.M. Babu Narayanan