VOLUME 21 JUNE 2002

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From The Editor's Desk

Dear Readers

I take this opportunity to welcome you all and present to you a newly designed BEACON. You shall find that a few additional features have been introduced. We have made an effort to focus on a topical issue. I received an e-mail on the subject How far are the SCADA installations prone to attack by hackers, this worked as the starting point and this special issue of BEACON on SCADA SYSTEMS AND THEIR SECURITY was conceived. I thought this would be a great topic for discussion and would motivate the students and the practicing engineers to work for the improved security of power generation, transmission and distribution systems. The cover page of this issue is specially designed to highlight this important message. It shows a beacon that is providing light to everyone. The energy for lighting is drawn from the solar panel shown in the lower right portion. The control of light switch is obtained through a RTU housed below the solar panel. The control signal is received at RTU through satellite communication. Some hackers are working on the stratigies to sabotage the power supply to the lighthouse by modifying the control signal. The altered signal can result in no supply during night resulting in accidents. The SCADA system designers have to work continuously to improve the security of their control systems to counter any feasible attack on their system.

I look forward to your suggestions and comments to improve your own House Journal. I would like to thank all the contributors and advertisers who have made this issue possible. I would like to express my special thanks to the guest editors (students from Lala Lajpat Rai Instt. of Engg. & Tech.) who have worked along with the editorial committee.This endeavour would not have been possible without the countinuos encouragement and support from my wife, Kumkum. I would also like to express my gratitude to all the members of the executive committee who have supported the idea of upgrading the newsletter to House Journal.

Regards

Ram Nath

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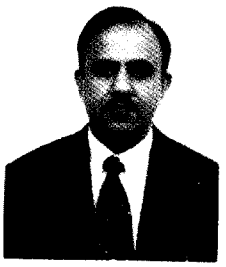

INTERNET TELEPHONY- AN EASY WAY TO COMMUNICATE

Dear Editor,

My sincere thanks to BEACON for introducing me to the world of internal telephony. Your article INTERNET TELEPHONY IN INDIAN CONTEXT published in July 2001 issue of BEACON has initiated me to exploit the potential of PC -to-PC communication as well as PC -to-PHONE communication. I could remain in touch with my children who are studying in U.S. Please countinue to include such articles of common interest in your magazine.

Kumkum

New Delhi

M E S S A G E

It is heartening to note that on Silver Jubilee , a special issue of BEACON is being brought out. I have been the Editor of BEACON for almost 12 years and so I feel specially happy that Delhi Section has decided to recognise its importance in such a complimentary way. Newsletter is an effective way of communication between the office bearers and members and I think, BEACON has served its purpose with satisfaction. In order to make it more effective, the Editorial Committee has decided to upgrade it from Newsletter to House Journal which is rather a very good step. I only hope , this enthusiasm will be sustained and the House Journal will be published regularly.

I would like to congratulate the Editor & the Editorial Committee of BEACON for this effort and wish all success for its future.

Promod K. Srivastava
Chairman , IEEE India Council

1st May , 2002

बी एच ई एल
BHEL

हर्ष वर्धन भटनागर
निदेशक
H.W. BHATNAGAR
Director
(Industrial Systems & Products)

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MESSAGE

It is a matter of great pleasure that to commemorate the Silver Jubilee of the IEEE Delhi Section and its house journal , BEACON, IEEE Delhi section is coming out with a special issue of the journal on the subject of SCADA SYSTEMS AND THEIR SECURITY – a subject which is of great significance and at the same time has become a major challenge.

With the rate of technology changes and the spread of computer literacy , SCADA security breaches are on the rise and the most popular is the internetwork. To effectively counter cyber crime, hacking and cyber terrorism , SCADA security has become an expensive necessity. It has become important for computing professionals and scientists to understand cyber terrorism not only for their own benefit but also for society as a whole.

I fully appreciate the IEEE Delhi section for considering this subject which acts as the backbone of the present industrial networks all over the world.

I have every hope and confidence that this special issue will certainly help in inspiring the concerned people to come forward with the feasible steps for enhancing SCADA security.

(H.W.BHATNAGAR)

Harbans L. Bajaj
1997-98 Region 10 Director

IEEE
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MESSAGE

IEEE Delhi Section has always been very active and growing fast. It gives me immense pleasure to know that to commemorate the silver jubilee of IEEE Delhi Section, BEACON - that used to be newsletter - has been upgraded to a House Journal and that Delhi Section is bringing out a special issue on "SCADA SYSTEMS & THEIR SECURITY". The theme selected is very appropriate in the present day context and I am sure that our esteemed members will find the technical contents interesting, informative, useful and would help in inspiring them to come forward with practical solutions for enhancing SCADA security.

I would like to congratulate and commend the editorial committee for their initiative and wish the Journal all success.

With best wishes

(HARBANS L. BAJAJ)

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MESSAGE

I congratulate the entire team of IEEE Delhi Section on the occasion of Silver Jubilee of IEEE Delhi Section and its House Journal, BEACON. Over the years, IEEE Delhi Section has efficiently organized many seminars and workshops on varied relevant topics related to electrical and electronic industry. In present day context, when the technology is growing at a very fast pace and the systems are becoming very large and complex, there is great need to have SCADA systems in place for effective operations. The theme of IEEE's house journal, BEACON on its Silver Jubilee the "SCADA SYSTEMS AND THEIR SECURITY" is timely placed.

I am sure that this special issue being released by IEEE will put forward valuable suggestions regarding the SCADA systems and their security. I extend my best wishes on their endeavour.

Date : 24th May,2002
Place : New Delhi

(S.C.MISRA)
Director (Projects)
Power Grid Corporation of India Ltd.

Feature Articles

Feature Articles

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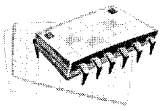
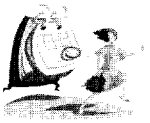


New Products & Services



Editorial Deadlines

The next issue of BEACON plans to highlight the issues associated with'Communication Systems and their Security'. Editorial material for the same must be submitted by 15th Aug 2002 (2 months prior to the issue date).The articles should be sent at the following address with a recent passport size photograph, a brief resume & declaration that the same article has not been published elsewhere earlier. Please submit text/ graphic files (via e-mail or on disk), a hard copy, and a cover letter granting permission to publish to Ram Nath, Editor, C-1/1484, Vasant Kunj, New Delhi-110070, E-mail ramnath@ieee.org. Text files should be submitted in MS Word and graphic files should be submitted in encapsulated postscript(.eps) or TIFF(.tif) format

ADVERTISING INDEX

FROM THE CHAIRMAN'S DESK

Dear Members,

It gives me immense pleasure to address the Membership of our Section through this special issue of '*BEACON*' being released to commemorate the Silver Jubilee of our Section. Though the Silver Jubilee of our Section was celebrated last year, because of our heavy commitment towards organizing the IEEE Annual Convention & Exhibition (ACE)-2001, this issue of '*BEACON*' got delayed to this year. However, more than compensating for this delay, Dr. Ram Nath, the new Editor of '*BEACON*' (also our Section Secretary), took a major initiative in bringing out this special issue on '*SCADA SYSTEMS & THEIR SECURITY*'. The issue has got a collection of excellent articles from engineers of eminence. In my opinion, this '*BEACON*' issue on this topical and hi-tech subject, with a totally new-look and attractive top cover design, will surely become a collector's delight. We, from the Section Executive Committee are extremely grateful to the Editor for the many days of hard work he has put in along with his '*BEACON*' Committee members to bring out this issue. He has plans of bringing out another special issue of '*BEACON*' covering the area of 'Communication' in the course of the next few months.

I take this opportunity to recapitulate the major activities of our Section during the Silver Jubilee Year-2001. The major event was the ACE-2001. A report on ACE-2001 appears separately in this issue. We had a Special General Meeting for celebrating the Section Silver Jubilee, in which we honored the Life Senior Members & Life Members belonging to our Section, who were mainly instrumental in the starting of our Section. We also felicitated the newly elected IEEE Fellow, Dr. Pradeep Dubey and he gave a special lecture on this occasion. Another salient feature of our activities was the visits of as many as 6 IEEE Distinguished Lecturers belonging to Power Engineering, Industrial Applications and Circuits & Systems Societies during the year, delivering special lectures and participating in ACE-2001 and other conferences/workshops. We also had the usual quota of evening lectures and Section administrative meetings, which together averaged to almost one every week. Incidentally, I am delighted to inform the members that our Section has been adjudged as the '*OUTSTANDING SECTION OF REGION 10*' for our activities of year-2000 and we received the award in the Region-10 Meeting at Singapore held in April, 2001.

I am also happy to report that our Delhi Section has entered into an 'IEEE Sister Section' Memorandum of Agreement with Washington-DC Section, through which both these Sections exchange information about the Section operations and gain mutually in organizing events and by helping each other in various ways. We have also participated in the meetings held at Delhi in connection with the formation of '*ENGINEERING COUNCIL OF INDIA*', which will maintain the National Register of Professional & Consulting Engineers and all the IEEE Sections in India have agreed for the IEEE India Council to register as a Founder Member of this Federation of Technical Institutes/Associations, operating in India.

I wish to take this opportunity to express my sincere thanks to our Section office bearers, Executive Committee Members and all the Members at large for making all these possible. I assure you that we will try to achieve further heights in our Section activities with your help, advice and cooperation.

R.Balasubramanian
Delhi Section Chair

SILVER JUBILEE YEAR CELEBRATIONS OF IEEE DELHI SECTION

Through the column of the Newsletter 'BEACON' I had addressed you for 5 years as its Editor and Publisher in the capacity of Chairman of Publication, Publicity and Public Relation Committee of IEEE-Delhi Section.

As Chairman of the History Committee, being responsible for the celebrations of the Silver Jubilee Year, today through the column of the same journal 'BEACON' I am having this opportunity to give you an account of the celebrations.

After operating as sub-section for two years beginning 1974, on May 13, 1976 it was elevated to full fledged section. Delhi Section completed 25 years of service to the members on May 13, 2001. Year long Silver Jubilee Year Celebrations are being organized from that date.

Special General Meeting was held on that day at India International Center, Lodhi Estate, New Delhi. Life Senior Members and Life Members of the Section were honored with the mementos.

In the same meeting it was proposed and adopted to present the mementos to the members of the Section for the lifelong memory of the Silver Jubilee Year and its celebrations. History Committee decided that let the mementos be such that it has utility too. Accordingly, it was decided that the memento would be a pen stand so that it can be kept on the table. Keeping it in view, the memento was got designed and developed.

Er M.M.S. Puri, Chair, History Standing Committee
E-mail: info@desein.com

HISTORY OF DELHI SECTION

Year	Chairman
2002	R. Balasubramanian (IITD)
2001	R. Balasubramanian (IITD)
2000	R.K. Asthana (BHEL)
1999	R.K. Asthana (BHEL) J.K. Pal (EIL)
1998	S. Mukhopadhyay (CEA)
1997	S. Mukhopadhyay (CEA)
1996	M.M.S. Puri (DESEIN)
1995	M.M.S. Puri (DESEIN)
1994	P.K. Srivastava (BHEL)
1993	P.K. Srivastava (BHEL)
1992	C.S. Indulkar (IITD)
1991	C.S. Indulkar (IITD)
1990	H.L. Bajaj (NTPC)
1989	H.L. Bajaj (NTPC)
1988	P.C. Tripathy (BHEL)
1987	P.C. Tripathy (BHEL)
1986	D.P.S. Seth (P&T)
1985	D.P.S. Seth (P&T)
1984	J.C. Anand (Army)
1978	S.V.S Juneja (Army)

HISTORY OF BEACON

Period	Editor & Publisher
2002	Ram Nath
1989-2001	P.K. Srivastava
1984-1988	M.M.S. Puri
1982-1983	K.B.Subramanian

MESSAGE TO THE STUDENT BRANCHES

Greetings to all IEEE members! I am very happy to write this note as the time has come to reap the benefits of the efforts all of us put in last year. I am happy to inform you that the student membership of Delhi section has risen from 387 in Jan 2001 to 752 in March 2002. This growth is phenomenal and we still are growing. Last year, NSIT student branch was reactivated and inaugurated by Prof. M.S. Sachdev on 31st Oct 2001. Prof. R Balasubramanian inaugurated a new student branch at CR State College of Engineering on 4th March 2002. The Murthal student branch seemed to be very enthusiastic and are going to have a year filled with activities. I congratulate the branch counselors Prerna Gaur of NSIT and S.K.Gupta of Murthal for their efforts. Two more student branches at MIT, Delhi and Bharti Vidyapeeth's College of Engineering, Delhi are waiting to be inaugurated later this year.

The student branches at M.R. Engg College, Jaipur; PEC, Chandigarh; Engineering College, Ajmer; DCE, Delhi and Jamia Millia Islamia Delhi are doing very well in terms of membership and activities. Congratulations, keep it up.

The student branches at SJPMLIET Radaur, REC Kurukshetra, BITS Pilani, MEM Engineering College Jodhpur and IIT Delhi are to be activated and membership raised to at least 20, the minimum requirement for a student branch. The branch counselors or any student members from these colleges kindly get in touch with me for any possible help or guidance to revamp these branches. This is very important. Each student branch kindly send me at least one active email ID which I can use to send information to your student branch about the events and other important announcements which has to be disseminated quickly.

As a general comment, kindly send a report of any event or activity of your student branch immediately to me at mini@ieee.org and Dr. S. Mukhopadhyay at subrata@ieee.org so that it can be included in ieeedelhinews or BEACON.

The student membership fee can be paid by the following modes:

1. *The student branch can take a single dollar draft for all the members, the applicant being the student branch and money transacted from the student branch account.*
2. *By UNESCO coupons, this can be obtained from the UNESCO Section, Ministry of Human Resource Development, Government of India, New Delhi. Ph 3384442*
3. *Online renewal with an International credit card.*

Wishing you all the best and a year full of technical and professional activities.

Prof. Mini S. Thomas
Chair, Student and Educational Activities Standing Committee,
E-mail: mini@ieee.org

A REPORT ON ACE-2001

The Annual Convention and Exhibition of India Council is organized every year in association with the IEEE Sections in India at different places by rotation. It is one of the very important events itself for both India Council and the respective Section. This event is popularly known as "ACE" combined with that year.

The prestigious Annual Convention & Exhibition (ACE)-2001 of IEEE India Council was hosted by the IEEE Delhi Section at the India Habitat Centre, New Delhi during November 1-3, 2001. The ACE is usually on a broad theme covering both the Electrical and Electronic Engineering areas. Keeping this in mind, the Organizing Committee of ACE-2001 decided to have the theme of ACE as "Convergence in **SPICE** (**S**emiconductor, **P**ower, **I**nformation Technology, **C**ommunication & **E**ntertainment)". Just like the Indian spice makes our food very tasty, the convergence of technologies has made the EEE discipline very powerful, interesting and challenging. The convergence of technologies in the Communication and Computer areas is being talked about very often in the past decade. The theme of ACE-2001 is an attempt to extend the convergence thinking to Power area also. In fact, the future direction of growth of Electrical & Electronic Engineering can clearly be visualized to be a highly interactive application of Electronics (including Power Electronics), Information Technology and Control to both the basic EEE areas, viz. Power and Communication. The theme of ACE-2001 is to highlight these convergence aspects.

We had a good response to the Call for Authors to contribute papers and our paper review committee selected 40 contributed papers covering almost all the topics suggested relevant to the conference theme. A redeeming feature of the conference was that in addition to these contributed papers, each of the 12 Sessions had an invited lecture by an eminent engineer/researcher. The Conference was preceded by 4 Tutorials by very eminent Researchers/Professors (mostly IEEE Distinguished Lecturers) namely Dr. Prabha Shankar Kundur Power Tech Labs, Canada; Prof. M.S. Sachdev, University of Saskatchewan, Canada; Prof. M. Balakrishnan, IIT Delhi; Dr. Aloknath De, Hughes Software Systems; Gurgaon, Dr. Arun Kumar, IIT Delhi.

The conference was inaugurated on November 2 by the Hon'able Union Minister of Power Mr. Suresh P. Prabhu. He stressed the issue of taking benefit from technological developments in various fields and coordinating their applications for producing quality goods and for efficient servicing to the end-users. In this regard, example of power line for use of telecommunication needs too was mentioned. Hon. Minister emphasized reduction in cost and time with advent of convergence of Technology. In his keynote address, Mr. H.W.Bhatnagar, Director. BHEL gave a brief account of advances in various fields of power, communications, electronics, entertainment and inter-dependence of each other in usage in the background of global scenario vis-à-vis that in India. Mr. H.L.Bajaj, Director, NTPC, while delivering the Presidential address in the same tone highlighted the status of technological development in India in comparison to that existing in advanced countries and suggested the goals to be targeted by us.

The Convention ended with a Panel Discussion chaired by Dr. D.P.S.Seth, Chairman & Managing Director, Bharat Sanchar Nigam Ltd. with Prof. R.Balasubramanian (IIT Delhi), Prof. M.S.Sachdev (University of Saskatchewan, Canada), Prof. H.M.Gupta (IIT Delhi), Dr. Dilip K. Paul (Nayna Networks Inc. USA) and Prof. V.K.Damodaran (IEEE India Council) as the other panelists. It emerged from the discussions that though the advances should continue in individual disciplines with specialization, there is also a need to utilize the emerging convergence in contemporary technologies to deliver some end-products (as already evident in certain spheres like, Cable TV, Internet Service, Communication). In this context strong inter-action between academia and industry towards Research & Development was also advocated.

The organization of an event of this kind needs support and encouragement from many individuals and organizations. We wish to express our sincere thanks to all the individuals, sponsors and advertisers who have helped us in organizing ACE-2001. We would like to specially thank all the members of the Technical, Organization and Advisory Committees and to the Tutorial Faculty, Invited Speakers, contributed Paper Authors and Delegates.

R. Balasubramanian, Chair, Delhi Section
Ram Nath, Secretary, Delhi Section

ACE- 2001 INVITED LECTURES

Session Theme	Invited Speaker
Convergence of Power, IT & Communications in Energy Control Centre	Dr. P.S. Kundur, Powertech Labs Inc. Canada
Embedded Systems	Dr. Anshul Kumar, IIT Delhi
Computerized Power System Operation	Mr.S.C.Mishra, Power Grid Corp. of India Ltd.
Digital Signal Processing & its Applications	Mr. S.C.Guin, All India Radio & Doordarshan
Semiconductors & Power Electronics	Dr. J.K.Chatterjee, IIT Delhi
Wireless & Personal Communications	Dr. S.Hariharan, Lucent Technologies
Intelligent Control of Power Transmission Systems	Mr. A.K. Tripathy, BHEL
Multimedia Applications for Internet	Mr. Amitabh Kumar, ZEE Telefilms
Intelligent Power System Protection	Dr. M.S. Sachdev, University of Saskatchewan, Canada
Communication Technology for Global Networking	Dr. Dilip K. Paul, Nayna Networks Inc. USA
Energy Management	Dr Mahesh Chandra, NIC
IT-Enabled Distribution System: Automation and Planning	Mr. Kumud Goel, KLG Systel Ltd.

PROCEEDINGS OF ACE - 2001

Mr. H.L.Bajaj, Director, NTPC lighting the ceremonial lamp *also seen in picture (L-R) Mr. Suresh P. Prabhu, Hon'ble Minister for Power; Mr.Promod K. Srivastava, India Council Chair; Mr. H.W.Bhatnagar, Director BHEL; Dr. Ram Nath, Delhi Section Secretary; Dr. R. Balasubramanian, Delhi Section Chair*

During the Inaugural Session *(front row L-R) Dr. M.S.Sachdev, Canada; Dr. P.S. Kundur, Canada; (second row L-R) Mr. Santanu Sur, Mr. Lakshman Swarup, Mr. K.C. Sood, Mr. V. Pandhi (all from BHEL)*

Mr. Suresh P. Prabhu, Hon'ble Minister for Power releasing the Conference Proceedings*; also seen in the picture (L-R) Dr. Mini S. Thomas, Mr. P.K. Srivastava, Mr. H.W. Bhatnagar, Mr. H.L. Bajaj, Dr. R. Balasubramanian, Dr. Ram Nath*

Mr. S.C. Misra, Director (Projets), POWERGRID *delivering the invited talk in the session on "Computerised Power System Operation"*

Dr. R. Balasubramanian *presenting a memento to Prof. J.K. Chaterjee, IIT Delhi (Invited Speaker, Session: Semiconductors and Power Electronics)*

Dr. S. Hariharan, Lucent Technologies *(Invited Speaker, Session: Wireless and Personal Communications) receiving memento from Mr. Ashok Golas IEEE, Delhi Section.*

PROCEEDINGS OF ACE - 2001 *(contd.)*

Dr. S. Mukhopadhyay, CEA presenting a memento to ***Mr. A.K. Tripathy, BHEL*** *(Invited Speaker, Session: Intelligent Control of Power Transmission Systems)*

Mr. Rajat Garg, Student Member, DCE (L) and Mr. Ashwini Kumar, Student Member, DCE *(R) presenting their paper during the session on the Multimedia Applications for Internet*

Mr. Prakash V. Ekande, NTPC presenting the memento to ***Mr. Amitabh Kumar, Vice President, Zee Telefilms*** *(Invited Speaker, Session: Multimedia Applications for Internet)*

Dr. Mahesh Chandra, National Informatics Centre *(Invited Speaker, Session: Energy Management) receiving a memento from Prof. B.R. Gupta*

Dr. D.P.S. Seth, CMD, BSNL chairing the Panel Discussion, *other Panel Members (L-R) Prof. R. Balasubramanian, IEEE Delhi Section;Prof. M.S, Sachdev; Canada, Prof. H.M. Gupta, IIT Delhi; Dr. Dilip K. Paul, USA; Prof. V.K. Damodaran, India Council.*

Panel Members with the Delhi Section Executive Committee Members *(L-R) Ashok Golas, Prakash V. Ekande, Manmohan S. Puri, Ram Nath, R. Balasubramanian, Mini S. Thomas, M.S. Sachdev, Subrata Mukhopadhyay, D.P.S. Seth, Promod K. Srivastava, V.K. Damodaran, Daman D. Sood, Dilip K. Paul, Ashok Bhottacharyya*

SUBSTATION AUTOMATION

Rajani Vaidyanathan
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Bhakti Joshi
Dept. of Electrical Engineering.
IIT Mumbai

Modern microprocessors, digital communication and digital signal processing techniques have revolutionized the conventional substation control protection and substation information management system. Human intervention in a modern automated substation can now be kept to the minimum and cost of design documentation and implementation cost of substation control, protection and monitoring can also be kept to the minimum.

Essential needs of a substation namely data collection, data sharing, data utilization for monitoring and control functions, data and event logging and human machine interface are met by modern automation system. The traditional substation protection and control creates an image of number of transducer and metering panels, large number of relays, wiring and noisy printers and heavy log books. A modern automation system has one or two RTUs, compact high speed data channels and a few processor based cards taking care of metering, control and protection. Instantaneous measurement of currents and voltages provide all the inputs required to analyse the system parameters for protection and control decisions and meet design requirements of reliability and dependability, coordinated control, event recording. The processor based control and protection is easily adaptable to periodic modifications and changes and do not require extensive waveform recording equipments such as oscilloscopes etc. The system is nearly maintenance free and highly user friendly.

The main system consists of a master station where a multi microprocessor based distributed processing system resides and which communicates with slave stations which are the RTUs or the remote terminal units. Input for typical protection functions like line fault protection, transformer fault protection, bus fault protection etc, and typical control functions like load shedding, automatic reclosing synchronization etc. are derived from measurements of currents and voltages at various points and used for evaluation of all indirect measurements like reactive power, active power, power factor, frequency etc.The hierarchy based architecture has three levels. At the lowest level are the data acquisition units in switchyard which sample the data very fast. A serial link connects data acquisition units to next level where protection logics and computer algorithm take over. The third level uses the processed data through a microprocessor and human machine interface and communicates with the remote SCADA as well as the data base which generates the management information system alarming, data logging etc.

Substation automation system can therefore take care of a large number of routine functions of substation staff and provide silent, efficient and cost effective service.

A PEEP INTO A HACKER'S MINDSET

Contributed by: **Harish Tejwani**
Hughes Software Systems
E-mail: htejwani@ieee.org

1. What is a Hacker?

There is a community, a shared culture, of expert programmers and networking wizards that traces its history back through decades to the first time-sharing minicomputers and the earliest ARPAnet experiments. The members of this culture originated the term 'hacker'. Hackers built the Internet. Hackers made the UNIX operating system what it is today. Hackers run USENET. Hackers make the World Wide Web work. If you are part of this culture, if you have contributed to it and other people in it know who you are and call you a hacker, you're a hacker.

The hacker mind-set is not confined to this software-hacker culture. There are people who apply the hacker attitude to other things, like electronics or music — actually; you can find it at the highest levels of any science or art. Software hackers recognize these kindred spirits elsewhere and may call them "hackers" too — and some claim that the hacker nature is really independent of the particular medium the hacker works in. But in the rest of this document we will focus on the skills and attitudes of software hackers, and the traditions of the shared culture that originated the term `hacker'.

There is another group of people who loudly call themselves hackers, but aren't. These are people (mainly adolescent males) who get a kick out of breaking into computers and 'phreaking' the phone system.

Real hackers call these people 'crackers' and want nothing to do with them. Real hackers mostly think crackers are lazy, irresponsible, and not very bright, and object that being able to break security doesn't make you a hacker any more than being able to hotwire cars makes you an automotive engineer. Unfortunately, many journalists and writers have been fooled into using the word 'hacker' to describe crackers; this irritates real hackers no end. The basic difference is this: hackers build things, crackers break them.

2. The Hacker Attitude

Hackers solve problems and build things, and they believe in freedom and voluntary mutual help. To be accepted as a hacker, you have to behave as though you have this kind of attitude yourself. And to behave as though you have the attitude, you have to really believe the attitude. But if you think of cultivating hacker attitudes as just a way to gain acceptance in the culture, you'll miss the point. Becoming the kind of person who believes these things is important for you — for helping you learn and keeping you motivated. As with all creative arts, the most effective way to become a master is to imitate the mind-set of masters — not just intellectually but emotionally as well.

Or, as the following modern Zen poem has it:

To follow the path: look to the master,
follow the master, walk with the master,
see through the master, become the master

(Collected from How to Become A Hacker, Copyright © 2001 by Eric S. Raymond)

DISTRIBUTION MANAGEMENT SYSTEM TECHNO–ECONOMIC CONSIDERATIONS

Dhananjay Ketkar
POWERGRID
E-mail: ketkar@powergridindia.com

Abstract

In India the transmission system has evolved mostly on the basis of detailed technical studies but the distribution system though planned initially generally has grown in an haphazard manner with the immediate objective of meeting growing demand of consumers. The approach over the years has created an inefficient distribution system that contributes very high T&D losses and poor quality of supply to the consumers.

Accordingly, the focus of ongoing power sector reforms has rightly shifted to sub-transmission and distribution level . This is leading to restructuring and optimal utilization of available resources. The corporatisation of Electric Utilities into separate Generation, Transmission and Distribution companies are one step forward in this direction. The next step would concentrate on minimizing losses and supplying quality power to the consumers. All this necessitates establishment of an effective SCADA/DMS system, which can ensure economy, efficiency and security of power supply .The present paper deliberates on key issues related to establishment of such a cost effective distribution management system (DMS).

1. INTRODUCTION

We have come a long way since independence. Our installed generating capacity has grown from 1362 MW in December1947 to 97,837 MW in March 2000.Side by side our transmission & distribution losses have increased from 14.4 % to a level of 24.4% (All India Level during 1997-98). These T &D losses are much higher than the desirable level of 6-10 %. Even the reported T&D losses in some states are to the tune of 40-50%. But these figures are estimated on the basis of unmetered energy/revenue billing etc., which do not segregate the technical and commercial losses separately. The commercial losses require managerial action and deployment of suitable technology options i.e. Remote metering etc. Reduction of technical losses require a detailed analysis of existing system, estimation of demand growth and pattern and adoption of distribution automation techniques so as to improve reliability and security of power supply, creation of authentic database and adoption of demand side management measures. A good distribution system shall ensure voltage within permissible levels, power factor close to unity, minimum losses, reliability/ security of supply and least overall system cost.

2. OVERVIEW OF SCADA/DMS SYSTEM

SCADA stands for Supervisory Control and data acquisition. The real time data is acquired from the field and the same is used for monitoring and control of associated power system through computerized control centres. The automation of power system can be implemented at four levels i.e.:

- Generation-transmission Level Automation
- Distribution Level Automation
- Substation Level Automation
- Feeder Level Automation

The Control Centres associated with the implementation of automation of power system at Generation–transmission system level and Distribution system level are referred as Energy Management System (EMS) and Distribution Management System (DMS) respectively. Generally the substation level automation is implemented independently alongwith installation and commissioning of substations and helps in achieving operational efficiency as well as reduction in manpower costs. The feeder level automation is effective only when the DMS is already available.

Typically, the SCADA/DMS system consists of:

- Data acquisition system consisting of RTUs (Remote Terminal Units) / IEDs (Intelligent Electronic Devices).
- Control Centre Hardware (Communication Front ends, MMI, Application processors etc.)
- Control Centre software consisting of System software, SCADA software and DMS software.
- Communication system
- Network Management System
- Auxiliary Power Supply & other facilities

Among others, the important DMS applications are as follows:

- Voltage/VAR Control (VVC): The VVC function monitors the set of telemetered voltage measurements associated with each VVC-controllable device. If it detects a limit violation, it advises the corrective control actions i.e. incrementing/ decrementing the transformer tap position, and switching in/ out a capacitor in a capacitor bank.
- Fault Management and System Restoration (FMSR) : The Fault Management & System Restoration function provides assistance to the DMS dispatcher for detection, localisation, isolation and restoration of the distribution system in case of faults.
- Loss Minimization via feeder reconfiguration: The loss minimization via feeder reconfiguration study application identifies an alternative network topology, which, while meeting the same nodal power demands, incurs smaller distribution losses.
- Remote Metering: This can be effectively utilized to monitor the actual energy flow to various loads. The meter reading is forwarded through suitable communication media to the control centre for necessary records/actions.
- Load Shed Application: The load-shed application automates and optimizes the process of selecting the best combination of switches to open in order to shed the desired amount of load.
- Network Connectivity Analysis (NCA) : The NCA function determines the topology of the distribution network based on the physical connectivity of devices in the network and the status of connecting devices such as switches. Also, the results of the NCA function serve as inputs to virtually every other application in the DMS software package.
- Trouble call and Outage Management System (TCOMS): TCOMS provides interactive voice response and automatic call dispatch facility to track and report problems, analyse and group problems by type and dispatch problems individually or by groups to appropriate work crews for resolution.
- Geographical Information System (GIS): GIS provides the accurate mapping between the geographic locations and the associated electrical network. This helps in topology recognition and effective fault management and restoration.

The DMS applications can be utilized in closed loop or in advisory mode. In closed loop the respective control is initiated automatically as and when the need arises. However, in case of advisory mode, Control Centre Operator can analyse the exigencies & available options and then issue the appropriate instructions to the controlled equipments directly or instruct O&M personnel at substations for performing suitable control actions.

3. STRATEGY FOR DMS IMPLEMENTATION

Considering the state of existing distribution systems under various State Electricity Boards (SEBs) and their operation and control philosophy, it is obvious that for implementing all the important DMS applications what they would require is a massive retrofitting of substation equipments for exercising suitable controls etc. It implies huge investment not only for establishing a new DMS system but also for making their system ready for related automation etc. This is an additional burden that all SEBs would not be able to bear at this stage.

So, it would be pragmatic that a preliminary investigation of the existing distribution system shall be made in order to assess the state of various important parameters of distribution system. These parameters include load profile, transformer loading, capacity/ availability of capacitor banks & motorised breakers etc. Also, important is the average time taken for fault isolation & restoration, average distribution losses per year and the geographic/network connectivity between the associated substations etc. The status of all theses parameters would indicate the level of automation already available and the appropriate/matching DMS applications that can be implemented with minimum effort, so that the optimal utilisation of resources can be ensured. Further, these investigations would lead in formulating a factual plan for incorporating critical applications like Remote Metering, Trouble call and outage managements and Geographical Information System etc. at a suitable stage (time).

For successful implementation of SCADA/DMS system and to encourage the SEBs to proceed further in this regard it would be pertinent to suggest that this can be done in two stages in such a way that by the implementation of first stage itself, SEBs are able to reap suitable qualitative and quantitative benefits for their distribution System. The qualitative benefits refer to improved efficiency and supply of quality power (proper Voltage & frequency) to the consumers whereas quantitative benefits implies related cost savings, recovery of cost /charges for the associated DMS system etc. Further the second stage of DMS system means the applications that may primarily bring qualitative benefits.

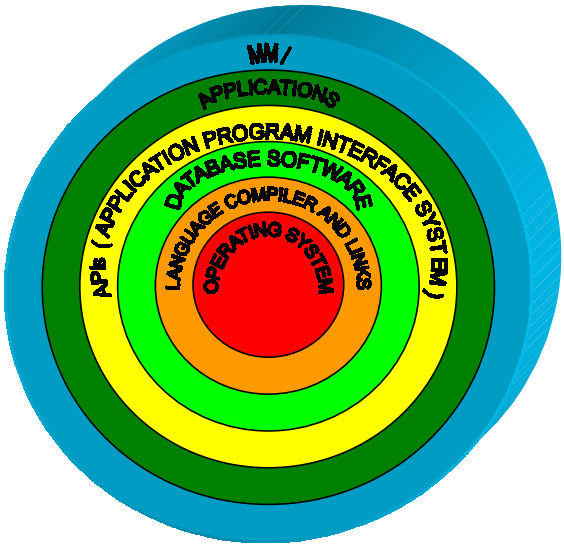
Thus the ideal strategy for DMS implementation would call for a step by step implementation of various DMS applications so that the benefactor of the same sees for itself the benefits associated with its staggered implementation and consolidates its position slowly depending upon the resources it gathers in the process.

4. ISSUES FOR CONSIDERATION

The reliability of SCADA/DMS System greatly depends on availability of appropriate data as input for SCADA and DMS software. Further, selection of suitable control centre Architecture plays very important role in deciding future expandability and reusability of hardware and software. All this calls for an approach that would lead to establishment of a SCADA/DMS system that is based on open system concept and offers flexibility in terms of implementation of applications in phased manner.

Primarily the open system architecture shall possess the following features:

Portability	The ability to use operating system or application software on a variety of computer systems made by different vendors.
Interoperability	The ability to support the exchange of information with computers from different vendors (selection of appropriate protocol for various communication needs).
Scalability	The ability to migrate the applications among the computers of different vendors and different sizes as computer needs grow and change.
Interconnectivity	The ability to support networking through a standard like the OSI reference model with users in a style that facilitates user portability.



System Software Architecture

Two fundamental features of modern SCADA/DMS Systems that distinguish them from the old design are the use of a redundant, industry standard local area network (LAN) and the distribution of functions among several computers or workstations on the LAN. This means critical application functions are configured in redundant mode, so that the failure of any software function or hardware does not affect the availability of the system. Further, the conformance to Open Architecture can be achieved by ensuring implementation of international standards for all the sub-systems i.e.

- Operating System based on POSIX (Portable Operating System Interface an IEEE standard).

- Graphic User Interface based on OSF/MOTIF standards.
- Common Information model of EPRI for power system Real-time database
- SQL (Structured Query Language) and ODBC (Open Database connectivity) for database.
- Communication protocols based on TCP/IP, ICCP, IEC870-5-101.
- SNMP for Network Management.
- ANSI/ISO standard for all programming languages.

In addition to these issues it is also important that suitability of implementation of DMS applications in closed loop or advisory mode shall be critically examined in the light of available level of automation and resources etc. An appropriate decision in this regard can translate into considerable savings at the initial stages of DMS implementation.

5. CASE STUDY

To illustrate the tangible benefits associated with implementation of SCADA/DMS Project, a case study has been performed for an Electric Utility. The proposed SCADA/DMS Project encompasses establishment of a full-fledged Control Centre with appropriate Hardware & Software (SCADA/DMS software, Application processors, Operator Consoles, dual LAN, Communication Front-Ends, Routers, printers etc.). The project includes installation & commissioning of sixteen new RTUs (Remote Terminal Units) and integration of existing twenty-four RTUs. The communication is based on copper cable, which is already existing and available among the various nodes (Only the cost of end equipments like modem etc. is included). The typical DMS applications envisaged for the project are Voltage VAR Control (VVC), Fault Management and System Restoration (FMSR), Loss minimization via feeder reconfiguration and Trouble call management (TCM). It was assumed that all the substations are equipped with suitable capacitor banks. The estimated cost for the above SCADA/DMS project comes out to be Rupees thirty crores approximately.

The other relevant information about the Electric Utility is as under:

- Average power factor: 0.959
- Units purchased per annum: 3394 million units
- Units sold per annum: 2951 million units
- Distribution loss: (13.1%) 443 million units
- Average cost per unit: Rs 3.83

It was observed that just by the improvement of power factor from 0.959 to 0.965 (keeping the voltage constant), reduction in current and consequential reduction in losses to the tune of 1.2 % (from 13.1% to 11.9%) is obtained. This reduction in losses translates into a yearly saving of Rs. 14.98 crores and the compounded benefit is that that the cost of above proposed SCADA/DMS system could be recovered in two years approximately. Noteworthy is the fact that the above saving is being achieved only through the implementation of VVC .The reduction in distribution losses to the tune of 3% of total distribution losses has not been taken into account. Moreover, significant benefits due to implementation of FMSR i.e. early fault isolation and faster restoration, and TCM have not been quantified in the above case study.

6. CONCLUSIONS

At present the overall power scenario demands that optimal utilisation of resources shall be made. Accordingly, preliminary assessment of Electric Utility environment and its requirements shall be made so that suitable DMS applications can be selected which can provide quantitative and qualitative benefits at the earliest. This will generate the much-wanted confidence and justification for carrying out the reforms in distribution system.

POWERGRID is already implementing Generation-transmission level of automation by establishing Regional System Coordination and Control Projects for all the regions of our country. It is prudent and timely that implementation of DMS shall also be accorded a high priority status to bring efficiency, security and economy to our dilapidated distribution system. ***To start with every SEB shall take a pilot project in their state and implement DMS with limited applications as per their requirements***. Progressively this can encompass the entire state.

NORTHERN REGION UNIFIED LOAD DESPATCH AND COMMUNICATION SCHEME

*Courtesy : **POWERGRID***

NR-ULDC scheme comprises modernisation of power system supervision and control infrastructure including dedicated communication system for the entire Northern Region. The scheme has been completed and has been put into operation from Jan 2002. It will establish three level hierarchical Supervisory Control and Data Acquisition along with Energy Management System. The scheme involves establishment of 33 control centres (1 Regional Load Despatch Centre, 9 State Load Despatch Centre and 23 Sub Load Despatch Centre, 369 Remote Terminal Units, 2,100 km of Optic Fiber Cable and 3,000 km of Microwave Communication Network for real time data monitoring and control of major generating stations & substations. The scheme covers more than 10 lakh sq. km of geographical area. The scheme is technically and organizationally among the most complex and high-tech in power development and one of its kind ever attempted in the world as a single project given its complexity. The NR-ULDC scheme has been established in close association with State Electricity utilities namely DVB, HPSEB, HVPN, J&KPDD, PSEB, RVPN, UPPCL and other constituents like BBMB, NHPC, NPC & NTPC with one SLDC in each State and Regional Load Despatch Center at New Delhi. The estimated cost of the scheme is Rs. 661 crores.

Benefits of ULDC scheme

- Real time monitoring, supervision & control of power system
- Improved system security, reliability and reduction of undelivered energy
- Savings in the operating cost
- Avoidance/minimization of Grid disturbances/failures
- Quick restoration during Grid disturbances/failures
- Capital Investment Saving
- Better Management Information
- Better System Operation and Control
- Real Time Environment for Operator Training
- Optimal utilization of Resources and Economic Despatch of power

HACKING ANALYSIS OF SCADA INSTALLATIONS

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1. INTRODUCTION

The increased use of computer based systems for electric power control and protection has created a parallel between the vulnerabilities of the power system and those seen in computer networks.

Multiple vulnerabilities exist when implementing remote access to SCADA systems. What is not obvious is the different nature of the risk involved with each point of access. The hacker who gains control over a SCADA system can do far more damage-and more widespread damage-than the person who intrudes into a substation controller.

Table 1 shows a listing of the vulnerabilities and risks involved in remote access to SCADA equipment:

2. INSTANCES

- It is believed Osama Bin Virus surfed the web to study widespread technology known as "Supervisory Control and Data Acquisition" (SCADA). Osama probably visited websites like www.eren.doe.gov/citiescounties/ watersy.html maintained by the U.S. Department of Energy and http://www.motorola.com/LMPS/ RNSG /fixed_data/water.htm maintained by Motorola Corporation.
- Hackers broke into computer systems owned by California's primary electric power grid operator and remained undetected for 17 days .The intention behind the network break-in at the Folsom, Calif.based California Independent System Operator (Cal-ISO) isn't clear. The FBI is investigating the incident, which took place between April 25 and May 11,2001.

3. ATTACK SCENARIOS

Electronic attacks concentrate on system vulnerabilities, and attack characteristics are based on the characteristics of the vulnerability being exploited. Following are examples showing how insiders and outsiders could exploit the vulnerabilities.

3.1 Insider Information-Using insider information, one can access protective equipment (either physically or electronically) and can change the settings such that the equipment either fails to operate when it should, causing bus, line, or transformer damage, or operates when it shouldn't, causing service interruption.

3.2 Trojan Horse-One can dupe an employee with access to computer information services into installing or running a computer game or otherwise seemingly innocuous applications with legitimate connections to the employee's company. The installed computer application contains a Trojan Horse program that opens a backdoor into the computer network.

3.3 Network Analyzer- A network analyzer can be attached to the network line to show the content of all data packets between the supervisory and remote equipment. The unencrypted data packets contain control and settings information that can be used in subsequent attacks on either the SCADA system or the protective equipment.

Equipment	Vulnerable Point of Access	Risk
SCADA equipment with remote access via private network.	1 Physical access to SCADA system 2.Electronic access to subordinate protection equipment 3. Electronic access to protection settings	1. SCADA system accidentally or deliberately damaged 2. SCADA functions accidentally or deliberately altered 3. Protection settings accidentally or deliberately altered
SCADA equipment with remote phone access.	1. Electronic access to SCADA system via modem . 2. Electronic access to subordinate protection equipment 3. Electronic access to protection settings	1. Dial-in number accessible via social engineering or automated modem scan 2. Access control circumvented by password attack 3. SCADA functions accidentally or deliberately altered 4. Protection settings accidentally or deliberately altered
SCADA equipment with remote network access.	1. Electronic access to SCADA system via system port or network address 2. Electronic access to control and data packets 3. Electronic access to subordinate protection equipment 4. Electronic access to protection settings	1.Network address accessible via social engineering or automated network port/IP scan 2. Access control circumvented by password attack 3. SCADA functions accidentally or deliberately altered

Table 1 : Vulnerabilities and Risks Involved in Remote Access

If an electronic intruder gained access to an electric utility SCADA system, the intruder could then:

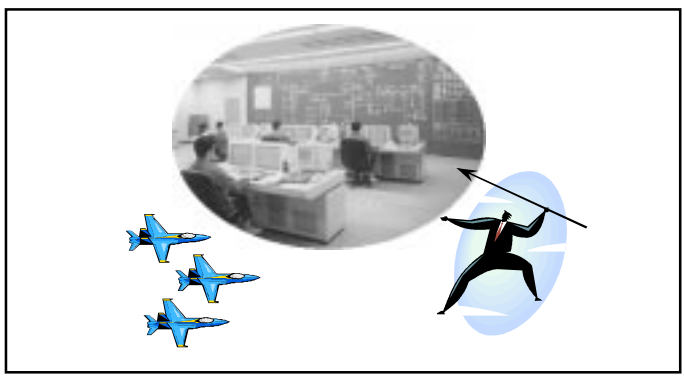
- Shut down the regional service controlled by that SCADA system, either immediately or in a delayed manner.
- Steal or alter metering data gathered by the SCADA system.
- Use the SCADA system as a backdoor into the corporate IT system to obtain customer credit and personal identity information commonly used in electronic theft.

4. RECOMMENDATIONS AND CONCLUSIONS

A variety of tools and techniques are available to mitigate risk associated with electronic intrusions into computer-based networks controlling electric power generation, transmission, and distribution. Recommendations for securing computer based SCADA and IT systems were compiled from the literature and are summarized below:

- Use passwords, data access restrictions, and other means of user authentication to guard against unauthorized access to protective equipment and SCADA systems. Match the strength of your user authentication to the criticality of the data being protected. Two-factor, and even three-factor, authentication may be appropriate for access to critical SCADA systems.
- For single-factor authentication, passwords are better than PINS because the increased permutation of characters makes them harder to crack. Use strong passwords of six or more characters with mixed case and special characters. Do not use common words, acronyms, or personal information like birthdays and names that can be cracked.
- Change passwords periodically (e.g., monthly or quarterly) and change them immediately after instances of contractor installation and maintenance, after suspected intrusions, and when personnel turnover or strife increases insider risk.
- Monitor alarms for intrusion detection and to verify device functionality. Automate alarm responses with preprogrammed disconnects, auto-dial warnings, and increasing audio and visual alarms.
- Implement access hierarchies with different levels of permission for viewing and setting devices. Use segmented network topologies and/or star topologies to increase survivability and avoid "one down, all down" vulnerabilities.
- Secure SCADA and IT systems with virus scanners, firewalls, and intrusion detection systems.
- Use secure dial-back, encrypting, or authenticating modems or modem-keys.

Terminate interactive sessions after long periods of inactivity and ensure that open ports are properly closed so the next user does not inherit unauthorized access privileges.



SCADA AND HACKERS

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1. INTRODUCTION

In October 1999, a computer hacker publicly announced his intention to release a report outlining how to break into power company networks and shut down the power grids of 30 United States utility companies. Since these announcements, heated debates have ensued concerning the level of security for **S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition (**SCADA**) systems. Today, India faces a possibility of a worse attack, thanks to the intents of our unfriendly neighbor.

2. THE COMMON MISCONCEPTIONS THAT MAKE SCADA SYSTEM SECURITY HARDER THAN IT ACTUALLY IS!

2.1 Misconception 1 – *SCADA system resides on a physically separate, stand-alone network.*

Most SCADA systems were originally built before and often separate from other corporate networks. As a result, IT managers typically operate on the assumption that these systems cannot be accessed through corporate networks or from remote access points. Unfortunately, this belief is usually fallacious.

- Corporate networks are closely associated with SCADA systems to enable their engineers to monitor SCADA systems from remote Corporate offices.
- Of late, the concept of Digital Nervous System (DNS) has risen. It's objective is to provide decision making authority access to all critical data. People forget the risks of unauthorized access while providing Digital Nervous System.

2.2 Misconception 2 – *Connections between SCADA systems and other corporate networks are protected by strong access controls.*

Many of the interconnections between corporate networks and SCADA systems require the integration of systems with different communications standards. The result is often an infrastructure that is engineered to move data successfully between two unique systems. Due to the complexity of integrating disparate systems, network engineers often fail to address the added burden of accounting for security risks. Although firewalls and intrusion detection systems (IDS), and commendable password policies may save SCADA systems, few entry points to the SCADA system are protected in this manner.

2.3 Misconception 3 – *"SCADA systems require specialized knowledge, making them difficult for network intruders to access and control."*

It is true that for a novice hacker, hacking SCADA systems is not a piece of cake. However, today the threat of hackers faced by India is institutionalized, well trained and well funded. Due to the presence of Remote Terminal Units (RTUs), the security level of SCADA systems are same as the security level of the networks they are attached to.

3. SECURITY VULNERABILITIES AFFECTING SCADA SYSTEMS

3.1 Public Information availability

- Websites often provide data useful to network intruders about company structure, employee names, e-mail addresses, and even corporate network system names

- Domain name service (DNS) servers permit "zone transfers" providing IP addresses, server names, and e-mail information

3.2 Insecure Network Architecture

- Configuration of file transfer protocol (FTP), web, and e-mail servers sometimes inadvertently and unnecessarily provide internal corporate network access
- Network connections with corporate partners are not secured by firewall, IDS, or virtual private network (VPN) systems consistent with other networks
- Dial-up modem access is authorized unnecessarily and maintenance dial-ups often fail to implement corporate dial access policies
- Firewalls and other network access control mechanisms are not implemented internally, leaving little to no separation between different network segments

3.3 Lack of Real Time Monitoring

- Vast amounts of data from network security devices overwhelm utility information security resources rendering monitoring attempts futile
- Even when intrusion detection systems are implemented, network security staff can only recognize individual attacks, as opposed to organized patterns of attacks over time

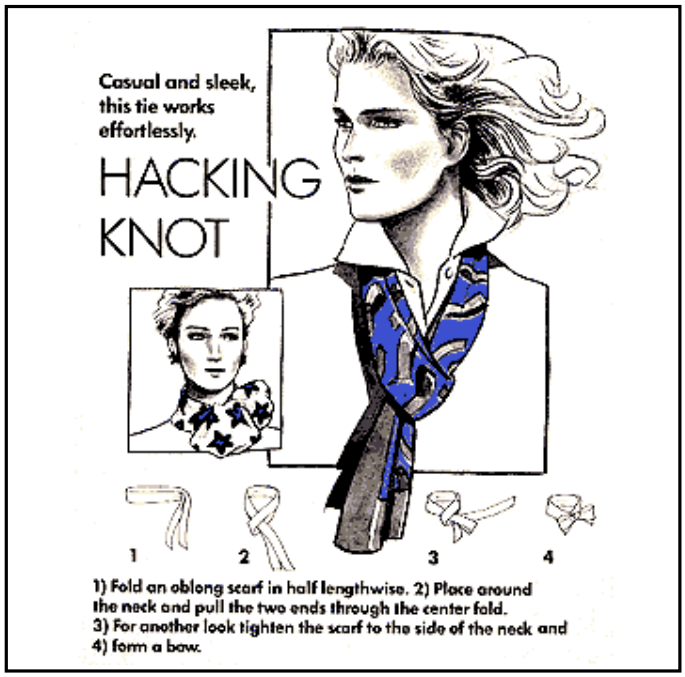
4. RECOMMENDED TACTICS TO STRENGTHEN SCADA SYSTEM SECURITY

Step 1*: Regular Vulnerability Assessments*

Many utilities fail to regularly assess the vulnerabilities of their SCADA and Energy Management Systems (EMS) systems, on a regular, recurring basis. In addition to assessing operational systems, corporate networks, web servers, and customer management systems should also be assessed to reveal unintended gaps in security.

Step 2: *Expert Information Security Architecture Design & Monitoring.*

While firewalls, IDSs, and VPNs can all help protect networks from malicious attacks, improper configuration and/or product selection can seriously hamper the effectiveness of a security posture. Advise from Information security professionals should help in this matter.



ELECTRONIC INTRUSIONS INTO SCADA SYSTEMS

A HACKER CAN PUSH YOU INTO DARKNESS!!

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1. INTRODUCTION

The introduction of competition in the electric power industry, coupled with an increased public demand for power, has resulted in a greater reliance on IT systems and networks by electric power utilities. IT systems are already crucial in the control and management of electrical power - from generation down through to end use. IT systems are also allowing the utilities to manage their other business processes more efficiently as well. Customer management, supplier communications etc. are becoming increasingly reliant on the use of IT systems and networks. As the power industry becomes more dependent on information systems such as the Internet and Net Technologies, its vulnerability to attacks become greater.

Though the physical destruction is the biggest threat facing the electrical power grids and distribution networks, the threat from *electronic intrusions* into the control systems related to the electrical power networks is real and it is growing. This fact needs to be addressed seriously by the electrical power industry.

2. THE THREATS AND RISKS INVOLVED

If one was asked to prepare a list of possible threats to an electrical power grid, one would possibly think of the common causes such as storms, equipment deterioration, fraud, theft, etc. However, if one actually sits down and gives it a deep thought, a different picture emerges. For example in the US, the White House subcommittees along with IEEE and NIST prepared a list of potential threats to the North American power grid. This list can be applicable to any electrical power grid across the world and includes the following:

- Natural disasters and events
- Accidental physical damage
- Physical maintenance and infrastructure
- Deterioration
- **Terrorism and sabotage**
- **Vandalism**
- Blunders, errors, and omissions
- Threats to personal privacy
- **Disgruntled employees and ex-employees**
- **Disgruntled customers**
- **Malicious hackers**
- **Recreational hackers**
- **Hacktivists**
- **Malicious code and viruses**
- **Information warfare**
- **Foreign (state sponsored) intelligence gathering**
- **Industrial and foreign espionage**
- Insiders and associates
- Fraud and theft
- Economic conditions
- Labor conflicts
- Civil/Political unrest
- Curiosity and ignorance

- Use of adjacent property
- Joint-use facilities
- Aesthetics

As can be seen, there are several items that do not come to our minds immediately, like the highlighted ones, but these threats do exist, are real, and cannot be ignored.

Let's focus more on the threats arising from *e-intrusions* into the electrical power systems. The IEEE standard governing substation security defines electronic intrusions as:

"Entry into the substation via telephone lines or other electronic-based media for the manipulation or disturbance of electronic devices. These devices include digital relays, fault recorders, equipment diagnostic packages, automation equipment, computers, PLC, and communication interfaces."

The risks are increasing because SCADA systems, like several other IT systems, are becoming increasingly networked. The people are also becoming increasingly skilled. Competitive markets are forcing utilities towards automation. Now, to realize effective use of automation, it becomes important that the different systems be interconnected to each other. In general, the various systems are connected by standard interfaces and public networks and interfaces, which increase the risk of hacking.

The vulnerability of the electrical power grids is increasing as deregulation and market forces are forcing the Generation and T&D companies to avoid or sometimes even do away with their proprietary systems in favour of standard, open systems, and also to connect the administrative and organizational networks with the control networks - that coordinate the flow and distribution of electricity.

3. THE "WEAK LINKS": AREAS OF VULNERABILITY

The points of vulnerability include access through the Internet or modems into a power company's local area network, and through the LAN, into their control systems. Dial-up access to substation RTU's and digital programmable devices are also possible. In the present times, several factors combine to raise the risk of electronic intrusions into electrical control systems. These threats result from the changing *social*, *political*, and *technological* issues. For instance some of the *technological issues* are:

- The expanded use of public protocols to interconnect protective equipment and SCADA systems (e.g. TCP/IP and UCA over Ethernet LANs/WANs)
- Increased dial-in and network access to remote sites through public communication services (e.g., public phones, Internet)
- In the US, increased public access to transmission system data is mandated by the FERC
- Rapid growth of a computer-literate population and widespread dissemination of hacker tools

The vulnerabilities of the electric Utilities and the power grid can be to three main areas:

- The Control Center
- The Substation, and
- The Communications Infrastructure

The Control Center monitors the generation facility, transmission and sub-transmission networks, the distribution systems and customer loads of a Utility. It provides a centralized monitoring of the operations of the power system, retains historical data, and allows the manual and automatic control of field equipment. The vulnerabilities of a Control Center lie in its links to the corporate MIS, to other utilities etc. Sometimes it is possible to carry out remote maintenance and administration thus creating another vulnerability. Whenever a Utility's Energy Management System (EMS) which controls the flow of power through that utility's section of the power grid), is connected to a Local Area Network, there is a danger of hackers gaining access to the power grid. All these access points potentially have the same vulnerabilities as any LAN connected to the Internet, giving determined hackers opportunities with which they are quite familiar.

Substation is the "clearinghouse" for power. Power is stepped down from the high (transmission level) voltages and then directed to distribution systems. Power is then delivered to ultimate consumers - the residential and commercial customers. In order to provide better service to customers, reduce staffing requirements, etc., substations are getting increasingly automated with the use of remote terminal units (RTUs), and a variety of intelligent electronic devices (IEDs). Both the RTUs and the digital programmable devices have vulnerabilities associated with them. RTUs collect data for the Control Center and operate as a "clearinghouse" for control signals to transmission and distribution equipment. Some of these RTU's have maintenance ports that can be accessed even without required dial-back connectivity. Intruders access to an RTU could result in commands given to substation equipment or reports of spurious data to the Control Center. If an RTU is knocked out, this could have significant impact on customers or systems connected to this substation. Similarly, if a hacker dials in to a digital breaker, he/she could reset the device protection, which might either destroy the device or cause it to shutdown for self-protection.

Communication Infrastructure is also vulnerable. The infrastructure, which is used for communication between control system elements, is composed of private microwave radio and private fiber networks and also of public networks for communication between control system elements. Besides the damage of physical attacks, the private network communications can be jammed or intercepted. The Internet contains sites describing how to assemble an inexpensive microwave-jamming unit.

4. MOTIVES: WHY WOULD SOMEONE WANT TO HACK A SCADA SYSTEM?

Several socio-economic factors increase the chances of an electronic, computer-based, cyber-attack being launched against a utility or a substation, causing local, regional or maybe even more widespread power failure. The motives may range from just plain fun or challenge, to getting revenge or even getting competitive advantage. Several causes of motivations can be cited:

- Instability in the electric power utility job market, creating disgruntled employees and ex-employees, caused by deregulation and mergers
- Increased competition for electricity generation and T&D services creating pressure to downsize, streamline, automate and cut costs, also causing disgruntled employees and ex-employees

- Instability in the electric power supply caused by deregulation and increased competition, creating disgruntled customers
- Disgruntled customers who may alter meter or billing related data to be charged low bills or even huge refunds
- Increased terrorism worldwide and information warfare
- Increased electronic theft, recreational hacking, and hacktivism (i.e., the destruction of electronic assets for a political or socio-economic cause)

The motivation for electronic attacks on electric power grids may follow the some patterns, which are seen in attacks on Internet E-commerce sites. These can be broadly categorized into the following groups:

- **Hacker**: this is a group of computer users who can access unauthorized systems simply because they can
- **Espionage**: someone might be interested in gaining industrial or political advantage by gathering information through both legal and illegal means
- **Sabotage**: someone who desires a personal, economic, or political gain caused through the destruction of his / her competitor's assets, organizational structure, and / or market share
- **Electronic Theft**: someone who is in search of credit and / or personal identity information, frequently stored in corporate IT systems, that can be then used in subsequent fraudulent schemes
- **Vandalism**: the destruction of property value without personal gain. This is different from sabotage because it is typically haphazard, random, and relatively localized

5. "CHAOS": THE CONSEQUENCES OF ATTACKS

Though the attack scenarios sometimes seem a bit far fetched, it is a fact that the computer network and telecommunications industries have already experienced such attacks and it is very much possible that the electric power utilities will also experience similar e-intrusions. If an electronic intruder gains access to substation control or protective systems, he/she could then:

- Shut down a substation or any portion of the subsystem controlled by the device that has been hacked. He/she may do it either immediately or in a delayed manner
- Change protection device settings to degrade reliability of the device and, subsequently, the electric power supply provided by the substation
- Gather control and protection settings information that could be used in a subsequent attack
- Change or corrupt the data in such a manner as to degrade electricity supply or cause loss of service
- Put in a malicious code that may trigger a delayed or coordinated attack

Further, if an electronic intruder gained access to an electric utility SCADA system, the intruder could then do the entire above, and also:

- Shut down the regional service controlled by that SCADA system, either immediately or in a delayed manner
- Steal or alter data gathered by the SCADA system
- Use the SCADA system as a backdoor into the corporate IT system to obtain customer credit and personal identity information commonly used in electronic theft

The biggest fear that the utilities have is an attack on both the electric power control system and the communications infrastructure simultaneously. This is described as a "nightmare scenario", since all means of coordination between the control center and generation and transmission elements would be lost in such a case. Total Chaos!!

6. CONCLUSIONS

With the vulnerabilities of the control system security increasing, the costs of security breaches become more severe. This does not mean the utilities start to fear automation and set aside plans to IT-ize their infrastructure. It only means that while designing automation systems, a considerable thought (and money!) also needs to go into the security aspect of the systems.

For the systems already in place, a good start by the power companies would be to identify the gaps in the security systems and work towards bridging these gaps. Basic steps can be taken up to minimize the number of breaches of security and the impact of the same. Such steps could be:

- Conduct a regular assessment of vulnerabilities
- Design a secure network architecture

The modern configurations of electric power control systems and protection systems are mainly with distributed intelligence – somewhat resembling a network of computers. The most common ways of managing electronic intrusions are to:

- Involve authentication of communicating partners
- Secure connection between sites
- Encrypt the data communication between different sites
- Identification and remediation of intrusions as and when they penetrate the network

There are several techniques and processes that can be used to safeguard IEDs, PLCs, RTUs, controllers, communications processors, SCADA systems, and virtually every type of programmable digital device used in electric power systems control and protection. The cornerstone to all network security is access restriction and user authentication. Beyond that we are concerned with safeguarding the communication packets from prying eyes, via encryption, and verification of packet transmission and reception.

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PLC BASED SUBSTATION AUTOMATION FOR DELHI VIDYUT BOARD

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1. INTRODUCTION

Traditional sub station designs used separate discrete devices for protection and control. The digital relays have been available for last decade, but have recently gained widespread popularity. In fact, the numerical relays and meters are increasingly being referred to as intelligent electronic devices (IEDs). The main feature that separates the digital relays from previous devices is in the ability to store the digitised information and communication. The control and protection system has to fulfil the basic power system requirement of security, dependability, fault tolerance and availability.

Programmable Logic Controllers (PLC) have been used widely in industrial applications, more so in the process industry. The main criteria for use of the PLC system for automation by the utility is as follows:

- *Step-by-step implementation and modular approach* The PLC systems have been widely used by the utility for other functions like frequency control and load shedding
- *Consistency* Using the same type of PLC system lead to consistent and compatible look and feel, engineering, platforms and tools
- *Availability and reliability* The mean time between failures for the PLC system is very high
- *Commercial availability* The hardware can locally be purchased off-the-shelf
- *Scalability* Easy to expand the system configuration and to create redundant and hierarchical systems
- *Reduced maintenance* As the number of devices like auxiliary relays, wiring and cabling are reduced it leads to reduced maintenance
- Cost reduction: There is a significant reduction in cost because of the reduction in cables and saving in space for conventional control panels

2. PROJECT FOR DELHI VIDYUT BOARD

2.1 Substation: The PLC based automation was implemented at four sub-stations of the utility. Two of the substations are of 66 kV and two of 33 kV level. A typical 66 kV outdoor sub station comprises of four numbers 66 kV lines, two numbers 66/11 kV transformers and 17-panel 11 kV indoor switchgear.

2.2 Control: PLC based automation system (central system) is provided for control, indication, supervision and monitoring of various analog parameters for the complete substation. The PLC and protective devices have not been provided with remote access. However, a communication processor and PC can act as a gateway through which the station PLC system can communicate with a higher level SCADA system. The data has got short term and long term value. For operation and maintenance, only the short-term real time data is required. PC can be provided at a later date when the long term data is required to be communicated. The PC can interact with PLC through the communication processor. This might be required later to communicate the relay settings and fault records through the PLC.

The PLC was chosen on the basis of the following main parameters -

- Number of inputs and outputs of both analog and digital variety
- Even though no redundancy has been provided either on the processor or input/output level, the processor should have the capability for use in future
- Capability to interact with remote input/output cards

Communication architecture is to be designed in such a way as to optimise cost and performance.

The PLC system accepts the following different kinds of inputs -

- Digital relay data – The PLC works on the digital principles and hence can communicate directly with the IEDs including numerical relays. PLC communicates to the relays through the data concentrator (Master bus communication module). The PLC reads various kinds of data like analog values (current, voltage, MW, MVAr etc) and the binary data.
- Analog inputs from transducers (for parameters that are not available in the relay).
- Binary inputs (from the potential free contacts) – The binary inputs are from the relays and from the field devices like circuit breaker, isolator and earth switch. There are three different types of binary inputs -
  - *Normal Input/Output cards* These controls and collects the data from the 11kV switchgear and the numerical relays provided for on the same. It has been provided in the main processor panel in the main control room
  - *Field Input/Output cards* These controls and collects the data from the 66 kV sub station and the numerical relays provided for the same. The Field I/Os have been provided to reduce the cabling from Field I/Os to the Field devices. The Field I/Os (with processor and power supply) have been mounted in two field junction boxes. One field junction box has been mounted in the switchyard. Second field junction box has been mounted in a container, which has been provided in the switchyard for protective relays and metering panel

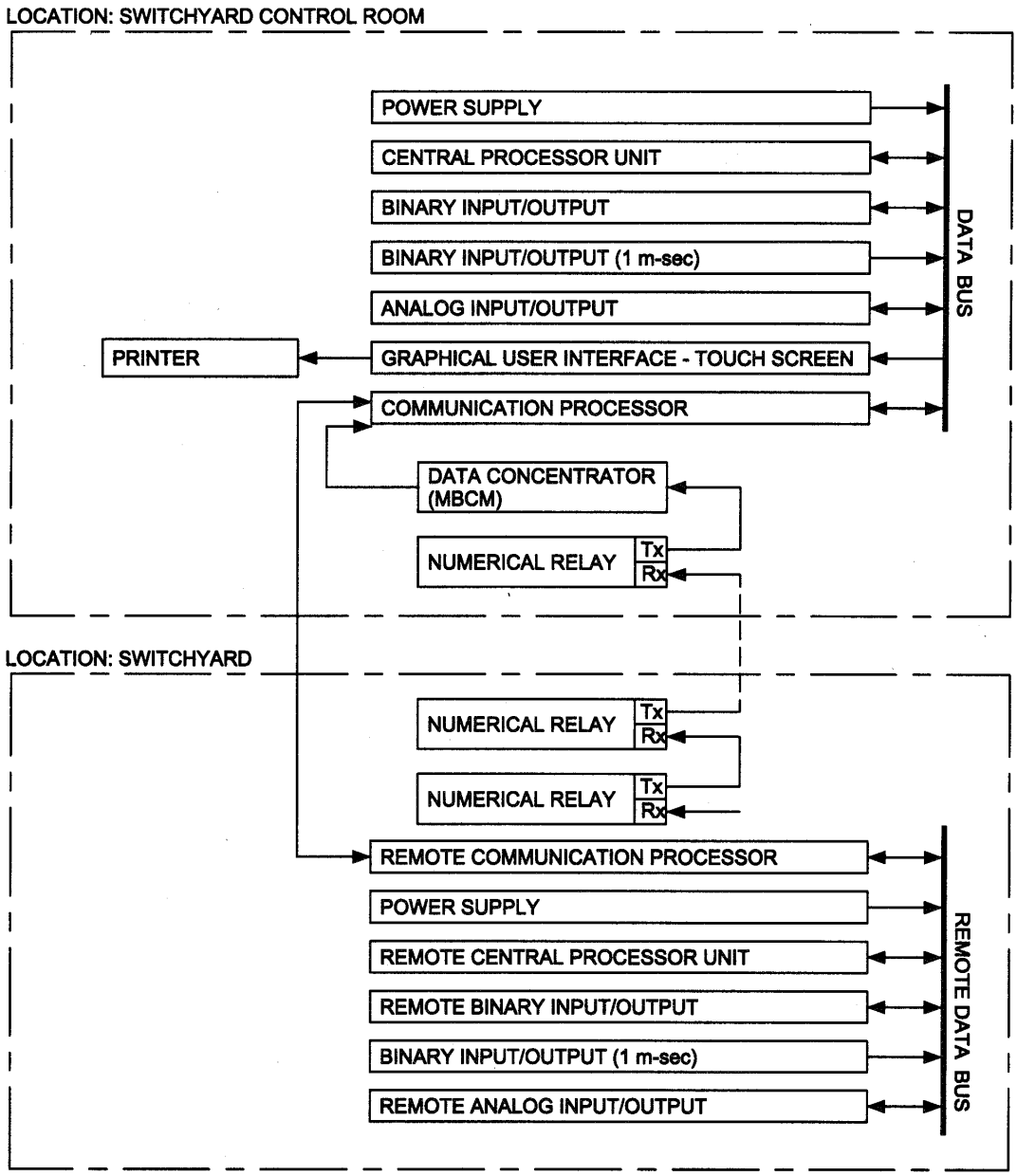

FIGURE 1 : ARCHITECTURE OF THE PLC BASED AUTOMATION SYSTEM

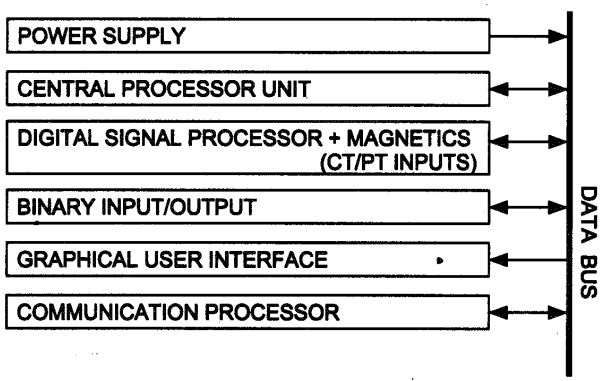

FIGURE 2 : ARCHITECTURE OF THE NUMERICAL RELAY

- *1ms resolution binary inputs* For sequence of event recorder function, the binary inputs are taken from the protection relays and from the circuit breaker. It has been provided both in the field junction box as well as in the main processor panel in the control room.

2.3 Graphical User Interface: A touch screen has been provided which is used for both inputting and outputting of data by the processor. The software is written using the ladder logic and is user friendly. Customisation is very simple for a project i.e. any change in configuration like addition and deletion of input/output points, mimic picture, implementing new interlocks etc. Once the software has been prepared for any project, the same software can be very easily customised for another project.

2.4 Metering: Multi function meters are used which can communicate digitally with PC. This function has not been used presently.

2.5 Protection: All the protection relays for both 11 kV and 66 kV system are of digital type. The communication architecture of the relay (refer Fig. 2) is based on the architecture of the PLC (refer figure 2). The digital relays and meters have been located as near to the source as possible. The digital relays and meters for 11 kV system are provided on the switchgear. The digital relays and meters for 66 kV system have been located in the switchyard inside an air-conditioned container.

The digital relays have the following features apart from the basic protection functions -

- Measurement functions (current, voltage, three phase power, energy and system frequency)
- Event sequence and history
- Fault location function
- Pre-fault, fault and post fault currents and voltages
- Monitoring functions (supervision of the relay itself)
- Synchro-check function (only for Distance relays)

The relays are connected in an optical fibre cable network as shown in Fig. 1. A data concentrator (master bus communication module) has been provided which collects real time data from various relays and communicates after converting the protocol with the PLC.

Interrogation and control can be performed on the digital relays from the serial port on the relay as well as from remote through PC, software and communication card/modem for setting of the relay and downloading fault records etc.

3. SECURITY CONCERNS FOR SCADA SYSTEM

Security is a function of the network topology. The vulnerable points of access provided to the outside world shall be identified. Access is primarily of two types - intermittent access through telephone or continuous access through networks.

Presently the PLC based automation system that has been provided is physically isolated (i.e. without any remote access). For the automation system, the access to the PLC and IEDs like relays is only available locally at the sub-station. Hence, the risk is limited automatically through reduced access. For inadvertent operation of equipment through the touch screen, a manual key has been provided on the operator's desk. To prevent change in software and settings, passwords shall be provided which should be alphanumeric consisting of case sensitive characters.

In future, when access will be provided through phones (land or mobile) or through networks, the attacks will be similar to the attacks on internet sites by hackers.

The systems and techniques which can be used will be similar to that used by the traditional networked computer system (connected via internet). The measures shall be as follows:

- redundancy
- restriction of physical access
- restriction of electronic access through PINs and passwords (as done by e-commerce sites)
- user authentication
- audit logs
- firewalls (protected gateway which discriminates between "inside" and "outside")

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SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM BY BHEL

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1. INTRODUCTION

There has been a continuous endeavor in last 15 years to introduce automation in all fields of industries, transmission and distribution including consumer and service sector. Automation basically implies replacing human involvement in control and data management and leaving this task to intelligent machines. SCADA system in a transmission application can be very compact alternative to conventional mimic boards, large displays and voluminous logging; Because of less human interference it can be very accurate and reliable. BHEL has been supplying distributed data management system for all thermal plants for long. It is now able to design and supply complete SCADA package for large substations and HVDC.The brief gives salient features of SCADA system supplied by BHEL.

2. SCADA FUNCTIONS

Bharat Heavy Electricals Ltd. (BHEL) has supplied a number of SCADA systems for power applications.
The functions performed in SCADA system are listed below:

- Data acquisition or control system interface
- Alarm/event management
- Video process control
- Trend management
- Logs management
- Historical data storage and analysis
- Remote monitoring, control & printing
- Database and picture engineering

3. PROJECTS

A brief description of some of these projects is given below.

Chandrapur-Padghe HVDC project

This is a 1500 MW, +/- 500 kV Bipole HVDC link. There are two convertor stations. One at Chandrapur and other at Padghe(near Mumbai), and they are about 700 km apart. A load despatch centre is located at Kalwa. BHEL has supplied UNIX based PROMPT-S SCADA system at all three locations with redundant configuration at both converter stations. The SCADA system is interfaced to the HVDC control system supplied by ABB, Sweden. In addition to remote monitoring and control through Operator Work Station (OWS), remote monitoring and control through mimic panel is also supported. (Refer Fig. 1) Remote communication is through fibre optic link and a backup PLCC link. The control system employs VENIX Operating System which is a real time version of industry standard UNIX.

National HVDC Project

A similar UNIX based SCADA system has been supplied to NHVDC II project, which is a 200 MW, 200 kV link between Lower Sileru and Barsoor in India. The control system has been developed manufactured, tested and commissioned at site by BHEL. The SCADA system is configured using one server and two OWS at each converter station.

Perungulam CCPP Project

SCADA system for 95 MW Combined Cycle Power Plant (CCPP) at Perungulam is designed to perform control and monitoring functions for 110 kV switchyard at Valuthur (TNEB). SCADA system supplied consists of two servers (configured as redundant system), one OWS (Operator Work Station). HMI (Human Machine Interface) is WINDOWS 2000 based system, and communicates with RTU via redundant communication link. (Refer Fig. 2) RTU has redundant system in hot standby configuration and communicates with server on redundant communication links. Input as well as output boards have redundancy.

4. CONCLUSIONS

The novelty in any SCADA systems is the volume of information that it can give, store or display at the click of a button and its capability to do remote operation. The reliability of such a system largely depends on reliability of communication links, the maintenance of terminal equipment, reliability of power supply and maintenance of software. BHEL's SCADA system has been operating satisfactory and is being upgraded continuously to suit customers' requirement.

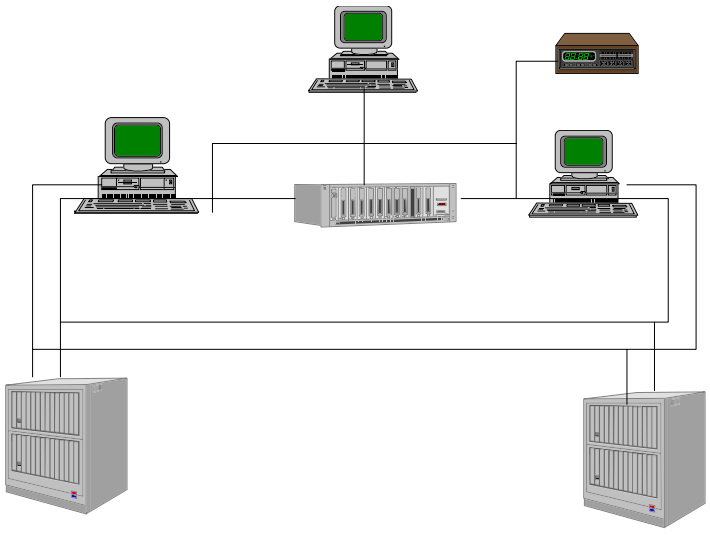

Fig. 2 : SCADA SYSTEM FOR PERUNGULAM CCPP

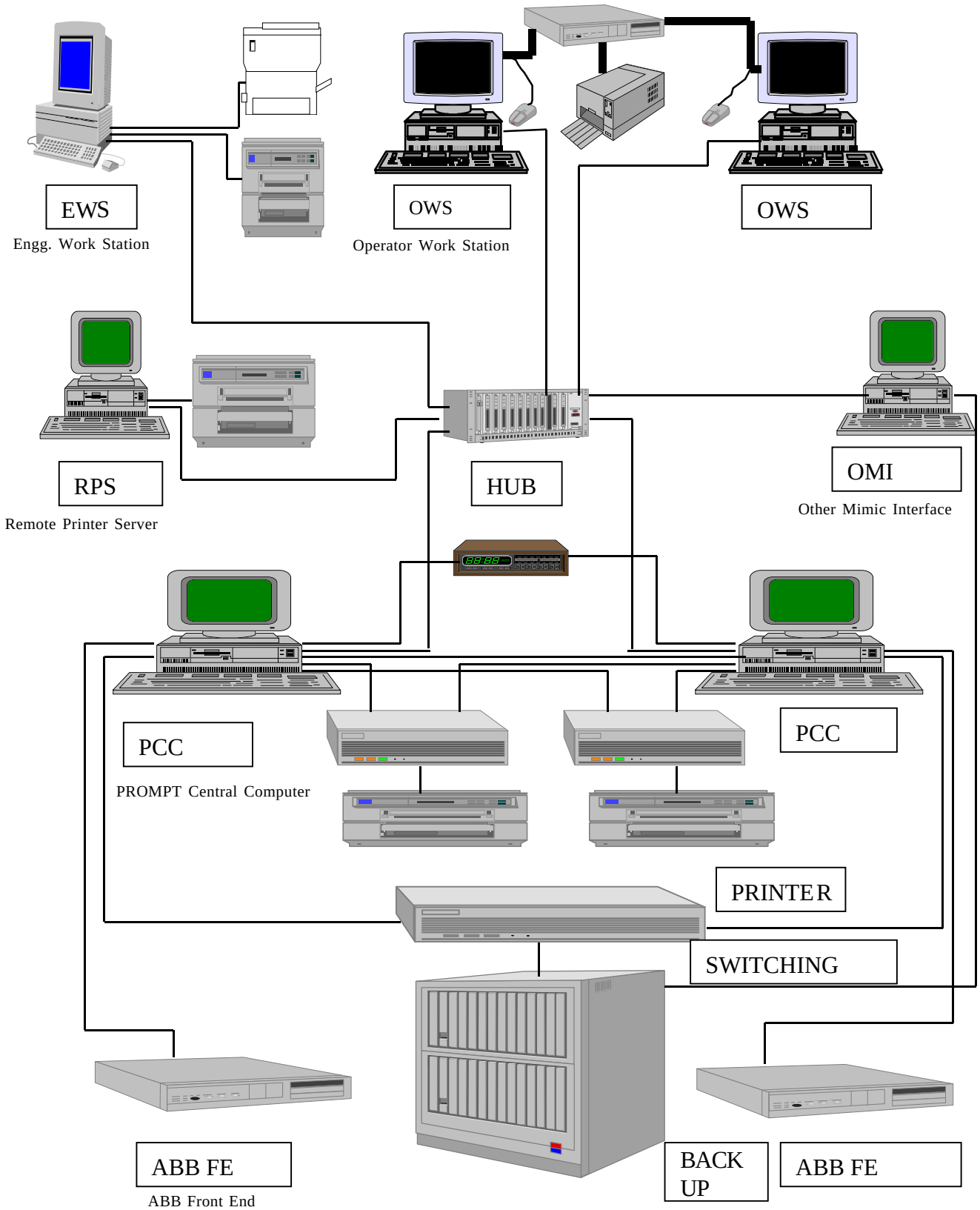

Fig. 1: SCADA system for Chandrapur -Padhge HVDC project (configuration for one converter station)

TECHNOLOGY DEVELOPMENT FOR POWER DISTRIBUTION AUTOMATION

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Technology Development Mission, sponsored by Planning Commission through Ministry of Human Resource Development, was initiated in 1995. The emphasis was on integrated development of technology (including that for the constituent components) for Power Distribution Automation (DA) System. Industry participated in the development process and provided cash and kind contributions. The development effort focussed on the following:
(a) Communication and networking technology using wired and wireless media,
(b) Micro-controller based remote terminal unit (RTU),
(c) Remotely operable switch for 11 kV and 415 V feeders,
(d) DA software to enable remote monitoring, alarm generation and remote control, and
(e) Distribution network simulator (a scaled down model of a real-life distribution network) to provide a test bed for a comprehensive testing of the developed technology, components and software.

1. SOME SALIENT FEATURES OF THE DEVELOPMENT

1.1 Communication and Networking Technology

This enables distributed data acquisition, monitoring and control system functions. Unlike traditional communication solutions, the approach here is to have a core communication controller in the base station that can support diverse choices of communication media (dial-up, Ethernet, WLL). This open approach facilitates cost effective implementation. The base station communication controller has cross-platform portability, supports functions for communications network management, and permits LAN, Internet, and Intranet connectivity through Ethernet. All command communication functions are invoked through GUI of automation software. Data transfer from/to RTUs supports industry standard data links.

1.2 Remote Terminal Unit

The micro-processor based substation and pole-top RTU has been designed and fabricated using standard off-the-shelf cards. The RTU is modular and has 24/48/54 analog and 24/48/96 digital I/O channels, and affords bi-directional data communication. The acquired data (voltage and current) is processed for rms and power factor calculations. Some design goals focus at low cost, flexibility and expandability, modularity at signal conditioning level, and communication interface.

1.3 Remotely Operable Switch

Load Break Switch (LBS) for 11 kV operation and a moulded case circuit breaker (MCCB) unit for 415 V operation have been developed and tested as per available specifications. The three-pole 11 kV LBS (developed for outdoor installation) opens in 90-100 milliseconds at the rated current of 80 A. While this switch is primarily meant for breaking load current, it can sustain 16 kA of fault current for one second and can also close on fault. The remote operation is through a three-phase induction motor coupled with gear mechanism. The 415 V MCCB unit, on the other hand, has an isolator on the incoming circuit and two MCCBs for two outgoing feeders. Flexibility exists to choose the MCCB of appropriate rating corresponding to the rated feeder current. The remote operation is through solenoid-plunger arrangement.

1.4 Distribution Automation (DA) Software

The DA software has the following components: (i) Distribution network software with attributes like graphical representation of network, cross-platform portability (Windows NT, Linux, Solaris), editing features, customizing, network validation, system topological information, component specification, and billboard printing; (ii) Set-up utilities for installation on different platforms; (iii) Automation software having real-time features, cross-platform portability, alarm generation (audio/video), system monitoring (of system quantities, equipment health and switch status), switch control commands, control interlocks and event log report; (iv) Database with real-time attributes that conforms to DNP3.0 library format, uses shared memory approach, provides SQL interface for backup in standard databases for all off-line applications, permits sharing of data in multiple processes, and has registry access for security and RTU identification; and (v) Application software which includes packages for network re-configuration, load shedding, volt-var control through capacitor switching, and fault detection and isolation.

1.5 Distribution Network Simulator

It is a scaled-down model of the actual IIT Kanpur distribution network, having suitably scaled-down versions of fourteen transformers, thirty 11 kV feeders, forty one circuit breakers represented by four-pole controllable relays (with selection for remote/local operation), LT loads which can be varied from 0-150% in steps of 25%, communication linkage (for Ethernet, dial-up), single generic RTU (96 digital and 128 analog channels) covering all transformers. The simulator applications include testing of various communication systems and protocols, testing of DA software, fine tuning of RTU and LBS control prior to field installation, and integration and testing of application software. As the simulator provides a feel of actual physical system, it can serve as a training tool for operators of DA system.

2. FIELD IMPLEMENTATION

As a pilot level installation for field reliability evaluation, the developed components and technologies of DA system has been installed in the IIT Kanpur distribution network for system monitoring and control. The portion of the network under DA implementation includes the main 33/11 kV substation and three 11/0.4 kV substations. Incoming supply is through two 33/11 kV transformers of 5/6.25 MVA each.

3. SOME SALIENT FEATURES OF DISTRIBUTION AUTOMATION SYSTEM ARE:

- Monitor voltage, current, power factor, real power, reactive power, voltage and current unbalance etc. on in-coming / out-going feeders and transformers
- Monitor circuit breaker, manual switch and isolator status and operation history
- Alarm generation under abnormal operating conditions
- Monitor local / remote selector switch status
- Monitor transformer health status
- Remote operation of 33 kV and 11 kV breakers and 11 kV Bus Coupler
- Solution retrofitted in 35 year old installation for monitoring quantities and status
- Detailed engineering tools for data acquisition and automation implementation

JAMIA MILLIA TO START STATE –OF- THE- ART SCADA LAB

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A supervisory system is used when the distance between the controlling location and the controlled devices is such that direct wire control is impractical. It is a collection of equipment that will provide an operator at a remote location with enough information to determine the status of a particular piece of equipment, or an entire substation or power plant, and cause actions to take place regarding that equipment or facility without being physically present. Although a supervisory system may exist to perform control and data acquisition at one specific location, the normal arrangement is to have one centralized location receiving data and exercising control over many remote locations. Indeed the term supervisory system is seldom used by itself anymore, the usual reference is to Supervisory Control And Data Acquisition systems or SCADA Systems.

SCADA system is the ultimate in automation. If there is a process going on, there are two ways of monitoring and controlling it. First is by manual control, which is obsolete, troublesome, risky and labor intensive. The second method is by automation where by, appropriate sensors monitor each process and the data fed to a central control unit, which monitors and regulates the process to bring about the desired output. This can be implemented in any process ranging from a small factory shop to a large and complex power plant, and to a geographically spread out power system. It optimizes the process and improves the quality of the process.

The supervisory systems are revolutionizing the industrial automation scenario in the world. In India, there has been significant rise in the level of automation, as more and more process industries like steel, cement, food processing, petrochemicals, refineries, electronic industries etc. are getting automated. In power system also, SCADA has tremendous applications in power transmission, distribution, substation automation etc, to name a few. Industrial automation is expected to attain phenomenal growth in a few years, worldwide and also in India.

In India, what ails the industrial automation sector is the shortage of qualified engineers for specialised jobs in automation. Especially nowadays, engineering students are opting for attractive non-technical job deviations such as managerial, marketing and administrative or as computer programmers. Hence, the engineering mainstream is being neglected and good talents are drained out. Jamia Millia Islamia has exploited the unlimited potential of the industrial automation sector to set up a state of the art center for SCADA research and training. Prof. Mini S. Thomas is setting up the SCADA Laboratory in the Department of Electrical Engineering at Jamia Millia Islamia. The laboratory will be fully operational by May 2002 and is being set up with the help of ABB, the world leaders in industrial automation. A brief description of the laboratory follows.

SET UP

The system being set up is a DCS based system, working on a 32 bit RISC based processor with 4 MB memory (ABB AC 800F Premium processors) which can support up to 100 masterless RTUs. The system has a capability of handling more than 1000 inputs and outputs, but to start with, it will have 80 inputs and outputs (Analog, Digital, Pulse etc) which will be expanded later. The system has an engineering station, 4 operator stations and a data logger at present. It has an ethernet data high way operating at 100 mbps. The input /output units are interconnected through the highly popular PROFIBUS. The MODBUS module is also incorporated in the system so that dedicated jobs can be done and also for better understanding of industrial buses. ABB is supplying 6 PLCs and an industrial drive so as to enhance the range of systems available in the lab.

The trainees in the laboratory will have the feel of a variety of field instruments and transducers, including Hall effect, smart and conventional types to measure temperature, level, voltage, current, frequency, phase angle etc. The laboratory also has a power analyser, stepper motors, RTDs, thermisters, etc.

The complete engineering and SCADA development is through a single software running on WINDOWS. The software has unlimited tags, trends, graphical displays and has a built in Sequence Of Events recording(SOE), which is very essential for fault diagnosis. The software also has the dynamic data exchange module, which enables it to import and export data with other application software. The SCADA software will be linked with MATLAB, ETAP etc so that the system is more versatile. Another important feature of the software is that it is web enabled. Hence, steps are already initiated to study and implement web-based automation, which is the future. Discussions are also on with DVB for a web-based distribution automation pilot project with wireless data entry.

APPLICATIONS

The SCADA Laboratory will be primarily used for regular research and training programmes for the benefit of faculty and students of Jamia, in order to give a hands on experience on SCADA systems to undergraduate and post graduate students. Another major emphasis is on doing industrial consultancy and research for the benefit of industrial houses. Presently, such a laboratory facility is not available in any of the major engineering and academic institutions in India. In addition, there will be regular training programmes for practicing engineers with ABB certification on SCADA systems. The courses will be modular and would suit both practising engineers and fresh graduates.

The All India Council for Technical Education (AICTE) has considered this as a Thrust Area Program in Technical Education (TAPTEC) project and has given the required monetary support for setting up of this laboratory. Discussions are on with major industrial players in the area of electric power to initiate collaborative research programs that will benefit both the industry and the academia. In view of the tremendous importance of SCADA systems in India, the Department of Electrical Engineering, Jamia Millia Islamia has also got technical approval from AICTE for an M.Tech program in **"**Electrical Energy System Management**"** with specific emphasis on SCADA systems and the course will be started soon.

Suggestions are invited from experts on SCADA to improve the future functioning of this lab and also the type of training modules required by companies, so that a proper curriculum and training schedule can be worked out. Industrial houses are requested to support this endeavor by making use of this laboratory facility and by setting up joint research, training and consultancy programmes.

SUPERVISORY LOAD CONTROL CENTRES FOR SAIL

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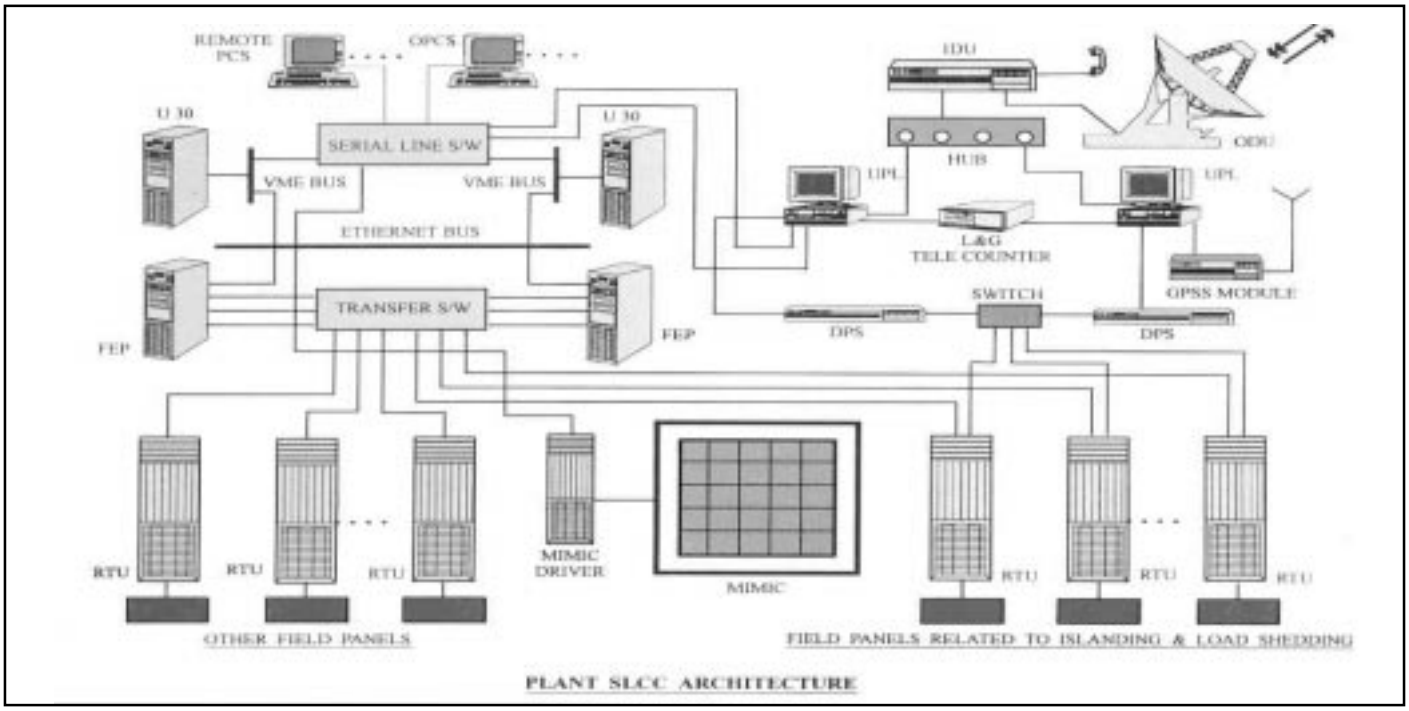
The Supervisory Load Control Centre (SLCC) Project of Steel Authority of India Ltd. (SAIL) is a SCADA project for integrated power management. This project consists of control centres at SAIL plants in the eastern region of India at Bokaro, Rourkela and Durgapur, a central centre at calcutta and one remote control sub-centre at SAIL's Corporte Office in New Delhi.

These centres help in optimal utilization of captive power generation facilities within various SAIL plants vis-a-vis import of power from the utility grid, provide a reliable database for planning, aid post-mortem review after a major disturbance, help in disaster control through islanding of captive generating units and load shedding, generate tariff calculations, generate MIS reports, etc.

Key parameters from the plant centres are transmitted to the Calcutta and New Delhi Centre. These centres also exchange important parameters with the Eastern regional load despatch centre at Calcutta

This project executed at a cost of Rs 200 million uses five sets of dual redundant mini computers (one for each steel plant and one for the central control centre) working on the real time operating system "VERSADOS" and the SCADA package "RPMC" (Remote Plant Monitoring and Control). The total number of I/Os handled by this system is approximately 13,000. The centres are interlinked through a 64 kbps VSAT network operating on the Ku-Band.



PLANT SLCC ARCHITECTURE

IEEE LAUNCHES VIRTUAL MUSEUM

The IEEE Virtual Museum is a web site that explores the history of technology, explains how different technologies work, and examines the societal and cultural impact of technology. Although it's primarily designed for a pre-college audience, the general reader as well as the engineer will find plenty of interesting and compelling material to pique their interest. Piscataway, NJ—Thomas Edison didn't invent the light bulb, so why does everyone think he did? What was the first computer? How did the patterns in a Utah cornfield lead to the development of TV? What is the "X" in an X-ray? Why are Alvin and the Chipmunks part of a museum about technology? The answers to these questions and more are found in the new IEEE Virtual Museum launched at http://www.ieee.org/museum. Designed for educators, pre-college students, and the general public, the virtual museum debuted with two exhibits containing audio and video clips, and interactive features: Socket to Me! How Electricity Came to Be and The Beat Goes On: How Sounds are Recorded and Played. Three more exhibits are in production and are scheduled for release by third quarter 2002. These will explore the different applications of microwaves, the works of Thomas Edison, and contributions women have made to electrical and information technologies. The IEEE Virtual Museum explores the global social impact of electrical and information sciences and technologies and demonstrates the relevance of engineering and engineers to society. It is supported by the IEEE Foundation, the IEEE Life Members, and the Trustees of the IEEE History Center.

FAQs

Q: Will you teach me how to hack?
A: Hacking is an attitude and skill you basically have to teach yourself. You'll find that while real hackers want to help you, they won't respect you if you beg to be spoon-fed everything they know. Learn a few things first. Show that you're trying, that you're capable of learning on your own. Then go to the hackers you meet with specific questions. If you do email a hacker asking for advice, here are two things to know up front. First, we've found that people who are lazy or careless in their writing are usually too lazy and careless in their thinking to make good hackers — so take care to spell correctly, and use good grammar and punctuation, otherwise you'll probably be ignored. Secondly, don't dare ask for a reply to an ISP account that's different from the account you're sending from; we find people who do that are usually thieves using stolen accounts, and we have no interest in rewarding or assisting thievery.

Q: How can I get started, then?
A: The best way for you to get started would probably be to go to a LINUX User Group (LUG) meeting. You can find such groups on the LDP General LINUX Information Page; there is probably one near you, possibly associated with a college or university.

Q: When do you have to start? Is it too late for me to learn?
A: Any age at which you are motivated to start is a good age. Most people seem to get interested between ages 15 and 20, but I know of exceptions in both directions.

Q: How long will it take me to learn to hack?
A: That depends on how talented you are and how hard you work at it. Most people can acquire a respectable skill set in eighteen months to two years, if they concentrate. Don't think it ends there, though; if you are a real hacker, you will spend the rest of your life learning and perfecting your craft.

Q: Are Visual Basic or C# good languages to start with?
A: No, because they're not portable. There are no open-source implementations of these languages, so you'd be locked into only those platforms the vendor chooses to support. Accepting that kind of monopoly situation is not the hacker way. In general, any language that isn't supported under at least LINUX or one of the BSDs, and/or at least three different vendors' operating systems, is a poor one to learn to hack in.

Q: How can I get the password for someone else's account?
A: This is cracking. Go away, idiot.

Q: How can I break into/read/monitor someone else's email?
A: This is cracking. Get lost, moron.

Q: How can I steal channel op privileges on IRC?
A: This is cracking. Begone, cretin.

Q: I'm having problems with my Windows software. Will you help me?
A: Yes. Go to a DOS prompt and type "format c:". Any problems you are experiencing will cease within a few minutes.

Q: Can you recommend useful books about hacking-related subjects?
A: I maintain a Linux Reading List HOWTO that you may find helpful.

Q: Do I need to be good at math to become a hacker?
A: No. While you do need to be able to think logically and follow chains of exact reasoning, hacking uses very little formal mathematics or arithmetic. In particular, you won't need calculus or analysis (we leave that stuff to the electrical engineers).

Q: What language should I learn first?
A: HTML, if you don't already know it. There are a lot of glossy, hype-intensive bad HTML books out there, and distressingly few good ones. But HTML is not a full programming language. When you're ready to start programming, try Python., Perl and C in that order.

Q: Do I need to hate and bash Microsoft?
A: No, you don't. Note that Microsoft isn't loathsome, but there was a hacker culture long before Microsoft and there will still be one long after Microsoft is history.

Q: But won't open-source software leave programmers unable to make a living?
A: This seems unlikely — so far, the open-source software industry seems to be creating jobs rather than taking them away. If having a program written is a net economic gain over not having it written, a programmer will get paid whether or not the program is going to be open-source after it's done. And, no matter how much "free" software gets written, there always seems to be more demand for new and customized applications.

Q: How can I get started? Where can I get a free Unix?
A: Elsewhere we have included pointers to where to get the most commonly used free Unix. To be a hacker you need motivation and initiative and the ability to educate yourself. Start now...

Contributed by: -
Harish Tejwani
(*Collected from How to Become A Hacker, Copyright © 2001 by Eric S. Raymond)*

GLOSSARY

CCPP	–	Combined Cycle Power Plant
DCS	–	Digital Control System
DMS	–	Distribution Management System
DNS	–	Digital Nervous System Domain Name Service
EMS	–	Energy Management System
FMSR	–	Fault Management and System Restoration
GIS	–	Geographical Information System
HMI	–	Human Machine Interface
IED	–	Intelligent Electronic Devices
MIS	–	Management Information System
NCA	–	Network Connectivity Analysis
OSI	–	Open System Interface
OWS	–	Operator Work Station
PLC	–	Programmable Logic Controller
PLCC	–	Power Line Carrier Communication
POSIX	–	Possible Operating System Interface
RTU	–	Remote Terminal Unit
SCADA	–	Supervisory Control and Data Acquisition
TCOMS	–	Trouble Call and Outage Management System
ULDC	–	Unified Load Despatch and Communication
VPN	–	Virtual Private Network
VVC	–	Voltage VAR Control
WILL	–	Wireless In Local Loop

CONTROLLED SHUNT REACTOR

A Controlled Shunt Reactor (CSR) based on a robust design has been installed at a 400 kV Itarsi substation of M/s POWERGRID. BHEL has developed this technology with consultancy from St. Petersburg University of Russia.

The controlled shunt reactor is expected to replace standard line connected reactor in long 400 kV lines, and control steady state over-voltage under light load and dynamic over voltage under load rejection. In principle, the controlled reactor is a 100% impedance transformer with a low-voltage secondary that can be switched from a fully shorted condition to a fully open condition in a controlled fashion by a thyristor switch. The CSR controller decides the thyristor firing angle depending on the loading of the line, and automatically takes the CSR out during full load condition and brings it back through a vernier control as the load decreases. In case of a load rejection, the controller immediately shorts the secondary, thus injecting maximum VAR into the system.

CSR, being a transformer-based technology, can be built for much higher rating and can be used for bus voltage control similar to an SVC but at practically half the cost.

The major advantage of CSR is that by taking itself out during peak load, it allows more power to be released through the line. The additional power and the revenue earned justify the investment on CSR in less than three years.

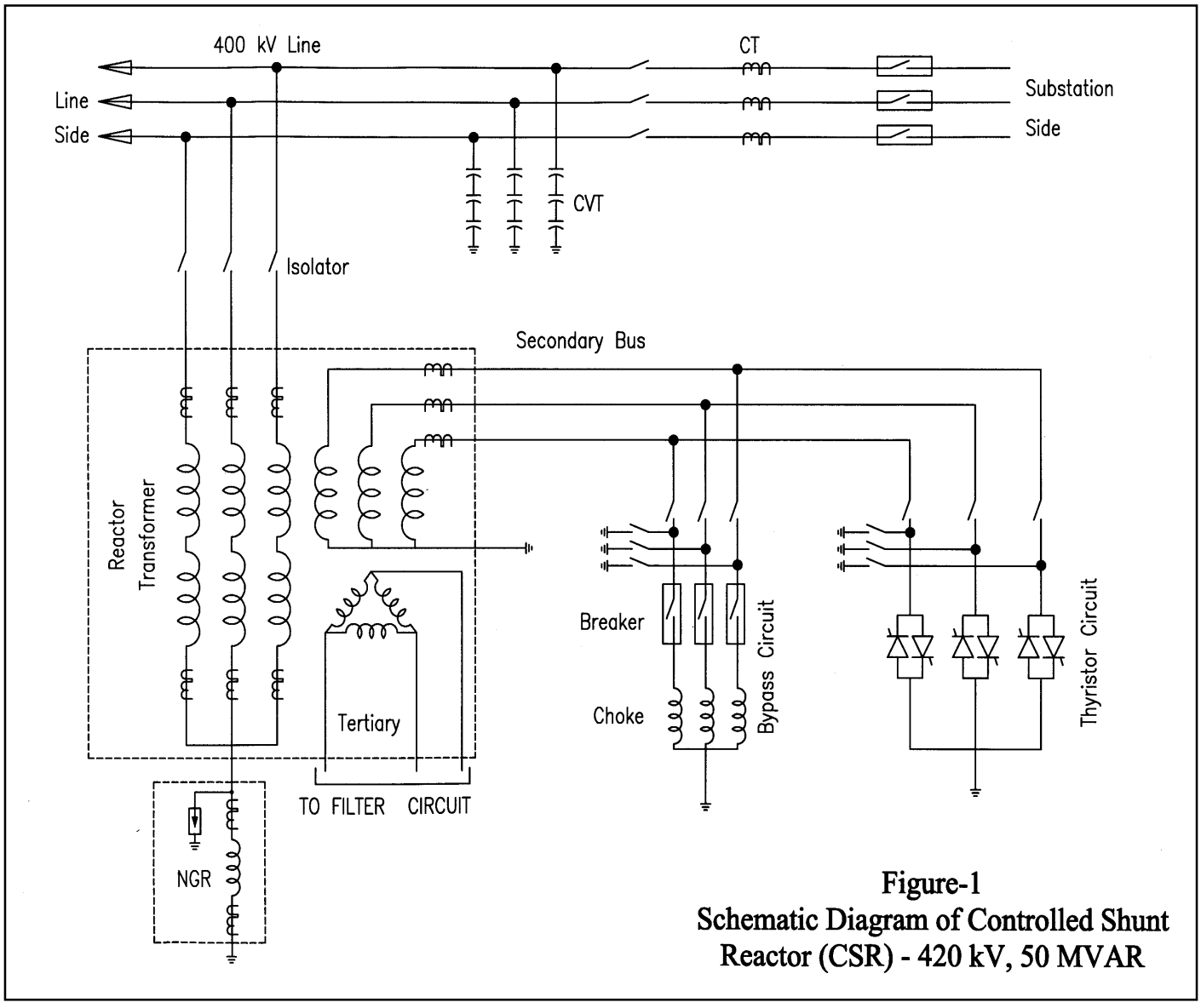


Figure-1
Schematic Diagram of Controlled Shunt Reactor (CSR) - 420 kV, 50 MVAR

KNOW YOUR EXECUTIVE COMMITTEE MEMBERS : 2002

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THE SCIENCE OF MAKING A SUCCESS OF TECHNICAL PRESENTATIONS – A PRIMER

Bhaskar Sinha
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Most engineers need to make presentations of some kind or the other in their working life. It could be presentation of a technical paper at a conference, a technical presentation on company capabilities, a business presentation, or simply, a brief address for a departmental meeting. It is very difficult for a professional to shy away from this activity altogether. This can get increasingly embarrassing as one rises to superior positions in the organisation. Rather than attempt to invent new excuses every time one is asked to make a presentation, it is much easier to get rid of that fear complex residing within one and acquire a few basic presentation skills that will serve the purpose.

There is a myth that good presenters are kind of *born* with that skill. Nothing is far from the truth. Anyone — even the most introverted person — can become a good presenter by self-training. Making presentations has hardly anything to do with a person's basic behaviour. The better a presenter one becomes the better one is able to put forth one's ideas to others. That way, within the organisation, the possibility of one's ideas or point of view winning acceptance stand a better chance.

PRINCIPAL AXIOM:
You must communicate successfully

Once you are on the dais, remember that you are there to *communicate* your ideas. If your presentation goes over the head it does not serve any purpose— you should rather be sitting at home. While a conference or a seminar is definitely not a classroom, it would be foolish to disregard the general grasping level of your audience altogether.

Prepare your presentation in advance
Even the best speakers *prepare* their presentation in advance. Preparation is *necessary* for

- Making yourself effectively *understood* with the minimum effort
- Boosting your own *confidence* level
- Management of *time*.

Each presentation is *unique* and must be prepared for *each* time. Even when the same material is being presented on different platforms, modifications may become necessary depending upon the mix and acceptance level of your audience. Close the doors and rehearse your complete presentation, again and again, till you are able to work your oral and written material in tandem and in harmony. This will also give you a chance to do away with or modify particularly *difficult* parts of your presentation.

Decide on the number of slides
Depending on the time allocated to you, decide upon the number of slides that you are actually going to show and select them *beforehand*. Never, never try to do this after reaching the dais, whatever your level of confidence and howsoever experienced a speaker you may be. You will lose extremely valuable time, cause irritation to your audience and, sometimes, disastrously lose control of your line of presentation altogether. Other than time control, pre-selection of slides is also necessary for ensuring that you cover your ground *as planned* and not miss out on important points.

Plan a presentation of shorter duration
Ascertain from your conference organiser or session chairman the rough duration allocated to your presentation. It pays to know this important information in advance. It will help you decide the number of slides to show. If it is not possible to ascertain this till your name is actually called out by the session chairman, decide your own realistic time-frame. For conferences/seminars organised by local bodies you may allocate yourself 10 minutes time and for national level events allow yourself not more than 5 minutes.

Once this is decided, plan for a presentation of duration *shorter* than the allocated time. For a 10-minute presentation plan for 8 minutes. For a 5-minute presentation plan for 3 minutes only. This little foresight will pay you rich dividends in terms of management of your presentation. First, you can afford to be a bit more relaxed with your material, dwell that extra 10 seconds on an odd slide when necessary. Second, you are well prepared for disaster management if, when your turn comes, the session chairman suddenly reduces your share of time to just 3 minutes instead of the 5 minutes you saw others being given. The extra 2 minutes will also stand you in good stead

- To introduce yourself briefly
- To cope up with emergencies
- To control the odd rebel in the audience
- Adding a few closing remarks.

Structure your presentation

Axiom 1: *The slide content will navigate your presentation. It must be structured like that at the very outset.*
Axiom 2: *What is written on the slide will not be spoken. What is spoken will not appear on the slide.*

The written material and the spoken word should complement each other. Use the slide pointer to link the two. *[An exception shall be made while showing the Opening Slide when the topic and the names of the presenter and the organization shall be spoken in addition to being displayed on the slide].*

In following Axioms 1 and 2 above, the intention is to

- Exploit the faculties of reading and hearing simultaneously, thus increasing the level of information-input to the audience significantly

- Increase the *coverage* of the presentation.

For every presentation there must be an opening slide and a closing slide. The Opening Slide should contain only the Presentation/Paper topic, name of the presenter and name of the Organisation. Display this slide the moment you arrive on the dais, even before you have spoken a word. The Opening Slide serves two important purposes:

- it allows people a little time to break away from the previous presentation and log on to you
- it *registers* you and your presentation.

Select an appropriate layout for your slides
Axiom: *Slides should never appear cluttered or overpopulated.*

Do not ever write more than 6 to 7 lines on a slide. Include drawings/ photographs wherever possible. Visual relief is a great soother. Borders do not necessarily look good always and should be used with caution. However, for sparsely populated slides it is an effective tool to bring out the contents.

Choose a visual style for your slides

Axiom 1: *Always choose a clean non-ornamental type of font.*

Never choose fancy fonts for presentations, they do not read well and require special efforts to read. This can irritate the audience. Remember that little things like this can put off people right at the beginning of the presentations. In the sans-serif category, ARIAL and 'Tahoma' fonts look well on the screen. Among others 'Times Roman' has elegance and universal acceptability.

Axiom 2: *Choose a letter height / font size that reads well on projection.*

Avoid using capitals for entire texts. The monotony is an eyesore and induces sleep. As for size, 8 mm lower case letters read very well when projected while 10 mm capitals look the right kind on screen.Maintain uniformity of font-types. In your entire presentation not more than 3 types of fonts should be chosen.

Maintain a uniform colour scheme Use the red colour sparsely, for titles / subtitles, and underlining, but never for the body of the text.

Choose and maintain a uniform colour scheme all through the presentation. Where slides are handwritten do not use fluorescent colours for textual material or drawings.

These will be an absolute washout on presentation. Use fluorescent colours for highlighting / backlighting text written in solid colours. In multimedia presentations fluorescent colours can be used for text/ drawings against a *dark* background only.

Close your presentation with finality The presentation should end with a Closing Slide. This last slide is only a 'Thank you' slide, but it serves an important purpose — the audience then knows for sure that your presentation is over!

ATTITUDE

Somewhere it is rightly said that 'Great People Do Not Do Different Things – They Just Do Things Differently'.

And it is the Attitude of the person that works more than his/ her Skills, Knowledge and Hard work, and brings out this Difference.

Try the following trick:

Assign a value (1 to 26) to all English alphabets so that you have a matrix like this:

Alphabet	Numerical Value	Alphabet	Numerical Value
A	1	B	2
C	3	D	4
E	5	F	6
G	7	H	8
I	9	J	10
K	11	L	12
M	13	N	14
O	15	P	16
Q	17	R	18
S	19	T	20
U	21	V	22
W	23	X	24
Y	25	Z	26

Now try assigning value to each alphabet in the words Skills, Knowledge, Hard work and Attitude, and then total them up all. You will get the following results:

SKILLS = 19+11+10+12+12+19 = **83**
KNOWLEDGE = 11+14+15+23+12+5+4+7+5 = **96**
HARDWORK = 8+1+18+4+23+15+18+11 = **98**
ATTITUDE = 1+20+20+9+20+21+4+5 = **100**

This is why Attitude is the winner.

With a positive, optimistic and cooperative attitude, a person with an IQ of 100 will earn more money, win more respect and achieve more success than a negative, pessimistic, uncooperative individual with an IQ of 120.

Just enough sense to stick with something – a chore, task, project – until it's completed, pays off much better than idle intelligence, even if intelligence be of genius calibre. For, Stickability is 95 percent of Ability. A batsman scoring 45+ every time is more valuable than the other scoring 0 to 120.

Another old saying is 'Knowledge Is Power' but I have a different opinion here too. Knowledge is only potential power – it becomes real power only when put to use – and only when put to constructive use. Attitude helps us here once again.

We can't do much to change the amount of native ability, but we can certainly change the way we use what we have.

I will close with this excellent quote:

The great scientist Einstein was once asked how many feet were in a mile. Einstein's reply was, "I don't know. Why should I fill my brain with facts I can find in two minutes in any standard reference book?"

The ability to know how to get information is more important than using the mind as a garage for facts – this is what great people do!

Contributed by:
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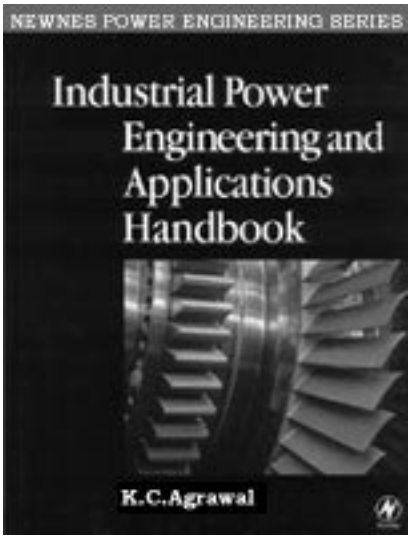
Industrial Power Engineering and Applications Handbook by K.C.Agrawal, Member IEEE



(A mini encyclopaedia)

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Volume III: Voltage surges and Over voltages. Including causes, effects and remedies and theory of over voltage. Ground fault protection schemes and grounding practices.
Volume IV: Power Capacitors: power factor improvement, system regulation and curing an ailing distribution network. Application of shunt and series capacitors, their switching behavior and protection.
Volume V: Non-isolated and Isolated Phase Bus Systems and Rising Mains, covering total design aspects of any current or voltage rating.

Each part is a book by itself.

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BOOK REVIEW

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INDUSTRIAL POWER ENGINEERING AND APPLICATIONS HANDBOOK

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Author: **K. C. Agrawal**
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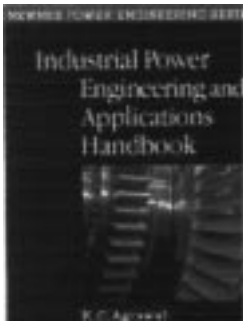


The release of a new title by the renowned technical publishing house of Newnes / Butterworth-Heinemann is usually a noteworthy event for the technical fraternity. The title under review has come as a surprise, not only because it far exceeds the standard usually set for handbooks but also because it has achieved the unique distinction of being a reference work equally useful and valuable for industry professionals, practising engineers, consultants, technicians, students, teachers, research scholars and all others professionally interested in industrial power systems.

By virtue of their diversity, complexity and size, industrial power systems throw a formidable challenge to the electrical engineer. Standard electrical engineer's handbooks books do not address the requirements of this special field completely. For the large number of day-to-day problems faced by production, operation and maintenance engineers working in industries there are few dedicated reference books to fall back upon for guidance. The ones that are available also do not cover the ground adequately. The present work is perhaps the most complete industrial power systems handbook currently available.

This is a reference for all engineers in design and application, protection and testing, production, project engineering, project implementation and maintenance. The text is structured into five parts: Part 1 covers selection, testing, controls and protection of electric motors; Part II, switchgear assemblies and captive power generation; Part III, voltage surges, overvoltages and grounding practices; Part IV, power capacitors and Part V, bus systems. The essential theory of each topic is covered first, followed by industrial practice information. The idea is that detailed theory can always be gleaned from textbooks. Agrawal knows where exactly he must draw the line between theory and application engineering.

Agrawal is a graduate in electrical engineering from Banaras Hindu University. He taught the subject for 2 years before finding a berth in the Industry where he remained for the next 6 years. He then opened his own industry, which he has run for 24 years. Being an Industry man with a teaching background, Agrwal effectively bridges the gap between theory and practice in his book. Clear application data and guidelines, manufacturer's practices, application practices, commercially available ratings of machines, selection, operation and maintenance of equipment and plant, troubleshooting – all are covered in every conceivable detail. The material is cleverly keyed in to the recommendations of international standards organizations like ISO, IEEE, ANSI, BSI, DIN, IEC etc.

One detailed flip-through leaves you convinced of the publisher's claim that 'never before has so much ground been covered in a single volume reference source'. Apart from doing yeomen's service to practising engineers, the author has done a great favour to teachers at technical institutes who have limited access to information from the Industry. Students will now not be deprived of this kind of information since teachers can always refer this excellent handbook to reply to questions raised in the classroom.

The production values of the book are excellent. Each page is lavishly illustrated with high quality drawings, graphs and photographs. Indian products are featured throughout the book. In all bibliographies documents produced by Indian statutory bodies, research institutes and manufacturers appear prominently. It somehow gives one a sense of national pride to observe these in an international handbook.

While the overall structuring of the book is excellent, the idea of coupling the subject of Switchgear Assemblies with the topic of Captive Power Generation under one Part could not be appreciated. Some spelling and punctuation errors are observed. There is no capsule biography of the author anywhere in the book. For most readers Agrawal will remain only a name. In the bibliographies, no fixed format has been followed. At some places the year of publishing is missing, at others, the name of the publisher itself. The book editor at the publisher's end should have taken better care of these aspects.

At the end of it all, the book emerges as a landmark achievement in its field. When you put it down, you cannot help wishing there were separate handbooks of identical character in the areas of transmission, distribution and utilization too.

All technologies keep changing. Any technology-oriented book will, therefore, need to be revised periodically if it is to remain relevant. This is a task Agrawal will have to undertake every five years or so. And much later, he will have to choose his successors to perform this job as laboriously, meticulously and competently as him.

LIST OF TECHNICAL & PROFESSIONAL ACTIVITIES

(from July, 2001 to May, 2002)

Visit http://www.ewh.org/r10/delhi for more details and future programs

Date	Activities
July 6	Talk on 'Possibility of Hydro-Power Development in the Private Sector' by Mr. Rajendra Singh, Ex-CEA, New Delhi (along with PES-IAS Chapter and IEE Delhi International Center)
August 6	Talk on 'Semi state Theory and Design of Analog VLSI Circuits' by Prof. Robert W. Newcomb, University of Maryland, USA (along with CAS-CS Societies Chapter and EE Dept. of IIT Delhi)
August 7	Talk on 'Microsystems Laboratory Research on New Classes of Computers' by Prof. Robert W. Newcomb, University of Maryland, USA (along with CAS-CS Societies Chapter and EE Dept. of IIT Delhi)
November 1	*Three-day* (Nov 01-03) XXVII Annual Convention and Exhibition of IEEE India Council with the theme Convergence in Semiconductor, Power, Information Technology, Communications and Entertainment (SPICE) featuring *four* tutorials, *twelve* invited lectures in as many sessions (including PES-IAS Chapter's *fifth* Thomas Alva Edison Memorial Lecture on 'Online Dynamic Security Assessment, Monitoring and Control of Power Systems' by PES DL Dr. Prabha Shankar Kundur, Powertech Labs Inc., Surrey, B.C., Canada and *forty-three* papers
December 7	Talk on 'Power System – Yesterday and Today' by PES DL Prof. Mohindar S. Sachdev, University of Saskatchewan, Canada (along with PES-IAS Chapter, IEE Delhi International Center and EE Dept. of IIT Delhi)
December 14	Talk on 'Co-design Tools and Architectural Adaptation for Deep Sub-micron VLSI Systems' by CAS DL Prof. Rajesh Gupta, University of California, Irvine, CA, USA (along with CAS-CS Societies and Computer Society Chapters and IEE Delhi International Center)
December 17	Talk on 'Optical Networking with IP over DWDM: Recent Advances, Trends, and Issues' by Prof. Raj Jain, Dept. of Computer and Information Sciences, University of Ohio, Columbus, Ohio, USA (along with ComSoc Chapter, EE Society of IITD and IEE Delhi International Center)
December 28	Talk on 'DWDM Technology for Optical Communication' by Prof. Banmali Rawat, University of Nevada, Reno, USA (along with ComSoc Chapter and EE Dept. of IIT Delhi)
January 9	Talk on 'Electromagnetic Scattering and Guidance by Two-Dimensional Photonic Bandgap Structures' by Prof. Kiyotoshi Yasumoto of Kyushu University, Japan (organized by ComSoc Chapter, AES-COM-LEO Societies India Chapter and Delhi University)
January 20	Talk on 'Power Sector - Growth and Reform' by Dr. D.V.Kapur, Reliance Power Ltd., New Delhi (along with PES-IAS Chapter)
January 25	Talk on 'Common Sense and Knowledge Approach to Electrical Safety' by IAS DL Mr. Bruce McClung, Charleston, WV, USA (along with PES-IAS Chapter and EE Dept. of IIT Delhi)
January 30	Day-long Seminar on 'Energy Efficient Equipment and System for Saving Electricity' (along with PES-IAS Chapter, IEE Delhi International Center and EE Dept. of IIT Delhi)
February 7	Talk on 'Emerging Trends in Information Technology and Impact of Slow Down' by Maj. Gen. (Dr.) R.K.Bagga, ASCI, Hyderabad (along with EMS and Computer Society Chapters and EE Dept. of IIT Delhi)
March 7	Talk on 'New Technologies in Electrical Power Transmission: Part-I' by Mr. R. Saha of CEA, New Delhi at EE Dept., IIT New Delhi (along with PES-IAS Chapter, IEE Delhi International Center and EE Dept. of IIT Delhi)
March 22	Talk on 'New Technologies in Electrical Power Transmission: Part-II' by Mr. K.K.Arya, CEA, New Delhi (along with PES-IAS Chapter, IEE Delhi International Center and EE Dept. of IIT Delhi)
April 19	Talk on 'SPC (Statistical Process Control) in a Software Factory' by Mr. A.N.Chatterjee of Tata Consultancy Services, New Delhi (along with Computer Society Chapter and EE Dept. of IIT Delhi)
April 24	Talk on 'Social Responsibility of Engineers' by Mr. K.K. Chopra of Ramakrishna Mission, New Delhi (along with EMS Chapter and National Resource Center for Value Education in Engineering of IIT Delhi)
April 26	Talk on 'Electromagnetic Pollution – Causes and Concerns' by Mr. Ashis Sanyal of Dept. of Information Technology, New Delhi (along with PES-IAS and CAS-CS Societies Chapters and IEE Delhi International Branch)

AWARDS

- **Delhi CAS – CS Societies Chapter is adjudged Best Chapter for the year 2001**
- **Dr. Subrata Mikhopadhayay wins PES Regional Outstanding Engineer Award for the Year 2001**

ANNUAL GENERAL MEETING

The Annual General Meeting (AGM) of the IEEE Delhi Section was held at 11.30 AM on January 20, 2002 (Sunday) at Indian International Centre, New Delhi. It was attended by 60 members. The meeting was preceded by a special lecture by Dr. D.V. Kapur, Chairman, Reliance Power Ltd. (Ex-Secretary, Ministry of Power) on Power Sector - Growth and Reform.

The deliberations of the AGM are as follows

1. Welcome Address by the Chairman, IEEE Delhi Section

1.1 Dr. R. Balasubramanian, Chairman, IEEE Delhi Section welcomed the members to the AGM. He briefed the members on the various activities organized during 2001. He mentioned that the Section had organized 49 events, of which 21 were technical, educational and professional activities.

1.2 Region 10 Meeting for the year 2001 was held at Singapore which was attended by the Section Chair. Mr. R.K. Asthana, Section Chair for 1999 also attended this meeting and received the award on behalf of Section for **Outstanding Section of Asia Pacific Region 10** for our technical activities and membership growth in 1999. IEEE President visited Delhi during the year and all members were invited for interaction with him.

1.3 Section membership grew from 1827 (31.12.2000) to 1947 (31.12.2001) during the year. For this, the Section Chair congratulated Mr. Raj K. Vir, Chair, Membership Development Standing Committee and wished a higher growth for the year 2002. Section Activities Chair congratulated Dr.(Mrs.) Mini S. Thomas, Student Activities Chair for spearheading the IEEE movement in student fraternity. Section brought out one issue of Section Newsletter BEACON, in July 2001. Section launched the monthly electronic newsletter **ieeedelhinews** to supplement BEACON. 12 issues of the newsletter were sent electronically to the members. Chair congratulated Dr. S. Mukhopadhyay, Electronics Coordinator for maintaining the timely release of **ieeedelhinews**.

1.4 The amendments to By-laws of Delhi Section were approved by Region 10 Director. Section Chair thanked Mr. Promod K. Srivastava, Chair India Council for his initiative in finalizing the amendments to Section By-laws.

2. Confirmation of the minutes of the last Special General Meeting held on May 13, 2001

2.1 The minutes of the last Special General Meeting (organized to celebrate the Silver Jubilee of formation of Delhi Section) were approved as proposed by Mr. P.V. Ekande and seconded by Dr. V.R. Singh.

3. Presentation of Activity Report by the Secretary

3.1 Dr. Ram Nath, Secretary presented the report on the activities of the Section during 2001.

3.2 After the discussion the report was approved as proposed by Mr. M.M.S Puri and seconded by Mr. P.K. Srivastava.

4. Presentation of Financial Report by the Treasurer

4.1 Dr. Balasubramanian presented the audited accounts for the year 2001. The one page report covered the various transactions under 'Receipts' and 'Disbursements' along with the corresponding figures for the previous two years, i.e. 1999 and 2000 for the purpose of comparison.

4.2 After discussions the report was approved with Mr. Daman D. Sood proposing and Mr. H.L. Bajaj seconding.

5. Introduction of the new Executive Committee

5.1 Since no petition was received, the Slate proposed by the Nomination Standing Committee was approved.

5.2 Dr. R.G. Gupta, Chair AES-COM Chapter informed the House about the **2001 Chapter Achievement Award** received by AES-COM Chapter.

5.3 Mr. M.M.S Puri, History Standing Committee Chair distributed token mementos (to commemorate the Silver Jubilee of IEEE Delhi Section) to all who attended the AGM.

5.4 The new Executive Committee members were introduced to the House. The concerned list appears in this issue of BEACON.

Jan 30, 2002

Ram Nath
Secretary, Delhi Section

Dr. R. Balasubramanian, Section Chair addressing the Delhi Section members; *others on the dais (L-R) Dr. Mini S. Thomas, Section Treasurer; Mr. R.K Vir, Section Vice Chair; Dr. Ram Nath, Section Secretary*

Dr. D.V. Kapur, Chairman, Reliance Power Ltd., delivering the talk; *members in front row (L-R) Mr. Raj K. Vir, Mr. M.M.S. Puri, Col. J.C. Anand (Retd), Dr. R. Balasubranian, Mr. P.K. Srivastava, Dr. V. R. Singh*

IEEE PRESIDENT MR. JOEL B. SNYDER VISITS INDIA

The IEEE President, Mr. Joel B. Snyder and his wife visited New Delhi on 16th & 17th August 2001. Almost all the IEEE Presidents have visited New Delhi and other Indian cities in last 10 years, which shows how important India is for IEEE. India has been showing highest growth in IEEE membership since last many years, which has been well recognized by the Headquarters.

During his visit, Mr. Snyder visited student branch of Jamia Millia Islamia University where he addressed students of all the student branches of Delhi.

He also signed the extension of MOU between IEEE and IETE that allows cooperation between the two professional bodies up to 31st December 2004.

He participated in the meeting of the Executive Committee of India Council in which members got opportunity to have free and frank interaction with him on various issues of interest to Indian members like library access to student branches, fellowship, representation in IEEE Committees/Subcommittees, signing in accounts by headquarter representative, delivery of publications, etc.

Mr. Snyder appreciated many points and tried to give headquarter perspective with the promise to look into in more details. He mentioned that India being the biggest potential for IEEE, he would see to it that things improve.

IEEE President addressing Delhi Section and India Council *(L-R) Dr.R..Balasubramanian, Chairman, Delhi Section; Mr. Joel B. Snyder, IEEE President, Mr.P. K. Srivastava, Chairman, India Council; Mr. R. K. Asthana, Secretary, India Council.*

The IEEE India Council Chair Mr. P. K. Srivastava addressing the gathering *when the IEEE President Mr. Joel B. Snyder visited Jamia Millia Islamia on 17th August, 2001. On the dais, from left to right, Dr Mini S. Thomas SAC Chair, Delhi Section, Prof. R. Balasubramanian, Delhi section Chair, Mr. Joel Snyder and Mr. H. L. Bajaj, former R10 Director.*

Mr. H.l.Bajaj presents a gift to IEEE President
Also seen in the picture are, Mr.R.K.Asthana, India Council; Mr. P.K.Srivastava, India Council; Mrs. Snyder, Dr. R. Balasubramanian, Delhi Section; Dr. Ram Nath, Delhi Section.

IEEE President with Delhi Section and India Council Members *Mr.R .Balasubramanian, Mr. B. R. Prabhu,Dr. Ram Nath; Mr. Harish Tejwani, Dr. R. G. Gupta, Mrs. Nimmi Bajaj, Mr. H. L. Bajaj, Mr. Joel B. Snyder, Mrs. Snyder, Mr.P. K. Srivastava, Mr. B. R. Prabhu*

IEEE DELHI SECTION EXECUTIVE COMMITTEE: 2002

Position	Name	Organization	Tel. (O), (R)	Fax	E-mail Address
Chairman	R. Balsubramanian	IITD	6591246, 6562181	6581121	balu@ieee.org
Vice Chairman	Raj K. Vir	Ex-RLYS	4352840, 2154214	4351112	rajvir@ieee.org
Vice Chairman	Prakash V. Ekande	NTPC	91 4410239, 6315865	914410136	pvekande@yahoo.co.uk
Secretary	Ram Nath	BHEL	4367725, 6894440	4365180	ramnath@ieee.org
Treasurer	Mini S. Thomas	JMI	6328847, 6680480	6328847	mini@ieee.org
Joint Secretary	Harish Tejwani	HUGHES	91 6346666, 7221116	916342810	htejwani@ieee.org
Past Chairman	Rajendra K. Asthana	BHEL	91 4554034, 2411218	6001128	asthanark@hotmail.com
Member	Subrata Mukhopadhyay	CEA	6170541, 3387501	6170541	subrata@ieee.org
Member	Promod K. Srivastava	Ex-BHEL	91 4552570 (R)		pksri@satyam.net.in
Member	Man Mohan S. Puri	DESEIN	6446438, 3271101	6469566	info@desein.com
Member	Ved R. Singh	NPL	5783303, 5752954	5852678	vrs@csnpl.ren.nic.in
Member	Ashok Golas	DOT	3323500, 6437566	3326029	ashok.golas@ieee.org
Member	Ashok Bhattacharyya	DCE	7850042 (R)		bh_asok@hotmail.com
Member	Daman D. Sood	TCS	91 6342941, 2115032	3318947	soods@id.eth.net
Member	Ranjan K. Mallik	IITD	6591049, 6591572	6581606	rkmallik@ee.iitd.ernet.in
Member	Ravi K. Aggarwal	BECHTEL	91 6343107, 6849827	91 6343110	rkaggar1@bechtel.com
Member (E/O)	Ram G. Gupta	DIT	4363095, 6255675	4365404	guptarg@mit.gov.in
Member (E/O)	Kandala S. Chari	DIT	4361464, 4362972	4361464	chari@mit.gov.in
Member (Co-op)	Krishnamurthy K. Subramanian	NIC	3239560, 6105497	3234014	ksdir@hub.nic.in
Member (Co-op)	Sushil K. Agrawal	POWERGRID	6428152, 2432351	6213390	drsushil@powrgridindia.com
Member (Co-op)	Shankar Prakriya	IITD	6591050, 6528137	6581606	shankar@ee.iitd.ernet.in

E/o Ex-officio
Co-op Co-opted

VARIOUS STANDING COMMITTEES OF IEEE DELHI SECTION FOR 2002

S. No.	Name of Standing Committee	Chairperson	Members
1.	Membership Development	Raj K. Vir	Mini S. Thomas Daman D. Sood Ashok Golas
2.	Awards and Fellow Nomination	Ved R. Singh	Subrata Mukhopadhyay Suhash C. Dutta Roy* (IITD) V.K. Aatre* (MOD)
3.	Student and Educational Activities	Mini S. Thomas	Ashok Bhattacharyya Ranjan K. Mallik Prerna Gaur* (NSIT)
4.	Public Relations and Publication	Ram Nath	Promod K. Srivastava Harish Tejwani Prakash V. Ekande Daman D. Sood
5.	Intersociety Relations	R. Balasubramanian	Subrata Mukhopadhyay Ram Gopal Gupta Man Mohan S. Puri Kandala S. Chari Krishnamurthy K. Subramanain
6.	Section History	Man Mohan S. Puri	Promod K. Srivastava Rajendra K. Asthana R. Balasubramanian
7.	Finance	Mini S. Thomas	Rajendra K. Asthana Subrata Mukhopadhyay R. Balasubramanian Ram Nath
8.	Technical and Professional Activities	Subrata Mukhopadhyay	Ashok Golas Ranjan K. Mallik Harish Tejwani Raj K. Vir Daman D. Sood Ram Nath
9.	Nomination	Rajendra K. Asthana	Subrata Mukhopadhyay Man Mohan S. Puri Promod K. Srivastava
	OTHERS ASSOCIATED FOR 2002		
1.	Electronic Communications Coordinator	Subrata Mukhopadhyay	Ram Nath (alternate)
2.	Auditor	Ranjan K. Mallik	Shankar Prakriya

*Representation from outside Executive Committee

ACTIVITIES OF STUDENT BRANCHES

ENCOMIUM 2001

ON THE 8th November 2001, a dream was fulfilled at the Faculty of Engineering & Technology of Jamia Millia Islamia. The members of the IEEE Student Branch JMI were organizing ENCOMIUM- the technical festival for the very first time. ENCOMIUM was organized with the aim of not only providing the upcoming engineers with a platform to share their technical knowledge and contributions with others but also for creating a common ground for the interaction between students from different engineering colleges from all over India. It is a matter of great credit that students from 19 leading technical institutions from India, as far as Coimbatore participated in the festival. The Inaugural Address was delivered by Prof. R.S. Sirohi (Director, IIT Delhi) in which he emphasized that every bright student should have a sound value structure along with engineering skills.
Following events were held under ENCOMIUM

RATIONALE	Technical Paper presentation
ENIAC	Software Design Contest
ENIGMA	Quiz

NASET

IEEE's Student Chapter at Electronics Society, Electronics Science Department, Kurukshetra University, Kurukshetra organized National level Symposium on Electronics Technology (NASET) on 15th and 16th March 2002. The symposium covered number of events like Paper Presentations, Hardware displays, Technical Quiz and Poster making. Young Engineers from different colleges across the country had displayed their projects based on various applications on electronics. NASET is promoted by India Council Electronic Devies Society / Microwave Theory and Techniques (EDS/MTT) Chapter, EDS/ MTT encouraged the activity through financial support and awards to winners of competition.

PLZ. DON'T LAUGH

Q). Why did the little pony lose his voice?
A). Because he was a little hoarse.

Q). What kind of profits do fishermen make?
A). Net profits.

Q). What is the language of chickens called?
A). Fowl language.

Q). What happened to the cow that could not give milk?
A). It was an under failure.

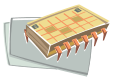
Q). What did the clumsy optician do at a party?
A). He made a spectacle of himself.

Q). Why is a Cross eyed teacher not successful in class?
A). Because she can't control her pupils.

What is 5-S

Definition
A Systematic and rational approach to work place organisation and methodical house keeping with a sense of purpose.

Letter	Japanese	English
1-S	SERI	Sorting
2-S	SEITON	Systematic arrangement
3-S	SEISO	Spic and Span
4-S	SEIKETSU	Serene atmosphere / sanitizing
5-S	SHITSUKE	Self discipline



NEW AGE RETIREMENT SOLUTIONS

New age retirement solutions are offered by ICICI Prudential Life Insurance Company. The Quality of its Insurance Advisors has been voted as the primary factor in raising it to the number 1 spot. The Innovative Products, on the other hand, have helped the advisors to raise the awareness of the masses to take Life Insurance to its real meanings and not merely a tax saving instrument. In line with the Government initiatives and realizing the importance of Retirement requirements for the Nation, the company has modified its existing Retirement product and introduced two new.

ICICI Pru Forever Life- Regular Premium based Pension with the option for spouse to take a lump sum
ICICI Pru LifeTime Pension– market linked, Regular Premium Pension
ICICI Pru LifeLink Pension– market linked, Single Premium Pension

LifeTime Pension and LifeLink Pension are perhaps the only products of their kind in the Indian market and are full of Power of Flexibility in the hands of the investor.

The features of these new products are

1. *Choose Death Benefit*: From 0 (ZERO) to Rs. 50 lacs
2. *Increase or Decrease Death Benefit*: Whenever – to whatever amount
3. *Select Retirement Age*: 50 to 70 years
4. *Invest in Fund of Choice*: Three to opt from – Income Fund, Balanced Fund, Growth Fund
5. *Mix 'n' Match*: Dictate your terms for percentage investment in the three funds
6. *Switch Between Plans*: Whenever - to whatever value
7. *Benefit From Rupee-Cost Averaging*: By investing in market-linked regular premium products
8. *Enjoy Premium Holiday*: The policy remains in force even if premiums are not paid
9. *Top-Up facility*: With the help of bonuses/ windfalls/ lump sum payments
10. *Increase The Value of Plan With Optional Riders*: Accident and Disability, Critical Illness (9 illnesses) and Major Surgical (43 surgeries)
11. *Take The Best Pension Provider From The Market*: Only if ICICI is not offering better annuity
12. *Pick From 4 Annuity (Pension) Options*: Joint Life Last Survivor With Return Of Purchase Price is the best recommended/ most opted for
13. *4 Premium Payment Options*: Monthly and Quarterly (through ECS), Half Yearly and Yearly
14. *100% pension to spouse* (if opted for)

As if all this was not enough, the company is Transparent from day one to share with you what are the insurance charges and administrative charges (exemplary, perhaps). Also the Insurance charges may be the lowest one and there comes a day in the life when Insurance becomes free and 100% of your payments are invested in units for you.

Tax Benefits: u/s 80CCC (1) – up to Rs. 10000/- deducted from taxable income (and this facility is still available to all in all income slabs); u/s 10 (10D) – all death benefits or withdrawals are 100% tax-free; u/s 80 D - medical riders; u/s 88 – accident and disability rider.

The company is currently offering Introductory Bonus on these products, as below:
1st June to 29th June: Extra Allocation – ICICI Pru LifeTime Pension * 3% * - ICICI Pru LifeLink Pension * 0.5% *

SIX REASONS TO BELIEVE THAT COMPUTERS ARE FEMALE

- **No one, but the Creator understands their internal logic.**
- **The native language they use to communicate with other computers in incomprehensible to everyone.**
- **The message 'Bad command or file name' is as informative as, "If you don't know why I'm mad at you, then I'm certainly not going to tell you."**
- **As soon as you make a commitment to one, you find yourself spending half your paycheck on accessories for it.**
- **Even your smallest mistakes are stored in long-term memory for later retrieval.**
- **Though they are hardware, yet they work on software**

BRAIN TEASER

This jugglery is completely based on the magazine and it covers the entire magazine including the articles, ads, etc. All you have to do is to hunt for the answers, which may occur horizontally, vertically or diagonally in the alphabets matrix. The answers may appear to abbreviarions too.

i.) Attached to the network line to show the contents of all data packets between the supervisory and remote equipment
ii.) A business entrepreneur that owns world's sixth largest thermal power generator.
iii.) Works as an edge over your skills, knowledge and hard work
iv.) Seemingly innocous software application installed to get access to the someone's computer information services.
v.) The control centre associated with the implemeation of automation of power system at generation-transmission level is referred as
vi.) Distributor of the Industrial Power Engineering and Applications Handbook
vii.) Expected replacement for standard line connected reactor in 400 kV lines
viii.) A common system used in the companies to provide access of all critical data to all the employees
ix) An ISO-9001: 2000 company and a leading manufacturer of single phase and three phase energy meters

A	F	I	K	C	O	N	T	I	M	E	T	E	R	S
N	C	C	E	A	S	D	I	T	S	E	M	C	D	G
I	R	H	B	U	R	E	Z	E	P	V	S	O	H	K
E	P	I	O	V	I	G	D	E	N	C	M	B	V	Z
S	I	P	I	B	I	U	X	M	D	R	G	Y	P	T
D	N	S	M	N	T	I	C	D	U	O	I	T	O	A
O	K	O	T	I	S	O	9	T	R	O	I	A	N	S
O	M	E	T	K	H	W	N	E	W	O	A	V	B	I
N	E	T	W	O	R	K	A	N	A	I	Y	Z	E	R
Z	A	C	B	S	P	U	B	I	I	S	H	E	R	S

TERMS AND CONDITIONS

1. Only the members of IEEE are allowed to participate.
2. Members of editorial committee are not eligible to participate.
3. Photocopies of the "Brain Teaser" are also permitted.
4. Each person can give single entry only.
5. All the entries should be addressed to the Editor, C-1/1484, Vasant Kunj, New Delhi-110070.
6. Decision of the Editor will be considered as final.

PRIZES

Logon to the www.ewh.ieee.org/r10/delhi for the details

FLOBO- AN EDGE OVER THE HUMAN HAND

Anubhav Bhogra
SJPMLIET, Radaur
E-mail: abhogra2127@indiatimes.com

FLOBO is a robot which has been designed to perform the tasks and jobs that a human hand is not capable to perform. This human incapability arises because of certain unfavorable working conditions at work place or inaccessibility of the work place.

For example in underground pipelines if one has to locate a leakage or any kind of blockage or any other fault, it is not possible for a man to go inside it and detect the fault. So the way left is to dig up most of the pipeline and check for the faults if any. This is a very time consuming job and also waste of labor. So a moving machine like FLOBO has been designed which would go inside the pipeline, judge the fault and simultaneously and continuously inform us of the inside conditions of the pipeline. This will help to avoid unnecessary or undue wastage of the labor as well as save a lot of time.

Also it is seen that in a nuclear reactor it is not possible for a human to go inside the reactor and detect the various faults because of the presence of radioactive radiations that are hazardous for human health. Most of these problems are left unsolved, ultimately resulting in the failure of the nuclear reactor. But if a machine which could go inside the reactor, detect the fault and even repair it without disturbing the working environment in the reactor and without even affecting its own working, most of the problems related to the nuclear reactor's working can be solved.

DEVELOPMENT OF BIVECTOR (kWh+kVAh) ELECTRONIC ENERGY METERS

Contimeters has introduced for the first time in the country, Bivector (kWh+kVAh) Polyphase Energy Meters with 2 impulse counters one for kWh & other for kVAh energy recordings with ratings:- 3x(10-60) Amp., 3x240 V, 50 Hz suitable for consumers load section 6 KW to 20 KW.

The Meter has following distinct ADVANTAGES over Polyphase Bivector meters with LCD Display:-

1. Low cost version (30% approx.) in comparison to STATIC kWh meters with kVA demand (with LCD Display) or trivector meters used for Small Industrial applications.
2. Easy to read & easy to compute power factor of the consumer's load & easy to bill the consumer with ordinary staff available with EB's for the purpose.
3. Billing can be directly on basis of kVAh energy recorded of consumer's load or otherwise consumer can be penalized for keeping low pf (below 0.85) of its load.
4. Meter recording of energies can be read even during power failure as no internal/external jacks are needed as recordings are stable & visible on Impulse Counters/ Stepper Motor counters.
5. Consumer can itself compute power factor to its load & is tempted to use power factor improvement devices for curtailing its energy billing.
6. No fear of loss of data due to rapid voltage fluctuations/ internal noise of circuit.

REGION 10 MEETING AT BANGKOK

The IEEE Region 10 Annual General Meeting was held at Bangkok, Thailand on 5th & 6th April 2002. the meeting was also attended among others by Mr. Ray Findlay, IEEE President, Mr. Joel B. Snyder, IEEE Past President, Directors Region 1 and 8 and Division X Director.

The highlights are as under:-

1. Discussions were held on strategic plans for enhancing value to members.
2. It was decided that a comprehensive operation manual simplifying the rules and reporting should be prepared.
3. Activities for promotion of students interest and their participation may be given more emphasis. For this purpose GOLD programs may help.
4. Efforts need to be made to retain student members.
5. Use of web reporting and e-forms need to be increased.
6. Industry may be approached for promotion of IEEE policies and activities.