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ABOUT IDC

IDC Technologies is internationally recognised as the premier provider of practical, technical training for engineers and technicians. We specialise in the fields of industrial data communications, telecommunications, automation and control, and are continually adding to our portfolio of over 300 different workshops.

Our instructors are highly respected in their fields of expertise and in the last 20 years have trained over 500,000 engineers, scientists and technicians worldwide.

With offices conveniently located worldwide, IDC Technologies has an enthusiastic team of professional engineers, technicians and support staff who are committed to providing the highest quality of training and consultancy.

COMPANY MISSION

“To provide our clients with measurable and significant productivity gains through excellence in cutting edge, practical engineering and technology training.”

TECHNICAL WORKSHOPS

**TRAINING THAT WORKS**

We deliver engineering and technology training that will maximise your business goals. In today’s competitive environment, you require training that will help you and your organisation to achieve its goals and produce a large return on investment. With our “Training that Works” objective you and your organisation will:

- Get job-related skills that you need to achieve your business goals
- Improve the operation and design of your equipment and plant
- Improve your troubleshooting abilities
- Sharpen your competitive edge
- Boost morale and retain valuable staff
- Save time and money

**HANDS-ON APPROACH TO TRAINING**

All IDC Technologies workshops include practical, hands-on sessions, where the delegates are given the opportunity to apply in practice the theory they have learnt.

**QUALITY MANUALS**

A fully illustrated workshop manual with hundreds of pages of tables, charts, figures and handy hints, plus considerable reference material is provided FREE of charge to each delegate.

**EXPERT INSTRUCTORS**

We search the world for good quality instructors who have three imperative attributes:

1. Expert knowledge and experience – of the course topic
2. Superb training abilities – to ensure the knowledge is transferred effectively and quickly to you in a practical hands-on way
3. Listening skills – they listen carefully to the needs of the participants and want to ensure that you benefit from the experience

Each and every instructor is evaluated by the delegates and we assess the presentation after each class to ensure that the instructor stays on track in presenting outstanding courses.

**CERTIFICATE OF ATTENDANCE**

Each delegate receives a Certificate of Attendance documenting their experience.

**100% MONEY BACK GUARANTEE**

IDC Technologies’ engineers have put considerable time and experience into ensuring that you gain maximum value from each workshop.

If by lunch time of the first day you decide that the workshop is not appropriate for your requirements, please let us know so that we can arrange a 100% refund of your fee.

ACCREDITATION AND CONTINUING EDUCATION

IDC Technologies is an Internationally Accredited Professional Training Organisation. IDC has received recognition, endorsement and/or accreditation (varies by course and/or a credit) from authorising bodies based around the world. These organisations include:

IDC Technologies is registered with Pembangunan Sumber Manusia Berhad (PSMB) (Human Resources Development Fund in Malaysia) in Category A Institute of Measurement and Control (IMC) in the United Kingdom is Britain’s foremost professional body for the Automation Industry. IDC Technologies is a recognised Companion Company of the IMC.

The Institution of Professional Engineers New Zealand (IPENZ) is the professional body which represents professional engineers from all disciplines in New Zealand. IPENZ members can self assess for CPD points associated with IDC Technologies’ public workshops.

Existing members of Engineers Australia are entitled to claim CPD hours for private study, short courses, and learning activities at the workplace. CPD hours can be claimed for our courses in most cases, but we would always advise individual members to check with the institution if unsure regarding a specific course.

The South African Institution of Mechanical Engineers (SAIMechE) covers all fields of application including automobile, energy generation, process engineering, heavy manufacture, design, management, research, mining and education.

It is very important to us, at IDC Technologies, to ensure that our clients can confidently attend our workshops and courses, knowing that the professional development they are receiving is of the highest standard and will provide them with personal measurable, productivity gains and the opportunity for career advancements.
Dear Colleague

Welcome to our latest technical training directory. I am proud to present the latest collection of engineering and technology courses that we present throughout the world.

We have been providing practical training for over 20 years throughout the USA, Canada, United Kingdom, Ireland, Australia, Singapore and New Zealand. Although we are one of the largest providers of this sort of training and have trained a remarkable 500,000 engineers and technicians in the past few years alone, we are not content with resting on our laurels and continue to achieve an amazing 99.8% satisfaction rating in which delegates indicated the course was “good”, “very good” or “excellent”. We want the course that you attend to be an outstanding, motivating experience where you walk away and say - “that was truly a great course with a brilliant instructor and we will derive enormous benefit from it”.

Our courses are not academic but are rather designed to immediately provide you with the practical skills which will contribute to your productivity and your company’s success. Our courses are vendor independent, free of bias and targeted solely at improving your productivity.

We have a remarkable group of instructors whom we believe are among the best in the industry. Of greatest benefit is that they have real and relevant practical experience in both industry and training.

Our policy is to continually re-examine and develop new training programs, update and improve them. Our aim is to anticipate the shifting and often complex technological changes facing everyone in engineering and business and to provide courses of the absolutely highest standards - helping you to improve your productivity.

We put tremendous efforts into our documentation with award winning manuals which are well researched, practical and down to earth in support of the course; so much so that many delegates have remarked that the manual itself justifies the course fees.

I would urge you to consider our courses and call us if you have any queries about them. We would be glad to explain in more detail what the courses entail and can even arrange for our instructors to give you a call to talk through the course contents with you and how it will benefit yourselves.

Finally, thank you for being such tremendously supportive clients. We are blessed with having such brilliant people attending our courses who are enthusiastic about improving themselves and benefiting their companies with new insights and methods of improving their productivity. Your continual feedback is invaluable in making our courses even more appropriate for today’s fast moving technology challenges.

We want to be your career partner for life - to ensure that your work is both satisfying and productive and we will do whatever it takes to achieve this.

Yours sincerely

Steve Mackay

(C P Eng, BSEE, B.Sc(Hons), MBA)
Technical Director

P.S. Don’t forget our no-risk guarantee - we give you a 100% guarantee of satisfaction or your money back.
The objective of training today is to gain knowledge and experience in the latest developments in technology through cost effective methods. The investment in training, by companies and individuals is growing each year as the need is recognised to keep topical and up to date in the industry in which they are operating.

In addition to the quality workshops which IDC Technologies present on a world-wide basis, all IDC courses are also available for on-site (inhouse) presentation at our client’s premises.

**ON-SITE TRAINING**

On-site training is a cost-effective method of training for companies with several employees to train in a particular area. Organisations can save valuable training dollars by holding courses on-site, where costs are significantly less. Other benefits are IDC’s ability to focus on particular systems and equipment so that attendees obtain the greatest benefit from the training.

All on-site workshops are tailored to meet with our client’s training requirements and courses can be presented at beginners, intermediate or advanced levels based on the knowledge and experience of the delegates in attendance. Specific areas of interest to the client can also be covered in more detail.

**CUSTOMISED TRAINING**

In addition to standard on-site training, IDC Technologies specialises in developing customised courses to meet our client’s training needs. IDC has the engineering and training expertise and resources to work closely with clients in preparing and presenting specialised courses.

You may select components of current IDC workshops to be combined with additional topics or we can design a course entirely to your specifications. The benefits to companies in adopting this option is reflected in the increased efficiency of their operations and equipment.

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**FOR MORE INFORMATION OR A FREE PROPOSAL PLEASE CONTACT OUR CLIENT SERVICES MANAGER:**

**Kevin Baker**

training@idc-online.com

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"Very good. The instructor customised the workshop content to the ongoing requirements of our plant."

David Wood

"Our company has already been able to measure the productivity improvements. Thanks again for an outstanding job."

Stephan Cocks

---

SAVE OVER 50%
ENGINEERING INSTITUTE OF TECHNOLOGY

Five years ago IDC Technologies started to offer selected courses via distance education using the latest e-Learning techniques. Demand for these courses has grown so much that we have over 1000 students worldwide. Hence we decided to launch a unique new division to focus on advanced distance learning in engineering and technology.

We are excited to invite you to find out more about the Engineering Institute of Technology (EIT). The EIT is intended to help you advance your career when you do not have the time for on-campus study or cannot find courses with practical “real world” content that you can apply at work.

The EIT offers engineering certifications, delivered online with practical course content by world class instructors. This provides you with the benefits of live classroom based study in a more efficient, flexible and cost effective manner.

The new Institute has been recognised by major international engineering organisations, including IEEE, ECSA and the Australian Government, building upon the solid foundation started by IDC Technologies.

COURSES INCLUDE:

Advanced Diploma Programs in:
- Industrial Automation
- Electrical Engineering
- HVAC
- Mechanical Engineering
- Electrical and Instrumentation Engineering for Mining
- Electrical and Instrumentation (E &I) Engineering for Oil and Gas Facilities
- Wireless Technologies
- Plant Engineering

Graduate Diploma Programs in:
- Engineering (Industrial Automation)

Masters Degree Programs in:
- Engineering (Industrial Automation)

And much more...

EIT also offers a wide range of short certificate courses in a variety of engineering topics.

ADVANCE YOUR CAREER WITHOUT LEAVING YOUR DESK

- International cutting edge engineering courses, with practical content
- Live and interactive on-line distance learning
- Flexible and cost effective
- Globally accredited and recognised
- Industry experienced instructors

For more information please visit the EIT website:

www.eit.edu.au or contact us at enquiries@eit.edu.au
SPECIALIST CONSULTING
IDC Technologies has been providing high quality specialist advice and consulting for more than ten years to organisations around the world. The technological world today presents tremendous challenges to engineers, scientists and technicians in keeping up to date and taking advantage of the latest developments in the key technology areas. We pride ourselves on being the premier provider of practical and cost-effective engineering solutions.

PROFESSIONALLY STAFFED
IDC Technologies consists of an enthusiastic and experienced team that is committed to providing the highest quality in consulting services. The company has thirty-five professional engineers; quality focussed support staff, as well as a vast resource base of specialists in their relevant fields.

CLIENT FOCUS
IDC’s independence and impartiality guarantee that clients receive unbiased advice and recommendations, focussed on providing the best technical and economical solutions to the client’s specific and individual requirements.

KEY AREAS OF SERVICE
IDC Technologies provides specialist advice and services to organisations around the world. Key areas in which the company provides consulting and engineering services include:

1. Communications
   • Industrial Communications and Telecommunications
   • Fiber Optics
   • Radio & Satellite Communications
   • Wide Area Networks
   • Local Area Networks
   • Intranets & TCP/IP
   • Fieldbus

2. Process Control & Automation
   • Instrumentation
   • SCADA & Telemetry Systems
   • Data Acquisition
   • PLC & DCS Systems
   • Intrinsic Safety
   • DSP Hardware, Firmware & Software Implementation
   • High Quality Earthing

3. Electrical Distribution & Protection
   • Transformers, Cables, Switchgear & other distribution equipment
   • Protection Systems (HT & LT) & Protection Grading Studies
   • Generator Protection, Excitation & Voltage Control systems
   • Synchronising Systems
   • Fast Power Transfer Systems
   • Electrical Network Studies
   • Power System Investigations & Analysis
   • Safety Earthing
   • Lightning Protection
   • Substation Automation
   • Power Quality
   • Power Factor Correction & Filter Design

RANGE OF SERVICES
IDC Technologies is structured to provide a wide range of services. These include:
• Pre-investment studies
• Project implementation
• Environmental management
• System design
• Engineering design
• Feasibility studies
• Cost estimates
• Strategic planning
• Preparation of contracts and specifications
• Customised training
• Tender evaluation
• System audits and evaluation
• Project management and execution
• On-site measurements and problem solving
• Preparation of system documentation
• Presentations, seminars and manuals
Additional services on application

For more information on IDC Engineering consulting services, contact our Technical Director:

Steve Mackay    tech@idc-online.com
PAST DELEGATES SAY:

“I’ve gained more useful info from this seminar than any I’ve previously attended.”
Jim Hannen, Wheeling-Misshen Inc.

“Excellent instructor with plenty of practical knowledge.”
Ian Kemp, ANSTO

“This course offered a layout of updated systems and modern trends to keep ahead.”
Chris Standish, Enterprise

“Excellent depth of subject knowledge displayed.”
Hugh Donohue, AMEC

“This was one of the best courses I have ever been on. The instructor was excellent and kept me fully interested from start to finish. Really glad I attended.”
Chris Mercer, Air Products

“Excellent knowledge of subject and ability to communicate it.”
Mark Moore

“Well presented, excellent material”
Stephen Baron, Air Products

“Very good workshop and instructor.”
John McLaren, Glaxo Smithline

“Excellent presentation! Well done.”
Brett Muhlhauser, Connell Wagner

“Well compiled technical material.”
Robert Higgenbotham, Yallourn Energy

“I like the practicality of the workshop.”
Karl Armfield, Joy Mining

“Excellent instructor with excellent depth and spread of knowledge in this subject.”
Logan Mudaly, Engen

“Great refresher on current practice. Also helped to bring me up to date on new technology.”
E. Burnie, Sellotape

“Excellent, I have taken a TCP/IP class before and didn’t understand it. After this course, I feel more confident with my newfound knowledge.”
John Armbrust, Phelps Dodge

“Filled in many gaps and helped me to see where I need to research further and where my knowledge is sufficient.”
David Robertson, NZ Worley Ltd

“Provided me with a good all round appreciation, essential for all mechanical engineers.”
Clive Waters, Santos Ltd

“Well presented and the instructor obviously has the practical knowledge to back things up.”
Mike Mazurak, ANSTO

“The course went through a good range of materials, requirements etc to meet practical applications.”
Shane Tucker, Epic Energy

“A very worthwhile course.”
Ron Scifleet, Sanitarium

“Training is a critical part of our business and gives us the edge.”
Philip Fraser, NHP

“Well structured and very informative.”
Bruce McLennan, Alcoa

“The course addresses a very big need in the industry.”
AD Swanepoel, Sasol

“Was worthwhile, touched on the subject in areas that I was unsure about, great workshop.”
Dave Thom, Eskom

“A most enjoyable and informative course. Thank you.”
Pat V Hammond, Johnson Matthey PLC

“Excellent instructor with excellent depth and spread of knowledge in this subject.”
Logan Mudaly, Engen
## DATA COMMUNICATIONS & NETWORKING

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PRACTICAL DATA COMMUNICATIONS AND NETWORKING FOR ENGINEERS AND TECHNICIANS

WHAT YOU WILL LEARN:
• The fundamentals of data communications
• How to troubleshoot RS-232 and RS-485
• How to install communications cables
• How to set up a simple Ethernet network
• How to troubleshoot protocols such as Modbus
• The fundamentals of FieldBuses

WHO SHOULD ATTEND:
Anyone with a need to understand the techniques required to use and apply industrial communications technology as productively and economically as possible. This includes:
• Instrumentation and Control Engineers
• Design Engineers
• Process Control Engineers
• Control Systems Sales Engineers
• Electrical Engineers
• Maintenance Supervisors
• Consulting Engineers
• Control Systems Applications Engineers
• Process Development Engineers
The Workshop

Practical Data Communications and Networking for engineers and technicians is a comprehensive 2-day workshop. It covers RS-232, RS-422, RS-485, industrial protocols, industrial networks and the communications requirements for 'Smart' instrumentation. It will equip you with the tools to analyse, specify and debug data communications and networking systems in the instrumentation and control environment, with much of the material presented being derived from many years of experience gained by the workshop instructor.

Workshop Aims

This workshop is designed to benefit people who are involved in specifying, commissioning and debugging data communications and networking systems for instrumentation and control, but who have little previous experience in this area. It has been structured to cover the main concepts of data communications, to clarify their meaning and to describe their applications in modern process control and automation systems.

Practical Sessions

There are six practical sessions throughout the workshop including:

- RS-232/485 troubleshooting
- Modbus simulation
- Protocol analysis on serial links
- Protocol analysis on Ethernet networks

The Program

BACKGROUND TO DATA COMMUNICATIONS

BASIC PRINCIPLES
- Analog and digital signals
- Parallel and serial communications
- Coding of messages e.g. Hex and ASCII
- Asynchronous vs. synchronous transmission
- UARTs

THE DATA COMMUNICATIONS INTERFACE
- RS-232
- RS-422 and RS-485
- Troubleshooting techniques

SELECTION AND INSTALLATION OF CABLES
- Copper and fibre optic cable
- Interference and noise
- Cable selection and installation

MODEMS AND INTERFACE CONVERTERS
- Modem control
- Modulation techniques
- Data compression techniques

OSI (OPEN SYSTEM INTERCONNECTION) MODEL

INDUSTRIAL NETWORKING (LANS)
- Topologies and medium access control
- Industrial Ethernet
- TCP/IP

PROTOCOLS
- Protocol basics
- Error detection
- Modbus and Allen Bradley Data Highway Plus

'SMART' INSTRUMENTATION SYSTEMS
- AS-i
- Seriplex
- DeviceNet
- Interbus-S
- Profibus
- Foundation FieldBus

On-Site Training

✓ SAVE over 50% by having an IDC workshop presented at your premises.
✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.

Contact us for a FREE proposal.

idc@idc-online.com • www.idc-online.com
PRACTICAL
DNP3, 60870.5 AND MODERN SCADA COMMUNICATION SYSTEMS

YOU WILL LEARN HOW TO:

- Explain the fundamentals of DNP3 and associated SCADA protocols
- Apply the best current practice for data communications for SCADA systems
- Specify the most up-to-date hardware and software requirements of the data communications system for instrumentation and control
- Have a good working knowledge of the DNP3 Protocol
- Apply the DNP3 Protocol to your next SCADA project
- Troubleshoot simple problems with the DNP3 protocol
- Explain how IEC 61850 is structured and works
- Provide a working explanation of SCADA Protocols and how they should be structured and applied
- Apply “best practice” decisions on the most cost effective use of SCADA open protocols for your company

WHO SHOULD ATTEND:

This workshop is designed for personnel with a need to understand the techniques required to use and apply SCADA and DNP3 industrial communications technology as productively and economically as possible.
The Workshop

This is a comprehensive two-day workshop covering the essentials of SCADA communication systems focusing on DNP3 and the other new developments in this area. The workshop commences with a brief review of the fundamentals of SCADA systems hardware, software and the communications systems (such as RS-232 and RS-485 Ethernet and TCP/IP) that connect the SCADA operator stations together.

A solid review is then done on the DNP3 protocol where it’s features, message structure, practical benefits and applications are discussed. The course is intended to be product independent but examples will be taken from existing products to ensure that all aspects of the DNP3 protocol is covered.

It provides you with the tools to design your next SCADA system more effectively using DNP3 to draw on the latest technologies.

The Program

OVERVIEW
- SCADA systems
- OSI reference model
- IEC 60870.5 and DNP3.0
- Local Area Networks, Ethernet and TCP / IP
- UCA and IEC 61850 protocols
- FUNDAMENTALS OF SCADA COMMUNICATIONS
- SCADA systems
- Remote Terminal Units (RTU)
- The master station
- Communication architectures
- Communication philosophies
- Interface standards: RS- 232 and RS- 485
- MODBUS protocols
- OPEN SCADA PROTOCOLS Dnp3 AND IEC 60870
- Interoperability and open standards
- Development of standards
- FUNDAMENTALS OF DNP3
- Fundamental concepts
- Understanding DNP3 message structure
- Physical layer
- Datalink layer
- Transport layer (pseudo-transport)
- Application layer message handling
- Application layer message functions
- Data object library
- ADVANCED CONSIDERATIONS OF DNP3
- DNP3 subset definitions
- Interoperability between DNP3 devices
- Implementation rules
- Conformance testing
- DNP3 polling and communication options
- Time synchronisation
- Secure authentication

CONFIGURATION OF DNP3 OVER SERIAL LINES
- General description
- Water industry example

REVIEW OF ETHERNET AND TCP/IP PROTOCOLS
- IEEE 802.3 CSMA/CD (‘Ethernet’)
- Physical layers
- Media access control
- Ethernet frame format
- Fast and Gigabit Ethernet
- Switched Ethernet
- TCP/IP model overview
- Internet protocol
- ICMP, TCP and UDP

DNP3 OPERATION OVER LAN AND WAN NETWORKS
- Routers
- Types of routers
- Routing protocols
- Wide area networks
- Digital transmission hierarchies
- WAN protocol overview
- DNP3 over TCP/IP and UDP/IP
- Link layer confirmations
- Time synchronisation over LAN

OVERVIEW OF IEC 60870-5 PROTOCOLS
- Introduction
- The IEC 60870-5 standards
- System topology
- Data link layer
- Addressing
- Message transport
- Application layer
- Interoperability
- IEC 60870-5-104 (T104) architecture

DIFFERENCES BETWEEN DNP3 & IEC 60870.5
- Differences between DNP3.0 and IEC 870
- Which one is better?

INTELLIGENT ELECTRONIC DEVICES (IEDs)
- Definition
- Functions
- Examples of GE power automation IEDs

IEC 61850 OVERVIEW
- Introduction
- Basic features of IEC 61850
- Data modeling
- Abstract communication service interface
- Information (data) exchange model
- Communication model
- Substation configuration language
- Conformance testing
- Benefits of IEC 61850

FIELDBUS & SCADA COMMUNICATIONS SYSTEMS
- Introduction
- Profibus
- Foundation Fieldbus

FUTURE DEVELOPMENTS
- The future of DNP3

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL TROUBLESHOOTING AND PROBLEM SOLVING OF ETHERNET NETWORKS

YOU WILL LEARN HOW TO:

- Install and configure a simple Ethernet network
- Install cabling, routers, switches and hubs effectively
- Troubleshoot Ethernet network problems
- Improve the performance of your Ethernet network
- Competently use a protocol analyser in fixing networks

WHO SHOULD ATTEND:

- Anyone involved in the installation, design and support of communications systems
- Instrumentation and Control System Engineers
- Process Control Designers and Systems Engineers
- Instrumentation Technologists and Engineers
- Systems Engineers
- IT Managers working with Networks
- Electrical Engineers
- Electrical and Instrumentation Technicians
- Project Engineers
- Maintenance Engineers and Supervisors
- Design Engineers
The Workshop

Ethernet is fast becoming the obvious choice for industrial control networking worldwide. While the basic structure of Ethernet has not changed much, the faster technologies such as Fast Ethernet and Gigabit Ethernet have increased the complexity and choices you have available in planning and designing these systems.

As Ethernet has become more complex, a number of misconceptions have arisen as to how Ethernet functions and how the system should be optimally configured. This workshop addresses these issues in a clear and practical manner, thus enabling you to apply the technology quickly and effectively in your next project.

The workshop commences with a brief outline of the fundamentals of Ethernet and its operation. The method of access is discussed in depth and topics such as full duplex and auto negotiation are explored. The best methods of designing and installing the cabling systems are then explored with the discussion ranging from 10Base-T over twisted pair to Gigabit Ethernet cabling. Methods of optimising Ethernet to obtain best performance are then defined.

Finally the all important topic of troubleshooting is examined by a summary of the typical problems you are likely to encounter from a two station network all the way up to a system comprising 30,000 PCs.

Pre-requisites

A fundamental knowledge of basic electrical concepts is expected with some knowledge of the basics of the Windows operating system.

Workshop Objectives

At the end of this workshop you will be able to:

• Specify how to install an Ethernet network
• Install and configure a simple Ethernet network
• Compare and know the strengths of the different types of Ethernet networks
• List and explain the main features of high speed (and Gigabyte) Ethernet
• Know when to use repeaters, bridges, switches and routers
• Install the cabling and hardware for a typical Ethernet network
• Learn the truth about deterministic operation of Ethernet networks
• Decide on the best cabling and connectors for your factory or office environment
• Apply the structured cabling system concepts to your next project
• Configure and show how TCP/IP is used with Ethernet
• Design and build a reliable Ethernet network
• Apply the principles of Ethernet security and redundancy
• Perform simple troubleshooting tasks on a network
• Use a protocol analyser to analyse Ethernet network activity
• Assess the performance characteristics of a typical network

The Program

I. INTRODUCTION TO ETHERNET BACKGROUND AND INTRODUCTION TO ETHERNET

• Background
• Network communications
• Open systems
• Network topologies

OPERATION OF ETHERNET SYSTEM

• Ethernet standards
• Logical link control frames
• Transmission media and access techniques
• Media access control protocol
• Full duplex Ethernet
• Auto negotiation

II. ETHERNET CABLING AND HARDWARE/PROTOCOLS - DIFFERENT CABLE TYPES

• Twisted pair Ethernet
• Fibre optic media
• Fast Ethernet twisted pair
• Fast Ethernet fibre optic cabling
• Gigabit Ethernet twisted pair
• Gigabit Ethernet fibre optic systems

LAN INTERCONNECTION COMPONENTS

• Repeaters
• Switches
• Bridges
• Routers
• Gateways
• Multi-segment configuration using repeaters
• Redundancy and reliability

PROTOCOLS THAT WORK WITH ETHERNET

• TCP/IP
• Modbus and TCP/IP
• Ethernet/IP
• IPX/SPX and NetBEUI
• IP addressing
• Routing on the networks
• Error and control messages
• User Datagram Protocol (UDP)
• Utilities with TCP/IP

III. CONSTRUCTION OF THE ETHERNET SYSTEM CABLING AND HARDWARE

• Structured cabling
• Twisted pair cables and connector
• Fibre optic cables and connectors
• Ethernet repeater hubs
• Ethernet switching hubs
• Industrial versus commercial networks

NETWORK DESIGN CONCEPTS

• System design
• Design simplicity
• Design documentation

IV. PERFORMANCE AND TROUBLESHOOTING TYPES OF PROBLEMS

• Hardware
• Protocols
• Software

TOOLS

• Basic utilities
• Protocol analyser
• Ethernet performance
• Troubleshooting of Ethernet

THERE ARE TEN PRACTICAL SESSIONS INCLUDING:

• Configuration of an Ethernet network
• Configuration of a simple network protocol
• Demonstration of typical failure points
• Diagnosis of network hardware problems
• Configuration of a network with a switch and hub
• Addition of the TCP/IP protocol
• Use of basic utilities for troubleshooting
• Troubleshooting with simple protocol analyser
• Identification of problems with utilities and protocol analyser
• Benchmarking performance of Ethernet

Practical Sessions

This is a practical, hands on workshop enabling participants to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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✔ Customise the training to YOUR workplace.
✔ Have the training delivered when and where you need it.

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PRACTICAL FIBRE OPTICS FOR ENGINEERS AND TECHNICIANS

WHAT YOU WILL GAIN:

- Practical hands-on experience in jointing, splicing and testing fibre optic systems
- A solid knowledge of fibre optic communications systems
- State of the art fibre optics technology and installation practices
- Correct procedures for cable installation and termination
- How to design and install your own fully operational fibre optics system
- New approaches to troubleshooting including how to use an OTDR

WHO SHOULD ATTEND:

The workshop will benefit engineers and technicians involved in specifying, commissioning and maintaining industrial fibre optic systems, but who have little previous experience in this field, including:

- I & C Engineers and Technicians
- Telecommunications Engineers and Technicians
- Maintenance Engineers and Technicians
- Electrical Engineers and Electricians
- Project Engineers and Managers
- Process Control Engineers
- Consulting Engineers
- Systems Engineers
The Workshop

This comprehensive two-day workshop will provide you with the necessary background to understand the fundamentals of fibre optic systems and their individual components including fibres, cable construction, connectors, splices and optical sources and detectors. Various pitfalls associated with the implementation of fibre optic systems are discussed and workable solutions to these problems are provided. It will provide you with the knowledge to develop the required techniques for design, installation and maintenance of fibre optic systems.

The workshop places significant emphasis on the practical techniques of component installation and system design. You will have the opportunity to get hands-on experience with mechanical and fusion splicing and with fitting the popular industrial fibre connectors. A fibre optic link design software package is provided to allow you to practice actual link design practically using various parameters. Finally, you will have the opportunity to practice using various fibre optic test equipment such as optical sources and power meters.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

- Fibre Optic Link Design - a complete design of a fibre optic link
- Optical Power Measurement - the use of an optical source and an optical power meter
- Continuity Tester - the principles of operation of a simple fibre optic continuity tester
- Optical Time Domain Reflectometer (OTDR) - demonstration on the practical use of OTDR with a video presentation
- Optical Connectors - gain experience in the techniques of fitting fibre optic connectors

To gain full value from this workshop, please bring your laptop/notebook computer.

INTRODUCTION TO FIBRE OPTIC SYSTEMS
- Introduction and overview
- Background to fibre optics
- Fibre optics vs copper systems

DEFINITIONS AND BASIC PRINCIPLES
- Data communications and communications channels
- Transmission modes
- The electromagnetic spectrum
- Revisiting copper

THEORY OF FIBRE OPTIC TRANSMISSION
- Fundamental principles of operation
- Light transmission nature of glass
- Numerical aperture
- Modal propagation in fibres
- Multimode, single mode, step-index and graded index
- Bandwidth of fibres
- Modal and chromatic dispersion
- Absorption, scatter, bending, radiation and mismatches
- Other types of fibres

CONSTRUCTION OF FIBRE OPTIC CABLES
- Cable objectives
- Tensile ratings and structural elements
- Strengthening members
- Housings, sheaths and moisture barriers
- Classes of cables

CONNECTING FIBRES
- Optical connection issues
- Fibre end preparation
- Splicing fibres
- Connectors and optical couplers

OPTICAL DRIVERS AND DETECTORS
- Light emitting diodes and lasers
- Transmitter modules
- Safety considerations
- PIN photodiodes
- Receiver modules
- Optical amplifiers

INSTALLING FIBRE OPTIC CABLES
- Preparation, installation rules and procedures
- Bending radius, cable tension and cable reels
- Cable trays, conduits and lubricants
- Indoor cable installation and leaving extra cable
- Outdoor cable installation and environmental conditions
- Splicing trays, organisers, termination cabinets, breakout boxes, patch and distribution panels

FIBRE OPTIC SYSTEM DESIGN
- Initial design considerations
- Future capacity, reliability and operating wavelength
- Repeaters and amplifiers
- Design loss calculations and link loss budgets
- Design bandwidth calculations

TESTING OF FIBRE OPTIC SYSTEMS
- Concepts of optical measurement
- Continuity and insertion loss testing
- Optical Time Domain Reflectometry (OTDR)
- Bit Error Rate (BER) testing
- Eye diagrams and laboratory fibre tests

TECHNOLOGIES THAT USE OPTICAL FIBRES
- Low speed modems
- 10 Base F/FDDI/FIOSL
- 100 Base F
- ATM
- LANs/MANs/WANs
- Analog modulators for video and microwave links
- HDTV

On-Site Training

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PRACTICAL TROUBLESHOOTING AND PROBLEM SOLVING OF INDUSTRIAL DATA COMMUNICATIONS

YOU WILL LEARN HOW TO:

• Identify, prevent and troubleshoot industrial communications problems
• Fix the most common problems that occur in industrial communications systems
• Gain a practical toolkit of skills to troubleshoot industrial communications systems
• Analyse, diagnose and fix problems

We have taken all the key troubleshooting and problem solving skills from experienced engineers and distilled these into one intensive course to enable you to solve real industrial communications problems.

WHO SHOULD ATTEND:

Anyone working with or required to troubleshoot industrial communications systems ranging from RS-232 to Fieldbus and Ethernet systems, including:

• Process Control Engineers
• Instrumentation and Control Engineers/Technicians
• Network Planners
• Electrical Engineers
• Test Engineers
• System Integrators
• Designers

• Electronic Technicians
• Consulting Engineers
• Design Engineers
• Plant Managers
• Systems Engineers
• Shift Electricians
The Workshop

The objective of this workshop is to help delegates identify, prevent and fix common industrial data communication problems. The focus is "outside the box", with the emphasis on practicals that go beyond the typical communications issues and theories. The workshop provides delegates with the necessary toolkit of skills to solve industrial data communication problems, whether they be RS-232/RS-485, Modbus, Fieldbus and DeviceNet or a Local Area Network, such as Ethernet.

Industrial communications systems are installed throughout plants. Communications problems range from simple wiring problems to the intermittent transfer of protocol messages.

The communications system on a plant effects the entire operation. It is critical that you have the knowledge and tools to quickly identify and fix problems as they occur, to ensure you have a secure system. No compromise is possible here. This workshop distills all the tips and tricks learnt with the benefit of many years of experience.

Typical faults are discussed in depth with a focus on troubleshooting.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

This course includes over 30 practical fixes for RS-232/RS-485/industrial protocols/ASI Bus/DeviceNet systems methodology given with real world examples, and over 40 troubleshooting tips for Profinet/foundation Fieldbus/Ethernet and TCP/IP.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

INTRODUCTION
• Overview of course
• List of typical problems

OVERALL METHODOLOGY
• Common symptoms, problems and solutions
• How to quickly identify likely causes
• Overall basic steps
• Communications issues
• Grounding/shielding/noise

BASIC STANDARDS:
• RS-232
- Fundamentals
- Problems: cabling, male/female, DTE/DCE, 9-pin, handshaking, voltages, noise, isolation
- RS-232 practical troubleshooting session
• RS-485
- Fundamentals
- Problems: cabling, common mode voltage, converters, isolation, idle state, terminations, control – hardware/software
- RS-485 practical troubleshooting session
• Current Loop
- Fundamentals
- Problems: cabling, isolation
• Fibre Optics
- Fundamentals
- Problems: splicing, interface to cable, connectors, multimode, monomode, laser vs LED transmitters, driver incompatibility, bending radius, shock, installation issues

INDUSTRIAL AUTOMATION STANDARDS:
• Modbus
- Fundamentals
- Problems: no response, exception reports, noise, radio interfaces, physical and application layers
- Modbus troubleshooting session
• Modbus Plus
- Fundamentals
- Problems: cabling, grounding, shielding, terminators, token passing
• Data Highway Plus/DH485
- Fundamentals
- Problems: cabling, grounding, shielding, terminators, token passing

HART
• Fundamentals
• Problems: cabling, configuration, intrinsic safety

ASI BUS
• Fundamentals
• Problems: cabling, connections, gateways

DEVICENET
• Fundamentals
• Problems: topology, power and earthing, signal voltage levels, common mode voltage, terminations, cabling, noise, node, communication problems, creeping errors

PROFIBUS PA/DP/FMS
• Fundamentals
• Problems: cabling, fibre, shielding, grounding, segmentation, colour coding, addressing, token bus, unsolicited messages, fine tuning of impedance terminations, drop-line lengths, GSD files, intrinsic safety

FOUNDATION FIELDBUS
• Fundamentals
• Problems: wiring, grounds, shielding, wiring polarity, power, terminations, intrinsic safety, voltage drop, power conditioning, surge protection, configuration

INDUSTRIAL ETHERNET
• Fundamentals
• Protocol analysis
• Problems: noise, thin and thick coax and connectors, UTP cabling, wire types, components, incorrect media selection, jabber, too many nodes, excessive broadcasting, bad frames, faulty auto-negotiation, 10/100MBit/s mismatch, full/half duplex mismatch, faulty hubs, switched networks, loading
• Industrial Ethernet practical troubleshooting session

TCP/IP
• Fundamentals
• Software utilities (ping, arp, netstat)
• Protocols analysis
• Problems: internet layer, IP addresses, subnet mask, routers, transport layer, triple handshake, incorrect ports
• TCP/IP practical troubleshooting session

RADIO AND WIRELESS COMMUNICATIONS
• Fundamentals
• Problems: reliability, noise, interference, power, distance, licences, frequency, over and under modulation
• Radio and wireless practical troubleshooting session

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL
INDUSTRIAL NETWORKING
FOR ENGINEERS AND TECHNICIANS

The Basics of Industrial Networked Systems including:

- Industrial Ethernet
- TCP/IP
- Fieldbus & DeviceNet
- Switches and Routers
- RS-485
- Cabling rules for Industrial Networks

YOU WILL GAIN:

- Practical hands-on experience in setting up a LAN including a comprehensive overview of current industrial networking technology
- Fundamental rules for cabling of industrial networking
- How to install and configure a network under expert guidance during practical sessions
- The most effective approaches to troubleshooting from the experts
- The important steps in designing, installing and managing an industrial network system
- How to improve the performance of your system, save your company money and relieve the frustrations of your co-workers and management

WHO SHOULD ATTEND:

- Instrumentation and Control System Engineers
- Electrical Engineers
- Project Engineers
- Design Engineers
- Electrical and Instrumentation Technicians
- Process Control Engineers
- Maintenance Engineers and Supervisors
- Systems Engineers
The Workshop

Practical Industrial Networking is a hands-on basic introduction to the world of industrial networking. The focus is on the physical layer and installing and commissioning simple Industrial Networking systems. Despite the focus on the basics and fundamentals you will still leave the workshop with valuable tools in designing, installing, commissioning and installing your own industrial network.

Ethernet is fast becoming the obvious choice for industrial control networking worldwide and the course will focus on this. While the basic structure of Ethernet has not changed much, the faster technologies such as Fast Ethernet and Gigabit Ethernet have increased the complexity and choices you have available in planning and designing these systems.

As Ethernet has become more complex, a number of misconceptions have arisen as to how Ethernet functions and how the system should be optimally configured. This workshop addresses these issues in a clear and practical manner, thus enabling you to apply the technology quickly and effectively in your next project.

The workshop commences with a brief outline of the fundamentals of Ethernet and its operation. The method of access is discussed in depth and topics such as full duplex and auto negotiation are explained. The best methods of designing and installing the cabling systems are then explored with the discussion ranging from 10Base-T over twisted pair to Gigabit Ethernet cabling. Methods of optimising Ethernet to obtain best performance are then defined.

Finally the all important topic of troubleshooting is examined with a summary of the typical problems you are likely to encounter from a two station network all the way up to a system comprising 30,000 PCs.

Pre-requisites

Fundamental knowledge of basic electrical concepts.

Practical Sessions

During the 2-days of this workshop there are ten practical sessions including:
• Configuration of an Ethernet Network
• Configuration of a simple Network Protocol
• Demonstration of typical failure points
• Diagnosis of Network Hardware problems
• Configuration of a network with a switch
• Addition of TCP/IP Protocol
• Use of basic utilities for troubleshooting
• Troubleshooting with simple Protocol Analyser
• Identification of Problems with utilities and Protocol Analyser
• Benchmarking performance of Ethernet

The Program

INTRODUCTION TO INDUSTRIAL NETWORKING
• Background
• Network Communications
• LANs/MANs/WANs
• The Open Systems Interconnection Model
• Interoperability
• Network Topologies
• Transmission Media and Access Techniques
• Protocols

FUNDAMENTALS OF INDUSTRIAL NETWORKING
• Main LAN Types
• RS-485
• Modbus
• Master-slave
• Ethernet
• Token Passing

FIELDBUS AND DEVICENET AS INDUSTRIAL NETWORKS
• ASibus
• DeviceNet
• Proibus DP/PA
• Foundation Fieldbus

OPERATION OF ETHERNET SYSTEM
• Ethernet Standards
• Logical Link Control Frames
• Transmission Media and Access Techniques
• Media Access Control Protocols
• Full Duplex Ethernet
• Auto negotiation

DIFFERENT CABLE TYPES FOR INDUSTRIAL ETHERNET
• Twisted Pair Ethernet
• Fibre Optic Media
• Fast Ethernet Twisted Pair
• Fast Ethernet Fibre Optic Cabling
• Gigabit Ethernet Twisted Pair
• Gigabit Ethernet Fibre Optic Systems

LAN INTERCONNECTION COMPONENTS
• Repeaters, Switches, Bridges
• Routers
• Gateways
• Multisegment Configuration using Repeaters
• Redundancy and Reliability

PROTOCOLS THAT WORK WITH ETHERNET
• TCP/IP
• Modbus and Ether/EP
• IPX/SPX and NetBEUI
• IP Addressing
• Routing on the networks
• Error and Control messages
• User Datagram Protocol (UDP)
• Utilities with TCP/IP

CONSTRUCTION OF THE ETHERNET SYSTEM CABLEING AND HARDWARE
• Structured Cabling
• Twisted Pair Cables and Connectors
• Fibre Optic Cables and Connectors
• Ethernet Repeater Hubs
• Ethernet Switching Hubs
• Industrial versus Commercial Networks

NETWORK DESIGN CONCEPTS
• System Design
• Design Simplicity
• Design Documentation

PERFORMANCE AND TROUBLESHOOTING TYPES OF PROBLEMS
• Hardware
• Protocols
• Software

TOOLS
• Basic Utilities
• Protocol Analyser

WIRELESS AND INDUSTRIAL NETWORKS
• Fundamentals
• Quick overview

SUMMARY, OPEN FORUM AND CLOSING

Workshop Objectives

At the end of this workshop participants will be able to:
• Detail where to apply each type of industrial network
• Specify how to install an Ethernet network
• Install and configure a simple Ethernet network
• List and explain the main features of High speed and Gigabit Ethernet
• Know when to use repeaters, bridges, switches, and routers
• Install the cabling and hardware for a typical Ethernet Network
• Learn the truth about deterministic operation of Ethernet Networks
• Decide on the best cabling and connectors for your harsh or office environment
• Apply the structured cabling system concepts to your next project
• Apply the principles of Ethernet security and redundancy
• Perform simple troubleshooting tasks on a Network
• Perform simple troubleshooting tasks on an industrial Network
• Configure and show how TCP/IP are used in a typical Network

idc@idc-online.com • www.idc-online.com
PRACTICAL TCP/IP AND ETHERNET NETWORKING FOR INDUSTRY

WHAT YOU WILL LEARN:

The workshop is designed to give you a superb fundamental grounding in TCP/IP and the internet, as it is applied to industrial automation and process control. The objective is to provide a useful and practical toolbox of skills that can be applied immediately to your plant or facility.

You will:
- Gain a practical understanding of what TCP/IP is and how to apply it
- Learn how to construct a robust Local Area Network (LAN)
- Learn the basic skills to effectively troubleshoot TCP/IP and LAN’s
- Be able to improve the performance of a network
- Understand how to set up an intranet
- Understand how to connect your LAN or intranet to the internet
- Be able to apply appropriate network management tools

WHO SHOULD ATTEND:

Anyone designing, installing, commissioning, maintaining or troubleshooting TCP/IP and intra/internet sites will benefit, including:
- Instrumentation engineers
- Design engineers
- Engineering managers
- Network system administrators
- Technicians
- Network engineers
- Electrical engineers
The Workshop

The internet has made a substantial impact on the way we do business, as well as the plant and factory environment. One of the great protocols inherited from the internet is TCP/IP, which is used by most present-day automation and process control systems. SCADA systems, Programmable Logic Controllers (PLCs) and even low level instruments are using TCP/IP and Ethernet to transfer information. TCP/IP and Ethernet are truly open standards, available to competing manufacturers and providing the user with a common standard at low cost.

This workshop covers the main aspects of TCP/IP and Ethernet in detail, including the practical implementation of TCP/IP in computer and industrial areas and the practical use of the internet and intranets. You will learn to troubleshoot and maintain TCP/IP networks and communication systems in an office and industrial environment.

Pre-requisites
A basic working knowledge of industrial communications and applications is useful.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:
- Construct simple Ethernet LAN
- Configure IP addresses and subnet mask
- Analysis of ARP/ICMP/IP/UDP/TCP protocols with protocol analyser
- Ping, Arp, Netstat, Tracert and route commands
- Set up and analyse FTP/HTTP sessions
- Interconnect networks with bridge or router

To gain full value from this workshop, please bring your laptop/notebook computer.

Excellent overview. Giving a good understanding of ethernet in general. Detailed course notes for further reference.

Lynne Kelly

The Program

INTRODUCTION
- LANs, WANs, VLANs and VPNs
- OSI and ARPA models

ETHERNET
- 10Mbps (half-duplex) Ethernet
- Fast and gigabit Ethernet
- Full-duplex, deterministic and dual redundant Ethernet

INTERNET LAYER PROTOCOLS (IP)
- IPv4, addressing, subnetting, fragmentation and header structure
- ARP
- ICMP
- Routing protocols
- IPv6 addressing modes, header structure and extension headers

HOST TO HOST LAYER PROTOCOLS (TCP)
- TCP/IP ports, sockets, sequence and acknowledgement numbers, establishing and closing connections and sliding windows
- UDP

APPLICATION LAYER PROTOCOLS
- BOOTP, DHCP, TELNET, FTP, TFTP, SMTP, POP3, HTTP, SNMP, and DNS

TCP/IP UTILITIES
- Ping, Arp, Tracert, Netstat, Ipconfig, Wntipcfg and hosts file

CONNECTION DEVICES
- Repeaters, hubs, bridges, switches, routers and gateways

SECURITY CONSIDERATIONS
- Authentication, encryption and firewalls

SATELLITE COMMUNICATIONS (OPTIONAL)
- Essentials of satellites
- Challenges with TCP/IP

TYING IT ALL TOGETHER
- Current and future trends

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL FUNDAMENTALS OF TELECOMMUNICATIONS AND WIRELESS COMMUNICATIONS

WHAT YOU WILL LEARN:

- Fundamentals of telecommunications
- The "jargon" used in telecommunications
- The "nuts and bolts" of selecting and installing telecommunications systems
- How to increase the bandwidth by exploiting your existing copper wire more effectively
- How to make "best practice" decisions on the best and most cost effective access options for your company
- How to apply the latest technologies such as wireless communications
- To understand and apply high speed access systems such as ADSL and beyond

WHO SHOULD ATTEND:

- Electrical Engineers
- Technicians
- Managers
- Instrumentation Engineers and Technicians
- Process Control Engineers and Technicians
- Project Engineers
- Systems Engineers
- Process Engineers
- Maintenance Engineers
- Sales Engineers
- Engineering Managers
- Network Administrators
- Software Engineers
- Field Technical Support Staff
The Workshop

The make-up and structure of telecommunications networks has changed dramatically in the past few years. These changes impact on the equipment you purchase, the services you use, the providers you can choose and the means of transporting the data. This workshop is of particular benefit to those who want to apply the latest and most effective telecommunications technology immediately. Your company may already be looking at operating its own telecommunications system or may be looking at using the systems on the market. With the vast array of equipment and systems and technology now available to you, you need the necessary knowledge to make the best decisions.

We believe this workshop allows you to achieve your objectives in learning and then applying the fundamentals of telecommunications to your next project.

Workshop Objectives

This is a cutting-edge practical workshop on the fundamentals of telecommunications for anyone looking for a complete understanding of the essentials of the terms, jargon and technologies used. This workshop is designed for those who require a basic but fundamental grounding in telecommunications and is of special benefit for those who want to apply the technology as quickly as possible.

On-Site Training

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The Program

INTRODUCTION
• Introduction
• Standards organisations

TELECOMMUNICATION BASICS
• Bandwidth, channel capacity
• Full vs. half duplex
• Baseband, broadband, narrowband and wideband
• Analogue vs. digital transmission
• Multiplexing techniques: FDM, TDM, PCM, WDM
• Connection oriented vs. connectionless communication
• Circuit switching vs. packet switching
• Switching vs. routing
• Local area vs. wide area networks
• The “Communications Cloud”
• The PSTN vs. the Internet
• The OSI model

THE PUBLIC SWITCHED TELEPHONE NETWORK
• PSTN infrastructure
• Local networks
• Switching
• Line circuit functions
• Signaling system #7

TRANSMISSION MEDIA COMPARISON
• Twisted pair
• Coaxial cables
• Fibre optic
• Power system carrier

PRIVATE SWITCHED SYSTEMS
• PBX
• Centrex
• Key systems

PUBLIC NETWORK TRANSPORT TECHNOLOGIES
• Analogue switched (dial-up)
• Public Switched Telephone Network (PSTN)
• Analogue dedicated (leased) alternatives
• Digital switched (dial-up) alternatives
• Digital dedicated (leased) alternatives

Practical Sessions

1. Fibre Optic Design Exercise - design a fibre optic system and calculate link power budgets
2. Network Design Exercise - involves given traffic flows between various offices and determining the number and type of communication links needed.
3. Microwave Design Exercise - to determine required antenna heights and calculate and select appropriate components to design the radio system
4. Basic Local Area Network Configurations
5. Overview Design Exercise - conceptual design of a company-wide communications network

CONCLUSION
• Pulling all the strands together

TRANSMISSION MEDIA COMPARISON
• Microwave radio
• Satellite systems
• Infra-red

CUSTOMER ACCESS TECHNOLOGIES (BROADBAND)
• Digital Subscriber Lines (xDSL): Asymmetric DSL (ADSL); High-data-rate DSL (HDSL); Symmetric DSL (SDSL); Very High Speed DSL (VDSL); G.Lite (ITU G.992.2)
• Etherloop (next generation DSL)
• Hybrid Fibre Coax (HFC)
• Multipoint Microwave Distribution System (MMDS)
• Local Multipoint Distribution Services (LMDS)
• Local Multipoint Distribution Services (LMDS)
• Bluetooth
• IEEE 802.16 WirelessMAN™

LOCAL AND WIDE AREA NETWORKING
• LAN topologies
• LAN media access control techniques
• LAN standards
• LAN extension and interconnection (bridging, switching, routing)
• Metropolitan Area Networks (MANs)
• Wide Area Networks (WANs)
• Virtual Private Networks (VPNs)

CONVERGED NETWORKS
• Applications: VoIP, FoIP, etc
• Protocols: Packet Transport
• WAN transport considerations
• Hardware: H.323 terminal; H.323 gateways; gatekeepers; multipoint control units; audio/video codecs
• Implementation considerations

WIRELESS COMMUNICATIONS
• Radio/cellular concepts and definitions
• Wireless local area networking: IEEE 802.11
• Wireless local loop applications
• Wireless data networks: Cellular Digital Packet Data (CDPD); General Packet Radio Service (GPRS)
• Cellular voice systems: Global System for Mobile Communications (GSM); Code Division Multiple Access (CDMA); Time Division Multiple Access (TDMA)
• Personal Communications Service (PCS)
• Wireless Application Protocol (WAP)
• Third Generation (3G) mobile communications technologies: Universal Mobile Telecommunications System (UMTS)
PRACTICAL TCP/IP, TROUBLESHOOTING AND PROBLEM SOLVING FOR INDUSTRY

A three-day workshop for all those designing, installing, monitoring, maintaining and troubleshooting Industrial Ethernet, TCP/IP and Intra/Internet sites

WHAT YOU WILL LEARN:

- Gain a practical understanding and application of TCP/IP
- Learn the basic skills to effectively set up TCP/IP networks
- Construct a secure, robust Local Area Network
- Diagnose and fix problems with TCP/IP utilities
- Plan and design improved networks
- Analyse and construct a typical firewall
- Understand how to optimise your company’s connectivity with LANs/Intranets and the Internet
- How to troubleshoot TCP/IP networks
- The essentials of network management
- How to track hackers and network problems
- To use a protocol analyser to diagnose real TCP/IP problems
- How to set up Virtual Private Networks (VPNs)
- How to construct Virtual LANs (VLANs)

WHO SHOULD ATTEND:

- Network Technicians
- Data Communications Managers
- Communications Specialists
- IT Support Managers and Personnel
- Network Planners
- Designers
- Programmers
- Network Administrators
- Design Engineers
- Network Engineers
- Electrical Engineers
- IT and MIS Managers
- System Integrators
- Network Support Staff
- System Analysts
- Systems Engineers
The Workshop

This is a truly hands-on workshop in the sense that you will spend over 70% of the course time in setting up TCP/IP based networks and troubleshooting problems. We have distilled all the practical tips and tricks in maintaining and troubleshooting TCP/IP based networks into this hard-hitting three-day workshop. Commencing with a simple introduction to the hardware level of Ethernet, you will quickly move onto coverage of the Internet (IP) layer.

The host-to-host or TCP layer will then be covered in considerable practical detail. The application layer of TCP/IP will be covered by a detailed examination of protocols such as Bootp, DHCP, SNMP and DNS. The vital but simple TCP/IP utilities such as ping, ARP and tracert will then be tested out on the network. The SNMP protocol will be looked at with hands on tests. Finally, you will construct a Virtual LAN and Virtual Private Network and configure a simple firewall.

One of the best ways to learn and retain your knowledge is with hands-on sessions where you will gain a broad range of skills that every competent network engineer needs in his skills toolbox. We believe this workshop provides this know-how.

Practical Sessions

In addition to the 15 practical mini-sessions that expose you to typical problems that could occur with TCP/IP networks, there are at least 10 practical sessions where you will get hands-on training to take advantage of the material covered in the class during days one and two:

- Construct simple 100 BaseTX LAN
- Configure network parameters
- Communicate over networks
- Configure IP addresses and Subnet Mask
- Use Ping utility and observe ARP in operation
- Analysis of ARP/ICMP/IP/UDP/TCP
- Router configuration
- Tracert and Route commands
- Use of Hosts file
- Set up and analyse FTP sessions

To gain full value from this workshop, please bring your laptop/notebook computer.

Very knowledgeable – presented workshop well.
M Torrance

INTRODUCTION
- Terms and definitions
- LANs, WANs, VLANs and VPNs
- Open Systems Interconnection, OSI and ARPA models

ETHERNET
- Fundamentals
- 10Mbps Ethernet systems
- Fast and Gigabit Ethernet
- Collisions and performance
- Full duplex, deterministic and dual-redundant Ethernet

The Program

INTERNET LAYER PROTOCOLS
- IPv4
  - Addressing
  - Subnetting
  - Super netting and CIDR
  - Fragmentation
  - Header structure
- ARP
- ICMP
- Routing protocols
- IPv6
  - Addressing modes
  - Header structure
  - Extension headers

NETWORK TROUBLESHOOTING ETHERNET AND TCP/IP
To be covered during the practical sessions:
- Configuration
- Use of TCP/IP and third party utilities
- Use of protocol analysers

SATELLITE COMMUNICATIONS
- Essentials of satellites
- Challenges with TCP/IP

DAY THREE

VIRTUAL LANS (VLANs)
- Introduction to VLANs
- VLAN identification
- IEEE 802.1p/Q
- Configuring a trunk line
- VLAN Trunk Protocol (VTP)
- VTP pruning
- Managing redundant links
- Inter VLAN routing

SECURITY
- Fundamentals
- Authentication
- Encryption
- Layer 2 Tunneling Protocol Concept
- IPSec Protocol
- Key management for IPSec

VIRTUAL PRIVATE NETWORKS (VPNs)
- Introduction to VPNs
- Layer 2 Tunneling Protocol Concept
- IPSec Protocol
- Key management for IPSec

FIREWALLS
- Fundamentals
- Types of firewalls
- Tips and tricks

TYING IT ALL TOGETHER
- Current and future trends
- Critical areas of focus

SNMP NETWORK MANAGEMENT
- SNMP overview
- MIB details
- SNMP traps
- Network management

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PRACTICAL
ROUTERS AND SWITCHES
(INCLUDING TCP/IP AND ETHERNET)
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Configure, maintain and manage your routers
- Understand TCP/IP and how to apply it
- Design, install and manage routes internetworks
- Segment networks with bridges, routers and switches
- Analyse internetwork protocols
- Troubleshoot and fix router and switch problems
- Improve the performance of both networks and internetworks
- Construct a secure robust Local Area Network (LAN)
- Plan and design your networks more effectively
- Analyse and construct a typical firewall
- Effectively troubleshoot TCP/IP and LANs
- Optimise your company’s connectivity with LANs/Intranets and the Internet
- Construct a basic intranet
- Apply the appropriate network management tools to routers and Internetworks

WHO SHOULD ATTEND:

Anyone who will be designing, installing and commissioning, maintaining or troubleshooting TCP/IP and Intranet/Internet sites will benefit including:

- Instrumentation Engineers
- Design Engineers
- Electrical Engineers
- Technicians
- Network Engineers
- Engineering Managers
## The Workshop

Routers and switches are key components of most networks and internetworks. Routers are simultaneously the most complex and the most important component of networks. This workshop goes through the basics of routers, routed and routing protocols and the basic rules to follow in building internetworks. If you are using any form of communication system or are applying modern PLCs/SCADA systems, this workshop will give you the essential tools in working with your networks. It is not an advanced workshop - but a hands on one.

### Pre-requisites

A basic working knowledge of industrial communications and applications is useful.

### Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

**Practical sessions include:**
- Connect simple networks together
- Construct a simple local area network using 10/100BaseT
- Configure network parameters
- Configure IP addresses and subnet masks
- Communicate over network
- Use ping utility and observe ARP operation
- Analysis of ARP/ICMP/IP/UDP/TCP
- Tracert and route commands
- Set up and analyse FTP sessions
- Quick analysis of packets using protocol analyser
- Web based view of network
- Configuration of switches
- Analysis of internetwork protocols
- Troubleshooting a router and switch
- Routers and switches - configuration issues
- Firewall configuration

## The Program

### INTRODUCTION
- Basic concepts, access methods and topologies
- LANs, WANs, VLANs and VPNs
- Open systems, OSI and ARPA Models
- TCP/IP protocol suite architecture

### ETHERNET
- 10MBps Ethernet systems
  - Media access control: CSMA/CD
  - Layer 1 versions (10Base5/2/T/F)
  - Layer 2 addressing (MAC addresses)
- Fast Ethernet
  - Media access control: Full Duplex
  - Layer 1 versions (100BaseTX/FX)
- Full duplex, deterministic and dual redundant Ethernet

### INTERNET LAYER PROTOCOLS
- IPv4
  - Address classes
  - Subnet masking
  - Classless addressing
  - Subnetting and VLSM
  - Supernetworking and CIDR
  - Fragmentation
  - Header structure
  - Deploying IP addresses
    - Public and private IP addresses
    - Allocating addresses with DHCP
  - Multicasting
    - Multicast address management: NAT, PIM
  - Network address translation: NAT and NAPT
  - Layer 2 vs Layer 3 address mapping
  - Address resolution: ARP
  - Reverse address resolution: RARP
  - Control messages: ICMP
- IPv6
  - Addressing modes
  - Header structure
  - Extension headers

### HOST TO HOST PROTOCOLS
- TCP
  - Principle of operation
  - Header structure
  - Ports and sockets
  - Sequence and acknowledgement numbers
  - Establishing and closing connections
  - Sliding windows
- UDP
  - Principle of operation
  - Header structure

### PROCESS/APPLICATION LAYER PROTOCOLS
- Boot Protocol (BootP)
- Dynamic Host Configuration Protocol (DHCP)
- TELNET
- File Transfer Protocol (FTP)
- Trivial File Transfer Protocol (TFTP)
- Network File System (NFS)
- Simple Mail Transfer Protocol (SMTP)
- Post Office Protocol 3 (POP3)
- Hyper Text Transfer Protocol (HTTP)
- Simple Network Management Protocol (SNMP)
- Domain Name System (DNS)

### TCP/IP UTILITIES
- Ping
- ARP
- Tracert
- Netstat
- Ipconfig
- Winipcfg
- Hosts file

### MECHANICS OF REPEATING
- Basic operation of Ethernet repeaters
  - Hubs
    - Hub interconnection
    - Dual speed hubs

### MECHANICS OF BRIDGING
- Basic operation of Ethernet bridges
- Transparent, translating and speed buffering bridges
- Application

### MECHANICS OF SWITCHING
- Basic operation of Ethernet switches
- Layer 2 vs Layer 3 switches
- Segment, port and IP switching
- Applications: VLANs, collapsed backbones and dual redundant rings
- Troubleshooting switches

### MECHANICS OF ROUTING
- Basic operation of routers
- Router functions
- Static vs dynamic routing
- Routing tables, metrics and protocols
- Route advertisement
- Convergence
- Route calculation: distance vector vs link state
- Autonomous systems
- Interior vs exterior gateway protocols
- Border routers
- Applications: WAN routers, collapsed backbones, parallel backbones

### ROUTING INFORMATION PROTOCOL (RIP)
- Origins
- Specifications
  - Packet format
  - Routing tables
- Operation
- Vector calculation
- Dealing with topology changes
- Limitations

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BEST PRACTICE IN INDUSTRIAL DATA COMMUNICATIONS

WHAT YOU WILL LEARN:

• Best practice in industrial data communications design, installation and commissioning
• How to design and install your own fully operational industrial data communications systems
• How to integrate different industrial communications protocols and standards into a complete working system

WHO SHOULD ATTEND:

Anyone working with or required to follow best practice in the installation of industrial data communications systems ranging from RS-232 to Fieldbus and Ethernet systems, including:

• Instrumentation and Control Engineers and Technicians
• Process Control Engineers
• Network Planners
• Electrical Engineers
• Test Engineers
• System Integrators
• Designers

• Electronic Technicians
• Consulting Engineers
• Design Engineers
• Plant Managers
• Systems Engineers
• Shift Electricians
The Workshop

The objective of this workshop is to outline the best practice in designing, installing, commissioning and troubleshooting industrial data communications systems. In any given plant, factory or installation there are a myriad of different industrial communications standards used and the key to successful implementation is the degree to which the entire system integrates and works together. With so many different standards on the market today, the debate is not about what is the best - be it Foundation Fieldbus, Profinet, Devicenet or Industrial Ethernet but rather about selecting the most appropriate technologies and standards for a given application and then ensuring that best practice is followed in designing, installing and commissioning the data communications links to ensure they run fault-free.

The industrial data communications systems in your plant underpin your entire operation. It is critical that you apply best practice in designing, installing and fixing any problems that may occur. This workshop distills all the tips and tricks learnt with the benefit of many years of experience and gives the best proven practices to follow.

The main steps in using today’s communications technologies involve selecting the correct technology and standards for your plant based on your requirements; doing the design of the overall system, installing the cabling and then commissioning the system.

Fibre optic cabling is generally accepted as the best approach for physical communications but there are obviously areas where you will be forced to use copper wiring and indeed, wireless communications. This workshop outlines the critical rules followed in installing the data communications physical transport media and then ensuring that the installation will be trouble-free for years to come.

The important point to make is that with today’s wide range of protocols available, you only need to know how to select, install and maintain them in the most cost effective manner for your plant or factory - knowledge of the minute details of the protocols is not necessary.

Practical Sessions

- Troubleshooting RS-232
- Troubleshooting RS-485
- Troubleshooting Modbus
- Troubleshooting Ethernet
- Troubleshooting TCP/IP
- Checking RS-485 behaviour at different frequencies
- Fabricating and testing Cat6 cables

The Program

INTRODUCTION
- Overview of the workshop
- OSI model
- Systems engineering approach
- Attributes of typical communications systems
  - Media
  - Physical connections
  - Protocols and applications
- General issues
  - Noise, earthing and shielding
  - Protection against dust and moisture

FUNDAMENTALS
- Copper/fibre
  - Cable and connector standards
  - Splicing
  - Connector attachment
  - Drivers and detectors
  - Earthing and termination
  - Protection against transients
- Physical layer standards
  - RS-232
  - RS-485
  - 4-20 mA
- Industrial networks
  - Industrial Ethernet
  - AS-i
  - DeviceNet
  - Profinet
  - Foundation Fieldbus
  - Modbus Plus
  - Data Highway Plus
  - HART
  - Ethernet/IP
  - Profinet
  - Foundation Fieldbus HSE
- Industrial protocols
  - TCP/IP
  - Modbus and Modbus TCP
  - DNP3
  - 60870 SCADA

SELECTION METHODOLOGY
- Which standards/technologies to use:
  - Field management (device) level
  - Process management (operator) level
  - Business management (enterprise) level
  - Long distance SCADA/telemetry links

INSTALLATION METHODOLOGY
- Copper cabling and connectors
  - System design and installation
- Fibre cabling and connectors
  - System design and installation
- Wireless
  - System design and installation

COMMISSIONING, TESTING AND TROUBLESHOOTING
- Copper infrastructure
- Fibre infrastructure
- Wireless infrastructure
- Networks
  - Physical layer issues (OSI Layer 1)
  - Data link layer issues (OSI Layer 2)
  - Network layer issues (OSI Layer 3)
  - Transport layer issues (OSI Layer 4)
  - Application and "user" layer issues (OSI Layers 7 & 8)
  - Client/server issues

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL FUNDAMENTALS OF VOICE OVER IP (VoIP) FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Understand how Voice over IP works and compares to Public Switched Telephone Network
- Understand the basics of VPN and International Telephony
- Be able to do a Voice over IP cost-benefit analysis for your organisation
- Understand how VoIP protocols work together
- Be able to assess other WAN transport alternatives for VoIP
- Understand the fundamentals of H.323 VoIP standard
- Know how to implement a simple VoIP system
- Be able to deal with packet loss, packet delay, packet jitter, signal echo and other QOS issues
- The “jargon” used in VoIP and telecommunications
- The “nuts and bolts” about selecting and installing VoIP telecommunications systems
- How to make “best practice” decisions on the best and most cost effective implementation of Voice over IP for your organisation

WHO SHOULD ATTEND:

- Electrical Engineers and Technicians
- IT Personnel
- Technicians
- Managers
- Instrumentation Engineers and Technicians
- Process Control Engineers and Technicians
- Project Engineers
- Systems Engineers
- Process Engineers
- Maintenance Engineers
- Sales Engineers
- Engineering Managers
- Network Administrators
- Software Engineers
- Field Technical Support Staff
The Workshop

In the past five years, technologies have converged to such an extent that one can transmit voice, fax and video over the same Internet Protocol Network that one uses for data. This workshop examines Voice over IP (VoIP) technologies and provides you with the skills to competently implement a VoIP network for your organisation. Numerous case studies and exercises throughout the course ensure that you get a good grasp on the technologies used. Solid practical advice is given on application, implementation and most importantly troubleshooting these systems.

Pre-requisites
A basic knowledge of communications and applications would be useful.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

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The Program

INTRODUCTION
• Overview of course
• Terms and Definitions

TELECOMMUNICATIONS FUNDAMENTALS
• Concepts: Signaling, Circuits, Channels, Lines, Trunks,
  • Bandwidth, Channel Capacity.
  • 2-Wire vs. 4-wire Circuits
  • Full vs. Half Duplex
  • Baseband, Broadband, Narrowband and Wideband
  • Analogue vs. Digital transmission
  • Dial-up vs. Leased Access
  • Multiplexing techniques: FDM, TDM, PCM, WDM, DWDM.
  • Connection Oriented vs. Connectionless Communication
  • Circuit Switching vs. Packet Switching
  • Switching vs. Routing
  • Local Area vs. Wide Area Networks
  • The "Communications Cloud"
  • The PSTN vs. the Internet
  • The OSI Model

FUNDAMENTALS OF TCP/IP
• Ethernet
• Internet Protocol
• Transmission Protocol
• Application Layer Protocols

PRINCIPLES OF CONVERGED NETWORKS
• Connectionless versus Connection Oriented Network architecture
• Voice and Data Network Characteristics

APPLICATIONS FOR THE CONVERGED NETWORK
• Telephone to PC communications via the Internet
• IP Voice/Virtual Private Network conversion
• Replacing International Leased Lines
• Fax over IP Networks
• Video over IP

BUSINESS CASE FOR CONVERGED NETWORKS
• Fundamental Financial Assumptions
• Network Traffic Assumptions
• Case Studies
• Interoffice
• In-bound customer call charges
• In-bound Call Centre charges

PROTOCOLS USED
• Ipv4, Ipv6 and ICMP
• Packet Addressing
• Packet Routing
• Host Name-Address Translation
• Protocols supporting VoIP

WAN TRANSPORT FOR CONVERGED NETWORKS
• WAN Transport Alternatives
• Digital Lines
• ISDN/ADSL
• IP over Frame Relay
• IP over ATM

HARDWARE SYSTEMS FOR CONVERGED NETWORKS
• Converged Network Environments
• H.323 Multimedia Standard
• Terminals
• Audio and Video Codecs
• Client Software
• Gateways
• Terminal to Gateway Communications
• Gatekeepers
• Multipoint Control Units

IMPLEMENTATION OF CONVERGED NETWORK
• Interoperability Frameworks
• Alternatives to H.323
• Application Programming Interfaces
• Quality of Service (QOS)
• Implementation of QOS
• Implementation of Converged Network

CONCLUSION
• Revision
• Pulling all the strands together

SUMMARY, OPEN Forum AND CLOSING
PRACTICAL TROUBLESHOOTING, DESIGN AND SELECTION OF INDUSTRIAL FIBRE OPTIC SYSTEMS FOR INDUSTRY

YOU WILL LEARN:

• Practical hands-on experience in jointing, splicing and testing fibre optic systems
• A solid knowledge of fibre optic communications systems
• State of the art fibre optics technology and installation practices
• Correct procedures for cable installation and termination
• How to design and install your own fully operational fibre optics system
• New approaches to troubleshooting including how to use an Optical Time Domain Reflectometer (OTDR)

WHO SHOULD ATTEND:

• Instrumentation and Control Engineers and Technicians
• Telecommunications Engineers and Technicians
• Maintenance Engineers and Technicians
• Process Control Engineers
• Project Engineers
• Electrical Engineers
• Consulting Engineers
• Systems Engineers
• Project Managers
• Electricians
The Workshop

This is a comprehensive two-day workshop that provides the necessary background to understand the fundamentals of fibre optic systems and their individual components including fibres, cable construction, connectors, splices and optical sources and detectors. Attendees will use this knowledge to develop the required techniques for design, installation and maintenance of fibre optic systems.

The workshop places significant emphasis on the practical techniques of component installation and system design. Attendees will have the opportunity to get hands on experience with mechanical and fusion splicing and with fitting the popular industrial fibre connectors. A fibre optic link design software package is provided to allow the attendee to practice actual link design practices using various parameters. Finally, attendees will have the opportunity to practice using various Fibre Optic test equipment such as optical sources and power meters.

The material presented in this workshop has been developed from the many years experience gained by IDC Technologies’ engineers working in consulting and contracting roles in industry. It is a practical, hands-on workshop enabling participants to work through practical exercises which reinforce the concepts discussed during the workshop.

Workshop Objectives

This workshop is designed to provide a thorough background to fibre optic communications systems and to illustrate how to design and install these systems. Various pitfalls associated with the implementation of fibre optic systems are discussed and workable solutions to these problems are provided. It will benefit engineers and technicians involved in specifying, commissioning and maintaining industrial fibre optic systems, but who have little previous experience in this field.

Practical Sessions

- Fibre Optic Link Design - a complete design of a fibre optic link
- Bit Error Rate - perform simple tests and examine the practical implications of the results
- Fusion Splicer - perform a fusion splice and gain experience in the techniques
- Mechanical Splice - perform a simple mechanical splice
- Optical Power Measurement - the use of an optical source and an optical power meter
- Continuity Tester - the principles of operation of a simple fibre optic continuity tester
- Optical Time Domain Reflectometer (OTDR) - demonstration on the practical use of ODTR with a video presentation

The Program

INTRODUCTION TO FIBRE OPTIC SYSTEMS
- Introduction
- Outline of workshop
- Historical background to fibre optics
- Comparison of fibre optics and copper systems

DEFINITIONS AND BASIC PRINCIPLES
- Data communications
- Communications channels
- Transmission modes
- The electromagnetic spectrum
- Revisiting copper

THEORY OF FIBRE OPTIC TRANSMISSION
- Fundamental principles of operation
- Light transmission nature of glass
- Numerical aperture
- Modal propagation in fibres
- Multimode / singlemode / step-index / graded index
- Bandwidth of fibres
- Modal and chromatic dispersion
- Absorption / scatter / bending / radiation / mismatches
- Other types of fibres

CONSTRUCTION OF FIBRE OPTIC CABLES
- Cable objectives
- Tensile ratings
- Structural elements
- Strengthening members
- Housings - loose tube / slotted core / tight buffered
- Sheaths and moisture barriers
- Classes of cables - aerial / underground / subaqueous / indoor

CONNECTING FIBRES
- Optical connection issues
- Fibre end preparation
- Splicing fibres - fusion / mechanical
- Connectors
- Optical couplers

OPTICAL DRIVERS AND Detectors
- Light emitting diodes
- Lasers
- Transmitter modules
- Safety considerations
- PIN photodiodes
- Receiver modules
- Optical amplifiers

INSTALLING FIBRE OPTIC CABLES
- Preparation - site survey and design
- Installation rules and procedures
- Bending radius / cable tension / cable reels
- Cable trays / conduits / lubricants
- Indoor cable installation / leaving extra cable
- Outdoor cable installation / environmental conditions
- Splicing trays / organisers / termination cabinets / patch panels / distribution panels / breakout boxes

FIBRE OPTIC SYSTEM DESIGN
- Initial design considerations
- Future capacity / reliability / operating wavelength
- Repeaters and amplifiers
- Design loss calculations / link loss budgets
- Design bandwidth calculations

TESTING OF FIBRE OPTIC SYSTEMS
- Concepts of optical measurement
- Continuity testing
- Insertion loss testing
- Optical Time Domain Reflectometry (OTDR)
- Bit Error Rate (BER) testing
- Eye diagrams
- Laboratory fibre tests

TECHNOLOGIES THAT USE OPTICAL FIBRES
- Low speed modems
- 10 Base F / FDDI / FIORL
- 100 Base F
- ATM
- LANs / MANs / WANs
- Analog modulators for video and microwave links
- HDTV

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TROUBLESHOOTING
INDUSTRIAL ETHERNET
AND TCP/IP NETWORKS

YOU WILL LEARN HOW TO:

• Install and configure a simple industrial Ethernet and TCP/IP network
• Troubleshoot and fix Ethernet network problems
• Use a protocol analyser to analyse Ethernet network activity
• Use the utilities supplied to fault find TCP/IP and Ethernet networks
• Learn how to troubleshoot TCP/IP networks
• Identify network problems and fix them
• Fault find at the Ethernet/TCP/IP and application levels
• Learn the essentials of network management
• Learn how to track hackers and network problems

WHO SHOULD ATTEND:

This is not an advanced workshop - but a hands-on one.
Anyone who will be designing, installing and commissioning, maintaining or troubleshooting TCP/IP and Intra/Internet sites will benefit including:

• Instrumentation Engineers
• Technicians
• Design Engineers
• Network Engineers
• Engineering Managers
• Electrical Engineers
• Network System Administrators
The Workshop

This workshop is a practical workshop devoted to two days of hands-on faultfinding and troubleshooting.

The workshop has been structured to cover key issues in troubleshooting TCP/IP and Ethernet in detail, while going through the practical implementation of TCP/IP in office and industrial networks and the practical use of the Internet and Intranets. Troubleshooting and maintenance of TCP/IP networks and communication systems in an office and industrial environment are also covered. 15 practical mini-sessions expose you to typical problems that could occur with industrial Ethernet and TCP/IP networks and shows you how to fix them. Most of each day comprises practical sessions with a modicum of discussion to explain the key points. There will be a minimum of two people to a PC so that the practical component will be emphasised.

At the end of this workshop you will walk away with a solid knowledge on troubleshooting industrial Ethernet and TCP/IP networks. A comprehensive 400 page manual will ensure that you have an excellent reference book for your future work in this challenging and yet rewarding area of engineering.

Pre-requisites

A basic working knowledge of industrial communications and applications is useful.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

On-Site Training

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The Program

BACKGROUND AND INTRODUCTION TO ETHERNET
• Network communications
• Open systems
• Network topologies

OPERATION OF ETHERNET SYSTEMS
• Ethernet standards (10Mbits/s to 10Gigabits/s)
• Full duplex Ethernet

TROUBLESHOOTING THE DIFFERENT ETHERNET CABLE TYPES
• Twisted pair
• Fibre optic
• Fast Ethernet twisted pair
• Fast Ethernet fibre optic
• Gigabit Ethernet twisted pair
• Gigabit Ethernet fibre optic
• Structured cabling
• Industrial versus commercial networks

TCP/IP
• Quick review of essentials of TCP/IP
• Internet Layer Protocols (IP)
• Host-to-Host Layer protocols (incl. TCP/UDP)
• Application Layer protocols (incl. DHCP, FTP, SNMR DNS)

TOOLS FOR TROUBLESHOOTING
• Basic utilities
• Protocol analyser
• Ethernet performance
• Troubleshooting of Ethernet and TCP/IP rules

TROUBLESHOOTING THE NETWORK INTERFACE CONNECTION
• NIC hardware errors
• Frame Collisions and how they impact on performance
• Incompatibilities with 802.3 and Ethernet V.2 Frames

TROUBLESHOOTING THE INTERNETWORK CONNECTION (IP PROTOCOL)
• DNS configuration errors
• DHCP configuration problems
• Fragmenting and reassembly of long messages
• ARP related problems
• Duplicate IP Addresses
• Incorrect Sub-Net mask
• Using ICMP Echo Messages (Ping)
• Misdirected datagrams
• Incorrectly configured routers

TROUBLESHOOTING THE HOST-TO-HOST CONNECTION (TCP PROTOCOL)
• Using BOOTP with UDP Transport
• Clock synchronisation with UDP
• Establishing and terminating TCP connections
• TCP data transfers
• Repeated Host Acknowledgments
• Using the Finger User Information Protocol
• Optimising TCP Window Size
• Problems with high delay links (e.g. satellite)

TROUBLESHOOTING ROUTERS AND SWITCHES
• Ethernet repeater hubs
• Ethernet switching hubs
• Routers

NETWORK MANAGEMENT
• Simple Network Management Protocol (SNMP) client/server session

WRAP UP AND CONCLUSION
• Revision of key concepts
• Summary of the basic rules
PRACTICAL INDUSTRIAL WIRELESS FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Understand current wireless networking offerings on the market
• Apply today’s wireless technology to industrial automation
• Implement your own simple wireless LAN (WLAN) for your office and industrial plant
• Implement simple radio telemetry links for SCADA systems
• Explain the strengths and weaknesses of the different wireless technologies
• Describe standards such as IEEE 802.15.4 and IEEE 802.11
• Implement effective security on your network
• Describe how spectrum and frequency allocation is done
• Understand the basic terminology and jargon used in this area

WHO SHOULD ATTEND:

This course is designed for personnel with a need to understand the techniques required for using and applying wireless communications technology as productively and economically as possible. This includes engineers and technicians involved with:

• Control and instrumentation
• Control systems
• Consulting
• Design
• Electrical installations
• Equipment manufacturing
• IT personnel
• Maintenance supervisors
• Process control
• Process development
• Project management
• Regulatory and legal issues
• SCADA and telemetry systems
The Workshop

Wireless communications is being rapidly implemented in the industrial environment, with great success, provided certain ground rules are applied. These include ensuring a robust wireless link, correct integration with the wired communications systems, and proper data security. The critical objective of wireless communications networks must be to achieve similar capacities, bandwidths, responsiveness and availability to that of wire-based communications systems.

Apart from covering wireless basics, the workshop provides an in-depth coverage of the main industrial wireless technologies in use today, viz. radio modems, IEEE 802.11 wireless LANs (Wi-Fi) and IEEE 802.15.4 wireless PAN technology as implemented by a multitude of process control system vendors. WirelessHART is a specific example of this.

The workshop also covers some of the secondary technologies that are not known as industrial technologies per se, but which still find widespread application in industrial environments. These include Bluetooth, LP radio, mobile (cellular) data systems and VSAT.

At the end of the course you should have a clear understanding of the choices available to you in designing and implementing your own industrial wireless network.

Pre-requisites

A working knowledge of data communications and applications is useful, but is not essential.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:
- Set up an IEEE 802.11 WLAN and connect to an Ethernet network
- Troubleshoot simple problems
- Perform a path loss calculation
- Perform a simple analysis of the protocol packets

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION
- Current trends in industrial wireless technology
- Wireless Industrial Networking Alliance (WINA) and ISA-SP100
- Review of the OSI model
- Brief review of Ethernet and the TCP/IP protocol suite

WIRELESS FUNDAMENTALS
- Radio/microwave spectrum and frequency allocations
- Modulation techniques
- Spread spectrum techniques

POINT-TO-POINT TERRRESTRIAL WIRELESS SYSTEMS
- Terrestrial microwave link design
- Wireless modems
- Point-to-point and point-to-multi-point configurations

WIRELESS LANs
- WLAN basics
- Specifications (IEEE 802.11 a/b/g/n)
- Medium access control and frame structures
- Industrial WLAN

WIRELESS MESH NETWORKS
- Mesh basics
- Wi-Fi mesh systems
- IEEE 802.15.4
  - ZigBee
  - WirelessHART

WIRELESS SENSOR NETWORKS
- IEEE 1451.5

OTHER RELEVANT WIRELESS TECHNOLOGIES
- IEEE 802.15.1 (Bluetooth)
- Low Power (LP) radio
- IEEE 802.16 (WiMax)
- Cellular data transmission (GPRS, 1xRTT, EV-DO, HSPDA)
- Satellite systems: VSAT

SECURITY ISSUES
- Physical security
- Authentication
- Encryption

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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DATA COMMUNICATIONS, NETWORKING AND PROTOCOLS FOR INDUSTRY - BACK TO BASICS

YOU WILL LEARN HOW TO:

• Understand the basic concepts of data communications used in industry
• Talk knowledgeably to their peers, clients and suppliers of equipment on data communications
• Have a good understanding of the best current practice for data communications
• Specify simple hardware and software requirements of data communications systems
• Competently explain the RS-232, RS-422 and RS-485 interface standards;
• Provide a working explanation of current industrial protocols such as Modbus
• Troubleshoot simple data communications systems
• Understand how to construct simple Ethernet and TCP/IP networks
• List and describe simply the most important Fieldbus and DeviceNet standards

WHO SHOULD ATTEND:

This workshop is designed specifically if you have NO knowledge of Data Communications, Networking and Protocols for Industry and wish to acquire a simple understanding of how to apply this to your work. You will be working in the engineering and industrial environment.
The Workshop

An efficient data communications system underpins all modern manufacturing industry, mining plant, water and electrical utilities and it is critical to have a good working knowledge of what is being used. No one and certainly no industrial equipment is an island any longer but connected together in some form of network. People who don’t work in the area of data communications often have a fear of the unknown and this workshop demystifies the technology and gives you a solid understanding of how to apply it effectively to your job.

This training workshop assumes you have no knowledge of the technology and gives you a thorough review of the basics of industrial data communications, networking and protocols so that you can apply this knowledge to your work immediately upon the completion of the course.

Pre-requisites
None whatsoever besides an enthusiasm to learn.

BACK to BASICS

Back to Basics - a low level introductory workshop for those of you who want to understand the basics of this exciting and fast growing technology which is essential to your plant, factory and business.

At least 50% of the course will be practical with hands on sessions with data communications equipment, networks and computers to give you a solid working knowledge of the basic principles of data communications without any focus on the advanced technology concepts.

You do not know anything about this technology and simply want to understand the basics which you can apply in to work with a minimum of fuss.

Good technical information and interchange of information between attendees.
Neil Miller

The Program

OUTLINE OF COURSE OBJECTIVES

BACKGROUND TO DATA COMMUNICATIONS
• What is Data Communications
• Brief Overview of the course
• Overview of modern industrial systems

DEFINITIONS AND BASIC PRINCIPLES
• Bits, Bytes and Characters
• Parallel and Serial Communications
• Analog and Digital Signals
• The Coding of Messages - The ASCII Code
• Practical Demonstration of Coding
• Data Transmission Speeds
• The Format of Messages
• Introduction to Error Detection and Correction
• The Importance of Standards
  - ISO, ANSI, CCITT, IEEE, EIA
  - EIA, RS-232 Interface Standard

DATA COMMUNICATIONS STANDARDS BASICS
• RS-232
• Trouble Shooting of RS-232
• RS-422 Interface Standard
• RS-485 Interface Standard
• Comparison of "RS" standards
• RS-232/485 interface Converters
  - Current Loop Interface
  - Troubleshooting RS-232 and RS-485

• Testing Equipment (Breakout Box, Line Analyser)
• Protocol Analyser Practical

SELECTION AND INSTALLATION OF DATA CABLES
• Cables with Copper Conductors
• Interference and Noise
• Optical Fibre cables
• Cable Selection and Installation Recommendations

MODEMS
• Concept of a modem
• Various Modulation Techniques
• Smart Modems
• Radio Modems

OSI-OPEN SYSTEMS INTERCONNECTION
• Modern Factory Automation & Process Control Systems
• OSI Reference Model and Standards

PROTOCOLS FUNDAMENTALS
• The Concept of a Protocol
• Simple ASCII Based Protocols
• Practical Demonstration of ASCII
• Industry Standard Protocols eg Modbus
• Practical Demonstration of Modbus
• Allen Bradley Data Highway Plus Protocol

ETHERNET AND TCP/IP BASICS
• How Ethernet Works
• The very basics of TCP/IP
• How TCP/IP fits onto Ethernet
• How to construct a simple Ethernet and TCP/IP network

SMART INSTRUMENTS CONCEPTS
• What is a smart instrument
• HART

FIELDBUS AND DEVICENET BASICS
• Actuator Sensor Interface (ASI)
• DeviceNet
• Profibus
• Foundation Fieldbus
• Where to use each smart instrument standard

SIMPLE ROADMAP OF DATA COMMUNICATIONS STANDARDS

On-Site Training
✓ SAVE over 50% by having an IDC workshop presented at your premises.
✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.
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idc@idc-online.com • www.idc-online.com
PRACTICAL FIELDbus, DEVICENET AND ETHERNET FOR INDUSTRY

COVERING:

- RS-232/RS-485
- DeviceNet
- Profibus
- Foundation Fieldbus
- ASiBus
- Industrial Ethernet

YOU WILL LEARN HOW TO:

- Compare the Ethernet and Fieldbus/Devicenet standards
- Troubleshoot and fix simple DeviceNet, Profibus and foundation Fieldbus problems
- Design and install simple Ethernet networks
- Know when to use repeaters, bridges, switches, and routers
- Apply switched Ethernet systems effectively
- Install the cabling and hardware for a typical industrial Ethernet network
- Decide on the best cabling and connectors for your harsh or office environment
- Apply the structured cabling system concepts to your next project
- Perform simple troubleshooting tasks on a network

WHO SHOULD ATTEND:

- Anyone involved in the installation, design and support of industrial communications systems
- IT managers working with networks
- Electrical engineers
- Project engineers
- Design engineers
- Systems engineers
- Electrical and instrumentation technicians
- Maintenance engineers and supervisors
- Instrumentation and control system engineers
- Process control designers and systems engineers
- Instrumentation technologists and engineers

IDC TECHNOLOGIES

Technology Training that Works
**The Workshop**

The Fieldbus and DeviceNet standards are becoming a standard at the field and instrumentation level, and are replacing the traditional approaches in the plant today. Ethernet is fast becoming the obvious choice for industrial control networking at the higher levels. While the basic structure of Ethernet has not changed much, the faster technologies such as Fast Ethernet and Gigabit Ethernet have increased the complexity and choices you have available in planning and designing these systems. There has also been a convergence between Fieldbus and DeviceNet standards in that they are also increasingly becoming based on industrial Ethernet for the higher speed data transfer applications.

There is a fair degree of confusion about where Fieldbus, DeviceNet and Ethernet, are applied and the workshop commences with a clear comparison between the different standards and where they are applied.

As Ethernet has become more complex, a number of misconceptions have arisen as to how Ethernet functions, how the system should be optimally configured and what exactly “Industrial Ethernet” means. This workshop addresses these issues in a clear and practical manner enabling you to apply the technology quickly and effectively in your next project.

**Practical Sessions**

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

- **Configuration of an Ethernet network**
- **Configuration of a simple network protocol**
- **Demonstration of typical failure points**
- **Diagnosis of network hardware problems**
- **Configuration of a network with a switch and hub**
- **Addition of TCP/IP protocol**
- **Use of basic utilities for troubleshooting**
- **Set up ASibus, Profibus and DeviceNet networks**
- **Design calculations of foundation Fieldbus systems**
- **Connection between Ethernet and Fieldbus/DeviceNet systems**
- **Design calculations for DeviceNet**

To gain full value from this workshop, please bring your laptop/notebook computer.

**On-Site Training**

- **SAVE over 50% by having an IDC workshop presented at your premises.**
- **Customise the training to YOUR workplace.**
- **Have the training delivered when and where you need it.**

Contact us for a FREE proposal.

**The Program**

**FUNDAMENTAL PRINCIPLES OF INDUSTRIAL COMMUNICATIONS**

- Quick revision of communications
- Interface standards (RS-232/RS-485)
- Industrial protocols (MODBUS)
- Industrial networks
- Road map and comparison of Ethernet/Fieldbus/DeviceNet standards

**DEVICENET**

- Fundamentals
- Configuration
- Troubleshooting

**ASI BUS**

- Fundamentals
- Configuration
- Troubleshooting

**PROFIBUS PA AND DP**

- Fundamentals
- Configuration
- Troubleshooting

**FOUNDATION FIELDBUS**

- Fundamentals
- Configuration
- Troubleshooting

**CONNECTING ETHERNET, FIELDBUS AND DEVICENET**

- Connecting the different systems together

**FUNDAMENTALS OF ETHERNET**

- Ethernet standards
- Collisions and CSMA/CD
- Ethernet frames
- MAC addresses – hardware/unicast/multicast and broadcast
- Sub Network Access Protocol (SNAP) frame format
- Full duplex Ethernet
- Frame related terms (runt/fragment/jabber/jam, interpacket-gap/slot time)
- 10Base-5, 10Base-2, 10Base-T
- Problems with and upgrade options
- Full duplex Ethernet

**CONSTRUCTION OF THE ETHERNET SYSTEM CABLELING – FIBRE AND COPPER**

- Structured cabling
- Unshielded twisted pair (Cat5, Cat5E, Cat6)
- Twisted pair cables and connector
- Fibre optic cables and connectors
- Ethernet repeater hubs
- Ethernet switching hubs
- Troubleshooting Ethernet

**100MBit/S FAST ETHERNET**

- Fundamentals of fast Ethernet
- Media Independent Interface (MII)
- 100 Mbit/s physical level encoding
- Fast Ethernet 100 Base-TX, 100Base-FX, 100Base-T4, 100Base-T2
- Design considerations

**1 GBit/S AND 10 GBit/S ETHERNET**

- Operation
- IEEE 802.3z
- Gigabit Ethernet repeaters and switches
- Backward compatibility

**VIRTUAL LANs (VLANs) USING ETHERNET**

- Essentials of VLANs
- VLANs based on ports, MAC addresses, protocols
- Frame encapsulation methods (eg IEEE 802.1Q)
- Trunking protocols

**ETHERNET INTERCONNECTION AND OPERATION**

- Repeaters, switches, bridges
- Routers
- Gateways
- Redundancy and reliability
- Switched Ethernet
- Spanning tree algorithm

**PROTOCOLS THAT WORK WITH ETHERNET**

- TCP/IP
- Modbus and Ether/IP
- Routing on the network
- User Datagram Protocol (UDP)
- Utilities with TCP/IP

**SUMMARY, OPEN FORUM AND CLOSING**

idc@idc-online.com • www.idc-online.com
PRACTICAL TROUBLESHOOTING AND PROBLEM SOLVING OF MODBUS PROTOCOLS

YOU WILL LEARN HOW TO:

- Identify, prevent and troubleshoot Modbus protocol communications problems
- Gain a practical toolkit of skills for working with Modbus
- Work competently with Modbus and RS-232, RS-485, wireless and Ethernet
- Gain skills to fault find your Modbus based Ethernet, RS-232/485, wireless, Ethernet and TCP/IP network problems

WHO SHOULD ATTEND:

Anyone working with or required to troubleshoot industrial communications systems ranging from RS-232 to Fieldbus and Ethernet systems, including:

- Consulting engineers
- Designers
- Design engineers
- Electrical engineers
- Electronic technicians
- Instrumentation and control engineers/technicians
- Network planners
- Plant managers
- Process control engineers
- Shift electricians
- Systems engineers
- System integrators
- Test engineers
Modbus industrial communications systems (based on RS-232/RS-485 and Ethernet) are being installed throughout industry today, from connecting simple instruments to Programmable Logic Controllers to PCs throughout the business part of the enterprise. Communications problems range from simple wiring problems to intermittent transfer of protocol messages. Whilst the main issues with the Modbus protocol will be covered in this workshop, a clear understanding of the protocols and standards that transport Modbus protocol data units are required in order to effectively work with Modbus. This includes such standards as RS-485/RS-232 and Ethernet (preferably industrial Ethernet) and TCP/IP. Modbus, effectively one of the few (arguably, the only) industrial messaging protocols recognised by the Internet world (port 502) has one of the largest installed bases worldwide with more than 7.2 million installed nodes. The Modbus TCP/IP profile has recently been accepted by the International Electronic-technical Commission (IEC) as a Publicly Available Specification (IEC 62030-1) and is now eligible to become part of future editions of the International Standards IEC 61158 and IEC 61784-2. So it enjoys the status of a widely available open standard available to everyone. And thus the popularity. Whilst detractors will say the Modbus protocol lacks some of the refinements of the newer offerings on the market, there is no doubt that it is one of the most popular standards available in the industrial world today.

The communications system in your plant underpins your entire operation. It is critical that you have the knowledge and tools to quickly identify and fix problems as they occur, to ensure you have a secure system. No compromise is possible here. This workshop distils all the tips and tricks learnt with the benefit of many years of experience.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:
- RS-232 (COM port) basics
- RS-232 point to point communications
- RS-485 basics
- Logging and protocol analysis on serial (RS-232/RS-485) communications system
- Modbus Serial operation: RTU mode
- Modbus Serial operation: ASCII mode
- Setting up a basic Ethernet network
- IP configuration
- Protocol analysis on Ethernet network
- Modbus/TCP
- Modbus (Serial) over IEEE802.11 wireless
- Installation and configuration of Modbus/TCP to serial communication gateway

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

✔ SAVE over 50% by having an IDC workshop presented at your premises.
✔ Customise the training to YOUR workplace.
✔ Have the training delivered when and where you need it.

Contact us for a FREE proposal.
PRACTICAL
RADIO TELEMETRY SYSTEMS
FOR INDUSTRY

YOU WILL LEARN HOW TO:

• Implement simple radio telemetry links for SCADA systems
• Understand the jargon, terminology and latest techniques
• Design and install an effective radio telemetry link
• Perform simple path loss calculations
• Troubleshoot radio telemetry communication problems
• Specify the main components of radio, satellite and microwave telemetry links
• Conduct a site survey
• Implement effective security on radio, wireless and Ethernet networks
• Explain the infrastructure requirements for effective systems
• Outline future trends in SCADA and telemetry systems

WHO SHOULD ATTEND:

• Consulting engineers
• Control systems applications engineers
• Control systems sales engineers
• Design engineers
• Electrical engineers
• Instrumentation and control engineers
• Instrumentation technicians
• Maintenance supervisors
• Network system administrators
• Process control engineers
• Process development engineers
The Workshop

This workshop has been designed in conjunction with radio telemetry experts from throughout the world (the SCADA list) and aims at providing you with all the critical information that we can effectively transfer across to you in two hard-hitting days.

The course commences with a discussion of radio and wireless fundamentals to ensure everyone is brought up to speed with the basics. Antennas are then discussed, followed by fixed systems. The essentials of data communications (and Ethernet) are then reviewed as they apply to radio telemetry systems. A review of Wireless LAN systems is undertaken and a comparison of radio modems is given. The fast growing topic of cellular radio data services is discussed. Protocols are a key part of all radio telemetry systems and the important ones outlined together with the challenges associated with radio.

A brief overview of satellite and microwave systems is given for completeness, followed by performance analysis. A discussion on radio telemetry systems would not be complete without sketching out the key issues of SCADA systems and alarm management. The overall network architecture of radio telemetry systems is then detailed. The course is concluded by an examination of troubleshooting techniques and the vital topic of security and encryption.

A thread throughout the workshop reflects today’s emphasis on using open protocols and networking standards such as DNP3, TCP/IP and Ethernet, and off-the-shelf hardware and software to keep the costs down. A selection of case studies is used to illustrate the key concepts with examples of real-world radio telemetry systems in the water, electrical and processing industries. This workshop will also be an excellent opportunity to network with your peers as well as to gain significant new information and techniques for your next radio telemetry project.

Practical sessions throughout the two days of the course ensure that you can apply the course materials easily and effectively.

Pre-requisites

Knowledge of basic electrical concepts.

The Program

**RADIO AND WIRELESS FUNDAMENTALS**
- Basics of electromagnetic transmission
- Analog and digital modulation techniques
- Spread spectrum
- Spectrum/frequency allocations

**ANTENNAS**
- Fundamentals
- Directionality and gain
- Diversity
- Specific types (directional and omni-directional)

**FIXED SYSTEMS**
- Wireless modems (serial)
- Wireless modems (Ethernet)
- Repeaters
- IEEE 802.16 (WiMax)

**SERIAL DATA COMMUNICATIONS**
- RS-232
- RS-422/485
- Industrial Ethernet

**WIRELESS LANS**
- IEEE 802.11 a, b, g and n
- Medium access control
- Components
- Topologies
- Roaming

**CELLULAR (MOBILE) DATA SERVICES**
- Cellular basics
- 2G systems
- 3G systems
- Cellular (mobile) data services

**PROTOCOLS**
- Modbus
- TCP/IP
- DNP3
- IEC 60870-5
- IEC 61850
- Differences between these alternatives
- Potential problems with wireless networks

**SATELLITES**
- Theory of operation
- Available satellite services
- VSAT TV

**LINE-OF-SIGHT MICROWAVE**
- Terrain mapping
- Fresnel zone and antenna height calculations
- Link budget
- Antenna selection

**PERFORMANCE ANALYSIS**
- Availability and reliability
- BER testing
- Complete system testing

**SCADA SYSTEMS**
- Terminology and overview
- Displays and HMIs
- Best practice configuration

**INFRASTRUCTURE REQUIREMENTS**
- Location
- Equipment selection
- Infrastructure

**NETWORK ARCHITECTURE**
- Design considerations
- Repeater types
- Network redundancy

**TROUBLESHOOTING AND MAINTENANCE**
- Equipment
- Procedures

**SECURITY**
- Introduction and terminology
- Firewalls
- Authentication
- Encryption
- Remote access to SCADA and telemetry systems

**FUTURE DIRECTIONS AND REVIEW**

**SUMMARY, OPEN FORUM AND CLOSING**

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**Practical Sessions**

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

**Practical sessions include:**
- Construction of Wireless LAN
- Site survey
- Extension of WLAN with wired distribution system
- Microwave point-to-point link design exercise
- Implementing encryption and authentication on a WLAN
- Protocol analysis of Modbus/TCP over wireless
- Design of a wireless telemetry system

*To gain full value from this workshop, please bring your laptop/notebook computer.*

idc@idc-online.com • www.idc-online.com
SETTING UP, UNDERSTANDING AND TROUBLESHOOTING OF INDUSTRIAL ETHERNET AND AUTOMATION NETWORKS

WHAT YOU WILL LEARN:

- A practical toolkit of know-how on latest data communications technologies
- How to grasp the latest updates to OPC
- How to understand the operation of industrial wireless systems
- Practical experience in troubleshooting cable and wireless systems
- Design tips and tricks for your own operational industrial data communications systems
- How to integrate the different industrial communications protocols and standards
- How to skill yourself up as the local guru in industrial data communications

WHO SHOULD ATTEND:

Anyone who wants to get the latest up to date practical information on industrial data communications systems and challenges ranging from fieldbus and Ethernet systems to OPC and security, including:

- Instrumentation and control engineers and technicians
- Process control engineers
- Network planners
- Electrical engineers
- Test engineers
- System integrators
- Designers
- Electronic technicians
- Consulting engineers
- Design engineers
- Plant managers
- Systems engineers
- Network maintenance staff
The Workshop

Ethernet is fast becoming the obvious choice for automation networks worldwide. It is a rugged, versatile technology, equally at home in a chemical plant, on an ocean-going vessel and in the cockpit of a fighter aircraft. While the packet structure of Ethernet has not changed since its inception, technologies such as fast and gigabit Ethernet, industrial Ethernet, VLANs, redundant rings and real-time (deterministic) Ethernet for motor control applications have increased the complexity and choices available in planning and designing these systems. As Ethernet has become more complex, a number of misconceptions have arisen as to how Ethernet functions and how the system should be optimally configured. This workshop addresses these issues in a clear and practical manner.

Ethernet can be easily augmented with wireless technologies, and the workshop takes a brief look at the current and emerging industrial wireless technologies such as IEEE802.11, wireless mesh and wireless sensor networks; how they function, and where they fit into the overall picture. Ethernet is almost synonymous with the TCP/IP protocol suite. Because of its rugged design and the fact that it is Internet-compatible, all major automation system vendors are adopting TCP/IP (and, of course, Ethernet). This complex topic will be covered in an easily-understandable and coherent manner.

OPC has made vast inroads into the process automation arena and has been adopted by every single SCADA system vendor. We will look at current standards, in particular the DA standard, and also at new developments such as the ‘Unified Architecture’. We will also highlight some tricky implementation issues and ways to avoid the pitfalls.

With regard to the automation arena there is a strong move to wireless and Ethernet/TCP/IP. We will look at the offerings of the HART communication foundation, the open DeviceNet Vendor Association, The PROFINET/PROFIBUS user organisations and the fieldbus foundation, as well as the latest Ethernet fieldbuses such as EtherCAT, EPL and SercosI11, to get an overall idea of the current trends. In particular we will focus on the real-time issue, a prerequisite for motor control applications. Real-time Ethernet can now operate at sub-millisecond access times and less than one microsecond jitter. We will look at the various offerings by the abovementioned vendors and the two basic methods through which this incredible performance is being achieved.

Finally we will look at every system manager’s nightmare, security, and will suggest some simple common-sense and internationally-accepted measures to keep the hackers at bay.

The Program

INTRODUCTION
- The OSI model and client/server paradigm
- The overall picture: where all these technologies fit in
- Current trends

INDUSTRIAL ETHERNET
- Background: IEEE 802.3 CSMA/CD
- Fast, gigabit and ten gigabit Ethernet
- Switched Ethernet networks, redundant rings and VLANs
- Industrial Ethernet components
- Real-time (deterministic) Ethernet and IEEE1588
- Implementation and troubleshooting

INDUSTRIAL WIRELESS
- Wi-Fi (IEEE802.11a/b/g/n)
- Wireless mesh networks (IEEE 802.15.4)
- Wireless sensor networks (IEEE 1451)

TCP/IP
- TheTCP/IP protocol suite
- Network layer protocols (IPv4, ICMP, ARP)
- Host-to-host layer protocols (TCP, UDP)
- Application layer protocols (FTP, HTTP, Telnet etc)
- Configuration and troubleshooting

OPC
- The OPC concept
- OPC specifications and unified architecture
- DCOM and registry issues
- OPD DA (Data Access)
- Redundancy, tunnelling and bridging
- Implementation and troubleshooting issues (especially Windows XP SP2)

AUTOMATION NETWORK DEVELOPMENTS
- Fieldbus definition and standards
- HART communication foundation: HART and WirelessHART
- ODVA: DeviceNet, Ethernet/IP and CIPSync
- PNO: PROFINET OPD/PA, PROFIBUS v1, v2 (SRT), v3 (IRT)
- Fieldbus foundation: FOUNDATION fieldbus H1 and HSE
- Real-time Ethernet fieldbuses:
  - EtherCAT
  - Ethernet PowerLink (EPL)
  - Sercos III

SECURITY FOR INDUSTRIAL NETWORKS
- Authentication
- Encryption
- Firewalls
- Wireless LAN issues
- Practical steps to safeguard your automation network

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:
- Install and configure an industrial wireless access point as part of Ethernet network
- Interconnect industrial wireless and Ethernet networks
- Control access with MAC address filtering
- Perform path loss calculations on radio link
- Use protocol analyser to solve Ethernet problems
- Connect up simple analog and digital I/O system to network
- Troubleshoot a HART instrument
- Analyse protocols for ProfiNet and Ethernet/IP
- Configure IP addresses and subnet masks
- Analyse ARP/ICMP/IP/UDP using protocol analyser
- Connect up different packages using OPC
- Troubleshoot a simple OPC problem
- Set up a simple firewall
- Demonstrate network security using encryption and authentication

To gain full value from this workshop, please bring your laptop/notebook computer.
PRACTICAL TROUBLESHOOTING OF TCP/IP NETWORKS

YOU WILL LEARN HOW TO:

- Troubleshoot TCP/IP networks
- Find faults at the network interface, internet, Host-Host and application levels
- Learn the essentials of network management
- Learn how to detect hackers

WHO SHOULD ATTEND:

- Communications specialists
- Data communications managers
- Designers
- Design engineers
- Electrical engineers
- IT and MIS managers
- IT support managers and personnel
- Network administrators
- Network engineers
- Network planners
- Network technicians
- Network support staff
- Programmers
- System analysts
- Systems engineers
- System integrators
The Workshop

This is a hands-on workshop in the true sense of the word, where you will spend over 70% of the course time in setting up and troubleshooting TCP/IP-based networks. We have distilled all the practical tips and tricks in maintaining and troubleshooting TCP/IP networks into this intensive two-day workshop.

Commencing with a simple introduction to the hardware level of Ethernet, you will quickly move onto coverage of the Internet (IP) layer. The Host-to-Host (TCP) layer also be covered in considerable practical detail. The application layer of the TCP/IP protocol suite will be covered by a detailed examination of protocols such as BOOTP, DHCP and SNMP. The simple but vital TCP/IP utilities such as Ping, Arp and Traceret will then be tested out on the network.

Finally, you will construct a virtual LAN and virtual private network, and configure a simple firewall. One of the best ways to learn and retain your knowledge is with hands-on sessions where you will gain a broad range of skills that every competent network engineer needs in his skills toolbox. We believe this workshop provides the required know-how.

Pre-requisites:

A basic working knowledge of industrial communications and applications is useful.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

NETWORKING BASICS (OVERVIEW)

- OSI model
- Ethernet
- TCP/IP protocol suite
- Internet layer (OSI layer 3) protocols: IP, ARP, ICMP
- Host-Host layer (OSI layer 4) protocols: TCP, UDP
- Application layer (OSI layer 5/6/7) protocols: FTP, HTTP, Telnet
- Network components

TOOLS

- DOS utilities
- Windows utilities (IP scanners, port scanners, route tracers)
- Protocol analysers

NETWORK CONSTRUCTION

- Constructing a simulated wide area network simulation with hubs, switches and routers
- Setting up cisco routers
- Setting up managed switch
- Setting up DHCP and BOOTP servers
- Configuring IP

BASIC SYSTEM CHECKS

- Host configuration (ipconfig, wintpcfg)
- Router configuration
- Switch configuration
- Connectivity (ping, arp, tracert)
- Name resolution (hosts file, NetBIOS name resolution)

TROUBLESHOOTING THE MEDIUM

- Fiber connectivity
- Cat5 connectivity (damaged and mis-wired cabling)

TROUBLESHOOTING AT LAYER 2

- Ethernet packet analysis
- Checking Ethernet NIC driver configuration
- Detecting duplicate MAC addresses

TROUBLESHOOTING AT LAYER 3

- Checking stack operation (loop-back test)
- Connectivity checking (ping, trace) between subnets
- Pinging and tracing via router (Telnet)
- Packet debugging via router (Telnet)
- Tracing Ethernet packet contents between subnets
- Detecting duplicate IP addresses
- Effect of incorrect subnet masks
- Effect of incorrect routing tables
- Automatic IP address allocation (DHCP server down)
- Faulty WINS resolution
- Inability of application programs to resolve NetBIOS names
- Checking router CPU resources and ACLs

INTERNET CONNECTION

- Setting up NAT router
- Testing internet uplink/downlink performance
- Ping and tracing across the internet (DOS and Windows utilities)

HACKING TOOLS

- Cain and Abel (packet diversion and analysis, password cracking)

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

✓ SAVE over 50% by having an IDC workshop presented at your premises.
✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.

Contact us for a FREE proposal.
PRACTICAL FIBRE OPTICS AND INTERFACING TECHNIQUES TO INDUSTRIAL ETHERNET AND WIRELESS

YOU WILL LEARN HOW TO:

- Practical hands-on experience in jointing, splicing and testing fibre optic systems
- A solid knowledge of fibre optic communications systems
- State of the art fibre optics technology and installation practices
- Correct procedures for cable installation and termination
- How to design and install your own fully operational fibre optics system
- New approaches to troubleshooting including how to use an OTDR
- Know-how on interfacing fibre/wireless and industrial Ethernet
- Ability to apply design rules for fibre/wireless and Ethernet

WHO SHOULD ATTEND:

The workshop will benefit engineers and technicians involved in specifying, commissioning and maintaining industrial fibre optic systems, but who have little previous experience in this field, including:

- Consulting engineers
- Electrical engineers and electricians
- I&C engineers and technicians
- Maintenance engineers and technicians
- Process control engineers
- Project engineers and managers
- Systems engineer
- Telecommunications engineers and technicians
The Workshop

This comprehensive two-day workshop will provide you with the necessary background to understand the fundamentals of fibre optic systems and their individual components including fibres, cable construction, connectors, splices and optical sources and detectors. Various pitfalls associated with the implementation of fibre optic systems are discussed and workable solutions to these problems are provided. It will provide you with the knowledge to develop the required techniques for design, installation and maintenance of fibre optic systems.

The workshop places significant emphasis on the practical techniques of component installation and system design. You will have the opportunity to get hands on experience with mechanical and fusion splicing and with fitting the popular industrial fibre connectors. A fibre optic link design software package is provided to allow you to practice actual link design practicals using various parameters. Finally, you will have the opportunity to practice using various fibre optic test equipment such as optical sources and power meters. At the conclusion of the workshop you will gain knowledge in interfacing, integrating and troubleshooting fibre with industrial wireless and Ethernet systems.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:
- Fibre optic link design - a complete design of a fibre optic link
- Optical power measurement - the use of an optical source and an optical power meter
- Continuity tester - the principles of operation of a simple fibre optic continuity tester
- Optical Time Domain Reflectometer (OTDR) - demonstration on the practical use of ODTR with a video presentation
- Optical connectors - gain experience in the techniques of fitting fibre optic connectors
- Use the patch cords constructed by participants to link 2 media converters to simulate (and test) a small backbone.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION TO FIBRE OPTIC SYSTEMS
- Introduction and overview
- Background to fibre optics
- Fibre optics versus copper systems

DEFINITIONS AND BASIC PRINCIPLES
- Data communications and communications channels
- Transmission modes
- The electromagnetic spectrum
- Revisiting copper

THEORY OF FIBRE OPTIC TRANSMISSION
- Fundamental principles of operation
- Light transmission nature of glass
- Numerical aperture
- Modal propagation in fibres
- Multimode, single mode, step-index and graded index
- Bandwidth of fibres
- Modal and chromatic dispersion
- Absorption, scatter, bending, radiation and mismatches
- Other types of fibres

CONSTRUCTION OF FIBRE OPTIC CABLES
- Cable objectives
- Tensile ratings and structural elements
- Strengthening members
- Housings, sheaths and moisture barriers
- Classes of cables

CONNECTING FIBRES
- Optical connection issues
- Fibre end preparation
- Splicing fibres
- Connectors and optical couplers

OPTICAL DRIVERS AND DETECTORS
- Light emitting diodes and lasers
- Transmitter modules
- Safety considerations
- PIN photodiodes
- Receiver modules
- Optical amplifiers

INSTALLING FIBRE OPTIC CABLES
- Preparation, installation rules and procedures
- Bending radius, cable tension and cable reels
- Cable trays, conduits and lubricants
- Indoor cable installation and leaving extra cable
- Outdoor cable installation and environmental conditions
- Splicing trays, organisers, termination cabinets, breakout boxes, patch and distribution panels

FIBRE OPTIC SYSTEM DESIGN
- Initial design considerations
- Future capacity, reliability and operating wavelength
- Repeaters and amplifiers
- Design loss calculations and link loss budgets
- Design bandwidth calculations

TESTING OF FIBRE OPTIC SYSTEMS
- Concepts of optical measurement
- Continuity and insertion loss testing
- Optical Time Domain Reflectometry (OTDR)
- Bit Error Rate (BER) testing
- Eye diagrams and laboratory fibre test

COPPER TO FIBRE
- Industrial Ethernet
- EMI/crosstalk/distance
- Where to switch out
- Interface devices - media converters/Gigabit interface converter modules/SFPs (Small Form Pluggable)
- Devices with multiple media converters
- Multiplexers
- Design considerations
- Compromises

COPPER TO WIRELESS
- Industrial wireless
- Wireless to fibre and copper
- Interface units

TROUBLESHOOTING FIBRE/WIRELESS AND COPPER
- Hardware troubleshooting
- Ping/arp/wireshark/tracert

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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HANDS-ON
DATA COMMUNICATION,
NETWORKING AND
TCP/IP TROUBLESHOOTING

YOU WILL LEARN HOW TO:

• Set up, configure and troubleshoot RS-232 and 2-wire as well as 4-wire RS-485 links
• Set up and configure basic Ethernet networks containing hubs, switches and routers, and troubleshoot these networks down to the packet level
• Configure IP parameters, and do basic TCP/IP troubleshooting down to the packet level by means of DOS and Windows utilities such as IP address and port scanners as well as protocol analysers
• Troubleshoot Modbus serial and Modbus TCP systems down to byte level
• Set up IEEE802.11 access points in infrastructure and point-to-point mode, do site surveys and ‘sniff’ packets
• Implement authentication and encryption on IEEE 802.11 wireless LANs

WHO SHOULD ATTEND:

This workshop is designed for personnel with a need to understand the techniques required to use and apply industrial communications technology as productively and economically as possible. This includes engineers and technicians involved with:

• Consulting
• Control and instrumentation
• Control systems
• Design
• Electrical installations
• Instrumentation

• Maintenance supervisors
• Process control
• Process development
• Project management
• SCADA and telemetry systems
The Workshop

Data communication is given high priority in today’s industrial environment. This workshop is designed to be hands-on, providing the participants with essential knowledge and helping them to understand troubleshoot systems.

This is a comprehensive two-day hands-on workshop that covers practical aspects of data communication such as serial communications, Ethernet networking, TCP/IP, Modbus, wireless communications and security.

This workshop is for enthusiastic engineers and technicians who wish to develop and enhance their practical knowledge in the field of data communications and networking. It will help them to understand the concepts behind data transmission, the various protocols involved, and the topologies that govern data exchange among various systems in industry. It will also equip them with the skills and tools to design and/or maintain these systems on an ongoing basis.

Pre-requisites:

A basic working knowledge of industrial communications and applications will be useful.

Real-life experience with equipment and hands-on testing will enable the workshop to be placed in context.

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The Program

SERIAL DATA COMMUNICATIONS
- Asynchronous serial communication basics
- RS-232, RS-485 basics
- Setting up the software
- RS-232 basics
- RS-232 point-to-point communication
- RS-232 via virtual null modem
- RS-485 basics (2W and 4W) using
  Listen 32 software, voltmeter and oscilloscope (if available)

ETHERNET AND TCP/IP NETWORKING

NETWORKING BASICS (BRIEF REVIEW)
- Ethernet
- TCP/IP protocol suite
- Internet layer (OSI layer 3) protocols: IP, ARP, ICMP
- Host-host layer (OSI layer 4) protocols: TCP, UDP
- Application layer (OSI layer 5/6/7) protocols: FTP, HTTP, Telnet
- Utilities
- Network components

PRACTICAL EXERCISES
- Constructing a simulated Wide Area Network simulation with hubs switches and pre-configured Cisco 2500 routers
- IP configuration (IP addresses, subnet masks, default gateways) of hosts

BASIC SYSTEM CHECKS
- IP configuration checks (ipconfig, wnpconfig)
- Router configuration checks using IOS commands via Telnet
- Switch configuration checks using browser
- Connectivity checks (ping, arp, traceroute)
- Name resolution (hosts file, Linhosts file)

TROUBLESHOOTING THE MEDIUM
- Fiber connectivity – basic checks
- Cat5 connectivity (damaged and mis-wired cabling, with cable tester)

TROUBLESHOOTING AT LAYER 2
- Ethernet packet analysis with Wireshark
- Checking Ethernet NIC driver configuration

TROUBLESHOOTING AT LAYER 3
- Checking stack operation with loop-back test
- Tracing Ethernet packet contents between subnets with Wireshark
- Detecting duplicate IP addresses
- Automatic IP address allocation (DHCP server down)

INDUSTRIAL PROTOCOLS: MODBUS

MODBUS SERIAL
- Basic client/server concept
- Addressing scheme
- Message structure

PRACTICAL EXERCISES
- Master/slave simulation over null modem

MODBUS TCP
- Basic concept
- Message structure

PRACTICAL EXERCISES
- Master/slave simulation over Ethernet and TCP/IP
- Modbus Serial/TCP gateway (Moxa Nport 6110)

WIRELESS
- IEEE802.11 wireless LAN overview

PRACTICAL EXERCISES
- Setting up Cisco Aironet access point
- Configuring an access point as a remote bridge to establish a point-to-point link (wireless bridge) with two Cisco Aironet access points
- Sniffing wireless packets with Wireshark
- Quick site survey
- Measuring signal-to-noise ratio with Netstumbler

SECURITY
- Basic security issues
- WPA2 encryption (AES)
- WPA2 authentication
  - Personal mode
  - Enterprise mode

PRACTICAL EXERCISES
- Enabling encryption (AES) on a wireless LAN
- Authentication via RADIUS server

SUMMARY, OPEN FORUM AND CLOSING

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.
PRACTICAL USE AND UNDERSTANDING OF FOUNDATION FIELDBUS FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• List the differences between a Fieldbus system and the traditional 4-20 mA approach
• Describe the fundamental operation of Foundation Fieldbus
• Describe the main wiring rules of Foundation Fieldbus
• List the main considerations in configuring and installing a Foundation Fieldbus System
• Perform a simple configuration of a Foundation Fieldbus system using Function Blocks
• Perform basic troubleshooting of a Foundation Fieldbus system
• Design fieldbus segments
• Select the proper components to build the segments
• Configure and connect FF field devices to the network.

WHO SHOULD ATTEND:

This workshop is designed for personnel with a need to understand the techniques required to use and apply Foundation Fieldbus technology as productively and economically as possible. This includes engineers and technicians involved with:

• Control and Instrumentation
• SCADA and telemetry systems
• Process Control
• Electrical Installations
• Consulting
• Design
• Process Development
• Control Systems
• Maintenance Supervisors
• Project management
• Instrumentation
Foundation Fieldbus (FF) is one of the leading fieldbuses in Process Automation. Its sophisticated architecture is tailor-made for today's automation systems. Its unique set of features allows for the implementation of true distributed control. The Foundation Fieldbus includes an H1 protocol based on IEC 61158-2 physical layer specification as well as an HSE standard for communication over Ethernet/IP. These features and the possibility for distributed control make the Foundation Fieldbus unique for process control application.

The main aim of this workshop is to give you a clear understanding of Foundation Fieldbus and to enable you to specify and design systems using this technology. In the past year there has been a surge of interest in Foundation Fieldbus due to the tremendous benefits it provides. This workshop aims to break down the terminology and jargon barriers and to explain Foundation Fieldbus in a simple and understandable way; thus enabling you to apply the technology effectively.

Delegates will gain a solid understanding of proper wiring practices when applying FF in non-incendive, explosion-proof, and intrinsically safe hazardous areas. Delegates will gain a solid understanding of proper wiring practices when applying FF in non-incendive, explosion-proof, and intrinsically safe hazardous areas.

The course includes an introductory overview of the technology of Foundation Fieldbus and its specifications. During the course you will gain knowledge about the architecture of Foundation Fieldbus and its relation to other communication systems.

Benefits and limitations will be discussed, so that you are in the position to evaluate the benefit of the Foundation Fieldbus for your individual application. The information will be demonstrated on a multi-vendor application.

**Pre-requisites:**
A basic working knowledge of industrial communications and applications is useful.

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**The Program**

**INTRODUCTION AND OVERVIEW OF FOUNDATION FIELDBUS**
- Theory of FF technology
- Key features and benefits of FF
- Topologies, cable types, and constraints
- Components required for building FF segments

**HANDS-ON FOUNDATION FIELDBUS**
- Design of FF segments - power, voltage, device load constraints
- Wire and configure devices to a process control system
- Installation in hazardous areas

**ECONOMICS OF FOUNDATION FIELDBUS**
- Quantifying potential savings
- Justifying a FF project

**FOUNDATION FIELDBUS CHARACTERISTICS**
- Connection types (cyclic/acyclic, one-to-one, one-to-many)
- Fieldbus Message Specification
  - coding of information
  - accessing data (process data, configuration data)
- Function Block Application
- High Speed Ethernet

**ROOTS OF FOUNDATION FIELDBUS (IN ISP, PROFIBUS)**
- Explanation of basic elements (OSI model etc.)
- IEC 61158 transmission technology
- "Data Link Layer"
  - device types and services
  - "Link Master", "Field Device"
  - address formats
  - connection types
  - DLL schedule
- Basics FMS object dictionary, communication relations, services
- "Network Management"
- "System Management"
- "Function Blocks" (concept, types, elements)
- Linking of "Function Blocks" to communication interfaces

**SUMMARY, OPEN FORUM AND CLOSING**

Good presentation and very knowledgeable.
Paul Swales, South Corp Technology Systems
TROUBLESHOOTING, DESIGNING AND INSTALLING DIGITAL AND ANALOG CLOSED CIRCUIT TV SYSTEMS

YOU WILL LEARN HOW TO:

- Understand the essentials of CCTV systems
- Install and commission simple CCTV systems
- Design a CCTV system
- Maintain CCTV cameras
- Define the differences between analogue and digital CCTV
- Apply the CCTV lab test charts
- Compare the standards used in CCTV
- Networking simple digital CCTV systems
- List the differences between wire and wireless video transmission
- Identify the security issues in CCTV
- Outline the main steps in maintenance and commissioning of CCTV

WHO SHOULD ATTEND:

- Building management technicians and engineers
- Consulting engineers
- Design engineers
- Electrical engineers and technicians
- Electronic engineers and technicians
- Plant engineers
- Security managers and consultants
- Security system designers, installers and vendors
The Workshop

The objective of this workshop is to provide a practical know-how in designing, installing, commissioning, maintaining and troubleshooting analog and digital CCTV systems.

The poor quality of CCTV images often seen doesn’t inspire much confidence in the technology. However the purpose of this workshop is to ensure you apply best practice in all your work with CCTV systems. With the recent terrorist outrages in London and other cities, CCTV systems have been essential as a key tool in fighting crime, and have perhaps shifted from being part of “Big Brother” to a useful tool.

CCTV systems have undergone remarkable technology transformation in the past decade, transitioning from analog to digital, operating on a wireless or cabled network, with a host of additional features. This has made the design and maintenance considerably more complex. This workshop thus provides useful expertise in building and maintaining high quality CCTV systems.

The workshop commences with a detailed review of the fundamentals; progressing to optics and TV systems. Modern CCTV cameras and monitors are then examined followed by a review of video processing equipment and analog video recording. The vital changes from the analog to digital world are then examined in considerable depth. The essentials of networking as applied to CCTV systems are then discussed with practical examples. The workshop is concluded with best practice in CCTV system design and commissioning and maintenance.

**Pre-requisites:** Fundamental knowledge of television and its parts and the very basics of CCTV.

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ADVANCED TCP/IP-BASED INDUSTRIAL NETWORKING FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Design redundant Industrial Ethernet networks
- Select appropriate Industrial Ethernet components
- Configure and troubleshoot TCP/IP
- Set up Industrial Ethernet switches and routers
- Address security issues on Industrial Ethernet networks
- Extend Industrial Ethernet networks with wireless technologies
- Select appropriate Ethernet-based technologies for real-time applications

WHO SHOULD ATTEND:

The workshop is designed for personnel with a need to understand the techniques required to use and apply Ethernet and TCP/IP-based industrial communications technology as productively and economically as possible. Anyone involved in the installation, design and support of Ethernet and TCP/IP-based networks:

- Control system engineers
- Design engineers
- Electrical engineers
- Electrical technicians
- Instrumentation engineers
- Instrumentation technicians
- Instrumentation technologists
- IT managers working with networks
- Maintenance engineers and supervisors
- Process control designers and engineers
- Project engineers
- Systems engineers
The Workshop

This workshop is for engineers and technicians who need a practical and extensive knowledge of the design and troubleshooting of Industrial Ethernet networks, as well as the selection, installation, and configuration of components such as routers and switches.

It deals in-depth with the underlying TCP/IP protocols, and specifically addresses both design and configuration issues related to IPv4 and the more recent IPv6.

It also covers the more advanced aspects and applications of Ethernet such as advanced switching and routing, CCTV over IP, OPC and Modbus/TCP over Ethernet, industrial security, intrinsically safe applications, switched rings (including the latest IEC 62439-3 redundant ring standard), and highly-deterministic Ethernet-based field buses (e.g. for servo control) capable of 1 millisecond repetition rates and jitter of less than 1 microsecond.

A strong practical hands-on focus with real equipment as detailed in the list of practical sessions ensures you apply and test out your knowledge and skills.

Pre-requisites:
A basic working knowledge of Ethernet networks and IPv4 addressing will be useful. Real-life experience with equipment and hands-on testing will enable the workshop to be placed in context.

On-Site Training
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The Program

OVERVIEW
• OSI and TCP reference models
• Topologies
• Medium Access Control

ETHERNET
• Frame structure and MAC addresses
• Variants (10 Mbps Ethernet, fast Ethernet, GbE, 10GbE, 100GbE)
• Industrial Ethernet
• Intrinsically safe (Ex) Ethernet
• Power over Ethernet (IEEE 802.3af, IEEE 802.11at)
• Point-to-Point Protocol over Ethernet (PPPoe)

INTERNET LAYER PROTOCOLS
• IPv4
  - Address structure and classes
  - Subnet masks and default gateways
  - Private addressing schemes
  - ARP and ICMP
• IPv6
  - Address structure: multicast, unicast and anycast addresses
  - Address scope
  - ICMPv6

HOST-TO-HOST LAYER PROTOCOLS
• Ports and sockets
• TCP operation, connections, header structure
• UDP operation, header structure

APPLICATION LAYER PROTOCOLS
• HTTP, HTTPS, FTP
• DNS and DynDNS
• SNMP
• DHCP, BootP and APIPA

SWITCHING
• Mechanics of switching
• Spanning Tree Protocols (STP, RSTP, MSTP, SPF)
• VLANs and port prioritisation (IEEE 802.1P/Q)
• QoS and DiffServ
• Redundant switch rings
• Parallel Redundancy Protocol (IEC 62439-3)
• Port-based authentication (IEEE 802.1X)
• Link aggregation/trunking (Etherchannel, IEEE 802.3ad, IEEE802.1ax)

ROUTING
• Mechanics of routing
• VLSM and CIDR
• Subnetting
• Virtual mapping (NAT) and masquerading
• Port forwarding
• Routing metrics
• Interior Gateway Protocols (RIPv2, EIGRP, IS-IS, OSPF)
• Exterior Gateway Protocols (BGPv4)
Multi-Protocol Label Switching (MPLS)

CCTV OVER IP
• Analog vs. IP cameras
• Compression (JPEG, MPEG4, H.264)
• Bandwidth requirements

ETHERNET AND TCP/IP IN INDUSTRIAL APPLICATIONS
• Modbus/TCP
• OPC
• Ethernet-based field buses

SECURITY
• Access Control Lists (ACLs)
• MAC address, port, and protocol filtering
• Stateful Packet Inspection (SPI)
• VPNs (IPSec and VTI)
• Authentication: IEEE 802.1x/EAP, LEPS
• Security Data Sheets (SDSs)
• Encryption: AES, TKIP
• Secure Shell (SSH) tunnelling
• DoS (Denial of Service) protection

WIRELESS
• Wireless Ethernet backhauls
• Ethernet modems for PtP and PtMP applications
• IEEE 802.11: Industrial WLANs
• Authentication: IEEE 802.11i (WEP, WPA, WPA2)

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions
This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:
• IP configuration
• Protocol analysis: IPv4, IPv6, ARP, ICMP, TCP, UDP
• Setting up an Industrial Ethernet managed switch
• Setting up an Industrial Ethernet router
• Analysing CCTV over IP traffic
• Simulating Modbus/TCP over Ethernet
• Setting up a Tofino firewall

To gain full value from this workshop, please bring your laptop/notebook computer.

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PRACTICAL TROUBLESHOOTING AND PROBLEM SOLVING OF ETHERNET TCP/IP AND MODBUS PROTOCOLS

YOU WILL LEARN HOW TO:

- Gain a practical understanding of what TCP/IP is and how to apply it
- Identify, prevent and troubleshoot Modbus protocol communications problems
- Gain a practical toolkit of skills for working with Modbus
- Work competently with Modbus and RS-232, RS-485, wireless and Ethernet
- Gain skills to fault find your Modbus based Ethernet, RS-232/485, wireless, Ethernet and TCP/IP network problems

WHO SHOULD ATTEND:

Anyone working with or required to troubleshoot Modbus systems; or anyone designing, installing, commissioning, maintaining or troubleshooting TCP/IP and intra/internet sites will benefit, including:

- Consulting engineers
- Design engineers
- Designers
- Electrical engineers
- Electronic technicians
- Engineering managers
- Instrumentation and control engineers/technicians
- Instrumentation engineers
- Network engineers
- Network planners
- Network system administrators
- Plant managers
- Process control engineers
- Shift electricians
- System integrators
- Systems engineers
- Technicians
- Test engineers
The Workshop

One of the great protocols inherited from the internet is TCP/IP, which is used by most present-day automation and process control systems. SCADA systems, Programmable Logic Controllers and even low level instruments are using TCP/IP and Ethernet to transfer information. TCP/IP and Ethernet are truly open standards.

Modbus is one of the few (if not the only) industrial messaging protocols recognised by the internet world, using port number 502. It has one of the largest installed bases world-wide with more than 72 million installed nodes. The Modbus TCP/IP profile has recently been accepted by the International Electro-technical Commission (IEC) as a Publicly Available Specification (IEC PAS 62030) and is now eligible to become part of future editions of the International Standards IEC 61158 and IEC 61784-2. So it enjoys the status of a widely available open standard available to everyone, hence its popularity.

Whilst detractors will say the Modbus protocol lacks some of the refinements of the newer offerings on the market, there is no doubt that it is one of the most popular standards available in the industrial world today.

This two-day workshop focuses on the main issues of troubleshooting Modbus serial (i.e. Modbus over RS-232, RS-485) and Modbus/TCP (i.e. Modbus over TCP and Ethernet) installations.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:
- RS-485 basics
- Logging and protocol analysis on serial (RS-232/RS-485) communications system
- Modbus serial operation: RTU mode
- Modbus serial operation: ASCII mode
- Setting up a basic Ethernet network
- IP configuration
- Protocol analysis on Ethernet network
- Modbus/TCP
- Construct simple Ethernet LAN
- Configure IP addresses and subnet mask
- Analysis of ARP/ICMP/IP/UDP/TCP protocols with protocol analyser
- Ping, Arp, Netstat, Tracert and route commands
- Set up and analyse FTP/HTTP sessions
- Interconnect networks with bridge or router
- Modbus (serial) over IEE802.11 wireless
- Installation and configuration of Modbus/TCP to serial communication gateway

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION
- What is Modbus?
- Overview of the Modbus standards
- Modbus and IDA
- How Modbus relates to the RS-232, RS-485, Ethernet and TCP/IP standards

OVERALL TROUBLESHOOTING METHODOLOGY
- Common symptoms, problems and solutions
- How to quickly identify likely causes
- Basic steps
- Communications issues
- Grounding, shielding and noise

BASIC SERIAL COMMUNICATIONS STANDARDS
- RS-232
  - Fundamentals
  - Problems: UART settings (Baud rate, parity, etc.), cabling, DTE/DCE, handshaking, voltage levels, noise
- RS-232 practical troubleshooting session
- RS-485
  - Fundamentals
  - Problems: cabling, common mode voltage, voltage levels, transient protection, biasing, termination, control (hardware/software), noise
- RS-485 practical troubleshooting session

INTRODUCTION
- LANs, WANS, VLANs and VPNs
- OSI and ARPA models

ETHERNET
- 10Mbps (half-duplex) Ethernet
- Fast and gigabit Ethernet
- Full-duplex, deterministic and dual redundant Ethernet

THE MODBUS SERIAL STANDARD
- Fundamentals: overall concept, protocol stack, client/server interaction, PDU and ADU
- Modbus RTU vs. Modbus ASCII: frame structures and timing considerations
- Problems: timeouts, checksums (CRC/LRC), incorrect function codes/data parameters, exception responses
- Modbus serial troubleshooting session

MODBUS/TCP (MODBUS OVER TCP/IP)
- Fundamentals: overall concept, protocol stack
- Packet structure: PDU, ADU, MBAP header
- TCP connectivity issues
- Protocol analysis
- Modbus/TCP to Modbus serial gateways
- Problems: TCP connection problems, timing issues

Practical session with Modbus over TCP/IP

RADIO AND WIRELESS COMMUNICATIONS
- Fundamentals
- Problems: noise, interference, power, distance, channel separation, encryption

Practical session with Modbus/TCP over IEEE802.11

TROUBLESHOOTING TIPS AND TRICKS
- Summary of all the problems faced
- Further troubleshooting tips

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL
WIRELESS ETHERNET
AND TCP/IP NETWORKING

WHAT YOU WILL LEARN:

- Understand current Wireless LAN (WLAN) technologies
- How to apply WLANs to industrial automation
- Implement a simple WLAN for your office and industrial plant and interface it to Ethernet
- Understand the strengths and weaknesses of the different WLAN technologies
- Understand the operation of IEEE 802.11 WLANs
- Implement effective security on Wireless and Ethernet LANs
- How to conduct a site survey in preparation for WLAN Implementation

WHO SHOULD ATTEND:

This workshop is designed for personnel with a need to understand the techniques required for using and applying WLAN technology as productively and economically as possible.
The Workshop

The use of Wireless and Ethernet in industrial and plant floor environments has grown dramatically in the last few years. Industrial users face a wide range of options when designing and implementing plant-level Wireless and Ethernet networks. Great success is being achieved using Wireless, provided certain ground rules are applied. This two-day workshop covers IEEE 802.3 Ethernet LANs and IEEE 802.11 WLANs, as well as all the supporting technologies. It addresses these issues in a clear and practical manner, thus enabling you to apply the technology quickly and effectively in your next project. By the end of the workshop you will have a clear understanding of the choices available to you in designing and implementing your own Wireless and associated Ethernet LANs.

Pre-requisites

A basic working knowledge of data communications and applications is useful, but is not essential. This workshop starts at a very basic level and advances to a solid practical implementation level. However with the outstanding IDC documentation; everything is detailed in a simple-to-understand manner for future reference.

Practical Sessions

There are various practical sessions ranging in difficulty from very simple to more challenging. Full support will be provided by the instructor to ensure that all participants will derive maximum benefit from these sessions.

• Install and configure Access Points (APs)
• Interconnect Wireless and Ethernet LANs
• Configure IP addresses and subnet masks
• Analyse ARP/ICMP/IP/UDP/TCP using protocol analyser
• Perform path loss calculations
• Demonstrate the use of encryption and authentication
• Control access with MAC filtering
• Measure wireless signal to noise ratio

The Program

INTRODUCTION
• LANs and WLANs vs the OSI model
• Brief overview of Wi-Fi, TCP/IP and Ethernet

ETHERNET
• Frame structure
• VLANs
• Half-duplex operation (CSMA/CD)
• Full-duplex operation
• Auto-negotiation
• Deterministic Ethernet

PROTOCOLS USED OVER ETHERNET
• Modbus/TCP and Ethernet/IP
• IP addressing
• Routing
• ICMP
• TCP and UDP
• TCP/IP utilities

LAN COMPONENTS
• Repeaters and hubs
• Bridges and switches
• Routers
• Gateways

WIRELESS FUNDAMENTALS
• Basics of electromagnetic transmission
• Frequency allocations
• Gain and loss (dB)
• WLAN modulation techniques (BPSK, QPSK, 16-QAM and 64-QAM)
• Spread spectrum techniques (FHSS and DSSS)
• OFDM and CCK

ANTENNAS
• Basics
• Dipole, Yagi and parabolic reflector antennas
• Diversity
• VSWR WLANs IEEE 802.11
• Architecture (Ad-hoc vs infrastructure)
• Bridging and roaming
• Specifications (IEEE 802b, a, g, n)
• Medium access control
• Frame structure

WIRELESS PANS:
• Bluetooth/IEEE 802.15.1
• Overall concept
• Practical implementation

INSTALLING AND CONFIGURING APs
• Site survey
• Component selection
• AP configuration

SECURITY
• LAN and WLAN vulnerabilities
• Authentication and encryption
• WPA2/IEEE 802.11i
• Firewalls

SUMMARY, OPEN FORUM AND CLOSING

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# ELECTRICAL POWER

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YOU WILL LEARN:

- The requirements for data communications in an electrical environment
- The suitability of different communication protocols for automation of power distribution and transmission networks
- New techniques in electrical protection, leading to increased reliability, performance and safety to personnel
- How to obtain extensive real-time information of your power network via SCADA, leading to informed decisions and productive use of manpower
- How to implement local and remote control of switchgear, including interlocking and intelligent load shedding
- How to effectively compare and critically analyse different products and systems available for protection, control and automation of electrical power networks

WHO SHOULD ATTEND:

- Electrical Engineers
- Control Engineers
- Project Engineers
- Design Engineers
- Consulting Engineers
- Power System Engineers
- Protection Engineers
- Technicians
- Maintenance Supervisors
The Workshop

Power System Automation is the cutting-edge technology in electrical engineering. It means having an intelligent, inter-active power distribution and transmission network including:

- increased performance and reliability of electrical protection
- advanced disturbance and event recording capabilities, aiding in detailed electrical fault analyses
- display of real-time substation information in a central control centre
- remote switching and advanced supervisory control over the power network
- increased integrity and safety of the electrical power network, including advanced interlocking functions
- advanced automation functions e.g. intelligent load-shedding

Workshop Objectives

This practical 2-day workshop will enable you to:

- identify the suitability of different communication protocols for the electrical environment
- evaluate the communication requirements for your specific circumstances
- apply new protection techniques to increase reliability and performance while reducing costs
- implement advanced real-time monitoring and metering techniques of your electrical network by implementing local and remote control
- specify the requirements for SCADA regarding your electrical network and substations
- recognise and evaluate the practical and economic benefits automating your power network can bring to your workplace

Practical Sessions

Participants will be given the vital hands-on experience needed to confidently work with this cutting-edge technology. On the second day of the workshop, there will be a demonstration of a Substation Automation System at work and the opportunity to configure a multi-function relay, communication link and SCADA system.

The Program

INTRODUCTION
- Discussion of concepts involved in automating power distribution and transmission networks

HISTORICAL DEVELOPMENT
- Short overview of technical developments in related industries

ELECTRICAL PROTECTION
- Short overview of the fundamentals of electrical protection
- New techniques in protection using intelligent relays
- Designing more advanced and economical protection schemes

CONTROL, MONITORING AND METERING
- Local intelligence and Intelligent Electronic Devices (IEDs)
- Limitations of conventional RTU systems and PLCs
- Modern trends

DATA COMMUNICATIONS IN AN ELECTRICAL ENVIRONMENT
- Basics of Data Communications
- Different communication protocols used for power networks
- Communication requirements for substations
- Suitability of different protocols for substation communications
- Standardisation of communication in substations: goals and status
- Radio and satellite communication
- Trends in technology

SCADA FOR ELECTRICAL MONITORING AND CONTROL
- Requirements of SCADA for electrical networks
- Hardware and support requirements
- Software and configuration

COMPARISON OF POWER SYSTEM AUTOMATION SYSTEMS
- Types of power system automation systems
- Discussion of leading manufacturers’ systems
- Advantages and disadvantages of various systems

PRACTICAL CONSIDERATIONS
- Benefits of power system automation systems
- Capital expenditure and maintenance issues
- Cost savings
- Evaluating your requirements
- Choosing a system and supplier

PRACTICAL DEMONSTRATION
- Demonstration of a power system automation system at work
- Configuration of IEDs

The workshop was excellent and valuable to my line of work.
David Selens

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PRACTICAL TROUBLESHOOTING OF ELECTRICAL EQUIPMENT AND CONTROL CIRCUITS

YOU WILL LEARN HOW TO:

- Diagnose problems "right-first-time"
- Eliminate expensive trial and error approach
- Reduce unexpected downtime on electrical motors and other equipment
- Improve plant safety
- Learn specific techniques to troubleshoot equipment and control circuits
- Analyse equipment problems
- Determine causes of equipment failure
The Workshop

There is a chasm between the theory of electron flow, magnetic fields and troubleshooting electrical equipment and control circuits in the plant. This workshop shows delegates how to troubleshoot electrical equipment and control circuits.

The course helps individuals and employers. It does this by increasing all delegates knowledge and skills in improving equipment productivity whilst reducing maintenance costs.

Attendance on this course will help all delegates identify, prevent and fix common electrical equipment and control circuits. The focus is “outside the box”. The emphasis is on practical issues that go beyond typical electrical theory and focus on providing those that attend with the necessary tool-kit of skills in solving electrical problems, ranging from control circuits to motors and variable speed drives.

This workshop focuses on the main issues of troubleshooting electrical equipment and control circuits of today to enable you to walk onto your plant or facility to troubleshoot and fix problems as quickly as possible.

This is not an advanced workshop but one aimed at the fundamentals of troubleshooting systems. The workshop is very practical in its approach to troubleshooting and the examples you will be shown are applicable to any facility.

Practical Sessions

You will work in teams on simulation software running on PC’s on electrical equipment to simulate real problems for at least 40% of the course proceeding through ten practical sessions ranging from the elementary to the more advanced. These will be very close in structure to the motor control circuits in your plant. In addition we will give three case study wiring diagrams with potential problems and expect you to uncover faults when given the symptoms.

To gain full value from this workshop, please bring your laptop/notebook computer.

“Very good. I will recommend this course to my technicians and other plant engineers.”
A.F. Barnard

The Program

INTRODUCTION

COURSE DESCRIPTION

BASIC PRINCIPLES
• Industrial electricity
• Single and three phase power systems
• Meters used in troubleshooting
• Clamp on ammeter/megohmmeter

DEVICES, SYMBOLS AND CIRCUITS
• Devices and symbols
• Language of control circuits
• Reading and understanding electrical drawings
• Reading and understanding ladderlogic
• Wire and terminal numbering

BASIC PRINCIPLES IN TROUBLESHOOTING

BASIC PRINCIPLES IN USING A DRAWING AND METER IN TROUBLESHOOTING CIRCUITS
• Circuits
• Equipment

TROUBLESHOOTING AC MOTORS AND MOTOR STARTERS
• Fundamentals of AC motors
• Types of AC and DC motors used
• Motor terminal identification and connection diagrams
• Identification and construction
• Connecting up a multiple speed motor
• Connection of dual voltage motor
• Motor name plate information
• Operating a motor for forward and reverse operation
• Motor braking methods
• Test equipment to check motor operation
• Why motors fail and how to extend life
• Troubleshooting of motors

MOTOR CIRCUIT BREAKERS AND SWITCHBOARDS
• Purpose and duty
• Clearance times
• Types

TROUBLESHOOTING VARIABLE SPEED DRIVES
• Fundamentals of variable speed drives
• Problems associated with variable speed drives
• Terminology used
• Manufacturer’s literature - what they don’t tell you
• Minimisation of equipment failure
• Troubleshooting Tricks

TROUBLESHOOTING CONTROL CIRCUITS
• Basic control circuits
• Ladderlogic circuits
• Troubleshooting strategies
• Two-wire control and hands-off/auto
• Overload protection
• Three-wire control - start/stop
• Jog/inch circuits
• Sequence start and stop
• Automatic sequence starting
• Reversing circuits
• Plug stop and anti-plug circuits
• Two speed motor control
• Reduced voltage starting circuits

TROUBLESHOOTING MORE COMPLEX CONTROL CIRCUITS
• Tank fill control
• Duplex Pump control

SUMMARY & OPEN FORUM

COMPLETE FEEDBACK SHEETS
CLOSING

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HIGH VOLTAGE SAFETY
OPERATING PROCEDURES
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Demonstrate approved ways of operating and earthing high voltage equipment to ensure safety of personnel at all times.
- Identify safe and unsafe working conditions
- Identify requirements for a responsible person or appointed operator
- Demonstrate a fundamental knowledge of the documentation required for Occupational Safety Acts
- Perform live chamber and limited access procedures

WHO SHOULD ATTEND:

- Electrical engineers
- Project engineers
- Design engineers
- Instrumentation and design engineers
- Electrical tradespeople
- Electrical technicians
- Field technicians
- Electricians
- Plant operators
- Staff visiting or working in hazardous areas
The Workshop

Safety should be the first consideration for anyone working with electricity, especially high voltage. This course introduces participants to all aspects of the procedures required for ensuring safe work in any job involving high voltage.

Pre-requisites

Fundamental knowledge of electrical engineering and some experience with high voltage systems.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

INTRODUCTION

• The requirements of a typical Safety Act with reference to employer and employee

PLANT SAFETY REGULATIONS IN PERSPECTIVE

• Identify industrial hazards
• Understand dangers and precautions
• Regulations awareness
• Identify basic duties/responsibilities of employers and employees
• Offences and penalties policy
• Protection against electrical hazards

DEFINITIONS AND BASIC SAFETY PRINCIPLES

• Official terminology
• Operating terms and their meanings
• Electric shock hazards
• Electrical arcing hazards
• Electrical insulation and its maintenance

FUNDAMENTAL PRINCIPLES

• Regulations and their purpose
• Operating regulations
• Fundamental principles that regulations are based upon
• Study the various dangers of electricity and the precautions to be taken to avoid these dangers
• High voltage operations and safety precautions

ISOLATION

• The meaning of isolation
• List the terms related to isolation
• Procedures of isolating a device
• Study breakers, links and switches and their uses

REASONS FOR EARTHING

• What is earthing?
• Earthing arrangement families
• The unearthed system
• The properties of safe earth connections
• The dangers of inadequate earth connections
• The concepts of dead and alive
• Understand how the apparatus can be accidentally alive
• Study the meanings of static charge and residual voltage
• List the reasons for earthing isolated apparatus

MAKING FEEDERS AND APPARATUS SAFE TO WORK ON

• Minimum earthing requirements
• Additional earths
• The procedure of work on a cable feeder
• The special provision for double circuit structures

THE WORK PERMIT SYSTEM

• Explain the purpose of the work permit system
• State the conditions under which a permit is not required
• List, in the correct order, the steps in issuing and clearing of a permit
• Explain the duties of a responsible person and the appointed operator, related to the Workman’s declaration
• Explain what the workman declares when he signs the workman’s declaration

LIVE CHAMBERS AND PROHIBITED AREAS

• The meaning of live chambers and prohibited areas
• The looking of doors and gate
• Entry to live chambers and prohibited areas
• The security of keys
• State the conditions under which skilled and unskilled persons may enter live chambers and prohibited areas
• List the responsibilities of persons to whom keys have been issued

ABNORMAL CONDITIONS

• What is emergency switching?
• Testing high voltage equipment
• Managing the testing
• The precautions taken for high voltage testing

APPOINTED OPERATOR AND THE RESPONSIBLE PERSON

• Operative procedures
• Appointed operators and their duties and responsibilities
• The responsible person and his duties and responsibilities
• Supervision of work
• The reasons, prevention and investigation of accidents/incidents

LOCKOUT AND TAGOUT PROCEDURES

• Hazardous energy control
• The lockout method and lockout/tagout program
• The Lockout/tagout procedures and policies
• Common lockout devices
• LOTO implementation steps

TYPICAL ELECTRICAL MACHINERY REGULATIONS

• List the safety appliances
• Safety in switch gear and transformer premises
• Electrical control gear and switch board
• Electrical machinery in hazardous locations
• Study proper use and precautions while handling portable tools
• Portable electric lights and electric fences
• The clearance of power lines

FIRST AID AND ARTIFICIAL RESUSCITATION

• Electric shock
• The types of contacts
• The parameters which lead to shock
• The precautions to avoid shock
• First aid facilities within the work place
• Resuscitation and emergency procedures

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OBJECTIVES:

- Correctly implement the right type of switchgear for the appropriate application
- Economically select and install the best-suited power cable for a specific application
- Evaluate the need for power factor correction and successfully implement correction strategies
- Implement successful maintenance strategies and procedures
- Effectively use software techniques to solve problem areas in your power network

WHO SHOULD ATTEND:

- Electrical engineers
- Project engineers
- Design engineers
- Instrumentation and design engineers
- Electrical technicians
- Field technicians
- Electricians
- Plant operators
The Workshop

A practical two-day workshop in power distribution, focusing on medium voltage (1kV-36kV) power considerations, switchgear, power cables, transformers, power factor correction, earthing, lightning protection and network studies.

You will gain technical know-how in these areas which are not covered by university or college programs.

Objectives
At the end of this workshop participants will be able to:

- Understand practical power distribution fundamentals
- Determine short-circuit ratings quickly and effectively
- Assess the influence of fault levers on switchgear ratings
- Select the correct type of switchgear for the right application
- Evaluate the advantages of modern state-of-the-art switchgear protection for your applications, including preventative maintenance information
- Recognise the different applications for various cable insulation types
- Know when and how to use single core cables vs three core cables
- Specify correct power cable installation methods
- Correctly utilise and protect power transformers
- Assess and specify correct grounding throughout your electrical network
- Determine the need for Power Factor Correction (PFC) for your environment
- Assess the economic justification for installing PFC equipment
- Correctly specify PFC equipment and be aware of practical consequences
- Confidently use computer simulation software to solve and predict power network

Pre-requisites
A fundamental knowledge of electrical engineering is very useful.

“Excellent experience, imports information freely.”
Gavin Bloch

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION
- History and growth of power distribution
- Typical characteristics of a distribution system
- Main components of a distribution system
- Main equipment types in a distribution system
- Electrical safety and power security

OVERVIEW OF POWER DISTRIBUTION
- Voltage classification
- Multiple voltage levels in power distribution
- Types of distribution arrangements and redundancy
- Expandability

SHORT-CIRCUIT CURRENT CALCULATIONS
- What is a fault?
- Effects of a fault
- Types of faults
- Limiting the damaging effects of a fault
- Need to know the magnitude of fault current
- Fault current calculations

PRACTICAL WORK
- Calculation examples

TRANSFORMERS
- Introduction
- Transformer theory
- Transformer construction
- Transformer cooling
- Transformer voltage control
- Power transformers and distribution transformers
- Installation of transformers
- Special aspects in installation of large power transformers
- Fire protection measures for large transformer installations
- Transformer troubleshooting

MEDIUM VOLTAGE (MV) CIRCUIT BREAKERS
- Role of a circuit breaker in a distribution system
- Distinction between circuit breaker and disconnector/isolator
- Different types of circuit breakers and their operating principle
- Comparison of relative features and applications
- Circuit breaker operating mechanisms
- Circuit breaker ratings

MV SWITCHGEAR
- Switchgear options
- Outdoor MV switchgear
- Indoor MV switchgear
- MV switchgear panel configurations
- MV switchgear auxiliary devices
- MV switchgear ratings

POWER CABLES
- Types and construction of cables
- Basic design and selection
- Insulating materials for LV and HV cables
- Accessories for cable installation
- High voltage power transmission using cables
- Failure of cables
- Fault detection
- New technologies – superconductivity for high capacity cables

PRACTICAL WORK
- Sizing and installation of power cables using cable datasheets - typical problems

ELECTRICAL SAFETY AND ROLE OF EARTHING
- Overview of system earthing
- Hazards posed by electrical equipment
- Electrical shock hazard
- Direct and indirect contact
- Role of protective earthing
- Indirect contact hazard – importance of protection
- Sensing of earth faults
- Equi-potential bonding
- Use of Personal Protective Equipment (PPE)
- Arc flash danger in electrical equipment

POWER QUALITY AND PF COMPENSATION
- Limits on electrical parameters
- What is power quality?
- Power quality indicators
- Power quality improvement measures
- Causes and effects of low power factor
- Power factor compensation
- Methods to improve power factor and benefits
- Economic justification for power factor correction - worked out examples
- Caution: capacitors with induction motors

POWER SYSTEM AUTOMATION
- Definition of the term
- What is power system automation?
- Power system automation architecture
- Use of DCS

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL POWER QUALITY: PROBLEMS & SOLUTIONS FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Develop a sound working knowledge of earthing and harmonics
• Gain practical knowledge of surge and transient protection
• Design electrical and electronic systems correctly by applying knowledge of harmonics and earthing principles
• Describe applications for the latest technologies in correcting earthing, harmonics, surge, and transient problems
• Troubleshoot electrical and electronic systems
• Isolate and rectify power quality problems

WHO SHOULD ATTEND:

• Instrumentation and Control Engineers
• Consulting Engineers
• Electrical Engineers
• Project Engineers
• Maintenance Engineers
• Building Service Designers
• Power System Protection and Control Engineers
• Data Systems Planners and Managers
• Electrical and Instrumentation Technicians
The Workshop

Monitoring power quality in industrial environments is essential to the health and stability of your plant and equipment. This hands-on workshop examines the procedures for design and installation for earthing and neutral systems, while reviewing the fundamentals of power quality and EMC. Common misconceptions about noise are discussed and reviewed along with surge and transient protection, you will walk away with practical steps outlined to minimise or even eliminate these problems. The two days are rounded off with realistic case studies covering a wide variety of industries ranging from manufacturing and process control to telecommunications. The material is covered by means of an interactive learning style, with plenty of practical examples and realistic case studies.

Pre-requisites

Some working knowledge of basic electrical engineering principles is required, although this will be revised at the beginning of the course. Real-life experience with earthing and harmonics problems will enable the workshop to be placed in context.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION TO POWER QUALITY AND EMC
- What is Power Quality and EMC?
- The IEC/IEEE and FIPS standards
- Interfacing with electrical utilities

RECOMMENDED DESIGN AND INSTALLATION PRACTICE
- Wiring and earthing for safety and performance
- Wiring and distribution systems
- Dedicated and derived neutral systems
- Earthing and bonding equipment

EARTHING AND NOISE CONTROL
- Site Auditing for noise control
- Misconceptions in performance grounding
- “Single Point” versus “Multi Point” techniques
- Noise and the zero signal reference grid
- Avoiding non-recommended practices

SURGE AND TRANSIENT PROTECTION
- Basics of lightning phenomena
- Power system faults and switching surges
- Mitigation techniques and case study review

CONDUCTING A SITE ANALYSIS
- Overview of sources of power quality problems
- Site survey procedures
- Monitoring and analysis instrumentation

HARMONIC SOURCES AND THEIR EFFECTS
- Principles of harmonic analysis
- Variable speed drives
- Power conversion equipment – and apparatus deterioration
- Controllers, power supplies, PCs and lighting equipment

POWER SYSTEM CAPACITIVE/INDUCTIVE RELATIONSHIPS
- Displacement and distortion power factor
- Reactive power relationships
- Power factor efficiencies

HARMONIC SITE ANALYSIS PROCEDURES
- Measurement fundamentals and true RMS/predictive analysis
- Instrumentation and procedures
- Harmonic order and sequences and resonances
- Voltage and current waveforms (signatures)
- Harmonic interaction auditing

POWER CONDITIONING
- Power conditioners
- Uninterruptible power systems
- Power quality source alternatives
- Power disturbance cost comparisons

CASE STUDIES
- Checklist for powering, earthing and communications
- Commercial buildings
- Manufacturing and process control
- Medical facilities
- Computers and data processing environments
- Telecommunications

SUMMARY, OPEN FORUM AND CLOSING

“Very good course. Learned a lot on causes and remedies for Power Quality. Very good presenter, knows the subject well.
A. Bloem”

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PRACTICAL POWER SYSTEMS PROTECTION FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Describe the fundamentals of electrical power protection
- Identify and rectify the different fault types
- Perform simple fault and design calculations
- Work with protection system components (including fuses/transformers/circuit breakers)
- Complete relay settings and check a current transformer
- Demonstrate a fundamental knowledge of applications in protection

WHO SHOULD ATTEND:

- Design engineers
- Electrical engineers
- Electrical technicians
- Electricians
- Field technicians
- Instrumentation and design engineers
- Plant operators
- Project engineers
The Workshop

This workshop has been designed to give plant operators, electricians, field technicians and engineers a better appreciation of the role played by power system protection systems. An understanding of power systems along with correct management will increase your plant efficiency and performance as well as increasing safety for all concerned.

The workshop is designed to provide excellent understanding on both a theoretical and practical level. Starting at a basic level and then moving onto more detailed applications, it features an introduction covering the need for protection, fault types and their effects, simple calculations of short circuit currents and system earthing. This workshop includes some practical work, simple fault calculations, relay settings and the checking of a current transformer magnetisation curve.

Objectives

This is an intermediate level workshop, by the end of which you will have an excellent knowledge of the principles of protection. You will also have a better understanding of the possible problems likely to arise and know where to look for answers. In addition you are introduced to the most interesting and “fun” part of electrical engineering to make your job more rewarding. Even those who claim to be protection experts have admitted to improving their knowledge after attending this workshop.

Pre-requisites

Fundamental knowledge of electrical engineering.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

NEED FOR PROTECTION
- Selectivity, stability, sensitivity, speed
- Reliability, dependability, security

FAULT TYPES AND THEIR EFFECTS
- Active, incipient, passive, transient, asymmetrical etc
- Phase and earth faults

SIMPLE CALCULATION OF SHORT CIRCUIT CURRENTS
- Revision of simple formulae
- Calculation of short circuit MVA and fault currents
- Worked examples

SYSTEM EARTHING
- Solid, impedance, touch potentials etc
- Effect of electric shock on human beings
- Earth leakage protection

PROTECTION SYSTEM COMPONENTS INCLUDING FUSES
- History, construction, characteristics
- Energy, let-through, application

INSTRUMENT TRANSFORMERS
- Current transformers: construction, performance, specification, magnetisation, curves etc
- Voltage transformers: types, accuracy, connections

CIRCUIT BREAKERS
- Purpose and duty, clearance times, types etc

TRIPPING BATTERIES
- Battery types, chargers, maintenance, D.C. circuitry

RELAYS
- Inverse Definite Minimum Time (IDMT) relay – construction principles and setting
- Calculation of settings – practical examples
- New era – modern numerical relays and future trends

PRACTICAL DEMONSTRATION SESSION
- Including simple fault calculations, relay settings and checking a current transformer, magnetising curve etc

APPLICATIONS CO-ORDINATED BY TIME GRADING
- Problems in applying IDMT relays

UNDERGROUND MINE DISTRIBUTION PROTECTION
- Earth leakage protection, pilot wire monitor, earth fault lockout, neutral earth resistor monitor

PRINCIPLES OF UNIT PROTECTION
- Differential protection – basic principles

FEEDER PROTECTION
- Cables
- Pilot wire differential
- Overhead lines
- Distance protection (basic principles, characteristics, various schemes)

TRANSFORMER PROTECTION
- Phase shift, magnetising in-rush, inter-turn, core and tank faults
- Differential and restricted earth fault schemes
- Buchholz relay, oil and winding temperature
- Oil testing and gas analysis

SWITCHGEAR (BUSBAR) PROTECTION
- Requirements, zones, types
- Frame leakage, high, medium and low impedance schemes, reverse blocking

MOTOR PROTECTION
- Thermal overload, time constants, early relays
- Starting and stalling conditions
- Unbalanced supply voltages, negative sequence currents, de-rating factors
- Phase-phase faults
- Earth faults – core balance, residual stabilising resistors

GENERATOR PROTECTION
- Stator and rotor faults
- Overload and over-voltage
- Reverse power/unbalanced loading
- Loss of excitation and synchronism
- Typical protection scheme for industrial generators

OVERHEAD LINE PROTECTION
- Basic principles of the distance relay
- Tripping characteristics
- Application onto power lines
- Effect of load current and arc resistance
- Various schemes using power line carrier

MANAGEMENT OF PROTECTION
- Routine testing, annual testing, investigation and performance assessment, up-grading
- Organisation, training, records, access planning

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL VARIABLE SPEED DRIVES (VSDs) FOR INSTRUMENTATION AND CONTROL SYSTEMS

YOU WILL LEARN HOW TO:

- Demonstrate a sound understanding of how AC Variable Speed Drives (VSDs) work
- Install VSDs properly
- Select the right VSD for a given application
- Troubleshoot VSDs competently
- Competently explain how flux-vector control works for drive applications
- Understand squirrel cage induction motors
- Identify the protection and control system requirements for VSDs
- Interface VSDs with PLCs
- Understand the causes of motor burnout
- Deal effectively with VSD harmonics and EMC/EMI problems

WHO SHOULD ATTEND:

Anyone associated with the use of Variable Speed Drive techniques in the industrial or automation environment. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting. Typical personnel who would benefit are:

- Plant engineers
- Instrument technicians
- Operations personnel
- Electrical maintenance technicians and supervisors
- Instrument and control engineers
- Process control engineers
- Mechanical engineers
- Service technicians
- Maintenance personnel
The Workshop

This course gives you a fundamental understanding of the installation, operation and troubleshooting of variable speed drives. Typical practical applications of VSDs in process control and materials handling, such as those for pumping, ventilation, conveyers, compressors and hoists are covered in detail. You will learn the basic setup of parameters, control wiring and safety precautions in installing a VSD. The various drive features such as operating modes, braking types, automatic restart and many others will be discussed in detail. You will learn the four basic requirements for a VSD to function properly with emphasis on typical controller faults, their causes and how they can be repaired.

The concluding section of the course gives you the fundamental tools in troubleshooting VSDs confidently and effectively.

Even though the focus of the course is on the direct application of this technology, you will also gain a thorough understanding of the problems that can be introduced by VSDs such as harmonics, electrostatic discharge and EMC/EMI problems.

Pre-requisites

A fundamental knowledge of basic electrical concepts would be useful.

The Program

INTRODUCTION TO VARIABLE SPEED DRIVES
- The need for variable speed drives
- Fundamental principles of speed control
- Efficiency, torque, inertia, horsepower/power factor
- Torque-speed curves
- How the motor produces torque
- Types of variable speed drives

3 – PHASE AC INDUCTION MOTORS
- Basic construction and physical configuration
- Principles of operation and performance
- Equivalent circuit and fundamental equations
- Starting, acceleration, running and stopping
- Power, torque and thermal rating

POWER ELECTRONIC CONVERTERS
- Definitions and basic principles
- Power diodes and thyristors
- Principles of communication
- Power electronic rectifiers
- Power electronic inverters
- Gate commutated converters
- Gate controlled devices – GTO, FCT, GTR, FET, IGBT

ELECTROMAGNETIC COMPATIBILITY (EMC)
- Sources of electromagnetic interference
- Harmonics on the power supply side of AC converters
- The effect of harmonic distortion on other connected equipment
- Methods of reducing the effect of supply side harmonics
- Electric motor protection
- Thermal overload protection – current sensing
- Thermal overload protection – direct temperature sensing

PROTECTION OF MOTORS AND CONVERTERS
- AC frequency converter protection
- Fault diagnostics
- Electric motor protection
- Thermal overload protection – current sensors
- Thermal overload protection – direct temperature

CONTROL SYSTEM FOR AC VARIABLE SPEED DRIVES
- The overall control system
- Power supply to the control system
- DC bus charging system
- VSD control loops
- Vector control and its applications
- Current feedback in AC VSDs
- Speed feedback from the motor

THE SELECTION OF AC CONVERTERS FOR VARIABLE SPEED DRIVE APPLICATIONS
- The basic selection procedure
- Loadability of converter fed induction motors
- Operation in the constant power region
- The nature of the machine load
- Starting and stopping VSDs
- How to calculate acceleration torques and times
- How to select the correct motor and converter for pump and fan loads
- How to select the correct motor and converter for constant torque loads
- Summary of the selection procedure

INSTALLATION AND FAULT FINDING TECHNIQUES
- General installation and environmental requirements
- Power supply connections and earthing
- Where to install the contactors in the power circuit
- Installing AC converters into metal enclosures

SPECIAL TOPICS
- PWM rectifier for AC converters
- Soft switching
- The matrix converter

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

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PRACTICAL ELECTRICAL WIRING STANDARDS: NATIONAL RULES FOR ELECTRICAL INSTALLATIONS - ET 101:2008 (INCLUDING AMENDMENTS 1 AND 2)

YOU WILL LEARN:

- The essentials of the ET 101 Standard
- How to find your way around ET 101
- Harmonisation issues with European standards
- Principles and practice of shock protection
- Calculation of circuit impedances
- Discrimination between devices
- Cable sizing
- Earthing and bonding
- Inspection and testing requirements
- Certification requirements

WHO SHOULD ATTEND:

- Building services engineers
- Electrical apprentices
- Electrical design staff
- Electrical engineers
- Electrical trades persons
- Engineering managers
- Graduate electrical engineer trainees
- Maintenance and shutdown planning staff
- Maintenance managers
- Private electrical contractors
The Workshop

Internationally there has been steady progress towards the harmonisation of electrical wiring standards. European standards are based on the international IEC 364 under the umbrella of Harmonisation Document HD 384. The format of these is reflected in the ETCI national rules ET 101: 2008 and the UK IEE wiring regulations BS 7671:2008.

This workshop is designed to provide up to date information and training on the current edition of National Rules ET 101: 2008. It will consist of in-depth teaching on all aspects of the national rules and their application with many practical examples and sample design calculations. The workshop includes references to safety, maintenance, inspection and testing. In addition, it provides a summary of some of the basic principles necessary for a good understanding of electrical installation technology.

Pre-requisites

You will need a fundamental understanding of electrical systems. We will provide this material to you if you feel you would like some further pre-course reading.

Please bring a calculator (or computer) and pen along to the course to assist with the calculations.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. There will be at least 8 exercises to illustrate some of the calculations that are required during installation design, to reinforce the knowledge gained on the course.

To gain full value from this workshop, please bring your calculator and if possible your laptop/notebook computer.

The Program

INTRODUCTION TO IRISH NATIONAL RULES
- Structure of international and Irish national rules
- Foundation electrical principles - terminology and definitions
- Scope of national rules
- Growth of electrical distribution systems and polyphase circuits
- Types of earthing systems
- Requirements for safety and planning of electrical installations
- Definitions

EARTHING ARRANGEMENTS
- Need for earthing in electrical systems
- Supply system earthing
- Protective earthing of consumer installations
- TN-C-S systems
- Earth faults
- Earth electrodes
- Equipotential bonding

PLANNING OF ELECTRICAL INSTALLATIONS
- Purpose, supplies and structure
- External influences
- Compatibility and maintainability
- Safety services
- Continuity of service
- Voltage band

ELECTRICAL HAZARDS AND PROTECTION
- Electrical hazards
- Codes for degree of protection by enclosures
- Principles of basic and fault shock protection
- Calculation of disconnection times
- Thermal effects
- Protection against voltage disturbances
- Isolation and switching

SELECTION AND ERECTION OF EQUIPMENT
- Common rules and wiring systems
- Isolation, switching, control and monitoring
- Earthing arrangement and protective conductors
- Luminaries and lighting installations
- Safety services

INSPECTION AND TESTING
- Initial verification
- Testing
- Periodic inspection and reporting
- Certification and reporting

SPECIAL INSTALLATIONS OR LOCATIONS
- Locations of increased shock risk such as bath or shower, swimming pools, hot air saunas
- Construction installations, agricultural and horticultural premises
- Installations in restrictive conductive locations
- Caravans and marinas
- Medical locations
- Exhibitions
- Solar photovoltaic power supply systems
- Outdoor lighting, mobile units, temporary installations such as fairgrounds and amusement parks
- Floor and ceiling systems
- Maintenance gangways

MAINTENANCE CONSIDERATIONS

SAMPLE DESIGN CALCULATIONS

SUMMARY, OPEN FORUM AND CLOSING

"Enlightening - dealing with daily problems which we find unexplainable."

Richard Collinette

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WIND & SOLAR POWER - RENEWABLE ENERGY TECHNOLOGIES

WHAT YOU WILL LEARN:

• The fundamentals of Photovoltaic technology
• The Essentials of wind power technology
• The vital practical issues of wind and solar power technology
• The practical steps in installing photovoltaic systems and windpower systems
• How to design and install simple photovoltaic and windpower systems
• How to deal competently with contractors and consultants installing these systems
• How to assist your company in complying with the ever growing "Greenhouse Gas" Laws
• To use the 32 Point checklist before commencing any work on Wind and Solar Power Systems

WHO SHOULD ATTEND:

• Mechanical, Electrical, Electronic Engineers
• Technicians
• Electricians
• Control and Instrumentation Engineers
• Facility Managers
• Energy Specialists
• And those who are keen to improve the environment and take advantage of cheap and clean power
The Workshop

In the past ten years there has been a significant increase in applying wind and solar power technologies from the domestic user to the corporate market. There has been a dramatic improvement in the efficiencies in these technologies and this has helped make the applications economical. Specific energy yields from wind turbines have increased by 60% and installation costs have dropped significantly (up to 50% in many cases). Global wind generating capacity has reached 100,000 MW capacity in March 2008 with almost 20,000 MW installed during 2007 alone.

Applications of photovoltaic (PV) systems are growing rapidly worldwide with worldwide installation of PV modules skyrocketing to 2,826 MW in 2007 (= 62% growth from 2006). Many countries are passing legislation to enforce greater use of PV systems and this is helping to drive up the production of these systems.

All of these technologies are interdisciplinary requiring a knowledge of topics as varied as aerodynamics, electricity and wind statistics for wind power and mechanical engineering, electronic and electrical engineering for solar power.

This workshop will outline the step by step process of designing, installing and commissioning photovoltaic and wind powered systems. It should be emphasised that this is not an advanced in-depth workshop but one covering the important issues enabling you to do simple designs and then to investigate the design and installation issues in more detail after the workshop either by further study or in conjunction with experts in the field.

In recent years the annual growth rate of the solar and wind energy industry has consistently exceeded 30% with 3 digit growth figures in many regional markets. So in these rather challenging economic times; this is a good industry in which to focus one’s career on.

Pre-requisites
You will need a fundamental understanding of electrical systems and an understanding of the fundamental issues driving renewable energy development. We will provide this material to you if you feel you would like some further pre-course reading.

Please bring a calculator (or computer) and pen along to the course to assist with the calculations.

The Program

INTRODUCTION
• Course Overview
• Energy
• Renewable and Sustainable Energy
• Applications of the technology
• Sustainable Energy
• Economics of Renewable Energy
• Forces Driving the technologies today
• Fundamentals of Electricity (dc and ac)
• Basics of Electronics for Renewable Energy
• Fundamentals of Mechanical Engineering

PHOTOVOLTAIC ENERGY SYSTEMS

FUNDAMENTALS OF PHOTOVOLTAIC TECHNOLOGY
• Applications
• Photovoltaic System components
• Typical System configurations
• Photovoltaic cells
• Modules and Arrays

MECHANICAL DESIGN AND INSTALLATION
• Mechanical Design
• Panel Assembly and Roof Attachment methods
• Mechanical Design Problems

ELECTRICAL DESIGN AND INSTALLATION
• Electrical System overview
• Inverters
• System Electrical Design
• Grid Connection
• Design Problems
• Storage of energy
• Load Profiles

SYSTEM INSTALLATION AND COMMISSIONING
• Check List of Items

WIND ENERGY

FUNDAMENTALS OF WIND ENERGY
• The wind Resource
• Mechanics of Wind
• Local Effects on Wind Flow
• Wind Assessment at a Potential Site

DEVELOPMENT
• Finance
• Site Design
• Planning
• Contracts

TURBINE TECHNOLOGY
• System Design
• Aerodynamics and Power Control
• Dynamics and Fatigue
• Electricity Generation
• Integration

BRIEF OVERVIEW OF MISCELLANEOUS SYSTEMS
• Solar Water Heating Systems
• Energy Efficient Building Design
• Hybrid Energy Systems

OPERATION AND MANAGEMENT
• Management
• Site Commissioning
• Monitoring and Maintenance
• Safety

TROUBLESHOOTING OF SYSTEMS
• Typical Problems
• Tips & Tricks

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL DISTRIBUTION AND SUBSTATION AUTOMATION (INCL. COMMUNICATIONS) FOR ELECTRICAL POWER SYSTEMS

YOU WILL LEARN:

- Fundamental principles of distribution and substation automation, specifically on protection, control and communication issues
- Important steps in designing, installing and managing a substation automation project
- The nuts and bolts of IEC 61850* standard
- Typical techniques in troubleshooting distribution and substation automation systems
- How to avoid pitfalls and costly mistakes when implementing a substation automation system
- How to critically appraise the different products and systems available for distribution and substation automation
- The IEC 61850 standard is being rapidly implemented throughout the world for substations and many other areas such as power quality, substation control centres, condition monitoring and power generation

WHO SHOULD ATTEND:

- Engineers and Managers responsible for planning and justifying substation automation
- Project Engineers responsible for implementing a substation automation project
- Communications Engineers working in the power industry
- Technicians and Operators installing and working with substation automation systems
and generally...

- Electrical Engineers
- Protection Engineers
- Electrical Technicians Engineers
- Power System Engineers
- Design Engineers
- Control and Instrumentation Engineers
The Workshop

Distribution and substation automation offers you a multitude of benefits including:
- Increased function and reliability of electrical protection
- Advanced disturbance and event recording capabilities aiding in detailed electrical fault analyses
- Display of real-time substation information in a central control centre
- Remote switching and advanced supervisory control over the power network
- Increased integrity and safety of the electrical power network, including advanced interlocking functions
- Advanced automation functions

The Program

THE SUBSTATION AND ITS PRINCIPAL COMPONENTS AND FUNCTIONS
- Role of substation as a node in power system
- Main functions and equipment
- Controls in conventional non-automated substations

SUBSTATION AUTOMATION-OBJECTIVES AND HISTORICAL PERSPECTIVE
- Automation functions at different levels
- Objectives of an integrated automation of the power network
- SCADA in electrical systems
- Key differences in the objectives of SCADA and substation automation

FUNCTIONS OF MODERN SUBSTATION AUTOMATION AND ITS BENEFITS
- Inputs and outputs (HMI)
- Controls and interlocking
- Alarms
- Protection and safety of individual equipment and feeders
- Remote protection setting and appropriate control
- Condition monitoring systems for substation equipment – integration with automation system

SUBSTATION AUTOMATION ARCHITECTURE
- Typical automation architecture of MV and HV substations
- Bay controller for HV and intelligent relays on a bus for MV
- RTU as a means of interfacing an MV panel
- Auxiliary equipment automation functionality through PLC/RTU
- Process level interconnection by a communication bus – future outlook

MODERN TRENDS IN CURRENT AND VOLTAGE MEASUREMENTS
- Current and voltage - the only parameters that are sensed
- Conventional equipment for measurement
- Problems inherent in these designs
- Modern measurement principles
- Conventional instrument transformer but with digital output
- Pure optical sensors using Faraday principle
- Optical interconnection to field bus of IED
- Typical utility experience from network

WIDE AREA FUNCTIONS INCLUDING PROTECTION
- Examples of functions that involve multiple stations
- Existing trends of dealing with such functions
- Limitation of communication
- Response based and event based systems

DATA COMMUNICATIONS FOR THE ELECTRICAL POWER SYSTEMS
- Basics of data communications, incl. different techniques and media access methods
- Physical media, including radio and satellite communication
- Different communication protocols used for substations

THE IEC 61850 STANDARD
- Need for a common standard and development phases of IEC
- Scope and outline of IEC 61850
- Use of IEC 61850 in SCADA applications
- Typical structure
- Use of SCL

INFORMATION MODELS (IEC 61850 PART 7-4 AND 7-3)
- Physical and logical devices
- Logical nodes
- Common Data Classes (CDC)
- Attributes and addressing
- IEC 61850 object model
- IEC 61850 data exchange model

COMMUNICATION MAPPINGS
- Interoperability
- ACSI models
- Protocols and mapping
- Sampled values and GOOSE applications
- SCL and XML

ENGINEERING AND CONFIGURATION OF SYSTEMS
- System configuration tool
- SCL applications
- Peer to peer, one to many messaging
- SCL, MMS and IEC devices data supports
- Time synchronisation
- Gateway engineering

CONFORMANCE TESTING
- Data structure
- System performance tests and FAT
- Tests during life cycle

SECURITY ISSUES IN SUBSTATION AUTOMATION
- Common vulnerabilities of automation systems
- Inappropriate use of wireless communication
- Inadequate authentication of control systems communications
- Lack of detection and logging of intrusion
- Dual use of control systems networks
- Lack of security checking of control systems software/applications
- Potential mitigation strategies based on multiple levels of implementation

IMPLEMENTATION ISSUES IN SUBSTATION AUTOMATION
- Planning automation in new substations
- Planning a retrofit
- Forward and backward compatibility issues

Practical Sessions

This is a practical, hands on workshop enabling participants to work through practical exercises which reinforce the concepts discussed.

On-Site Training

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SAFE OPERATION AND MAINTENANCE OF CIRCUIT BREAKERS AND SWITCHGEAR

WHAT YOU WILL LEARN:

- Selection of appropriate type and rating of circuit breakers and switchgear
- Fundamentals of operating switchgear
- Switchgear components (CTs, VTs, relays and cable terminations)
- Safe operational policies including safety rules and safety documents
- Diagnostic tools and test equipment
- Safe maintenance policies including safe working in switch rooms, indoor and outdoor substations

WHO SHOULD ATTEND:

- Managers, engineers and technicians who work with switchgear and circuit breakers and who need to update their skills and knowledge in this critical area of electrical power systems protection.
The Workshop

Switchgear (and circuit breakers) are critical components in electrical distribution systems and their operation significantly affects the overall operation of the system. This two-day workshop will discuss application, installation, maintenance and testing issues relating to medium and high voltage switchgear and circuit breakers. Low voltage switchgear will be covered in detail. You will gain a solid understanding of the issues associated with the proper application, installation and maintenance of these critical items of equipment with an overriding emphasis on safety.

This comprehensive and practical two-day workshop emphasises medium voltage switchgear which represents most of the switchgear installed on electrical distribution systems. The focus is on air blast, oil, SF6 and vacuum circuit breakers. Case studies covering the main manufacturer’s equipment will illustrate the important practical principles. Other power system protection components will be discussed as well to ensure that switchgear is understood in the correct context.

Practical Sessions

This is a practical, hands on workshop enabling participants to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

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The Program

SWITCHGEAR- ORIGINS AND TYPES
- Single line diagrams
- Active and passive network components
- Circuit breaker utilisation
- Alternative forms of MV switchgear- ring main units and load breaking/fault making switches
- Fuse switches
- HV fuses in combination with, and as alternatives to circuit breakers
- Auto-reclosers and auto-reclose operations

APPLICATION OF SWITCHGEAR
- Principles of current interruption
- Plain break circuit breakers
- Bulk and small oil volume circuit breakers
- Turbulator (explosion pot)
- Operating mechanisms
- Transfer earth circuit breakers
- Air break and air blast switchgear
- SF6 and vacuum
- Switchgear in association with disconnectors
- Fixed and withdraw-able designs
- Switchgear standards
- Factors affecting switchgear selection

SPECIFICATION OF SWITCHGEAR
- Switchgear ratings- highest system and impulse withstand voltages, load and short circuit currents
- Simple and complex protection systems
- Switchgear ancillaries, measurement CTs, VTs and relays
- Cable terminations
- Indoor and outdoor operations
- Substation and switch room layouts and design

SHORT CIRCUIT TESTING
- Symmetrical and asymmetrical breaking
- Make and break operations
- Understanding test oscillograms
- Case study- Specification for a 132 Kv Switchboard

SAFETY POLICIES
- General safety precautions and the use of personal protective equipment
- Principles of safety rules
- Principles of personal authorisation
- Operative training for safe operation of switchgear
- Isolation in a circuit breaker context
- Safety documentation
- Operational and safety locking, caution and danger notices
- Work safety in a substation environment
- Safety interlocks
- Substation alarms
- Individual study tasks and presentation-safety policies in my company and how they might be improved

OPERATION OF MODERN SWITCHGEAR
- Case studies
- Sprecher and Schuh
- Schneider
- ABB
- Siemens

ASSETS MANAGEMENT IN A SWITCHGEAR CONTEXT
- Principles of time and condition based asset management
- Asset registers
- Asset management systems

DIAGNOSTICS, TESTING AND MAINTENANCE
- Switchgear inspection methodologies
- Partial discharge measurement and survey
- Timing tests
- Thermovision
- Mechanisms of deterioration
- Principles of circuit breaker maintenance
- Maintaining oil circuit breakers
- Contact maintenance and contact wipe
- Oil testing
- Maintaining vacuum circuit breakers
- Maintaining SF6 circuit breakers
- SOPs and DINs
- Switchgear defects and defect control systems

SUMMARY, OPEN FORUM AND CLOSING
TROUBLESHOOTING, MAINTENANCE AND PROTECTION OF AC ELECTRICAL MOTORS AND DRIVES

YOU WILL LEARN HOW TO:

- Understand AC motor operation and construction
- Specify, select and install motors
- Specify protection requirements for motors
- Specify speed control requirements for motors
- Install and commission motors
- Fix faults on motors
- Interpret motor performance curves
- Interface control circuits of motors with PLCs/DCSs
- Reduce downtime on electrical motors
- Improve plant safety
- Improve plant throughput
- Reduce your spares usage and requirements

WHO SHOULD ATTEND:

Anyone associated with the use of electrical motors in the industrial or automation environment. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting. Typical personnel who would benefit are:

- Electrical maintenance supervisors
- Electrical maintenance technicians
- Instrument and control engineers
- Instrument technicians
- Maintenance personnel
- Mechanical engineers
- Operations personnel
- Plant engineers
- Process control engineers
- Service technicians
The Workshop

It is estimated that electrical drives and other rotating equipment consume about 50% of the total electrical energy consumed in the world today. The cost of maintaining electrical motors can be a significant amount in the budget item of manufacturing and mining industries. This workshop gives you a thorough understanding of electrical motor’s working, maintenance and failure modes and gives you the tools to maintain and troubleshoot electrical motors.

You will gain a fundamental understanding of the installation, operation and troubleshooting of electric motors. Typical applications of electric motors in mining, manufacturing, materials handling, process control are covered in detail. You will learn the basic steps in specifying, installing, wiring and commissioning motors. The concluding section of the workshop gives you the fundamental tools in troubleshooting motors confidently and effectively.

Pre-requisites
A fundamental knowledge of basic electrical concepts would be useful.

The Program

INTRODUCTION

FUNDAMENTALS OF MOTOR TECHNOLOGY
- Basic principles of rotating electric machines
- Fundamental principles of speed control
- Efficiency, torque, inertia, horsepower/ power factor
- Torque-speed curves
- How the motor produces torque
- Types of motors

AC MOTOR THEORY, CONSTRUCTION AND MAINTENANCE
- Basic construction and physical configuration, windings
- Principles of operation and performance

THREE PHASE AC INDUCTION MOTORS
- Components
- Theory of operation
- Induction motor design
- Duty cycles
- Insulation and cooling requirements
- Starting methods
- Selecting motors
- Maintenance of AC machines
- Types of faults, fault finding and testing of AC machines
- Testing instrumentation

PROTECTION OF AC MOTORS
- Protective devices
- Thermal overload
- Over current / overload
- Under-voltage / over-voltage
- Under frequency
- Current unbalance or negative phase sequence
- Earth fault protection
- Pole slip / out of step
- Loss of excitation
- Inadvertent energisation
- Over fluxing
- Stall protection / acceleration time / start up supervision (time between starts / starts per hour)
- Voltage controlled or restrained over current
- Protection settings

SPEED CONTROL OF AC MOTORS
- Introduction to variable speed drives or power electronic converters
- Types, and designs of variable speed drives

PROTECTION OF AC CONVERTORS AND MOTORS
- Frequency converter protection circuits
- Protection settings

CONTROL SYSTEMS FOR AC VARIABLE SPEED DRIVES
- Control theory of VSDs explained

THE SELECTION OF AC CONVERTORS FOR VARIABLE SPEED DRIVE APPLICATIONS
- Selection procedure
- Nature of the load
- Selection of correct size motor and converter

INSTALLATION AND COMMISSIONING OF AC VARIABLE SPEED DRIVES
- General installation and environmental requirements
- Electrical connections and earthing requirements
- Control wiring and pre-commissioning
- Commissioning tests

NEW TECHNOLOGIES AND DEVELOPMENTS

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

✓ SAVE over 50% by having an IDC workshop presented at your premises.
✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.

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idc@idc-online.com • www.idc-online.com
POWER TRANSFORMERS - OPERATION, MAINTENANCE AND TESTING

WHAT YOU WILL LEARN:

• Fundamental theory and principles of the operation of power transformers
• Insight into the identification and application of transformers types
• Understand the power transformer components and their construction
• Power transformer protection
• Power transformers’ oil, oil tests and interpretation of results
• The most effective power transformer electrical tests
• How to manage power transformer breakdowns to ensure a minimum disruption

WHO SHOULD ATTEND:

• Power System Engineers
• Electrical Engineers
• Consulting Engineers
• Project Engineers
• Power System Technicians
• Electrical Contractors and Technicians
• Tradesman Electricians
• Electrical Inspectors
• Utility Engineers
The Workshop

Installation of high voltage distribution and transmission equipment has increased significantly over the years due to ongoing global demand for power. As a result, the need to ensure reliability of operation of power systems is paramount. Power transformers are among the most important and most expensive components of power systems. Their failure can impose extraordinarily high costs on plants, factories and utilities of all descriptions. It is critical that all personnel operating and working with such equipment have a sound knowledge of their operational requirements and maintenance. This practical workshop provides knowledge on both the theory and operation of power transformers. The course will develop and enhance an understanding of what is involved in the maintenance of these essential components of the power systems, through the tips and tricks learnt and developed by some of the world’s preeminent electrical engineers.

Pre-requisites

Some basic knowledge of electrical engineering and general knowledge of nature and operation of transformers is required. However participants do not need specific knowledge on transformers as the course will start from the basic theory.

Practical Sessions

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On-Site Training

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The Program

TRANSFORMERS’ MAIN FUNCTIONS AND CLASSIFICATION
- Construction (shell type and core type)
- Classification and type in relation to insulation, windings, core, cooling systems, voltage level, sizing, tank and breathing action
- Transformer parts

POWER TRANSFORMERS AND SAFETY
- How to install, operate and work with high voltage power transformers safely
- Earthing of HV transformers

TRANSFORMER THEORY
- Electrical values and their definition in a power transformer - voltage, current, number of turns, impedance and their interrelation

OPERATION OF POWER TRANSFORMERS IN A POWER SYSTEM
- Thermal performance, loading, paralleling, tap-changing, connections and vector groups

POWER TRANSFORMER PROTECTION
- Surge protection
- Protective relaying (differential, over-current and earth fault)
- Buchholz relay and pressure relief relay
- Thermal devices and instruments (oil temperature alarm and trip)

STATION TRANSFORMERS
- Design criteria
- Specifications

POWER TRANSFORMER OIL AND OIL QUALITY
- Oil contents: water, acidity and dissolved gas
- Oil tests: dielectric breakdown, moisture, resistivity, interfacial tension, specific gravity, power factor and furan analysis.
- Recovery voltage measurement test

POWER TRANSFORMER ELECTRICAL TESTS
- AC Tests:
  - Power factor tests (insulation, oil, and bushings)
  - Single phase excitation current test
  - Transformer turns ratio test
- DC Tests:
  - Insulation resistance test
  - Dielectric absorption test
  - Polarisation index test
  - Step voltage test
  - Hi-pot test

PREVENTATIVE MAINTENANCE ON POWER TRANSFORMERS
- Techniques to improve life expectancy

SUMMARY, OPEN FORUM AND CLOSING
LIGHTNING, SURGE PROTECTION AND EARTHING OF ELECTRICAL AND ELECTRONIC SYSTEMS IN INDUSTRIAL NETWORKS

YOU WILL LEARN HOW TO:

- Select and apply an appropriate lightning dissipation system
- Understand how earth electrodes work and their role in preventing lightning and surges from damaging equipment
- List the types of systems that cannot be earthed
- Describe what systems can be operated unearthed
- Correctly select and apply surge protection appropriate to the type of equipment being protected
- Apply practical knowledge of surge and transient protection
- Troubleshoot and fix earthing and surge problems
- Design, install and test an effective earthing system for electronic equipment
- Understand lightning and how to minimise its impact on your facility
- Protect sensitive equipment from lightning

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Consulting engineers and safety professionals
- Electrical engineers and contractors
- Project engineers
- Power system protection and control engineers
- Maintenance engineers
- Building service designers
- Data systems planners and managers
- Electrical and instrumentation technicians
- Electricians and electrical inspectors
### The Workshop

Few topics generate as much controversy and argument as that of lightning and surge protection of electrical and electronic systems. Poor practices in earthing, and incorrect application and selection of lighting and surge protection devices can be the cause of continual and intermittent problems in a facility, often resulting in lost production and equipment failure.

This workshop looks at these issues from a fresh yet practical perspective and enables you to reduce expensive downtime on your plant and equipment by the correct application of these principles. Essentially the workshop is broken down into the methods used to prevent lightning entering a facility such as dissipation arrays and those that divert surge energy away from sensitive equipment.

Dissipation systems are discussed with associated earthing systems. The unique properties of various surge protection devices are reviewed, enabling you to select the correct device suited to the application required. Earthing and surge protection for telecommunications and IT systems are examined in detail as well as the impact of lightning and simple techniques for minimising its impact.

### Pre-requisites

Some working knowledge of basic electrical engineering principles is required, although there will be a revision at the beginning of the workshop. Experience with earthing problems will enable the workshop to be placed in context.

### Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

*To gain full value from this workshop, please bring your laptop/notebook computer.*

### On-Site Training

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- **✓ Have** the training delivered when and where you need it.

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### The Program

#### INTRODUCTION AND BASICS
- Fundamentals of earthing
- Bonding
- Lightning
- Surge protection
- Dissipation arrays

#### RECOMMENDED DESIGN AND INSTALLATION PRACTICES
- Wiring and earthing for safety and performance
- Wiring and distribution systems
- Dedicated and derived neutral systems
- Earthing and bonding equipment
- Earth electrodes and earth mats
- Supplementary earthing systems (chemical earths)

#### FUNDAMENTALS FOR BUILDING ELECTRICAL SYSTEMS
- Earthing of building systems
- Which electrical systems can be operated unearthed?
- Proper methods of earthing building electrical systems
- Location of the service earthing connection
- Proper sizing of earthed (neutral) conductors

#### TYPICAL RULES TO BE APPLIED
- Rules for multiple services to one building
- Rules for low impedance and high impedance systems
- Rules for bonding requirements at building service equipment
- Earthing electrodes, systems and conductors
- Bonding enclosures and equipment
- Equipment earthing conductor types
- Enclosure and equipment earthing
- Earthing of separately derived systems
- Earthing at more than one building
- Disconnecting means for separate buildings

#### ELECTRICAL FAULTS
- Earth fault circuit interrupters
- Equipment earth fault protection systems

#### APPLICATIONS OF EARTHING AND BONDING
- Earthing and bonding in hazardous (classified) locations
- Earthing and bonding for health care
- Earthing and bonding for swimming pools, hot tubs and spas
- Static and electricity: earthing and bonding requirements
- Common violations
- Building electrical inspection procedures
- How to recognise hazards

#### LIGHTNING
- Need for a lightning protection system
- Which protection systems work and which don’t
- Best location for IT equipment
- Optimum earthing for building
- Pitfalls of isolated earthing
- Shielding and bonding of electronics and communications
- Optimum location of surge protection devices

#### SURGE AND TRANSIENT PROTECTION
- Lightning phenomena
- Protection of power supply
- Protection of electric communications circuits
- Power system faults and switching surges
- Mitigation techniques
- Case studies

#### POWER CONDITIONING
- Power conditioners
- Uninterruptible power systems
- Power quality alternative sources

#### SUMMARY, OPEN FORUM AND CLOSING

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[Image of workshop setup]
MAINTENANCE AND TROUBLESHOOTING OF UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS AND BATTERIES

Also including high reliability power supplies

YOU WILL LEARN HOW TO:

- Describe the basic building blocks of UPS and high reliability power supply systems
- Understand the construction and operation of the major commercial UPS systems
- Detail the operation of the popular UPS systems
- Maintain and test lead acid and nickel cadmium batteries
- Understand how to performance test lead acid and nickel cadmium batteries
- Identify the relevant hazards and apply safe working practice for UPS systems and batteries

WHO SHOULD ATTEND:

- Electrical Technicians and Engineers
- Instrumentation and Control Engineers
- Consulting Engineers
- Project Engineers
- Maintenance Engineers
- Power System Protection and Control Engineers
- Building Service Designers
- Data Systems Planners and Managers
- Maintenance Tradespeople and Technicians
- Electrical and Instrumentation Technicians
The Workshop

This practical workshop will provide you with a basic understanding of the application, installation, operation and troubleshooting of UPS systems and batteries. It covers theory of operation and standard testing as well as troubleshooting and maintenance of typical single and three phase uninterruptible power supplies and batteries.

Day one commences with the fundamentals of UPS's and a comparison between the various topologies and how they operate. Typical issues with troubleshooting and maintenance of UPS's are also covered. The fundamentals of typical electrical components within a UPS are detailed as well as the operation of the conversion process from AC to DC and then back to AC.

The second day focuses on how to work competently and safely with lead acid and nickel cadmium batteries. The initial discussions centre around battery theory, types of batteries, installation, testing and maintenance. The workshop is concluded by examining case studies of various configurations of batteries and UPS systems.

Pre-requisites

Some working knowledge of basic electrical engineering principles is required, although this will be revised at the beginning of the course. Real-life experience in working with batteries and UPS systems will enable the workshop to be placed in context.

Practical Sessions

There are eight practical exercises and demonstrations throughout the workshop.

On-Site Training

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The Program

INTRODUCTION
• Maintaining continuity of power and the role of the UPS in ensuring reliable power

POWER QUALITY-BASIC FACTS
• What constitutes power quality?
• Sags and swells
• Voltage fluctuations and mitigation
• Interruptions
• Surges - their causes, effects and remedies
• Noise and harmonics
• Frequency disturbances and mitigation

RELIABILITY AND CONTINUITY OF POWER SUPPLY
• Interruptions and their impact
• Deciding the requirements of your plant and equipment
• Uninterrupted power - how much and where?
• Improving reliability by redundancy and automation
• Uninterrupted power options available?
• Rotary UPS systems

BASICS OF RECTIFIERS AND INVERTERS
• Solid state devices - diodes, transistors, thyristors and IGBTs
• Basic configurations of rectifiers and their output waveforms
• Ripples and control
• Rectifiers in static UPS systems
• Controlled rectifiers and their impact on power factor
• Why are rectifiers treated as sources of harmonics?
• Basic principles of an inverter
• Synthesizing the AC wave
• Pulse width modulation technique of synthesis

STATIC UPS SYSTEMS
• Static UPS
• Basic components of the general UPS configuration
• Passive standby, line interactive and double-conversion type of UPS
• Preferred metering, indication and alarms in a UPS
• Power quality and UPS
• Need for isolation transformer
• Computer power supplies and comparison of UPS configurations
• Rating of UPS systems - pitfalls
• Redundant UPS systems
• Earthing of UPS systems - recommendations from the IEEE Green Book

UPS SYSTEM TROUBLESHOOTING AND MAINTENANCE
• Critically apply the manufacturer's recommendations
• Basic use of test equipment and tools
• Rectifier and Inverter troubleshooting

BASICS OF BATTERIES
• Types of batteries: primary and secondary
• General features of lead-acid and nickel-cadmium batteries
• Comparison of the chemistry involved
• Lead acid batteries - subtypes, construction and relative features
• Manufacture of batteries

CHARGING AND DISCHARGING OF BATTERIES
• Float charging and boost (equalizing) charging
• Facts about charging of lead acid batteries
• Internal loss and the factors that affect it
• Current during charging cycle - variants
• Overcharging and undercharging
• Sulphation and hydration
• The discharge process
• Specifics about charging of UPS batteries
• Nickel cadmium batteries
• Charging strategy for nickel cadmium batteries

SELECTION, CONFIGURATION AND SIZING OF BATTERIES
• Matching the battery type to the application
• Life cycle cost of battery
• Battery configuration - selecting the voltage
• Use of parallel battery strings
• Alternative approaches to sizing of battery for DC supply systems
• Battery sizing for UPS systems

INSTALLATION OF BATTERIES
• Receiving, checking and storage
• Pre-installation planning and rack installation
• Installation of cells and inter cell connections
• Safety precautions

BATTERY UPKEEP, FAILURES AND DISPOSAL
• Need for upkeep and monitoring
• Causes of failures and failure modes
• Periodic inspection and residual life assessment
• Test equipment and safety of personnel
• Predictive monitoring by conductance testing
• Disposal and recycling

CASE STUDIES
• Selection and sizing
• UPS systems
• Batteries
• Combination of batteries and UPS systems
PRACTICAL
POWER SYSTEM HARMONICS,
EARTHING AND POWER QUALITY
- PROBLEMS AND SOLUTIONS

YOU WILL LEARN HOW TO:

- Develop a sound working knowledge of power quality problems and solutions
- Do a step-by-step site analysis on various aspects of power quality such as power interruptions, voltages variations, harmonics, surges and electrical noise
- Deal with power interruptions
- Gain practical knowledge on surge and transient protection
- Design electrical and electronic systems correctly by applying knowledge of harmonics and earthing principles
- Troubleshoot electrical and electronic systems for power quality and harmonic problems
- Isolate and rectify power quality, harmonic problems and electrical noise
- Network with your peers on solving these problems

WHO SHOULD ATTEND:

This course is designed for personnel who want to understand the issues related to power quality in plants. Those who will benefit the most from this workshop include the following:

- Electrical designers and engineers
- Electrical maintenance engineers
- Personnel from EPC (Engineering, Procurement and Construction) companies
- Project engineers
- Consulting engineers
- Plant maintenance personnel
- Electrical and electronics technicians
The Workshop

The practical quality and harmonics – problems and solutions course is a comprehensive, highly interactive and practical two-day course dealing with the various types of power quality problems that have a wide ranging effect on the power systems equipment and apparatus in any plant.

You will have an opportunity to learn and discuss the fundamentals of power quality problems such as surges and voltage sags. Other problems having wide ranging effects on power system equipments such as voltage swells, voltage fluctuations, supply interruptions, frequency variations, harmonics and noise shall also be discussed in details. Issues related to control of the occurrence of these problems by appropriate system design and mitigation of the effects of these by adoption of appropriate protective measures and by the addition of power conditioning equipment shall be discussed.

Also, aspects related to designing of the systems, proper installation practices analysis of the probable reasons and corrective measures will be measured in detail. Practical examples from actual projects will be used extensively to illustrate the principles and drive home the point.

The material is covered by means of an interactive lecturing style, with plenty of practical examples and realistic case studies derived from real work performed in this area.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Outline

The workshop commences with a review of the fundamentals of power quality issues and the need to improve and maintain the quality of power in any installation. The ways to deal with power interruptions and voltage variations are explained in details. Surge and transient protection is then reviewed with practical steps outlined to minimise or even eliminate this problem. Hereafter the workshop focuses on what harmonics in power systems are and how to minimise them. The common problem of noise is reviewed and some misconceptions in this area are discussed.

The second day moves onto conducting a site analysis with a step-by-step set of instructions on harmonic site analysis procedures. A practical discussion on power conditioning is also discussed and the two days are rounded off with realistic case studies covering a wide variety of industries ranging from manufacturing and process control to telecommunications. You will also be provided with a high quality course manual that IDC is known for. This course manual will be useful for many years after the course.

The Program

POWER QUALITY OVERVIEW
• What is power quality?
• Power quality indicators
• Need for improving power quality

DEALING WITH POWER INTERRUPTION
• Failures and power interruptions
• Redundancy and automation
• Types of UPS systems
• UPS configuration for computer application

VOLTAGE VARIATIONS
• Reasons for voltage variations
• Sags and swells
• Handling voltage fluctuations
• Control measures for mitigation
• Recommended system changes

SURGE AND TRANSIENT PROTECTION
• Basics of lightning phenomena
• Power system faults and switching surges
• Mitigation techniques and case study review

VOLTAGE ASYMMETRY
• Reasons and analysis of voltage asymmetry
• Effects of asymmetry
• Permissible limits of asymmetry
• Dealing with assymetrical loads

HARMONICS IN POWER SYSTEMS
• Principles of harmonic analysis
• Problems due to harmonics
• Limits of harmonic presence
• Analysis of harmonic components
• Control of harmonics

ELECTRICAL NOISE AND MITIGATION
• How are sensitive circuits affected by noise?
• Time and frequency domain representation of noise
• Categories and sources of noise
• Importance of grounding in noise control
• Zero signal reference grid and signal transport ground plane

SYSTEM INSTALLATION GUIDES
• Commercial power, power interruptions and issues of location
• Evaluation of power conditioning options
• Noise suppression sensitive loads by proper grounding
• Checking for redundancy requirement
• Signal/data cabling susceptibility
• Radio Frequency Interference (RFI) protection
• Static electricity related problems
• Surge and lightning protection
• Documentation
• Planned maintenance

CONDUCTING SITE ANALYSIS AND SURVEY
• Overview of sources of power quality problems
• Site survey procedures
• Solutions generated

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL
MOTOR PROTECTION, CONTROL
AND MAINTENANCE TECHNOLOGIES

YOU WILL LEARN HOW TO:

- Specify protection requirements for motors
- Maintain electrical motors
- Specify speed control requirements for motors
- Understand essentials of motors and drives
- Detail the main issues with testing of motors
- Prevent or at least minimise motor bearing failure
- Troubleshoot and fix faults on motors and drives
- Interface control circuits of motors with PLCs/DCSs
- Reduce downtime on electrical motors
- Improve plant safety
- Improve plant throughput
- Reduce your spares usage and requirements

WHO SHOULD ATTEND:

Anyone associated with the use of electrical motors in the industrial or automation environment. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting. Typical personnel who would benefit are:

- Electrical consulting engineers
- Electrical contractors
- Electrical maintenance supervisors
- Electrical maintenance technicians
- Engineering and design personnel
- Instrument and control engineers
- Instrument technicians
- Maintenance personnel
- Mechanical engineers
- Operations personnel
- Plant engineers
- Process control engineers
- Service technicians
The Workshop

It is estimated that electrical drives and other rotating equipment consume about 50% of the total electrical energy consumed in the world today (and this figure increases to 70% if you only consider industry). The cost of maintaining electrical motors can be a significant amount in the budget item of man-facturing and mining industries. This workshop gives you a thorough understanding of electrical motor’s protection, control and maintenance and gives you the tools to maintain and troubleshoot electrical motors.

You will gain a fundamental understanding of the protection, control and maintenance of electric motors and drives. Typical applications of electric motors in mining, manufacturing, materials handling, process control are covered in detail. The concluding section of the workshop gives you the fundamental tools in troubleshooting motors confidently and effectively.

Pre-requisites
A fundamental knowledge of basic electrical concepts would be useful.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

FUNDAMENTALS OF MOTOR TECHNOLOGY AND CONSTRUCTION
• Basic principles of rotating electric machines
• Fundamental principles of speed control
• Efficiency, torque, inertia, horsepower/power factor
• Torque-speed curves
• Induction/synchronous/wound rotor types
• Basic construction and physical configuration, windings
• Principles of operation and performance

THREE PHASE AC INDUCTION MOTORS
• Components
• Theory of operation
• Induction motor design
• Duty cycles
• Insulation and cooling requirements
• Starting methods
• Selecting motors
• Types of faults, fault finding and testing of AC machines
• Testing instrumentation

ENERGY LOSSES AND EFFICIENCY OF THREE PHASE AC INDUCTION MOTORS
• Standards
• Types of losses
• Tests for measurement and computation of losses and efficiency
• Dynamometers
• Principles of load application by braking
• Torque measurement basics
• Types of practical dynamometers

MOTOR FAILURE ANALYSIS
• Frequent starts
• High inertia
• Inadequate cooling
• Convection on fan cover
• Improper spacing at end of motor
• Incorrect belt alignment
• Solid belt guards
• Excessive loading causing bearing clearance problems
• Insulation failures
• Bearing current problems

TESTING
• Insulation life and resistance
• Polarisation index
• DC hipot
• DC ramp test
• AC hipot
• Capacitance test
• Dissipation factor
• Partial discharge
• Surge test
• Mechanical testing
• Online testing

BEARING FAILURE ANALYSIS
• Bearing failures
• Grease and greasing
• Belt drive aspects
• Balance
• Storage issues
• Service factor loading

PROTECTION OF MOTORS
• Thermal overload
• Time constraints
• Early relays and new digital relays
• Starting and stalling conditions
• Over current/overload
• Under-voltage/over-voltage
• Under frequency
• Pole slip/out of step
• Loss of excitation
• inadvertent energisation
• Stall protection/acceleration time/start up supervision (time between starts)
• Unbalanced supply voltages
• Negative sequence currents
• De-rating factors
• Earth faults – core balance, residual stabilising resistors
• Calculation of protective relay settings

MOTOR CONTROL
• Power circuit
• Control circuit
• Full online voltage starting
• Reduced voltage starting
  - Delta-star
  - Reactor
  - Autotransformer
• Soft start
• Braking
• Speed control
• Reversing

CONTROL SYSTEM FOR AC VARIABLE SPEED DRIVES
• Overall control system
• Power supply for the control system
• DC bus charging system
• VSD control loops (open loop/closed loop)
• Vector control
• Current feedback in AC variable speed drives
• Speed feedback from motor

INSTALLATION AND FAULT FINDING
• General installation and environmental requirements
• Power supply connections and earthing
• Where to install contactors in power circuit
• Installation of AC converters into metal enclosures

NEW TECHNOLOGIES AND DEVELOPMENTS

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training
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idc@idc-online.com • www.idc-online.com
PRACTICAL MEDIUM & HIGH VOLTAGE TESTING OF ELECTRICAL EQUIPMENT FOR ENGINEERS AND TECHNICIANS

WHAT YOU WILL LEARN:

- Types of HV and MV test performed
- Good industry practice
- The need for testing of MV and HV electrical equipment
- Various types HV equipment encountered in the industry
- Testing equipment
- The need for good record keeping on tests conducted
- The role of standards on testing, test basis and interpretation of results
- National test labs and their importance in quality assurance

WHO SHOULD ATTEND:

- Instrumentation and Control Engineers
- Consulting Engineers
- Electrical Engineers
- Project Engineers
- Maintenance Engineers
- Power Systems Protection and Control Engineers
- Building Service Designers
- Data Systems Planners and Managers
The Workshop

Testing is an essential activity in any engineer’s career. Whatever your role in the industry - electrical designer, purchase engineer, manufacturer, installation contractor or maintenance engineer, solid knowledge of electrical tests is a necessity. This workshop is designed to familiarise you with various aspects of testing general electrical equipment and high voltage testing in particular.

Examples are used from various international standards regarding the procedures for conducting tests and interpreting the results. The need for keeping proper records of tests conducted both in the initial stages and later during routine maintenance is discussed. Some of the tests are too complex to be performed on a routine basis or may require specialised equipment which may not be normally available to user industries or even manufacturers. This is where the services of an independent and accredited test lab are useful. The roles of such labs are briefly discussed.

Practical Sessions

A mixture of videos, equipment and exercises will be used to illustrate key principles with seven sessions:

Practical sessions include:
- Insulation testing
- High voltage test equipment
- Oil dielectric testing
- Transformer testing
- CT testing
- PT testing
- Doctor testing

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

INTRODUCTION
- HV AND MV equipment
- Need and purpose of testing
- Categories of testing

INSULATION TESTING
- Purpose of insulation testing
- Equipment
- Insulation
- Construction of a tester
- Connections of tester to test equipment
- Safety precautions
- Discharging
- Noting of readings and interpretation
- Determining dryness of insulation using absorption ratio

Practical Session: Insulation Testing

HIGH POTENTIAL TESTS
- Purpose of testing
- AC and DC Hipot tests
- Test equipment/block diagram and construction details
- Connections of tester to test equipment
- Safety precautions
- Discharging after test
- Noting of readings and interpretation
- Standards and precautions

Practical Session: High Voltage Test Equipment

OIL TESTING
- Dielectric test using high voltage testing kit
- Electrodes and test voltage
- Test voltages as per applicable standards
- Tests of acidity
- Effect of additives
- Other possible uses of oil testing (dissolved gas analysis)
- Improvement of dielectric strength by filtration

Practical Session: Oil Dielectric Testing

TRANSFORMER TESTING
- Induced over voltage tests
- Winding resistance measurement
- Ratio testing
- Vector group verification
- Tests for transformer losses
- Partial discharge testing
- Tan Delta testing
- Test Instruments

Practical Session: Transformer Testing

CT TESTING
- Ratio test of Current Transformers (CTs)
- Test with rated burden
- Polarity testing
- Magnetising current and knee point voltage measurement
- Insulation test and high voltage test
- Test instruments

Practical Session: CT Testing

PT TESTING
- Ratio test of Potential Transformers (PTs)
- Test with rated burden
- Polarity testing
- Magnetising current measurement
- Insulation and HV tests
- Test instruments

Practical Session: PT Testing

DUCTOR TESTING
- Working principle
- Use of doctor for verifying contact resistance of circuit breakers
- Precautions and analysis

Practical Session: Doctor testing

OTHER MISCELLANEOUS TEST EQUIPMENT SUMMARY
WHAT YOU WILL LEARN:

- The basic principles of grounding of electrical systems
- The function of power system grounding and the various options available
- Role of protective grounding in ensuring safety; sizing of grounding conductors
- Importance of equipotential bonding in ensuring safety
- Design of ground electrodes, measurement of soil resistivity and ground electrode resistance
- Fundamental principles in the design of grounding systems in substations
- Solving static electricity-related hazards by grounding and bonding
- Role of grounding in protecting substation structures from lightning hazard
- Role of grounding in surge protection of power distribution equipment and sensitive systems
- Noise in electrical systems and the role of grounding in noise mitigation

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Consulting engineers
- Electrical engineers
- Project engineers
- Maintenance engineers
- Power system protection and control engineers
- Building service designers
- Data systems planners and managers
- Electrical and instrumentation technicians
The Workshop

Few topics generate as much controversy and argument as that of grounding (or earthing as it is called in some countries) and the associated topics of lightning and surge protection of electrical and electronic systems. Any engineer dealing with power supply networks needs to understand the basic principles of grounding system design and its role in ensuring safety of equipment and personnel. A correct understanding of the basic principles involved will help him/her to avoid mistakes in grounding system design, mistakes that could lead to expensive failures and long downtime.

In this workshop, we will try to demystify the concepts of grounding as applicable to utility networks and industrial plant distribution systems as well as their associated control equipment. In fact, a lot of myths have been built around this subject, although it is quite a simple one when approached from basic principles. Our endeavour will therefore be to explain the fundamentals of grounding, which we hope will enable the readers to gain a correct perspective of the subject and give them the knowledge needed to solve real life grounding problems.

Essentially this workshop is broken down into system grounding, protective grounding and surge/noise protection of power and electronics systems normally found in distribution networks. A brief introduction to the design of substation grounding has been included. Detailed information on ground electrodes and measurement of ground resistance is also available.

Pre-requisites

Some working knowledge of basic electrical equipment is required, although this will be covered at the beginning of the course. Real-life problems with such equipment and hands-on testing will enable the workshop to be placed in context.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

The Program

OVERVIEW
- Basics of grounding
- Bonding
- Role of grounding in lightning protection
- Ground electrodes and factors affecting their efficiency
- Grounding issues in outdoor substations
- Grounding for static charges
- Surge protection
- Importance of grounding in mitigation of noise in sensitive circuits
- Importance of local codes

POWER SUPPLY SYSTEM GROUNDING
- Types of system grounding
  - Ungrounded systems
  - Solidly grounded systems
  - Impedance grounding using neutral reactor
  - Resonant grounding using neutral reactor
  - Impedance grounding through neutral resistance
- Classification of supply systems based on grounding
- Point of grounding
- Other challenges

PROTECTIVE GROUNDING
- Electric shock, its cause and effects
- Direct and indirect contact
- Touch and step potential
- Role of protective grounding in minimising the shock hazards
- Equipotential bonding
- Protective grounding conductors and installation
- Ground fault protection
- System classification based on system/protective grounding

GROUND ELECTRODE SYSTEMS
- Soil resistance and factors affecting soil resistivity
- Measurement of soil resistivity
- Resistance of ground electrode and distribution of resistance in surrounding soil layers
- Electrode current capacity
- Ground electrode configurations
- Parallel electrodes
- Ground electrode resistance measurement
- Chemical electrodes
- Concrete encased electrodes and splicing methods
- Corrosion of buried electrodes
- Grounding system maintenance

SUBSTATION GROUNDING DESIGN
- Grounding practices
- Basic design approach
- Calculating the ground fault current
- Ground potential rise in HV systems
- Grounding design in LV and MV substations/installations
- Grounding grid design for HV/EHV substations - a step-by-step approach
- Introduction to two-layer soil model

SUBSTATION GROUNDING DESIGN cont.
- Transferred potential and ways of avoiding
- Properly involving special attention in substation grounding design and for GIS equipment
- Design of substations containing converter equipment feeding to HVDC transmission systems
- Ensuring effective substation grounding - important aspects

STATIC ELECTRICITY AND PROTECTION
- What is static electricity and how is it generated?
- Examples of static charge build up and its dangers
- Energy of spark due to static electricity
- Ways of controlling static build up
- Risk assessment and preventive measures

GROUNDING FOR LIGHTNING PROTECTION OF BUILDINGS AND STRUCTURES
- The physics of lightning
- Lightning incidence in different land masses
- Lightning stroke probability
- Lightning protection
- Planning for protection and decision factors
- Improved approach to lightning protection and non-conventional systems
- Effect of lightning strikes on electrical installations

SURGES AND SURGE PROTECTION
- Surges, their causes and mitigation
- The ways by which surges couple into electrical circuits
- Bonding of grounding systems
- Basic principle of surge protection and commonly used surge protection devices
- Graded surge protection
- Selecting appropriate surge protective devices and their positioning in a system
- Importance of correct grounding practices for sensitive equipment
- Other ways and devices for mitigating surge problems
- Comparative merits of different types of SPDs for sensitive equipment
- Hybrid surge protective devices
- Surge protection of telemetry and data communication systems

ELECTRICAL NOISE AND MITIGATION
- Definition of electrical noise
- How are sensitive circuits affected?
- Noise categories
- Noise from power electrical equipment
- Noise coupling into signal circuits
- Noise mitigation measures
- Role of proper grounding in reducing noise
- Noise control by proper grounding of UPS derived supplies

SUMMARY, OPEN FORUM AND CLOSING

To gain full value from this workshop, please bring your laptop/notebook computer.
PRACTICAL ELECTRICAL SUBSTATION SAFETY FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Identify the hazards in operation and maintenance work in different parts of electrical installations
- Identify the various statutory and legal regulations/acts dealing with electrical safety at work
- Appreciate the basic theoretical aspects involved in electrical safety
- Understand the importance of proper design of electrical equipment in ensuring safety
- Gain a clear understanding of the procedures/practices adopted for safe working
- Appreciate the role of regular inspection and condition-based maintenance in ensuring safe operation
- Gain an insight into the organisational aspects of safety
- Become familiar with the organisation’s electrical safety rules (applicable to on-site training)

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Consulting engineers
- Electrical engineers
- Project engineers
- Maintenance engineers
- Power system protection and control engineers
- Building service designers
- Data systems planners and managers
- Electrical and instrumentation technicians
The Workshop

Electrical substation safety is an important issue in utility networks as well as large industrial installations and requires adequate attention in the stages of system planning, design, installation, operation and maintenance.

A number of serious accidents including fatalities occur every year in industrial establishments due to accidents involving electricity, resulting in huge financial losses and wasted man-hours.

Electrical safety is a well-legislated subject and the various Acts and Regulations lay a lot of stress on the responsibility of both employers and employees in ensuring safe working conditions.

In this course, we will take a look at the theoretical aspects of safety as well as the practical and statutory issues. Safety is not simply a matter of taking precautions in the workplace. It has to start at the stage of equipment design. Safety should be built into the design of electrical equipment and it is the responsibility of every manufacturer of electrical equipment to remove every possible hazard that can arise from its normal use.

Correct selection and application of electrical machinery is also important for ensuring safety. A thorough inspection during initial erection and commissioning as well as on a periodic basis thereafter is also very essential to ensure safety. Batteries used in substations need particular attention since they contain toxic materials such as lead, corrosive chemicals such as acid or alkali.

Electrical safety is not just a technical issue. Accidents can only be prevented if appropriate safety procedures are evolved and enforced. This includes appropriate knowledge of equipment and systems imparted through systematic training to each and every person who operates or maintains the equipment. We will cover all these aspects in detail.

Pre-requisites

Some working knowledge of basic electrical equipment is required, although this will be covered at the beginning of the course. Real-life experience with such equipment and hands-on testing will enable the workshop to be placed in context.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

OVERVIEW
- Hazards of general nature in industrial installations
- Electrical hazards
- Direct and indirect shock
- The deadly combination of heights and electric shock
- Hazards due to arcing/flashover
- Hazards from use of electrical equipment in explosive environment
- Hazards due to high temperature in electrical equipment
- Need for periodic inspection and maintenance for safe operation of electrical equipment

BASIC THEORY OF ELECTRICAL SAFETY
- Electrical shock - why does it happen?
- Touch and step potential (voltage)
- Direct and indirect contact
- Role of electrical insulation in safety
- Avoiding electric shock-different approaches
- Earth leakage circuit breakers
- Earthing of power supply systems and its safety implications
- Role of earthing of equipment enclosures (protective earthing) in human safety
- Earthing in outdoor installations
- Earthing of buildings and structures for safety during a lightning strike
- Dangers due to arc flash in electrical equipment

SAFETY ASPECTS IN ELECTRICAL EQUIPMENT DESIGN
- Objectives of safe design
- Insulation and its role in safety
- Enclosures for safety
- IP classification
- Adverse thermal effects and prevention
- Isolation and blocking of switching to prevent hazards
- Role of standards in safety

SAFE OPERATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT
- Key safety issues in O&M of electrical installations
- Isolation and earthing of equipment
- Use of warning signs for operation and maintenance
- Safety while working in outdoor switchyards and overhead lines
- Work on underground cable systems
- Use and upkeep of safety appliances in substations and other electrical premises
- Gas safety and ventilation
- First-aid for burns and electric shock

INSPECTION OF ELECTRICAL SYSTEMS FOR SAFETY
- Objectives of inspection
- Stipulations of IEE Regulations
- Inspection of new installations
- Checklists of items/aspects to be inspected
- Periodic inspection
- Documentation of inspection
- Planned and condition-based preventive maintenance

SAFETY IN BATTERY INSTALLATIONS
- Hazards involved in lead-acid battery installations
- Premises used for housing lead acid batteries
- Transportation and storage
- Installation and commissioning
- Charging and storage
- Dismantling and disposal
- Protective clothing
- First-aid measures

ORGANISATIONAL ASPECTS OF SAFETY
- Legislative aspects of safety
- Role of an organisation in ensuring/improving Work safety
- Functional requirements
- Intra-organisational safety implementation
- External interfacing and compliance

DISCUSSION ON ELECTRICAL NETWORKS, SPECIFIC HAZARDS AND SAFETY RULES APPLICABLE

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL
HV CABLE JOINTING AND TERMINATIONS
FOR ENGINEERS AND TECHNICIANS

WHAT YOU WILL LEARN:

- Basic principles of cable jointing and terminations
- Construction of electrical power cables, different types of cables for various voltage ratings and manufacturing aspects
- Different types of connectors and connection methods
- Methods of cable terminations and jointing and choosing an appropriate type for every application
- Importance of stress control and methods of stress redistribution in joints and terminations
- Important installation aspects in cable joints and terminations
- International and national standards applicable
- Type testing and routine testing
- Failures, failure analysis and failure prediction
- Future trends in cable technology and cable accessories

WHO SHOULD ATTEND:

- Consulting Engineers
- Electrical Engineers
- Project Engineers
- Maintenance Engineers
- Power System Protection and Control Engineers
- Building Service Designers
- Data Systems Planners and Managers
- Electrical and Instrumentation Technicians
- Master Electricians
The Workshop

The range of voltage and capacity of power transmitted through cables has shown a steady increase overtime. Environmental concerns, aesthetic issues, lack of transmission corridors and difficulty in routing overhead lines in crowded human habitats are some of the reasons for the explosive growth of cable technology well into the extra high voltage range. Due to physical limits on cable lengths for manufacturing and packaging, joints in cable become inevitable, particularly in the context of the utility sector. The cables also need to be terminated at sending and receiving end equipment, a very wide variety of them, in utility as well as industry applications and this calls for appropriate cable termination accessories. Cable terminations and joints form the weakest link in any distribution system. Also, a failed joint in an underground distribution system is much more difficult to locate and repair compared to any similar problem in overhead distribution systems. This means that we should do our utmost to achieve a good joint or termination, which can give years of trouble-free service. The quality of a joint or termination depends to a large extent on the skill of cable jointer. The aim of a cable jointer must therefore obtain a joint whose electrical properties are as good as the original cable both in electrical and mechanical terms. The design of cable jointing and termination accessories is based on this perception. Dependence on operator-skill is sought to be reduced by good choice and quality of jointing materials, though such dependence cannot be totally eliminated.

We will discuss these issues in this course by looking at the fundamental aspects involved so that the importance of the correct execution of a termination or joint will be brought home to those who attend the workshop.

Pre-requisites

Some working knowledge of basic electrical equipment is required, although this will be covered at the beginning of the course. Real-life experience with such equipment and hands-on testing will enable the workshop to be placed in context.

On-Site Training

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The Program

INTRODUCTION
- Need for cable joints and terminations
- Cables - types and historic perspective
- Types of insulation materials
- Basic types of terminations and joints
- Installation aspects - reducing the number of joints by proper planning
- Standards and testing
- Failures

CABLES
- Basic construction
- Conductor materials and configurations
- Insulation materials for different applications and voltages: PVC, paper and XLPE
- Use of screen in HV cables
- Use of armour for earth continuity and mechanical protection
- Special aspects of single core cables
- Voltage rating of cables and impact of system earthing method on voltage rating
- Stress distribution in single core and multicore power cables
- Electrical breakdown of insulating materials
- HV cables using XLPE insulation
- Treeing in XLPE and need for end sealing of cables in storage
- Basic manufacturing process

CABLE CONNECTORS
- Materials
- Types of connectors for cable terminations and joints
- Current path
- Method of connections: soldering, brazing, welding, crimping (compression) and bolting
- Comparison
- Contact resistance
- Preferred methods in practice for different cable ratings
- Contact of dissimilar materials and galvanic effects, use of bi-metal accessories

JOINTS AND TERMINATIONS - THEORY
- Basic approaches
- Broad classification of joints/terminations approach: prefabricated and site fabricated from kits
- Comparative merits
- Prefabricated: pre-moulded (slip-on) and cold shrink
- Site fabricated: taped and compound sealed, taped and cast resin sealed and heat shrinkable
- Additional requirements of outdoor terminations
- Reconstitution of cable properties: insulating tape, semi conducting tape, high permittivity stress control tape and sealing against moisture
- Connectivity for cable screen and armour
- Mechanical protection of joints and terminations

STRESS CONTROL
- Effect of joints and terminations on stress gradients
- Areas requiring stress control: terminations and joints
- Basics of stress control approach: geometric solutions, use of stress control tubes, cones, high permittivity solutions, use of stress control tapes

JOINTING AND TERMINATION PRACTICE
- Kits for joints and terminations
- Shelf life issues
- Importance of matching diameter of insulated conductor with kit specifications in pre-fabricated kits
- Preparation of cable for termination and jointing
- Connection
- Reconstitution of cable properties
- Continuity and earthing aspects
- Sealing
- Healthiness of joint/termination
- Installation aspects for joints: buried joints and markers for identification, joints placed on cable structures with other cables-safety issues, access for repairs

STANDARDS AND TESTING
- International/national standards
- Type tests
- Limitations
- Routine tests
- Training and certification of personnel

TERMINATIONS TO EQUIPMENT
- Terminations to indoor switchgear: need for coordination with manufacturer of switchgear, issues arising from multiple terminations, design of switchgear terminals
- Terminations to electrical machines
- Terminations of outdoor HV installations
- Terminations to GIS installations
- Importance of correct orientation of terminations

FAILURES AND ANALYSIS
- Reasons for failures
- Documentation of work
- Documentation of failures
- Analysis of failures
- Predictive approach: use of partial discharge detection

NEW TRENDS
- Reasons for increasing preference to underground cables
- New technologies for very high capacities and voltages
- EHV XLPE
- High temperature superconductivity in cables and likely impact on current practices

SUMMARY, OPEN FORUM AND CLOSING
OPERATION AND MAINTENANCE OF DIESEL POWER GENERATING PLANTS

WHAT YOU WILL LEARN:
You will gain valuable know-how related to diesel generating plants on:
• Combustion processes and engine operation principles
• Types and applications
• Fuel and lube oil requirements
• ISO ratings and terminologies
• Engine components and their functions
• Generator principles and construction
• Plant layout requirements for single and multiple units
• Associated control panels and operation
• Testing and commissioning procedures
• Plant performance troubleshooting techniques
• Good maintenance practices

WHO SHOULD ATTEND:
• Mechanical Engineers
• Instrumentation and Control Engineers
• Electrical Engineers
• Project Engineers
• Maintenance Engineers
• Power System Protection and Control Engineers
• Building Service Designers
• Systems Planners and Managers
• Electrical and Instrumentation Technicians
The Workshop

Diesel generating plants have an important role in power plants as well as in industries and commercial installations to meet continuous and emergency standby power requirements for day to day use. Good knowledge of basic operation principles, layout requirements, associated components and maintenance practices for diesel power plants help the career development of many engineers and technicians in today’s demanding world. Whatever your role in industry - designer, purchase engineer, installation contractor or maintenance engineer, a solid understanding of diesel power plants is always useful.

This workshop is designed to familiarize you with various aspects of diesel generating power plants for practical application. Examples are taken from various industrial standard practices regarding the construction, layouts, application and maintenance procedures followed for reliable and trouble free operation of diesel power plants. The various tests conducted during commissioning and maintenance checks to ensure proper and long term operation of diesel power plants are covered along with some essential systems such as fuel oil layouts, lube oil requirements and control circuitry.

Pre-requisites

Some working knowledge of diesel power plant and testing on electrical items may be of use, although this will be covered in the workshop. Real-life experience with diesel generating units and use of such equipment and hands-on testing will enable the workshop to be placed in context.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION

- Power generation methods
- AC power vs DC power
- Single phase and three phase AC power
- Prime movers
- Power plant types
- Diesel power plants
- Advantages of diesel power generation
- Engine types

DIESEL TECHNOLOGY AND CLASSIFICATIONS

- Basic engine processes
- Reciprocating and spark ignition engines
- Diesel and dual fuel engines
- Speed and service classifications

BASIC ENGINE DESIGN AND RATINGS

- Design characteristics and formulas
- Turbo charger
- Ambient conditions
- ISO ratings
- Performance, efficiency and engine speed
- Fuel combustion methods

FUEL OIL SYSTEMS AND LAYOUTS

- Crude oil, HSD, LDO and heavy fuels
- Economics of fuel selection
- Pressure and temperature characteristics
- Viscosity
- Specific heat and temperature
- Specific fuel consumption
- Filters, heaters, nozzles and igniters
- Emission control and storage requirements
- Fuel system layouts and components

LUBE OIL SYSTEMS

- Lube oil specification
- Lube oil consumption in diesel engines
- Typical lube oil system layouts
- Viscosity and temperature
- Lube oil filters and heaters

GENERATORS

- Principle of operation
- Major components
- Generator types
- Low voltage and medium voltage generators
- Typical circuitry
- Load types and generator sizing
- System earthing methods
- Faults and protection
- Performance evaluation and testing

DIESEL GENERATING SETS

- Coupling requirements
- Skid mounting
- Layout requirements
- Paralleling of multiple DG sets
- Standard control panels
- Interconnections

OTHER COMPONENTS

- Starting methods and characteristics
- Battery sizing
- Step load requirements
- Standby requirements
- Auto start and auto transfer schemes
- Auto transfer switches

DG PLANT LAYOUTS

- Industrial applications
- Power generation plant applications
- Single and multiple sets
- Fuel storage requirements
- Air intake system
- Exhaust system
- Auxiliary power requirements
- Typical power schemes

TESTING AND COMMISSIONING

- Factory tests
- Pre-commissioning checks and tests
- Performance monitoring
- Fuel and lube oil consumption checks

OPERATION AND MAINTENANCE

- Safety requirements
- Operation monitoring based on applications
- Maintenance techniques
- Spares and inventory management
- Inspection
- Engine overhaul and repair
- Troubleshooting

SUMMARY AND CLOSING

- Contact us for a FREE proposal.
ENERGY EFFICIENCY, DESIGN, ENGINEERING AND AUDITING

YOU WILL LEARN HOW TO:

- Establish an “energy savings strategy” for your organisation
- Put together practical energy efficiency plans
- Use the energy savings toolkit and checklist
- Conduct a simple energy audit
- Read and interpret data from measurement equipment
- Interpret and analyse case study data
- Improve employee working conditions and productivity
- Assist in the reduction of greenhouse gases
- Set demand-side energy management strategies
- Decide the importance of choices with energy suppliers

WHO SHOULD ATTEND:

- Energy managers
- Project and consulting engineers
- Electrical contractors and engineers
- Electrical inspectors and maintenance engineers
- Building service designers
- Electrical and instrumentation technicians
The Workshop

Reducing the energy costs at your facility must be one of the most effective and achievable strategies for lowering the operating costs. This workshop gives you the practical tools to identify and implement programs and projects to reduce energy consumption in the most effective and practical ways. You will be provided with the skills and latest knowledge on proven methods of making real savings in your energy bills. You will be greatly surprised at the levels of energy loss and the poor efficiency of some of the devices in your facility - some that consume power even when the facility is not operational. These factors are costing your organisation money. Energy bills are generally at least 20% of the running costs of a business, so reductions in these bills are directly responsible for better profits. This workshop teaches you the fundamental principles of energy efficiency by assessing wastage, cost of energy and looking at the benefits you will accrue from improving your facilities efficiency.

Pre-requisites
A working knowledge of basic engineering principles is required. Adequate industrial experience in operating and maintaining energy intensive equipment and processes will enable better appreciation of the topics discussed.

Practical Sessions
This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

You will perform calculations and examine case studies to practice many of the principles covered and have the opportunity to use software for some energy saving solutions.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training
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The Program

MANAGEMENT OVERVIEW OF ENERGY EFFICIENCY

WHAT IS ENERGY EFFICIENCY?
• Energy and environment
• Energy forms and conversion
• Energy sources and sinks
• Channelling waste energy into useful output
• Energy audit and principles

CASE STUDIES
• Schools, mines and factories
  Practical Exercises
  • Simple checklist on doing an energy audit

ALTERNATIVE ENERGY SOURCES
• Fossil fuels, green energy and fuel cells
• Alternatives - renewable energy and hydrogen

MAIN FORMS OF ENERGY
• Energy converted to electricity for direct use
• Electricity in metal smelting
• Use of fuels for motive power
• Direct use of fuels for heating applications
• Use of fuels as part of a process
• Conversion equipment and challenges

ELECTRICAL ENERGY GENERATION
• Electricity as the preferred energy carrier
• Conversion systems for electrical energy
• Commonly used fuels
• Improving conversion efficiencies
• Better equipment
• Waste energy recovery and process improvements
•Cogeneration for better efficiency
• Combined cycle process for gas turbines

ELECTRICAL ENERGY USAGE
• Sectors using the major portion of electricity
• Better efficiencies in electricity usage
• Uses of electricity
• Motive power
• Lighting, space heating and cooling

ENERGY EFFICIENT PRACTICES IN ELECTRICITY USE
• High efficiency motors
• Better T&D practices
• Role of power factor
• Motor rating and efficiency correlation
• Variable speed drives as energy-savers
• Lighting efficiency
• Efficient luminaires
• Use of daylight and intelligent buildings

ENERGY EFFICIENCY IN CLIMATE CONTROL APPLICATIONS
• Need for climate control
• Efficiency in heating and cooling
• Reducing heat loss
• Building design features to improve cooling
• The paradox of cooling
• Temperature reduction but no energy recovery
• Use of waste heat for cooling
• Comparison between compression refrigeration and absorption chillers

INTRODUCTION TO ENERGY AUDITS
• Know your process, fuels and major systems
• Compare energy usage
• Energy use and cost index
• Lighting and HVAC energy use
• Data forms and collection
• Walk-through inspections

AUDIT AREAS AND ESSENTIAL INSTRUMENTS AND SOFTWARE
• Building and HVAC systems
• Motor and boiler systems
• Water systems and lighting
• Heat recovery areas

FINANCIALS AND COSTINGS
• Energy audit reports and economic measures
• The time value of money
• Cost and benefit analysis
• Rate of return and life-cycle costing
• After tax cash flows

SUMMARY, OPEN FORUM AND CLOSING
CRITICAL POWER SUPPLY OPTIONS
AND PLANNING OF HIGH
AVAILABILITY SUPPLIES

YOU WILL LEARN HOW TO:

- Critically assess the different uninterruptible power supply options
- System design for high reliability power
- Deal with harmonics generated by loads
- Perform best practice design on critical power distribution systems
- Identify the level of failure-proofing for specific equipment

WHO SHOULD ATTEND:

- Automation engineers
- Control engineers
- Distribution planning engineers
- Electrical and instrumentation engineers
- Engineering managers
- Facilities managers
- Operators and technicians
- Plant engineers

Anyone actively involved with implementing or optimising a critical power supply system
The Workshop

Our dependence on electricity is growing and even a few seconds or minutes of power disruption has become unthinkable. An unscheduled interruption can cause immense damage and loss of life. While it is impossible to guarantee 100% availability of power at all points in any system, vulnerable sections can be provided with alternative critical power supply equipment to ensure reliable power availability, thereby avoiding the problems of power interruption.

This workshop shows you how to ensure reliable power supply to critical systems using various available options. The solutions can vary from the simple diesel generating set as standby sources to super conducting sag support systems. Nascent technologies like fuel cells have matured and are fast becoming mainstream solutions. Of course, all this comes at a price, which means that the solution must match the actual needs without excessive insurance and thereby optimise investments. This workshop will discuss how to save dollars by finding the right solution to your needs so that you invest just what is needed and where it is needed.

Another major aspect is to ensure that the critical power supply is itself very reliable. This will need suitable redundancies and a well-engineered distribution system so that when the need arises they cut-in and take over the load without any hitches. This workshop will also briefly look at the design issues involved in planning the distribution of critical power by deploying state-of-the-art control devices such as static transfer equipment.

If you are responsible for maintaining power availability in your facility, this workshop is something, which you simply cannot afford to miss. You will learn the basics of static transfer systems and how to implement them.

Pre-requisites

Working knowledge of electrical engineering and hands-on work with power distribution systems in a plant environment with critical processes is desirable. Real-life experience with critical power supply sources such as Uninterrupted Power Supply (UPS) systems will further enable the workshop to be placed in context.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

CRITICAL POWER NEEDS AND SOLUTIONS

- Problems arising from power failure in industries
- Tolerance for interruptions and voltage/frequency excursions
- CBEMA, IITC and ANSI voltage sensitivity curves
- Distinguishing between standby power, emergency power and critical power
- Different solutions for critical power needs
  - Sag support systems for transient disturbances-Electrical and electromechanical
  - Critical power supply systems to cater to outages
- Reliability assessment
  - What is MTBF?
  - What is MTTR?
- Arriving at overall reliability expectation from a critical power supply system

CRITICAL POWER SUPPLY EQUIPMENT

- Critical power supply
  - Stored energy systems using flywheel/compressed air
  - Rotary power supply systems
  - Battery-backed static UPS
  - Fuel cells as source of power
  - Stored energy systems
  - Battery UPS system for critical supply
  - Battery-backed UPS system
  - Fuel cells basics
  - Fuel cell applications for critical power
- Choosing the right option
  - What is the quantum of load that is considered critical?
  - What are the characteristics of this load (technical criteria)?
  - Power system reliability and cost of outage
  - Comparing the costs (upfront, operating both in short term and long term)

CONFIGURING A POWER DISTRIBUTION SYSTEM FOR CRITICAL LOADS

- Integrating normal and critical power needs in the distribution network
- Multiple units nearer the consumer vs. larger centralised units
- Capacity and voltage planning for critical power in large industries
- Sizing of critical power supply
- Paying attention to motor starting requirements and accompanying voltage sag
- Beware of harmonic producing loads and their effect on rated capacity of power supply
- Tackling harmonics produced by static UPS
- Typical distribution scenarios in large industrial systems for integration of critical power
- Ensuring that process does not abnormally terminate due to non-critical load interruption
- Safe shutdown requirements
- Control room power and escape route lighting
- High reliability systems- 4-tier model
- Use of redundant modules and impact on availability

STATIC TRANSFER SYSTEMS FOR CRITICAL POWER SUPPLIES

- UPS as a separately derived source
- Need for neutral isolation between input and output
- Multiple sources with independent neutral connections
- Basics of static transfer
- Static transfer applications in practical critical power systems
- Neutral management
- Comparing 3-pole and 4-pole static transfer equipment
- Standards governing static transfer systems
- EMC and performance compliance aspects

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL ELECTRICAL SAFETY TECHNIQUES FOR INDUSTRY

YOU WILL LEARN HOW TO:

- Identify the hazards in operating and carrying out maintenance work in different substations (including batteries)
- Identify the various statutory or legal regulations/acts
- Appreciate the basic theoretical aspects involved in electrical safety
- Understand the importance of proper design and selection of electrical equipment
- Gain a clear understanding of the procedures/practices adopted for safe working
- Appreciate the role of regular periodic inspection and planned/condition based maintenance
- Draw up procedures for reporting accidents and carrying out investigations

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Mechanical engineers
- Consulting engineers
- Electrical engineers
- Project engineers
- Maintenance technicians and engineers
- Power system protection and control engineers
- Building service designers
- Data systems planners and managers
- Electrical, mechanical and instrumentation technicians

Any staff working within an industrial environment will benefit from this training, all staff that may enter, pass by or have any direct or indirect contact with electrical infrastructure should attend.
The Workshop

A number of serious accidents and fatalities occur every year in industry due to accidents involving electricity, taking a huge financial and human toll. The dangers and risks from electrification, shock, explosions and arc blast can never be eliminated but you can take definite steps to protect yourself and your co-workers.

Safety should be built into the design of electrical equipment and followed up with proper installation, operation, maintenance and periodic inspection. Electrical safety is not just a technical issue. Accidents can only be prevented if appropriate safety procedures are developed and enforced. This includes complete familiarity with equipment and systems often imparted through structured training to each and every person who operates or maintains the equipment. In this workshop, we will take a look at the theoretical aspects of safety as well as the practical issues including the statutory and safety-training related aspects. This know-how will certainly enable participants to deploy appropriate safety procedures in their workplace and improve their safety record.

Practical Sessions

Throughout the workshop, participants will work through a number of practical exercises and case studies to support the theory presented during the workshop.

To gain full value from this workshop, please bring your laptop/notebook computer.

“Thoroughly enjoyed the workshop and was impressed with the instructor’s knowledge and experience.”

Stephen Miller, Energy Australia

The Program

PRINCIPLES OF SAFETY RULES
- Electrical hazards
- Requirements for safety
- Operative training
- Personnel levels of competency
- Safety documentation
- Work on live Systems, close to live systems

ELECTRICAL SHOCK AND METHODS OF SHOCK PREVENTION
- Shock - direct and indirect contact
- Touch and step potential
- Effects of shock on the human body
- The deadly combination of heights and electric shock
- Locations of increased shock risk
- Principles of shock protection
- First-aid for burns and electric shock
- Earth leakage circuit breakers
- Role of electrical insulation in safety

HAZARDS DUE TO ELECTRICAL ARcing AND HEATING
- Arc flash definition
- Arc blast
- Hazards due to arcing/flashover
- Effects of arc flash on humans - physiological effects, tissue damage, internal organ damage, burns, fibrillation, curable 2nd degree burn, arc blast pressure, sound pressure
- Reducing arc-flash hazards - minimise risk with good safety practice, consideration for new equipment, reduce the available fault current, increasing worker distance, faster tripping time
- Hazards from use of electrical equipment in explosive environment
- Hazards due to high temperature in electrical equipment

STATIC ELECTRICITY AND PROTECTION
- What is static electricity?
- Generation of charge
- Common examples of static build up
- Energy of spark and its ignition capability
- Dangers of static electricity build up
- Control of static electricity
- Static electricity danger in un-energised overhead lines
- Assessment of static risks and planning prevention

SAFETY ASPECTS IN ELECTRICAL EQUIPMENT DESIGN AND SELECTION
- Design of equipment for ensuring safety
- Equipment ratings and fault withstand capability
- Containing and deflecting arcs during equipment faults
- Role of equipment enclosures in ensuring safety-discussion on motor terminal boxes as an example
- Degree of protection and its significance in safety
- Damage due to overload or excessive fault current in electrical conductors
- Types of insulation and their temperature limits
- Protecting electrical systems by over current protective devices (relays, releases, fuses, circuit breakers)
- Detection of hot spots by infrared sensors or viewing devices
- Equipment selection-its contribution to safe operations
- In-built earthing devices and interlocks
- Special requirements to be observed in restrictive conductive locations (IEE Wiring Regulations)

SAFE OPERATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT
- Key safety issues in O&M of electrical installation
- Policies of operational and safety locking, safety notices and remote operation
- Use of warning signs for operation and maintenance
- Personnel protective equipment
- Work on underground cable systems
- Use and upkeep of safety appliances in substations and other electrical premises
- Gas safety and ventilation
- Switching schedules
- Electrical testing procedures
- Need for periodic inspection and maintenance for safe operation of electrical equipment

EARTHING AND BONDING
- Objectives of earthing
- Earthing of power supply systems and its safety implications
- Role of earthing of equipment enclosures (protective earthing) in human safety
- Neutral earthing of electrical supply systems
- Thermal capability
- Use of protective metallic conduits for earthing conductors
- Objectives of bonding
- Equipment bonding

SUBSTATION SAFETY
- Safety while working in outdoor switchyards and overhead lines
- Special precautions when working on switch gear
- Substation check list
- Fire protection in substations

SAFETY IN BATTERY INSTALLATIONS
- Hazards involved in lead-acid battery installations
- Premises used for housing lead acid batteries
- Transportation and storage
- Installation and commissioning
- Charging and storage
- Dismantling and disposal
- Protective clothing

REGULATIONS GOVERNING WORKPLACE SAFETY (COUNTRY-SPECIFIC)
- Evolution of safety-related legislation
- Safety at work act
- Electricity at work regulations
- Electricity supply regulations
- Electricity usage regulations
- Special regulations for hazardous areas (ATEX or other applicable rules)
- Codes of practice (non-mandatory guidelines)

ORGANISATIONAL REQUIREMENTS OF SAFETY
- Statutory requirements for working in electrical installations
- Competency and authorisation
- Responsibility of employer and employee in regard to electrical safety at work
- Safety organisation within the company
- Accident reporting, investigation, analysis and prevention
- Safety awareness promotion among workforce and importance of appropriate training

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EMERGENCY POWER SUPPLIES: ELECTRICAL DISTRIBUTION DESIGN, INSTALLATION AND COMMISSIONING

WHAT YOU WILL LEARN:

- Understand the level of failure-proofing that specific equipment may require
- Know the various available options of critical power supply systems
- Evaluate options objectively
- Specify the solution that is the best and most economical for your needs
- Design a suitable power distribution system for emergency power
- Manage the installation, commissioning and maintenance of the distribution system

WHO SHOULD ATTEND:

- Power System Protection and Control Engineers
- Electrical Engineers
- Maintenance Engineers
- Building Service Designers
- Project Engineers
- Systems Planners and Managers
The Workshop

Power is becoming a commodity that cannot be taken for granted. Our dependence on electricity is growing and even a few hours of power disruption has become unthinkable. While it is impossible to guarantee 100% availability of power at all points in any system, vulnerable sections can be provided with alternative emergency power supply to ensure more reliable power availability, thereby avoiding the problems of interruption. This workshop has the objective of teaching the basic facts about ensuring reliable power supply to critical systems using various available options. The solutions can vary from the simple diesel generating set as standby sources to superconducting energy storage systems. Newer technologies like fuel cells are now available and are fast becoming mainstream solutions. This workshop will discuss how to save costs by finding the right solution to your needs so that you invest just what is needed and where it is needed. This workshop will also briefly look at the design issues involved in planning the distribution of emergency power.

Pre-requisites

Working knowledge of electrical engineering and hands-on work with power distribution systems in a plant environment with critical processes is desirable. Real-life experience with diesel generating units and other critical power supply sources such as Uninterrupted Power Supply (UPS) systems will further enable the workshop to be placed in context.

Practical Sessions

This is a practical hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

POWER QUALITY
- Electrical parameters
- What is power quality?
- Problems - effects and mitigation
- Reliability
- Available solutions and making the right choices

VOLTAGE VARIATIONS
- Voltage amplitude
- Voltage sag and its effects
- Equipment sensitivity
- Control measures
- Voltage improvements, fluctuations and flicker

CONTINUITY OF POWER
- Power failure
- Needs of equipment
- Understanding failures
- Interruptions and voltage/frequency excursions
- Uninterrupted, emergency and standby power
- Redundancy and automation

DIESEL TECHNOLOGY AND CLASSIFICATIONS
- Basic engine processes
- Reciprocating engines
- Spark ignition engines
- Diesel and dual fuel engines
- Speed and service classifications

BASIC ENGINE DESIGN AND RATINGS
- Design characteristics and formulas
- Turbo charger
- Ambient conditions
- ISO ratings
- Performance and efficiency
- Engine speed
- Fuel combustion methods

CONVENTIONAL UNINTERRUPTED POWER SUPPLY
- Main classification
  - Rotary and static
- Rotary, advanced and hybrid UPS systems

STATIC UPS SYSTEMS
- Configuration
- Types of static UPS systems
- UPS metering, indications, alarms and protection
- Power quality and UPS
- UPS configurations
- Redundant UPS configuration and building high reliability power supplies

NEW TECHNOLOGIES
- Problems in existing technologies
- Maintenance issues on prolonged operation
- Environmental problems
- Fuel cell
- Micro turbine

FUEL CELL
- Historical perspective
- Operating principle
- Types of cells available and comparison
- Fuel cell system for backup power overview
- Comparison with battery powered UPS
- Case study

MICRO TURBINE
- Conventional gas turbine power plant
- Efficiency issues and combined cycle power generation
- Comparison of micro turbines with conventional turbines
- Typical micro turbine based standby power unit
- Case study involving critical process application

CONFIGURING POWER DISTRIBUTION SYSTEM FOR EMERGENCY LOADS
- Integrating emergency and critical power needs in the distribution network
- Multiple units nearer the consumer vs. larger centralised units
- Paying attention to motor starting requirements and accompanying voltage sag
- Typical distribution scenarios in large industrial systems for integration of emergency power
- Automation of starting, load change over and shutdown

PARALLEL OPERATION AND TIE PROTECTION
- Parallel operation between emergency sources
- Load sharing between sources
- Parallel operation of emergency source with normal source
- Utility stipulations and local codes
- Issue of tie-line separation
- Static transfer switch and its application in critical power installations

SUMMARY, OPEN FORUM AND CLOSING

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POWER CABLES: OPERATION, MAINTENANCE, LOCATION AND FAULT DETECTION

WHAT YOU WILL LEARN:
Participants can use the skills and knowledge gained in this course to select and operate Power Cables and to perform testing and preventative maintenance on power cable to ensure safety and longer equipment life.

WHO SHOULD ATTEND:
Anyone associated with power cable operation, maintenance, location and fault detection techniques. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting.
Typical personnel who would benefit are:
- Operations Personnel
- Electrical Maintenance Technicians and Supervisors
- Process Control Engineers
- Service Technicians
- Maintenance Personnel
Faults in underground cable may cause loss of supply to customers and loss of revenue for suppliers so it is imperative that the fault location process is efficient and accurate to minimise excavation time, which results in reducing inconvenience to all concerned. For fault locating to be efficient and accurate technical staff need to have expert knowledge accompanied with experience in order to attain service reliability.

This course is designed to ensure that those responsible for the selection, laying, operation, maintenance and monitoring of power cables understands the technical issues involved and comply with relevant specifications and requirements.

**Pre-requisites**
A fundamental knowledge of basic electrical concepts would be useful.

### Practical Sessions
- Study of manufacturer’s specifications and data of typical cable types
- Examples of selection and sizing of cables in actual applications
- Study of manufacturer’s information for different types of MV cable accessories
- Case studies of investigations of cable systems for residual life assessment
- Study of manufacturer’s application notes of typical test instruments

*To gain full value from this workshop, please bring your laptop/notebook computer.*

### On-Site Training
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### The Workshop

### INTRODUCTION
- Historical perspective
- Development of cables for LV and HV systems
- Role of cables in modern power distribution systems
- Cable accessories and their role
- Cable failures and installation practices
- Detection of faults

### BASIC THEORY
- Construction
- Conductor materials and configurations
- Insulation materials
- Use of screen in HV cables
- Use of armor for earth continuity and mechanical protection
- Special and single core cables
- Voltage rating
- Stress distribution in single core and multicore power cables
- Electrical breakdown of insulating materials
- HV cables using XLPE insulation
- Treeing in XLPE and need for end sealing of cables
- Manufacturing process
- Standards for cables

**Practical Session**

### SELECTION OF CABLES AND INSTALLATION
- Criteria for selection
- Cable sizing
- Installation - directly buried
- Installation - conduits
- Installation on structures
- Special needs Eg. bending radii

**Practical Session**

### JOINTS AND TERMINATIONS
- Basic approach
- Broad classification
- Comparative merits
- Pre-fabricated
- Site fabricated
- Additional requirements of outdoor terminations
- Reconstitution of cable properties
- Special joints
- Mechanical protection
- Stress control

**Practical Session**

### JOINTING AND TERMINATIONS PRACTICE
- Kits for joints and terminations
- Shelf life issues
- Matching diameter of insulated conductor with kit specifications in pre-fabricated kits
- Preparation of cable
- Connection
- Reconstitution of cable properties
- Continuity and earthing aspects
- Sealing
- Healthiness
- Installation aspects for joints

### COMMISSIONING AND PERIODIC TESTING
- Review of codes for testing requirements
- Drum length checks
- Post-installation checking
- Pre-commissioning and periodic tests
- Tests as tools for condition monitoring and early failure alarm
- HV tests using DC and very low frequency AC
- Partial discharge tests and mapping of results
- Dielectric dissipation factor measurements
- Micro destructive and non-destructive tests for life assessment
- Operation and maintenance of cables

**Practical Session**

### FAILURE MODES AND FAULT DETECTION
- Types of failures
- Reasons for failures
- Fault location
- Electrical tests for detection of cable faults
- Safety issues in fault location
- Analysis of failures

**Practical Session**

### NEW TRENDS IN CABLE TECHNOLOGY
- Increasing preference to underground cables
- New technologies for very high capacities and voltages
- EHV XLPE in sub transmission systems
- High temperature superconductivity in cables

**SUMMARY, OPEN FORUM AND CLOSING**
PRACTICAL ELECTRICAL WIRING STANDARDS - - IEE BS 7671:2008+A1:2011 EDITION

WHAT YOU WILL LEARN:

- Up to date information and training on the current edition of BS7671:2008+A1:2011, requirements for electrical installations
- In depth teaching on all aspects of the regulations and their application with many practical examples and sample design calculations
- References to safety, maintenance, inspection and testing
- The course also provides a summary of some of the basic principles necessary for a good understanding of electrical installation technology

WHO SHOULD ATTEND:

- Building services engineers
- Electrical apprentices
- Electrical design staff
- Electrical engineers
- Electrical trades persons
- Engineering managers
- Graduate electrical engineer trainees
- Maintenance and shutdown planning staff
- Maintenance managers
- Private electrical contractors
The Workshop

INTERNATIONAL SEMINAR ON IET WIRING REGULATIONS
22nd-23rd April, 2009

The Workshop

Internationally there is steady progress towards alignment of the electrical wiring standards for low voltage installations. This is reflected in the IEC standard 60364, the European Harmonisation Document HD 60364 and the UK “IET Wiring Regulations” 17th edition, now also known as British Standard BS7671:2008+A1:2011, all of which share a common format.

Each day will be divided into sessions with practical examples of each of the concepts discussed. Delegates will have the opportunity to raise relevant issues and debate these in the sessions.

The programme below sets out the various sessions and the content of the sessions. Delegates should note that the order of the sessions and content will be varied according to the needs of the delegates. Practical worked examples will be interspersed with the slides used. There is always time during coffee, lunch and tea breaks for further discussion.

Pre-requisites

You will need a fundamental understanding of electrical systems. We will provide this material to you if you feel you would like some further pre-course reading.

Please bring a calculator (or computer) and pen along to the course to assist with the calculations.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. There will be at least eleven exercises (with many sample calculations and designs to be undertaken) to re-inforce the knowledge gained including an in-depth study on the second day.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

INTRODUCTION TO REGULATIONS
• Structure of international and UK wiring regulations
• Foundation electrical principles and terminology
• Scope of regulations
• Requirements for safety

PROTECTION FOR SAFETY
• Shock
• Basic and fault protection
• Effects of shock on the human body and livestock (IEC 60479)
• Electrical hazards
• Calculation of disconnection times
• Voltage disturbances and protection against overvoltage
• Operating gangways
• Measures against electromagnetic disturbances

CABLE PROTECTION
• Over-current
  - Cable sizing
  - Neutral conductors
• Selecting protective devices
• Calculation of adiabatic heating effect
• Effect of harmonic currents – thermal effects
• Parallel cables

SELECTION AND ERECTION OF EQUIPMENT
• Wiring systems
• Switchgear
• Characteristics and limitations of fuses and circuit breakers
• Breaking capacity
• Co-ordination and discrimination between devices
• Calculation of fault levels

EARTHING ARRANGEMENTS
• Calculation of protective conductor sizes
• Bonding requirements
• Supplies for safety services

SPECIAL INSTALLATIONS OR LOCATIONS
• Locations of increased shock risk, including:
  - Medical locations
  - Bathrooms
  - Swimming pools and fountains
  - Saunas
  - Confined spaces

INSPECTION AND TESTING
• Test Instruments
• Certification including reference to new documentation

MAINTENANCE CONSIDERATIONS

SAMPLE DESIGN CALCULATIONS

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL ELECTRICAL WIRING STANDARDS - AS/NZS 3000:2007

YOU WILL LEARN HOW TO:

- Identify the various sections and requirements of the standards
- Understand these requirements and apply them in your day-to-day functioning
- Appreciate the importance of fulfilling the requirements for safe use of electrical equipment and systems
- Have a clear knowledge of earthing and its importance in safety
- Make simple calculations to check the adequacy of conductors and protective earthing components to ensure safe operation
- List the periodic checks and verification measures to be carried out in an electrical installation as mandated by the standard

WHO SHOULD ATTEND:

- Building service designers
- Consulting engineers
- Data systems planners and managers
- Electrical and instrumentation technicians
- Electrical contractors
- Electrical engineers
- Electrical inspectors
- Electricians
- Instrumentation and control engineers
- Maintenance engineers
- Power system protection and control engineers
- Project engineers
- Safety professionals
The Workshop

This workshop aims to familiarise the participants with the requirements laid down in the standard AS/NZS 3000:2007, commonly known as Australia-New Zealand Wiring Rules. For those installations covered in the scope of this standard, its provisions are mandatory and must be followed. Any engineer involved in planning and design of electrical systems, their installation or maintenance must have a clear idea about the various requirements contained in the standard.

The primary purpose of this standard, like many of its various other equivalent national standards, is to ensure the safety of personnel against the dangers arising from the use and handling of electrical equipment and appliances. The introductory modules of this workshop outline the basic principles that should be understood for a better appreciation of the standard. These include modules, which illustrate the calculation for the power demand of a system and the computation of earth fault current as discussed in the appendices of the standard, which are informative in nature but yet are very important in making an electrical system safe for operation. The actual provisions of the standard are then discussed in detail in the subsequent modules.

Pre-requisites

A working knowledge of basic electrical engineering principles is required. Experience in planning, installation, and maintenance of electrical equipment and systems will enable the workshop to be placed in context.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Please bring your copy of the AS/NZS3000:2007 Wiring Rules to the workshop.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION
• Evolution of electrical distribution systems
• Electrical insulation
• Current limits of conductors based on insulation
• Current ratings based on installation methods
• Earthing and its importance in safety
• Methods adopted for system earthing
• Earth fault sensing methods
• Other hazards
• AS/NZS 3000:2007 preface and contents

AS/NZS 3000 STANDARD-SCOPE AND DEFINITIONS
• Application areas
• Learning a few terms
• Alterations, additions and repairs alternative arrangements
• Protection for safety
• Design of an electrical installation
• Selection and installation of electrical equipment
• Inspection and testing

SELECTION AND INSTALLATION OF SWITCHGEAR AND CONTROLGEAR
• Arrangement and control of electrical installation
• Devices for isolation and switching
• Fault protection
• Devices for protection against overcurrent and short circuit
• Coordination and discrimination
• Protection against earth leakage current, overvoltage and undervoltage
• Switchboards
• Circuit arrangements, protection coordination, limits of LV feeder lengths for proper earth fault detection (as per AS/ NZS 3000:2007)
• Calculating the demand of electrical systems for proper conductor sizing (as per AS/NZS 3000:2007)
• The degree of protection of an item of enclosed equipment (as per AS/NZS 3000:2007)

PRACTICAL WORK – CALCULATIONS

SELECTION AND INSTALLATION OF WIRING SYSTEMS
• Types of wiring systems
• External influences
• Current-carrying capacity
• Sizing of conductors
• Voltage drop considerations in sizing
• Electrical connections
• Identification of wires and cables
• Installation
• Enclosure of cables
• Underground wiring systems
• Aerial wiring systems
• Cables supported by a catenary
• Emergency systems
• Busbar trunking systems and rising mains
• Earth sheath return system
• Sinking depth and sizes of support structures for private aerial lines (as per appendix D of AS/NZS 3000:2007)
• Application of the WS classification of wiring systems in accordance with AS/ NZS 3013 (as per appendix H of AS/NZS 3000:2007)

PRACTICAL WORK – CALCULATIONS

SELECTION AND INSTALLATION OF APPLIANCES AND ACCESSORIES
• Protection against thermal effects
• Socket outlets
• Lighting equipment and accessories
• Cooking appliances
• Heaters
• Motors
• Capacitors
• Transformers
• Batteries

REQUIREMENTS FOR EARTHING IN ELECTRICAL INSTALLATIONS
• Earthing arrangements
• Multiple Earthed Neutral (MEN) system
• Earthing conductors
• Earthing system components
• Equipment earthing and equipotential bonding
• Earth fault loop impedance
• Earthing requirements for other (non-electrical) systems

REQUIREMENTS FOR SPECIAL ELECTRICAL INSTALLATIONS/LOCATIONS
• Locations containing baths, showers or other fixed water containers
• Swimming pools, paddling pools and spas
• Locations containing sauna heaters
• Refrigeration rooms
• Locations where general hosing down operations are carried out
• Fountains and water features
• Extra-low voltage electrical installations
• High voltage electrical installations
• Hazardous areas
• Emergency systems
• Requirements for electrical installations operating at high voltage as per appendix K

TESTING AND VERIFICATION REQUIREMENTS OF THE STANDARD
• Visual inspection
• Testing
• Common inspection and test methods for low voltage, Multiple Earthed Neutral (MEN) electrical installation as per AS/NZS 3017
• Periodic verification of existing electrical installations of low voltage AC supply system as per AS/NZS 3019

SUMMARY, OPEN FORUM AND CLOSING

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ELECTRICAL DRAWINGS
AND SCHEMATICS

WHAT YOU WILL LEARN:

• Various types of electrical drawings and their applications
• Planning electrical drawings, selecting a proper (paper) size for each type of drawing and the most appropriate scale to be used
• Use of industry-standard symbols/representation approach
• Formulation of company standards for drawing naming and preparation
• Drawing office organisation and workflow procedures
• Use of CAD tools and linkage to CAM for manufacturing
• Challenges in the management of CAD drawings and future possibilities

WHO SHOULD ATTEND:

• Design engineers
• Design technicians
• Drawing office managers
• Facility managers and technicians
• Installation engineers
• Maintenance engineers
• Maintenance technicians
• Manufacturing engineers
• Project engineers
• Testing engineers
The Workshop

It is often said that drawing is engineers' language. Drawings are used to communicate and share information between different teams of engineers; the design engineer who conceptualises an equipment or system, the production engineer who plans the steps in manufacturing the required components and subsystems, the assembly engineer who puts the components together, the testing engineer who tests the complete system, the installation engineer who installs the system or equipment and the maintenance engineer who is responsible for its upkeep. To all these engineers with diverse backgrounds and expertise, a drawing should convey precise and identical information. This calls for standardised methodologies, conventions and approach in preparing drawings. This workshop will cover all these aspects with respect to engineering drawings in general and electrical drawings in particular. Various types of electrical drawings and their application, the steps in planning a drawing, selection of drawing size and scale, use of standardised symbols etc will be described in detail with commonly used examples from industry practice.

Computer Aided Drafting (CAD) has brought about a major change in the way drawings are prepared and has caused a phenomenal improvement in drawing office productivity. No organisation can afford to use the older manual methods of preparing drawings today. Apart from reuse and easy modification of existing drawings to create new ones, complete or partial automated drawing preparation has also become a possibility. The workshop discusses the advances made in this field and the links between drawings and manufacturing using 3D visualisation tools and Computer Aided Manufacturing (CAM) approach. Use of CAD-CAM tools presents its own challenges in the way drawings are stored, shared between different groups of users and revised for reuse. The workshop also covers these aspects and takes a look at future possibilities in the way drawings will be used to disseminate information.

Pre-requisites
A basic knowledge of electrical engineering is expected. It will be assumed that the participants use some types of electrical drawings in their day-to-day work but no previous exposure to drawing preparation is essential, as the course starts right from the basics.

The Program

ENGINEERING DRAWINGS - AN INTRODUCTION
- Drawings – their relevance to engineering
- Origin of worldwide standards in electro-technology
- Purposes served by different types of drawings
- Standards in a drawing office
- Organisation of a typical drawing office
- Printing and distribution – different options for making multiple copies

COMPONENTS OF A DRAWING, DRAWING SIZES AND SCALES
- What is a typical engineering drawing made up of?
- Various categories of electrical drawings
- Planning a drawing
- Sizes/arrangement
- Single and multi-sheet drawings
- Use of drawing scales
- Multi-scale drawings
- Title block in a drawing and what should a title block contain?
- Legend block
- Bill of materials block
- Drawing notes block
- Revision history, revision numbering and use of revision marks

SYMBOLS USED IN ELECTRO-TECHNOLOGY AND GOVERNING STANDARDS
- Which are the drawings that need symbols?
- Symbols as per electro-technology standards – particularly IEC
- Non-standard symbols – when and why?
- Use of colours and line types in representing various services
- Company standards for drawings – why?

SINGLE LINE AND 3-LINE DIAGRAMS
- Purpose
- Typical examples
- Use of symbols
- The differences between single-line and 3-line diagrams
- Applications
- Conventions used
Practical exercises involving reading and interpretation of single line diagrams

SCHEMATIC DIAGRAMS
- Purpose
- Typical examples
- Use of symbols
- Applications
- Schematics spread over a number of sheets
- Cross-referencing between coils and contacts
Practical exercises involving reading and interpretation of schematic drawings

LOGIC DIAGRAMS
- Purpose
- Typical examples
- Use of symbols
- Applications
- Logic diagrams spread over a number of sheets
- Cross-referencing
Practical exercises involving reading and interpretation of logic diagrams

CABLING AND WIRING DRAWINGS
- Purpose
- Typical examples
- Sub types of cabling drawings
- Cable layouts
- Cable schedules
- Tray/conduit schedules
- Control cable interconnections
- Panel internal wiring
- Applications
- Conventions used
Practical exercises involving reading and interpretation of cabling drawings

LAYOUT DRAWINGS
- Purpose
- Typical examples
- Sub types of layout drawings
- Electrical room layouts
- Lighting and lighting conductors layouts
- Earthling layouts
- Cabling layouts
- Applications
- Conventions used
Practical exercises involving reading and interpretation of layout drawings

ADVANCES ARISING FROM COMPUTER AIDED DRAFTING (CAD)
- Drawing office revolution by CAD and the role of PC based CAD applications
- 2-D and 3-D CAD applications and links to CAM
- Drawing to true dimensions in CAD applications
- Use of symbols, attributes and symbol libraries
- Automated bill of material generation from a CAD drawing
- Information sharing on multi-disciplinary drawings
- Concept of layers and their use in sharing information
- Automation of drawing through programming
- Linking imagery with drawings – GIS related applications

MANAGEMENT OF DRAWINGS
- Planning and assigning of drawings
- Need for drawing numbering standards
- Drawing process flow
- Revision control and ownership of drawing
- Comments and their marking
- Drawing management system for work flow control
- On-line distribution of drawings - the end of the era of paper drawings?
- Drawing as a database for engineering and construction – the future

SUMMARY, OPEN FORUM AND CLOSING
SOUTH AFRICAN STANDARD SANS 10142
- THE WIRING OF PREMISES

WHAT YOU WILL LEARN:

- The role of the Occupational Safety and Health (OSHA) standards
- The necessity of international and national standards and their hierarchical relationships
- An introduction and elucidation of the SANS 10142:1 standards
- Basics of electrical power distribution systems
- Role and functioning of the different components of power distribution systems
- Simple calculations of equipment and rating requirements
- Safety requirements in power distribution systems
- Electrical system protection, bonding and earthing practices
- Electrical system and equipment operational and safety installation practices
- The nature, identification and mitigation of electric shock hazards in electrical distribution systems
- Verification and certification requirements for installations

WHO SHOULD ATTEND:

A workshop designed to teach electrical and instrumentation personnel, who have prior knowledge of electrical engineering. This workshop is a "must have" for those working in the residential, commercial, or industrial electrical industry. Each article of the code is thoroughly discussed and reviewed in easy-to-understand language.
Electricity has long been recognised as a serious workplace hazard. SANS electrical standards are designed to protect employees exposed to dangers such as electric shock, electrocution, fires, and explosions. This unit standard is intended for use in the training of electricians and covers a basic understanding of the framework of standards, which govern their work in South Africa.

This workshop is designed to provide up to date information and training on the latest edition of South African Standard SANS 10142 – ‘The Wiring of Premises’. With references to safety, maintenance, inspections, testing, and wiring of premises, it provides a summary of some of the basic principles necessary for a good understanding of electrical installation technology. It is compulsory for each user to follow the instructions given by authorised person to obtain the necessary certificate of compliance.

Pre-requisites:
Fundamental knowledge of basic electrical engineering.

**Practical Sessions**

- Study of surge protection requirements
- Harmonic correction
- Earthing of information technology equipment
- Assessment of load in domestic installations
- Cable sizing considering correction factors for installation
- Voltage drop calculation
- Conduit selection
- Testing documentation
- Compliance documentation

To gain full value from this workshop, please bring your laptop/notebook computer.

**On-Site Training**

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### DISTRIBUTION SYSTEM OVERVIEW

- Historical perspective of growth of 3 phase AC electrical systems
- Generation, transmission and distribution
- Transformers
- Switching equipment
- Circuit breakers LV and HV
- Dangers of electricity
- Need for safety in operation and maintenance

### SAFETY REQUIREMENTS OF ELECTRICAL INSTALLATIONS - BASICS (PARTS 1 AND 2)

- Electric shock
- Earthing and bonding for safety
- System classification based on earthing
- Safe clearances
- Arc danger in electrical installations
- Protection against arc faults
- Importance of isolation
- Insulation
- Enclosures of electrical equipment (IP ratings)
- Role of electrical protection
- Protection against surge voltages
- Harmonics – fundamentals and need for harmonic control
- Designing for safety
- Role of periodic maintenance and safety procedures and safety education
- Certification and authorisation

### INTRODUCTION TO SANS 10142 STANDARD

- Need for standards in industry
- Objectives of SANS 10142
- Overview of the standard
- Scope and exclusions
- Applicability of amendments to the standard in contracts
- Compliance with acts for occupation health and safety
- Future development – part 2 for HV installations
- Mandatory and informative requirements of the standard
- Information given under annexure to the standard
- Comparison with IEC and UK codes of wiring

### FUNDAMENTAL REQUIREMENTS

- Safety stipulations
- Basic requirements of electrical systems and wiring
- System characteristics
- Harmful effect of equipment on electrical systems
- Derating for altitudes exceeding 2000m
- Special requirements for medical location
- Safety by extra low voltage systems and special requirements

### INSTALLATION REQUIREMENTS (PARTS 1 AND 2)

- General circuit arrangements
- Current-carrying capacity of conductors and cables
- Installation of conductors and cables
- Positioning and fixing of cables
- Rigid and flexible wire ways
- Distribution boards
- Protections against excessive currents and earth leakage
- Circuit breakers and their use as disconnector
- Main switch disconnectors
- Disconnection of neutral
- Fuses
- Earthing and consumer’s earth terminal
- Bonding
- Requirements for lightning circuits
- Socket outlets
- Requirements for wiring of fixed appliances

### SPECIAL LOCATIONS AND INSTALLATION (PARTS 1 AND 2)

- Bathrooms, showers and spas
- Swimming pools, paddling pools and ornamental pools
- Saunas
- Construction and demolition sites
- Agricultural and horticultural locations
- Caravan parks, mobile homes and marinas
- Medical locations
- Temporary installations
- Extra low voltage lighting installations
- Stage and theatre equipment
- Safety and emergency lighting
- Alternative supplies
- High-voltage (HV) apparatus
- Hazardous locations
- DC system earthing

### VERIFICATION AND CERTIFICATION OF INSTALLATIONS

- Responsibility
- Installation characteristics
- Electricity supply system
- Prospective short-circuit current
- Inspection
- Testing
- Certificate of compliance

### SUMMARY, OPEN FORUM AND CLOSING
ELECTRICAL MAINTENANCE
FOR ENGINEERS AND TECHNICIANS

WHAT YOU WILL LEARN:

• A practical toolkit of know-how on latest testing and maintenance requirements
• Grasp the latest updates in cable testing and technical skills in EPM programming
• Understand the operation of electrical motors, transformers, switchgears, UPS, SCADA and circuit breakers
• Practical experience in MV and HV testing, transformer troubleshooting and fire protection measures for large transformer installations
• Design tips and tricks in motor and circuit breaker cleaning, testing and installations
• How to detect faults in cables and motors
• Skill yourself up as the local guru in electrical maintenance and testing

WHO SHOULD ATTEND:

• Consulting engineers
• Design engineers
• Designers
• Electrical engineers
• Electronic technicians
• Instrumentation and control engineers/technicians
• Plant managers
• Process control engineers
• System engineers
• System integrators
• Test engineers
The Workshop

We have taken all the latest techniques and know-how relating to electrical maintenance and distilled this hard-hitting workshop so that you can update yourself in this fast-moving and powerful area. This workshop will also update you with the latest information on the maintenance and installation aspects of cables, substations and switchgear, transformers, circuit breakers and motors. You will become familiar with the latest techniques in safety operations of the above-mentioned electrical equipment.

The section on Electrical Preventive Maintenance (EPM) within the program covers the key aspects of EPM and its benefits. The electrical drawing and schematics area discusses the various types of drawings logic diagrams, ladder diagrams, cabling and wiring diagrams etc.

Safety is a very important aspect of electrical maintenance and equipment needs to be inspected and maintained according to the relevant international regulations. In this workshop the basic concepts related to safety rules and hazards are covered in detail with a separate section on inspection procedures.

Special focus has been given to the maintenance and asset management of switchgear. We also look at the testing procedures for major electrical equipment. A section is dedicated to covering special aspects of the installation of large power transformers and fire protection measures taken while installing them. A section on troubleshooting of transformers is also included.

This course also covers the new approaches of fault finding, maintenance, testing and troubleshooting of electric motors. As well as a section on installation and fault detection for cables.

Grounding techniques, types of faults and their effects, effects of inadequate grounding and inspection, concepts of SCADA, testing and maintenance of SCADA are covered in detail. We have also focused on issues with power quality, the role of the UPS in maintaining power quality, installation and maintenance of UPS, types of relays and relay maintenance.

Pre-requisites:
Delegates will need a general understanding of electrical systems.

Please bring a calculator (or computer), pens and notepaper along to the course to assist with the calculations and practical exercises.

Practical Sessions

This is a practical hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION

ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM
• EPM and its benefits
• Energy conservation
• Planning an EPM program
• Personal safety
• Equipment loss
• Production economics
• Main parts of an EPM program
• Programmed inspections
• Recordkeeping
• Training for safety and technical skills

ELECTRICAL DRAWINGS AND SCHEMATICS
• Single line and 3 line diagrams
• Schematic diagrams
• Logic diagrams
• Ladder diagrams
• Cabling and wiring diagrams

ELECTRICAL SAFETY TECHNIQUES
• Principles of safety rules
• Basic theory of electrical safety
• Static electricity and protection
• Hazards due to electrical arcing and heating
• Inspection of electrical systems for safety

SUBSTATION COMPONENTS, MAINTENANCE AND ASSET MANAGEMENT OF SWITCHGEAR
• Substation types
• Substation components
• Switchgear diagnostic techniques
• Substation battery conditioning and monitoring
• Circuit breaker measurement
• Maintenance and asset management of switchgear

PRACTICAL MV AND HV TESTING OF ELECTRICAL EQUIPMENT
• Introduction
• Insulation testing
• High potential tests
• Oil testing
• Testing of transformers
• CT testing
• VT testing
• Ductor testing
• Tests on other major equipment
• Field tests

TRANSFORMERS
• Installation of transformers
• Special aspects of installation of large power transformers
• Fire protection measures for large transformer installations
• Transformer troubleshooting

MOTOR PROTECTION, CONTROL AND MAINTENANCE
• Protection of motors
• Installation and fault finding
• Motor failure analysis
• Testing
• Maintenance and cleaning

CABLES
• Cable installation
• Failure of cables and fault detection
• Visual inspection
• Cable testing

POWER QUALITY
• Introduction to power quality
• Installation guidelines

UNINTERRUPTED POWER SUPPLY (UPS)
• Static-UPS systems
• Testing
• Periodic inspection and maintenance of UPS batteries

SAFE OPERATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT
• Introduction
• Key safety factors in operations and maintenance of electrical installations
• Isolation during maintenance of electrical installations
• Visual checks for safety
• Monitoring hot spot to improve safety
• Earthing for safety during maintenance
• Need for periodic inspection and maintenance
• Emergency first aid training

GROUNDING AND GROUND FAULT PROTECTION
• Need for protection
• Basic requirements of protection
• Types of protection
• Faults, types and effects
• Causes of inadequate grounding
• Grounding system inspection
• Testing and monitoring
• Maintenance of grounding system
• Grounding for safety during maintenance
• Use of personal protective equipment
• Fault finding and troubleshooting

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)
• Introduction
• SCADA components
• Monitoring
• Testing and maintenance

OTHER TOPICS
• Relay types and maintenance
• Portable electric tools
• Maintenance reports

SUMMARY, OPEN FORUM AND CLOSING
INSTALLING, PROGRAMMING AND COMMISSIONING OF POWER SYSTEM PROTECTION RELAYS AND HARDWARE

WHAT YOU WILL LEARN:

• Fundamentals of power system protection
• Key electrical system protection techniques including fault analysis
• How to calculate basic fault currents flowing in any part of your electrical system
• Key technologies and principles behind protective devices
• Architecture of the modern numerical (or microprocessor based) relay
• How to configure the various relays
• How to apply the modern relays to your distribution network
• How to assess and manage relay settings
• Typical problems and solutions with modern power system relays
• How to improve your electrical system protection against faults and other disturbances

WHO SHOULD ATTEND:

• Electrical engineers
• Project engineers
• Design engineers
• Instrumentation and design engineers
• Electrical technicians
• Field technicians
• Electricians
• Plant operators
The Workshop

The continuity of the electrical power supply is very important to consumers especially in the industrial sector. Protection relays are used in power systems to maximise continuity of supply and are found in both small and large power systems from generation, through transmission, distribution and utilisation of the power. A good understanding of their application, operation and maintenance is critical for operating and maintenance personnel.

In this workshop, you will gain a thorough understanding of the capabilities of power system protection relays and how they fit into the overall distribution network. The practical sessions covering the calculation of fault currents, selection of appropriate relays and relay coordination as well as hands-on practice in configuring and setting of some of the commonly used types of protection relays used in industry will give you an excellent understanding. Simulation software and real relays (but at safe voltages) will be used to give the participants practical experience in setting up and configuring the various power parameters. Both electromechanical and microprocessor relays will be used to demonstrate the key configuration settings required and the major differences in the approach adopted between these two classes of relays.

The strengths and weaknesses of the latest microprocessor (or numerical) relays as compared to the older electromechanical relays will be outlined. You will also gain a solid appreciation of how the modern relay communicates not only to the central SCADA system but also between themselves resulting in a truly multifunctional system which includes protection, control and monitoring. Finally, you will gain a solid understanding of issues of reliability and security for the modern relay.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

There will be at least nine practical sessions interspersed within the different theory sessions. These will enable participants to gain a practical feel of actual power systems and their protection system designs, as well as the flexibility afforded by numerical protection systems. Participants will also be exposed to substation automation and wide area protection architecture using the communication facilities of numerical protection systems.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

BASICS OF POWER SYSTEM PROTECTION
- Requirements of protection in an electrical system
  - Reliability, dependability, security
- Types of faults
- Evaluation of short circuit currents in a power system
- Exercises in fault calculations in simple circuits
- Earth faults and role of system earthing
- Characteristics of protective relaying
  - Sensitivity
  - Selectivity
  - Stability
  - Speed
- Protection using fuses
- The protective relay/release and circuit breaker combination
- Instrument transformers and their application in protection systems
  Practical session 1: Fault level calculations of typical power distribution networks

RELAYS AND THEIR DEVELOPMENT
- Types of protective relays (IDMT and DMT)
- Electromechanical static relays
- Microprocessor relays and numerical relays
- IDMT characteristics expressed as a mathematical function
  - Comparison of electromechanical/static and numerical relays
    - Key features: flexibility/reliability/communications/SCADA interface
    - Cost
    - Integrated protection and control
  Practical session 2: Reconstructing different IDMTL characteristics using a spreadsheet graphical display

PROTECTION COORDINATION
- Need for coordination
- Time grading
- Current grading
- Application of time and current grading in power systems
- Grading using IDMTL characteristics
  Practical session 3: Grading between IDMTL characteristics of current relays by using Excel spreadsheet

TYPICAL BLOCK DIAGRAM OF NUMERICAL PROTECTION
- Basic approach used in numerical protective relays
- Typical block diagram
- Hardware and software architecture of a numerical relay
- Importance of sampling interval in the operation of relay
- Examples of how waveform asymmetry and harmonic components are handled in numerical relays
- Extension of capabilities of relays in numerical design

TYPICAL BLOCK DIAGRAM OF NUMERICAL PROTECTION CONT.
- From individual protection relays to a complete protection management system
- Structure of the Intelligent Electronic Device (IED)
- Typical examples of the use of IEDs in functions other than protection
- Configuring substation automation using IEDs
  Practical session 5: Designing a substation automation system using IEDs

DIFFERENT TYPES OF NUMERICAL PROTECTION SYSTEMS AND PRINCIPLES
- Functional protection relays
- Equipment protection systems with multiple functions
  Practical session 6: Designing the protection system of a typical HV/MV step-down substation with outgoing feeds to MV motors and MV switchboards and incoming transformer feeders and standby generator source

CONFIGURATION OF NUMERICAL RELAYS
(Examples using industry standard protective relays)
- Setting approach in conventional relays
- Configuring numerical relays
- Configuration security through passwords
- Protection settings as a part of configuration
- Methods adopted for setting numerical relays
- Configuration exercises for typical relays/simulation software
  Practical session 7: Hands on configuration using the front keyboard of a typical single function numerical current relay
  Practical session 8: Hands on configuration using a PC and configuration software with actual relays

COMMUNICATION ASPECTS OF NUMERICAL PROTECTION DEVICES
- Setting up a substation automation system using the communication capability of numerical relays
- Problems of compatibility between vendors
- DNP3 communication standard
- The new substation standard IEC 61850
- Logical grouping of functions
- Intercommunication using GOOSE
- Using IEC with Unified Modeling Language (UML)
- Example of substation automation system with IEDs compatible with IEC 61850
  Practical session 9: Designing a wide area network protection system architecture by connecting the substation automation systems of different substations all using IEC 61850 compatible devices

SUMMARY, OPEN FORUM AND CLOSING

idc@idc-online.com • www.idc-online.com
PRACTICAL
POWER CABLELING AND EARTHING

YOU WILL LEARN HOW TO:

• Select appropriate power cables
• Perform testing and preventative maintenance on power cables
• Design and install appropriate earthing systems
• Size earthing conductors
• Apply equipotential bonding in ensuring safety
• Protect structures from lightning hazard
• Protect power distribution equipment and sensitive systems from surges

WHO SHOULD ATTEND:

Anyone associated with design, operation, installation, commissioning and maintenance of electrical systems can benefit from this workshop. Typical personnel who would benefit are:

• Building service designers
• Electrical engineers and technicians
• Electrical maintenance technicians
• Electrical supervisors
• Maintenance personnel
• Operations personnel
• Process control engineers
• Service technicians
The Workshop

In any distribution system, cabling and earthing are critical components in ensuring continuity, reliability and safety of operation and maintenance. The entire flow of power in a system (or at least a major part of it) goes through cables and thus any failures would result in major disruption of power flow. Correctly selected, sized and installed cables can give trouble-free operation for several decades. Not only cables, but also accessories used for jointing and terminating cables play an important role in reliability. As the voltage rating of cables goes up, installation, termination and jointing require greater care since failures could be expensive to repair and can cause widespread disturbances in the power system. And when failures do occur, they need to be pinpointed accurately using modern test methods so that repairs can be undertaken promptly and service restored with minimum delay.

On the other hand, the earthing system does not play a direct part in the normal power flow but is very important in ensuring that insulation failures can be promptly detected and isolated by proper selection of system earthing. The other major function is to ensure that any unsafe voltages appear in any external or extraneous conducting parts of an electrical system. A good knowledge of earthing system is necessary to design a safe system and ensuring continued safe operation. This course is designed to ensure that those responsible for the selection, installation, and maintenance of power cable and earthing systems understand the technical issues involved and comply with relevant specifications and requirements in a practical and effective manner.

Pre-requisites

A fundamental knowledge of basic electrical concepts would be useful.

On-Site Training

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The Program

INTRODUCTION
• Role of power cables in electrical systems
• Main issues in ensuring trouble free operation of cabling in power distribution systems
• Earthing and its importance
• Various functions of earthing in electrical installations
• System and protective earthing

SECTION I: CABLES

CABLES AND ACCESSORIES
• Low and high voltage cables
• Advantages over overhead transmission lines
• Disadvantages of cables in power transmission
• Various types of cables
• Cable jointing (splicing) accessories
• Need for termination kits
• Installation of cables

CONSTRUCTION OF CABLES
• Basic constructional aspects
• Insulation
• Application areas
• Cable standards

SELECTION AND INSTALLATION OF CABLES
• Selection criteria
• Sizing
• Installation
• Special locations
• Fire prevention and fire protection for cable installations

PRACTICAL ASPECTS OF CABLE JOINTING AND TERMINATION
• Kits for joints and terminations
• Shelf life
• Issues with prefabricated kits
• Preparation of cable for termination and jointing
• Connection and reconstitution of cable properties
• Continuity and grounding aspects
• Sealing, healthiness of joint/termination and repairs
• Safety issues and access for repairs
• Termination to electrical machines
• Termination of outdoor HV installation
• Terminations to GIS installation
• Importance of correct orientation of terminations
• Installation aspects for cable joints and terminations
• Safety issues and access for repairs

CABLE FAILURES
• Types of failures
• Reasons for failures
• Fault location
• Electrical tests for detection of cable faults
• Safety issues in fault location
• Analysis of failures
• Documentation of work and failures

NEW TRENDS
• Increasing use of underground cables
• New technologies for very high capacities and voltages
• EHV XLPE cable systems
• High temperature superconductivity in cables

SECTION II: EARTHING

EARTHING OF POWER SUPPLY SYSTEMS
• Types of system earthing and comparison
• Ungrounded systems
• Solidly grounded systems
• Impedance and resonant earthing using neutral reactor
• Impedance earthing through neutral resistance
• Point of earthing in power supply systems without a neutral point

EQUIPMENT (PROTECTIVE) EARTHING
• Shock hazard
• Earthing of equipment
• Operation of protective devices
• Thermal capability
• Touch potential during ground faults
• Induced voltage problem
• Mitigation by multiple ground connection
• Mitigation by reduction of conductor spacing
• EMI suppression
• Metal enclosures for earthing conductors
• Earthing connections for surge protection equipment
• Sensing of ground faults
• Equipotential bonding

GROUND ELECTRODE SYSTEMS
• Earthing electrodes
• Soil resistance
• Measurement of soil resistivity
• Resistance of a single rod electrode
• Current carrying capacity of an electrode
• Use of multiple ground rods in parallel
• Measurement of ground resistance of an electrode
• Concrete encased electrodes
• Corrosion problems in electrical earthing systems
• Maintenance of earthing system
• Chemical electrodes

CABLING AND EARTHING: CONVERGENCE
• Inter-relation between cabling and earthing
• Need to earth insulation screens of cables
• Earth continuity in cable joints
• Use of armour in providing earth continuity
• Earthing of cable screen/armour in cable terminations when using core balance CT

SUMMARY, OPEN FORUM AND CLOSING
THE FUNDAMENTALS OF POWER DISTRIBUTION AND POWER SYSTEMS: HANDS-ON PRACTICAL ANALYSIS AND DESIGN

WHAT YOU WILL LEARN:

• You will have a deeper understanding of the fundamentals of power distribution systems
• Carry out advanced calculations in power distribution systems with greater confidence
• Master difficult concepts like three-phase power system network analysis, active, reactive and apparent power calculations, power factor correction and much more
• Extend your learning experience by problem solving; use specific solution formulations on your own applications

WHO SHOULD ATTEND:

This course is designed for practical engineers and technicians interested in maintaining power quality and minimising outages in power distribution networks:

• Design engineers
• Electrical engineers
• Electrical technicians
• Electricians
• Field technicians
• Instrumentation engineers
• Plant operators
• Project engineers
The Workshop

Practical Engineers and Technicians are always under pressure to meet the day-to-day challenges of maintaining power quality and minimising outages in power distribution networks. As a result of this challenge they tend to sharpen their skills only with regard to the most obvious practical and theoretical tools and to allow other insights that are as necessary to power systems as vitamins are to biological systems, to be relegated to the archives or to the "experts". It is often possible to apply quick-remedies or to use trial and error to obtain "cures" to correct difficult to diagnose faults in power distribution systems. By gaining a deeper and more fundamental understanding of the basics, the traditional trial-and-error approach makes way for deterministic solutions with surer cures.

Pre-requisites

A fundamental knowledge of electrical engineering is very useful.

Workshop Objectives

At the end of this workshop delegates will understand:

- Fundamentals of power distribution systems
- Master difficult concepts that relate to power distribution

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

**REVIEW OF AC CIRCUIT FUNDAMENTALS**
- Definitions of AC voltages, currents and power based on concepts of time
- Review of DC circuit principles and extending those to AC circuits with sinusoidal waveforms
- Review of complex algebra, important trigonometric relations, polar and rectangular coordinate systems
- RMS and average values of periodic waveforms

**Practical Exercises**

**INTRODUCTION TO VECTORS AND PHASORS**
- Introduction to voltage and current rotating vectors and phasors and their use in AC circuit calculations
- Multiplication and division of complex quantities
- Fundamental physical meanings of resistance, inductance and capacitance and their influence on power distribution systems
- Impedance of resistance, inductance and capacitance in AC circuits
- Impedance networks and their use in AC circuit calculations

**Practical Exercises**

**INTRODUCTION TO ELECTRICAL SYSTEM STUDIES**
- Time domain simulations of different types of single phase AC circuits
- Transient and steady state behaviour of AC circuits
- Admittance, conductance and susceptance and their usage in power distribution system calculations
- Principles of AC network reductions and its use in power distribution circuits
- Definitions of power in AC circuits, time dependent power, active, reactive and apparent power
- Power dissipation and storage in AC circuits involving resistance, inductance and capacitance

**Practical Exercises**

**INTRODUCTION TO ELECTRICAL SYSTEM CALCULATIONS**
- Usage of software for calculating RMS and average values of periodic non-sinusoidal waveforms
- Use of real, imaginary and complex power to streamline power calculations in AC circuits
- Phasor diagrams and their use in AC circuit analysis
- Meaning, consequences and correction of displacement power factors in AC circuits

**Practical Exercises**

**INTRODUCTION TO STUDY OF THREE PHASE SYSTEMS**
- Introduction to balanced three phase power systems: voltage, current and power relationships between phases
- Comparison of single and three phase power systems and the advantages of three phase systems over single phase systems
- Per phase calculation method and single line diagram representation of balanced three phase power distribution systems
- Analysis and definitions of voltages, current and impedance in three phase networks with star and delta configured sources and loads
- Calculation of power in three phase power distribution systems
- Time domain simulations of examples to complement analytical calculations of three phase power systems

**Practical Exercises**

**INTRODUCTION TO ANALYSIS OF TRANSFORMERS**
- Transformers and their use in AC power transmission and distribution systems
- Transformer design principles: flux density, number of turns, voltage transformation, current ratio, core size, core material implications
- Development of the equivalent circuit of a power transformer through addition of winding resistance, leakage inductance, magnetostrictive inductance, core losses
- Three phase power transformers and their use in power distribution systems
- Extending single phase concepts for transformers to balanced three phases
- The per unit system for multi-voltage level power distribution system calculations
- Calculations and simulations showing phase shift and the effects of different vector groupings

**Practical Exercises**

**FUNDAMENTALS OF HARMONICS**
- Introduction to steady state harmonics
- Fundamental definitions under sinusoidal conditions
- The concept of orthogonality
- What is meant by power system harmonics
- Harmonic problems in practice
- Limits of harmonic presence in power system
- Quality factor
- Bandwidth
- Series and parallel resonance in power systems
- Neutral overloading
- Other harmonic problems in brief

**Practical Exercises**

**INTRODUCTION TO HARMONIC STUDIES**
- The one sided exponential fourier series
- Power system definitions based on a time domain model
- Modelling of power systems with harmonics

**Practical Exercises**

**SUMMARY, OPEN FORUM AND CLOSING**
PRACTICAL
HV AND LV SWITCHING OPERATIONS
AND SAFETY RULES

YOU WILL LEARN HOW TO:

• Appreciate the basic theoretical aspects involved in electrical safety
• Understand the importance of proper isolation procedures for HV and LV equipment
• Understand the coordinating permit access authority procedures
• Gain a clear understanding of the procedures/practices adopted for safe working
• Identify the various statutory and legal regulations/acts dealing with electrical safety at work
• Gain an insight into the organisational aspects of safety
• Become familiar with the organisation’s electrical safety rules (applicable to on-site training)

WHO SHOULD ATTEND:

• Building service designers
• Consulting engineers
• Data systems planners and managers
• Electrical and instrumentation technicians
• Electrical engineers
• Instrumentation and control engineers
• Maintenance engineers
• Power system protection and control engineers
• Project engineers
The Workshop

In this workshop, we will take a look at the theoretical aspects of safety as well as the practical and statutory issues. One of the main causes of electrical accidents is said to be incorrect isolation of the circuits where work is to be done. To ensure safety of operators and maintenance personnel, proper switching procedures are necessary and more so when the circuits have multiple feeds and are complex. The possibility of voltage being fed back from secondary circuits needs to be considered as well. This workshop emphasises on the isolation procedures to ensure proper and safe isolation of HV, LV and secondary circuits.

Electrical safety is not just a technical issue. Accidents can only be prevented if appropriate safety procedures are evolved and enforced. This includes appropriate knowledge of equipment and systems imparted through systematic training to each and every person who operates or maintains the equipment. We will cover all these aspects in detail.

Pre-requisites

Some working knowledge of basic electrical equipment is required, although this will be covered at the beginning of the workshop. Real-life experience with such equipment and hands-on testing will enable the workshop to be placed in context.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

✓ SAVE over 50% by having an IDC workshop presented at your premises.

✓ Customise the training to YOUR workplace.

✓ Have the training delivered when and where you need it.

Contact us for a FREE proposal.
YOU WILL LEARN HOW TO:

- Identify the important hazards in O&M work in different parts of electrical installations
- Recognise the dangers of arc flash events to working personnel and their impact on equipment
- Know the codes and standards dealing with arc flash danger
- Acquire the necessary theoretical knowledge to carry out arc flash impact studies by collecting system data and computing the arc flash incident energy and flash protection boundary
- Understand the importance of proper design of electrical equipment in avoiding arc flash incidents and ensuring safety in the event of an arc flash.
- Select appropriate Personal Protective Equipment (PPE) and Flame Resistant (FR) clothing required for avoiding serious or lethal injuries

WHO SHOULD ATTEND:

- Consulting engineers
- Electrical and instrumentation technicians
- Electrical design engineers
- Electrical maintenance engineers
- Power system protection and control engineers
- Project engineers
- Purchasing engineers
- Safety engineers
Electrical safety is an important issue for those working on electrical facilities in utility networks and large industrial installations. A number of serious accidents including fatalities occur every year due to accidents involving electricity resulting in huge financial losses and wasted man-hours. Arc flashes in electrical equipment are now considered one of the major causes of electrical accidents even surpassing the well-known hazards of electric shock. Avoiding arc flash incidents and the resulting injuries is one of major challenges today facing electrical workers and requires adequate attention in the stages of system planning, design, installation, operation, and maintenance.

Injuries due to arc flash can depend on many factors, one of which is the incident thermal energy on a worker exposed to a flash. Today, a considerable body of knowledge exists as a result of research efforts and is available to designers and maintenance engineers in the form of standards such as IEEE 1584 and NFPA 70E. This workshop will detail the basis of this approach and also about the major advances have been made in the area of PPE made of HR fabrics and rated for different levels of thermal exposure. Prevention however still remains the best form of protection and switchgear manufacturers have made considerable design advances to ensure that the effect of arc flash incidents is contained within the enclosure of switchgear (often called arc flash resistant switchgear) and methods of testing such switchgear have also evolved simultaneously. Another important factor is the approach to avoid arc incidents within the switchgear by proper design and maintenance techniques to reduce the severity of the flash should such incidents occur.

These would form the key focus areas of this workshop.

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** Electoral and Mechanical Hazards**
- Hazards with examples
  - Electric shock, arc flash events
  - Working at heights
  - Working in confined spaces
  - Fire and explosion
  - Mechanical hazards
- Common electrical equipment and hazards posed

**ARC Flash and its Effects**
- Definitions
- Reasons for arc flash events
- What really happens in an arc flash event?
  - Insulation failure/violation of clearances
  - Arc flash mechanism
- Impact on equipment
- Hazards to personnel in the vicinity
  - Burns
  - Organ damage due to pressure wave
  - Hearing damage
  - Shrapnel effects

**Fundaamentals of Power Systems**
- Configurations
- Equipment used
- System Earthing and its role
- Protective earthing and its role

**Calculation of Fault Currents**
- Fundamentals of short circuit calculations
- Simplifying assumptions
- Ohmic impedance and per unit impedance
- Infinite bus
- Base KVA of a system and its use in calculations
- Network theorems commonly used
- Equivalent diagrams
- Fault calculation approach for a simple system

**Protection in Power Systems**
- Fundamentals of power system protection
- Protection attributes
- Protective devices (fuses, built-in release and relays)
- Time-current characteristics
- Impact of bolted faults on tripping time
- I2t: the important factor in deciding the hazards of faults
- Commonly used protection approaches

**Arc Flash Study - Codes and Standards**
- OSHA 29 CFR - part 1910
- National Electrical Code NFPA 70E - standard for electrical safety in the workplace
  - Safety related work practices
  - Installation safety requirements
  - Table 130.2(C)
- IEEE Standard 1584
  - Guide for arc flash hazard analysis
  - Definitions used in arc flash study

**Arc Flash Study Detailed Procedure**
- Flash protection approach boundary
  - 1.2 calories per square centimeter
  - 4 foot boundary
- Calculated boundaries based on transformer size and bolted short circuit MVA
- Detailed arc flash study
  - Calculation of incident energy and electrical hazard indexes
  - Warning labels
  - Personal protective equipment requirements
- Calculation of working distance and flash boundary as per IEEE Standard 1584

**Data Collection and System Modeling**
- Data for calculation of fault currents
- Modes of operation
- Lower short circuit conditions with long tripping times

**Determining Arc Flash Hazard Risk Category**
- Detailed examples and exercises simplified tables approach
- Matrix table
- Single line diagram approach
- Short circuit study report coordination
- Hazard risk category for metal clad switchgear 1kv and above
- NFPA/IEEE table 130

**Practical Work: arc flash study calculations**

**Reducing Arc-Flash Hazard**
- Mitigation of energy by reduced short circuit current and faster protection
- Overvoltage protection to reduce insulation failure risk
- Reducing the risk of arc flash by better equipment design (clearances, creepage, insulation)
- Providing arc vents to direct arc away from operator
- Containing internal arc flash by switchgear that is arc resistance
- Avoid local operations and live work
  - Insulation status and PD monitoring
  - Contacts and joint status-monitoring through thermography

**Personal Protective Equipment Made of FR Clothing**
- The evolution of Flame Resistant (FR) fabrics
- The various types of FR fabrics that are available in the marketplace
- FR fabrics and the effects of undergarments
- Limitations of FR fabrics
- Test method ASTM F 1959
- Garment construction standard ASTM F 1506-02a

**Summary, Open Forum and Closing**
PRACTICAL
ELECTRICAL METERING, MEASUREMENT AND
INSTRUMENT TRANSFORMERS
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Understand the importance of proper measurement
• Identify different types of measuring instruments
• Appreciate the role of instrument transformers in measurement
• Use and apply metering devices and principles of operation
• Maintain, commission and test measuring equipment
• Understand future technologies in measuring instruments

WHO SHOULD ATTEND:

• Instrumentation and Control Engineers
• Consulting Engineers
• Electrical Engineers
• Project Engineers
• Maintenance Engineers
• Power System Protection Engineers
• Building Service Designers
• Data Systems Planners and Managers
• Electrical and Instrumentation Technicians
The Workshop

Measurement of electrical parameters is necessary to know the status of a power system and for protection against abnormal incidents such as short circuits and earth faults. Accurate measurements are also important for tariff metering since large sums of money can be involved in these transactions and is therefore in the interest of both suppliers and consumers of electrical energy. This course discusses the details of instrument transformers including their construction, ratings and specifications. Various measuring devices such as instruments and transducers, their operating principles and applications will be covered as well.

Pre-requisites

Some working knowledge of basic electrical equipment is required, although this will be covered at the beginning of the course. Real-life experience with such equipment and hands-on testing will enable the workshop to be placed in context.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

INTRODUCTION TO ELECTRICAL MEASUREMENT
- Introduction to electrical measurement
- Need of measurement in electrical installations
- Why accuracy is important in measurement
- Different types of measuring devices used for measuring
- Transducers and their principle of operation
- Instrument transformers and principles
- Purpose of instrument transformers

VOLTAGE TRANSFORMERS (PT OR VT)
- Basic electrical theory of voltage transformers
- Types and categories of voltage transformers
- How voltage transformers are used for measurement
- Characteristics and classes of voltage transformers
- Standards for voltage transformers
- Hazards with voltage transformers
- Accuracy checks on voltage transformers
- Applications of voltage transformers

CURRENT TRANSFORMER (CT)
- Basic electrical theory of current transformers
- How current transformers are used for measurement
- Characteristics and classes of current transformers
- Comparison of a metering CT and a protection CT
- Standards for current transformers
- Hazards with current transformers
- Accuracy of current transformers
- Applications of current transformers

METERING DEVICES AND PRINCIPLES
- Different types of meters
- Classification of meters
- Measurement principles
- Alternating current system and peak value, RMS value
- Active and reactive power
- Circuit configurations (direct and through instrument transformers)
- Ammeters and voltmeters
- Frequency meter
- Power factor meters
- Power and energy meters
- Measurement of current, power and frequency
- Integrating instruments
- Registering instruments
- Recording instruments
- Digital instruments
- Instrument mounting and wiring

TRANSDUCERS
- Types of transducers depending on principle, active and passive
- How measurement is carried out with transducers
- Power transducers and their use
- Average responding transducers
- RMS responding transducers
- Use of interposing transformers
- Applications of transducers

APPLICATIONS IN PRACTICAL SYSTEMS (CIRCUIT CONNECTIONS)
- Traffic metering and control and indication metering
- Metering code
- Parameters monitored and purpose
- Tariff metering arrangements
- Importance of accurate and reliable metering
- Standards applicable with stress on accuracy

COMMISSIONING, TESTING AND MAINTENANCE OF MEASURING SYSTEMS
- Testing of a voltage transformer
- Testing of current transformers
- Testing of transducers
- Commissioning of voltage transformers
- Commissioning of current transformers
- Commissioning of transducers
- Maintenance of current transformers, voltage transformers and transducers
- Special emphasis on accuracy checks

THE FUTURE OF MEASURING TECHNOLOGY
- Smart metering
- Technology behind smart metering
- Benefits of smart metering
- AMR and metering for smart grids
ELECTRICAL AND INSTRUMENTATION (E & I) ENGINEERING FOR OIL AND GAS FACILITIES

WHAT YOU WILL GAIN:

- Skills and competencies in E&I oil and gas engineering
- Knowledge of the latest technologies in E&I oil and gas engineering
- Key techniques in operating your facility to the highest level of safety and in protecting the environment
- Decades of real experience distilled into the course presentations and materials
- Guidance from real E&I oil and gas experts in the field
- Hands-on, practical knowledge from the extensive experience of instructors, rather than the theoretical information from books and colleges
- Networking contacts in the oil and gas industry

WHO SHOULD ATTEND:

This workshop is ideal for you if you are seeking expertise in the oil and gas business, including:

- Recent graduate electrical, instrumentation or mechanical engineers
- Chemical engineers
- Electrical engineers
- Experienced electricians
- Fire and gas engineers
- Instrument and control systems engineers
- Instrument and process control technicians or technologists
- Instrument fitters
- Mechanical engineers

Even if you are highly experienced you will find this a great way to become familiar with the oil and gas technology as quickly as possible.
The Workshop

There is a growing shortage, and hence opportunity, for Electrical and Instrumentation (E&I) technicians, technologists and engineers in the oil and gas industry. This is due to an increasing need for higher technology methods of obtaining and processing oil and gas as it is a finite declining resource. The price of oil is heading upwards steadily, thus making personnel and their associated oil and gas expertise in these industries even more valuable. The technical challenges of extracting oil and gas are becoming ever more demanding, with increasing emphasis on more marginal fields and previously inaccessible zones such as deep oceans, Polar regions, Falkland Islands and Greenland. The aim program is to provide you with core E&I engineering skills to enhance your career, and to benefit your firm.

This course provides a wide spectrum of activities ranging from basic electrical and instrumentation engineering to advanced practice including hazardous areas, data communications along with a vast array of E&I equipment utilised in an oil and gas environment as well as practical treatment of electrical power systems and instrumentation within the oil, gas, petrochemical and offshore industries. Whilst there is some theory this is used in a practical context giving you the necessary tools to ensure that the E&I hardware is delivering the results intended. No matter whether you are a new electrical, instrumentation or control technician/technologist/graduate engineer or indeed, even a practising facilities engineer, you will find this course beneficial in improving your understanding, skills and knowledge. This is a 5-day intensive workshop, covering considerable material, if you are looking for a far higher level of knowledge and competencies, you can undertake our 18 month in-depth Advanced Diploma of E&I Engineering for Oil and Gas Facilities through the EIT.

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The Program

INTRODUCTION – SETTING THE SCENE IN OIL AND GAS E & I ENGINEERING
- Fundamentals of electrical engineering
- Fundamentals of instrumentation, measurement and process control engineering

INSTRUMENTATION AND CONTROL
- General instrumentation standards in oil and gas
- Best practice in process, electrical and instrumentation drawings and documentation
- Process instrumentation
- Calibration, installation and maintenance of instruments
- Process control basics
- Control valves sizing, selection and maintenance (including pressure relief valves)
- Programmable Logic Controllers
- SCADA systems
- Distributed control systems
- Industrial data communications (including Fieldbus and industrial Ethernet)
- Safety instrumentation and emergency shutdown systems for oil and gas (IEC 61511 and IEC 61508) – basic introduction
- Wellhead and flowline control – control systems
- Emergency wellhead blowout controls

SPECIALISED APPLICATIONS IN OIL AND GAS
- Power generation
- Cathodic protection
- Compressor control (including surge control)
- Drilling control systems and instrumentation
- Subsea instrumentation and control systems
- Pig launcher/receiver systems
- Critical flare knock out drum controls and instrumentation
- Flare flame front generator and ignition monitoring system
- Distributed control systems

ELECTRICAL ENGINEERING IN OIL AND GAS
- Electrical drawings, documentation and schematics
- Transformers
- Troubleshooting, maintenance and protection of AC electrical motors
- Power distribution
- Power system protection and co-ordination (including fault calculations/stability and protective relays)
- Switchgear and distribution systems
- Cables and wires – maintenance and installation practice
- Variable (or adjustable) Speed Drives (VSDs) for instrumentation and control systems
- Electrical safety
- Earthing/grounding, power system harmonics and power quality – onshore/ offshore
- Lightning and surge protection
- Uninterruptible Power Supplies (UPSs), batteries and battery chargers
- Emergency power supplies
- Electrical equipment in hazardous areas
- Electrical applications to an oil and gas platform and site

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.
WHO SHOULD ATTEND:

This workshop is designed for personnel who want to understand the design and engineering principles involved in smart metering. Those who will benefit the most from this workshop include the following:

• Billing managers
• Business development managers
• Commercial people within utilities
• Customer service directors/managers/supervisors
• Data and MDM directors/managers/supervisors
• Distribution managers
• Energy managers
• Energy marketers
• Energy service providers
• Facilities managers
• Heads of electricity, water, gas unit
• IT professionals within utilities (senior and middle-management)
• Marketing managers
• Metering project directors/managers/supervisors
• Tariff managers
• Technical managers
• Regulators/commissioners
• Regulatory affairs directors/managers/supervisors

WHAT YOU WILL LEARN:

• Need for smart metering
• What smart metering means
• How to implement a smart metering system
• Technologies used in smart metering
• Components in a smart metering system
• What smart meter data management means
The Workshop

Smart metering is a technique used to meter the energy consumption in more detail than a conventional meter. The increasing cost of energy has put power consumption firmly on the political radar. It is one of the factors driving the adoption of smart metering technology.

The objective of this workshop is to learn the implementation of smart metering for domestic and business places and to learn to design smart homes and smart premises using this technique. The workshop also introduces the participants to the new methods adopted and the implementations of smart metering done across the globe by different countries.

This workshop will cover the methods and concepts used in smart metering. The technologies used to handle data from smart meters and the new software utilities to handle the reading. The technologies used in the billing and handling of customers. Upon completion of this course the attendees will have a clear understanding of the design and engineering principles used in smart metering. This workshop will increase understanding of energy utilisation and energy efficiency.

Practical Sessions

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The Program

kWh AND kVARh METERS
- kWh meters
- After Diversity Maximum Demand (ADMD)
- Principle of operation of various kWh meters
- kVARh meters
- Various connections of kWh and kVARh meters
- Calculation of multiplier factor
- Apparent, active and reactive power calculation
- kWh and kVARh meters: testing and calibration

INTRODUCTION TO SMART METERING
- Energy measurement
- Gas/water/heat metering
- Conventional meters
- Metering approaches
- Need of smart metering
- Features of smart metering

BASICS OF SMART METERS
- Definition of a smart meter
- Functions and features of smart meters
- Block diagram and design of smart meters
- Introduction of prepaid meters
- Tampering and security of meters
- Introduction to M-bus (EN13757) and wireless M-bus

METERING TECHNOLOGIES
- Metering technologies for smart metering
- Technologies used for communication
- Technologies for data storage
- Meter Data Management (MDM)
- Methods used for billing (tariff structure)
- Load control technology
- System architecture and implementation

ADVANCED METERING INFRASTRUCTURE (AMI)
- Definition of AMI
- Advanced Meter Reading (AMR) solutions
- Implementing AMI
- Benefits of AMI
- AMI communication strategy
- Security aspects for AMI
- AMR vs AMI capability

INTRODUCTION OF SMART GRID
- Need for smart grid
- Characteristics of smart grid
- Future of smart grid
- Features and implementation of smart grid
- Technologies for smart grids
- Smart grid milestones

APPLICATIONS OF SMART METERING
- Implementation of smart metering for water utilities
- Implementation of smart metering for gas utilities
- Study reports of smart metering for energy savings
- Designing of smart homes using smart metering
- Designing of smart premises using smart metering
- AMR used in submetering

IMPLEMENTATION OF SMART METERING IN DIFFERENT COUNTRIES
- Smart metered countries
- Smart metering initiatives around the world
- Cost benefit analysis for AMI
- Case study and roll out of AMI trials for Australia

SUMMARY, OPEN FORUM AND CLOSING
WHO SHOULD ATTEND:
This workshop will be appropriate for the following professionals:
• Electrical engineers
• Maintenance engineers
• Maintenance supervisors
• Power electricians
• Power engineers

WHAT YOU WILL LEARN:
• Gain the valuable know-how used by electrical engineers in operation and maintenance of power transformers
• Understand different kinds of testing of transformers and their purposes
• Understand the basis of acceptance and rejection of a test result based on standards
• Be aware of important points to be considered between the manufacturer and the requestor to avoid dispute at a later stage
The Program

INTRODUCTION: TRANSFORMER AND THEIR TESTING

KINDS OF TESTS
• Routine test
• Type test
• Special test

GENERAL REQUIREMENTS OF TESTS

TRANSFORMER TESTS
• Measurement of winding resistance
• Measurement of voltage ratio and check of voltage vector relationship
• Measurement of impedance voltage/short-circuit impedance (principal tapping) and load loss
• Measurement of no load loss and current
• Measurement of insulation resistance
• Dielectric tests
• Temperature rise
• Test on on-load tap changers
• Short-circuit test
• Measurement of acoustic noise level
• Measurement of the harmonics of the NLC
• Measurement of power taken by fans/oil-pumps
• Magnetising current test
• Magnetic balance test

INSULATING OIL
• Characteristic of insulating oil
• Causes of deterioration of insulating oil
• Testing of insulating oil
• Inhibitors – an introduction

INTRODUCTION TO DISSOLVED GAS ANALYSIS

TOLERANCE TABLE

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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The Workshop

This will provide you with practical knowledge (including tips, tricks and tools) covering the fundamentals of power transformers and their testing. It will greatly assist you in communicating more effectively with your electrical engineering colleagues. At the end of this workshop, participants will be familiar with the importance of transformer testing and their purpose, the different kinds of transformer tests and their procedures and the practical applications of principals applied in transformer operation and maintenance.

Pre-requisites

An elementary understanding power transformers and their purpose in an industry will be undertaken at the commencement of the course. Please bring a pocket calculator for solving problems during the practical sessions.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.
MEDIUM VOLTAGE AC MOTORS
FOR THE POWER INDUSTRY –
WORKING PRINCIPLES, INSTALLATION,
MAINTENANCE AND TROUBLESHOOTING

YOU WILL LEARN HOW TO:

• Understand ac motor operation and construction
• Specify, select and install motors
• Specify protection requirements for motors
• Specify speed control requirements for motors
• Install and commission motors
• Fix faults on motors
• Interpret motor performance curves
• Interface control circuits of motors with PLCs/DCSs
• Reduce downtime on electrical motors
• Improve plant safety
• Improve plant throughput
• Reduce your spares usage and requirements

WHO SHOULD ATTEND:

Anyone associated with the use of electrical motors in the industrial or automation environment. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting. Typical personnel who would benefit are:

• Electrical maintenance supervisors
• Electrical maintenance technicians
• Instrument and control engineers
• Instrument technicians
• Maintenance personnel
• Mechanical engineers
• Operations personnel
• Plant engineers
• Process control engineers
• Service technicians
The Workshop

It is estimated that electrical drives and other rotating equipment consume about 50% of the total electrical energy consumed in the world today. The cost of maintaining electrical motors can be a significant amount in the budget item of manufacturing and mining industries. This course gives you a thorough understanding of electrical motor’s working, maintenance and failure modes and gives you the tools to maintain and troubleshoot electrical motors.

You will gain a fundamental understanding of the installation, operation and troubleshooting of electric motors. Typical applications of electric motors in mining, manufacturing, materials handling, process control are covered in detail. You will learn the basic steps in specifying, installing, wiring and commissioning motors. The concluding section of the course gives you the fundamental tools in troubleshooting motors confidently and effectively.

Pre-requisites

A fundamental knowledge of basic electrical concepts would be useful.

Practical Sessions

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On-Site Training

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The Program

FUNDAMENTALS OF MOTOR TECHNOLOGY
- Basic principles of rotating electric machines
- Fundamental principles of speed control
- Efficiency, torque, inertia, horsepower/power factor
- Torque-speed curves
- How the motor produces torque
- Standardisation and the meaning of frame size
- Types of motors and their characteristics
  - Cage motors
  - Slip ring motors
  - Synchronous motors
- Relative merits of the above types and reasons for preferring cage type motors
- Relationship between output of motor and the voltage of operation-some pointers
- Medium voltage motors (3.3kv, 6.6 kv and 11 kv) and features

THREE PHASE AC INDUCTION MOTORS
- Components
- Theory of operation
- Induction motor design
- Duty cycles
- Insulation and Cooling requirements
- Starting methods
- Selecting motors

AC MOTOR CONSTRUCTION AND MAINTENANCE
- Basic construction and physical configuration, windings
- Mechanical components and their role
- Bearings and lubrication system
- Types of enclosure, cooling arrangements and temperature supervision
- Embedded temperature sensors for winding and bearings
- Special constructional features of medium voltage motors

DETERMINATION OF LOSSES AND EFFICIENCY OF THREE PHASE AC INDUCTION MOTORS
- Standards
- Types of losses
- Tests for measurement and computation of losses and efficiency
- Dynamometers
- Principles of load application by braking
- Torque measurement basics
- Types of practical dynamometers
- Eddy current dynamometer and its characteristics
- dc and ac dynamometers and their working principles
- Testing of larger motors - back-to-back test approach

PROTECTION OF AC MOTORS
- Protective devices
  - Thermal overload
  - Over current / overload
  - Under-voltage / over-voltage
  - Under frequency
  - Current unbalance or negative phase sequence
  - Earth fault protection
  - Pole slip / out of step
  - Loss of excitation
  - Inadvertent energisation
  - Over fluxing
  - Stall protection / acceleration time /
  - Start up supervision (time between starts / starts per hour)
  - Voltage controlled or restrained over current
  - Protection settings

MEDIUM VOLTAGE MOTORS IN POWER INDUSTRY
- Overview of a typical power generation plant using steam turbines
- Important drives and their requirements
- Considerations for selection and deployment of electric motors for these applications
  - High inertia fan drives
  - Pump drives
  - Mill drives
  - Need for immunity from electrical voltage disturbances
  - Critical auxiliary systems
- Selection of motors for these applications

SPEED CONTROL OF AC MOTORS
- Introduction to variable speed drives or power electronic converters
- Types, and designs of variable speed drives
- Control theory of VSDs explained

INSTALLATION, COMMISSIONING, PERIODIC MAINTENANCE AND TROUBLESHOOTING OF MEDIUM VOLTAGE MOTORS
- General Installation and environmental requirements
- Electrical connections and earthing requirements
- Commissioning tests
- Maintenance of AC machines and periodic checks/tests
- Condition monitoring and record keeping for optimum maintenance
- Bearing and lubrication system and their monitoring
- Types of faults, fault finding and testing of AC machines
- Failure mechanism in AC motors
- Identifying the underlying causes
  - Extended starting
  - Harmonic related failures
  - Single-phasing and consequential failures
  - Insulation overheating and accelerated aging
- Testing instrumentation
- New technologies and developments

SUMMARY, OPEN FORUM AND CLOSING
SWITCHGEAR AND DISTRIBUTION SYSTEMS

WHAT YOU WILL LEARN:

• How to identify typical characteristics of an industrial distribution system
• Become familiar with the main components of an industrial distribution system
• Learn about the different types of distribution system equipment
• Cover aspects of electrical safety and power security

WHO SHOULD ATTEND:

This workshop is designed for personnel who want to understand the design and engineering principles involved in industrial distribution systems. Those who will benefit the most from this workshop include the following:

• Design engineers
• Electrical engineers
• Electrical technicians
• Electricians
• Field technicians
• Instrumentation and design engineers
• Plant operators
• Project engineers
The Workshop

Electrical supply is important in any industry. It is necessary to protect power distribution systems, equipment, motors, generators, etc. from dangerous fault conditions in an electrical supply. Hence, it is necessary to arrange the equipment so it can be switched ON or OFF under different conditions such as, no load or load conditions, or even under fault conditions. The collection of equipment used for switching and protecting purposes in a power system is called switchgear. The most important element of good power system design is the proper selection of the distribution equipment.

The purpose of this workshop is to familiarise students with the basic concepts of a power distribution system, switchgear design and the principles of operation and applications of protection systems for the industrial electrical distribution systems.

The workshop provides an overview of the basics of industrial power distribution systems, the various components in the distribution systems, components of power system protection schemes and concludes with safety and maintenance aspects. This workshop should be helpful for engineers and technicians in the field of electrical design or maintenance.

The Program

OVERVIEW
• Typical characteristics of an industrial distribution system
• Main components of an industrial distribution system
• Distribution system equipment
• Electrical safety and power security

COMMON DISTRIBUTION SYSTEM ALTERNATIVES
• Voltage classification
• Voltage levels in a distribution system
• Types of distribution - simple radial distribution, radial with redundant sources, radial with redundant feeds, primary loop type distribution
• Typical industrial distribution configuration
• Single and multiple incoming feeders
• Isolation arrangements
• Need for a transformer
• Imperatives of distribution without a transformer
• Voltage control in installations fed from transmission/sub-transmission circuits
• Outdoor vs indoor arrangement

PLANNING OF POWER DISTRIBUTION SYSTEMS
• System planning - why is it needed?
• Approach
• Data needed for planning and collection of data
• Studies needed - load estimation, load flow (active and reactive), fault level, voltage profile, motor starting, harmonic power flow, relay coordination

IN-PLANT GENERATION REQUIREMENTS AND ALTERNATIVES
• Why in-plant generation?
• Engine generators as source of power
• Emergency power, standby power
• Integrating emergency sources with plant distribution
• Parallel operation of generator with external supply
• Points to note in parallel operation

TRANSFORMERS
• Basic theory
• Constructional features
• Cooling methods
• Voltage control
• Power vs distribution transformers
• Installation features
• Transformer protection
• Fire safety
• Troubleshooting

CIRCUIT BREAKER BASICS
• Function
• Historical development
• Principle of operation
• Major components
• Typical construction - HV circuits, MV circuits, LV circuits

MV DISTRIBUTION SWITCHGEAR
• Indoor and outdoor construction
• Comparison
• Metal clad switchgear basics
• Major components
• Safety features
• Protection

SELECTION OF CIRCUIT BREAKERS AND SWITCHGEAR AND THEIR RATINGS AND SPECIFICATIONS
• Standards
• Factors affecting circuit breaker selection
• Rated voltage
• Rated insulation level
• Rated short time withstand current
• Rated peak withstand current
• Symmetrical and asymmetrical rating
• Rated supply voltage of closing or opening devices
• Stored energy operation
• Locking and interlocking devices
• Enclosure degrees of protection

PROTECTION, PROTECTIVE RELAYS AND COORDINATION OF PROTECTION
• Need for protective apparatus
• Basic requirements of protection
• Basic components of protection
• Protection in distribution systems
• Protective relays for circuit breaker application
• Role of fuses in LV and MV distribution
• Protection integrated in LV devices
• Importance of settings and coordination of protective relays
• Time and current grading

POWER DELIVERY SYSTEMS - CABLES FOR POWER DISTRIBUTION
• Types and construction of cables
• Basic design and selection
• Insulating materials for LV and HV cables
• Accessories for cable installation
• Buried installation vs open installation
• Fault detection of underground cable installations

DC SUPPLY EQUIPMENT FOR ELECTRICAL SWITCHGEAR
• Need for DC supply
• Possible alternatives to DC control
• Power source for DC supply
• Batteries - basic principles and common types
• Battery sizing
• Battery charging
• Battery chargers - principle and basic schemes
• Trip circuit supervision for circuit breakers
• Substation battery condition and monitoring
• Overcharging
• Measurement of contact resistance

SAFETY IN OPERATION AND MAINTENANCE OF CIRCUIT BREAKERS AND SWITCHGEAR
• Basics of electrical safety
• Electrical shock
• Touch and step potential (voltage)
• Direct and indirect contact
• Role of electrical insulation in safety
• Avoiding electric shock - different approaches
• Earth leakage circuit breakers
• Earthing of power supply systems and its safety implications
• Role of earthing of equipment enclosures (protective earthing) in human safety
• Safety regulations and procedures

MAINTENANCE AND ASSET MANAGEMENT OF CIRCUIT BREAKERS AND SWITCHGEAR
• Asset records
• Condition Based Maintenance (CBM)
• Reliability Centered Maintenance (RCM)
• Insulation deterioration
• Diagnostic techniques
  - Partial discharge
  - Partial discharge - Transient Earth Voltage (TEV) monitoring
  - Partial discharge testing by acoustic methods
  - Tan delta testing
  - Thermal imaging
• Problems that may be found during switchgear maintenance
• Defect management
• Examples of switchgear defects

SUMMARY, OPEN FORUM AND CLOSING

idc@idc-online.com • www.idc-online.com
**ELECTRICAL POWER SYSTEM FUNDAMENTALS FOR NON-ELECTRICAL ENGINEERS**

**WHAT YOU WILL LEARN:**

- The basics of electrical power engineering
- Basic electrical design rules
- Practical steps in selection, installation and commissioning of electrical systems
- How to work more effectively with electrical engineering professionals
- How to apply the local electrical codes effectively
- The role that electrical power plays within your organisation

**WHO SHOULD ATTEND:**

- Administration staff
- Civil, mechanical, chemical, mining engineers, technologists and technicians
- Electrical contractors
- Finance, IT and accounting managers
- Human resources managers
- Managers who are involved with or work with staff and projects in electrical engineering
- Non-electrical engineers and technicians
- Non-electrical personnel who want to understand the broader picture
- Plant and facility engineers
- Project managers
- Procurement and buying staff
- Sales engineers

Comprehensive Course Documentation

In addition to the course materials, we will also include comprehensive reference manuals comprising *Practical Power Distribution* and *Safe Operation and Maintenance of Circuit Breakers and Switchgear.*
The Workshop

The focus is on the building blocks of electrical engineering, the fundamentals of electrical design and integrating electrical engineering know-how into the other disciplines within an organisation. Unnecessary theory will be minimised and you will focus on best practice over the two days of the course.

The course will commence by reviewing basic electrical circuits and electrical laws. You will then be exposed to the basic principles of electrical generation, transmission and distribution. Electrical distribution will then be covered in considerably more detail. The interesting area of electrical measurements as applied to single phase and three phase systems will then be reviewed. You will then be exposed to earthing, transformers, isolators, fuses and circuit breakers.

The second day will commence with an examination of AC and DC motors, followed by a review of electrical lighting and illumination concepts. You will then cover electrical heating, power electronics, power quality and power systems protection in some detail.

The workshop is concluded with modern developments such as substation automation, the smart grid, industrial data communications and the still controversial topic of carbon trading. In two action packed and enjoyable days, you will leave with a valuable toolbox of skills in electrical engineering, thus becoming far more productive and safer in your career and in working with electrical engineers, technicians and managers.

Pre-requisites

No formal electrical education is required as everything is examined from a fundamentals and practical point of view.

Practical Sessions and Activities

We firmly believe that no one learns by simply listening to an instructor. So we have added in numerous activities to “liven the show up” and to make it a truly memorable and enjoyable course. You will thus engage in: eight hands-on practical electrical labs with real equipment to demonstrate the basics, twelve simple electrical design exercises using software and calculators, five case studies undertaken in groups of your colleagues in assessing real situations, a case study in a group of your colleagues where you go through an entire project for design, specification, procurement, installation and commissioning to “sign off and handover”.

We will also make extensive use of video clips, visual effects and simulation software to help you with the understanding of these concepts.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

OVERVIEW OF THE ELECTRIC POWER SYSTEMS

• A brief historical perspective, overview of course

BASIC CONCEPTS

• Units and electrical quantities, voltage, current, resistance, power, energy, frequency, inductance and capacitance, Ohm’s law, rms and average values, single and three phase systems, power factor

Practical session

ELECTRICAL GENERATION, TRANSMISSION AND DISTRIBUTION

• Various forms of energy, energy conversion, modern power station, coal-fired power plant, hydro and nuclear, impact on environment, solar, wind, geothermal, transmission of electricity, distribution, power demand and tariffs, power factor, HVDC

Practical session

ELECTRICAL DISTRIBUTION

• Power source, typical electrical power system, electrical distribution systems, substations, step down transmission, distribution substation, distribution feeder circuits, switches and circuit breakers, industrial and residential customers, types – radial, loop, network, network reliability (outages/power interruptions), power transformers and distribution boards

Practical session

ELECTRICAL MEASUREMENTS AND APPLICATIONS

• Electrical parameters – W/VA/AR, measuring, power and energy measurement, smart metering, measuring voltages, currents and resistance

Practical session

EARTHING

• Need for earthing, direct and indirect shocks, touch and step potential, types of earthing, system and protective earthing, isolation, earth conductors and electrodes, measurement of earth resistance, lightning protection, bonding connection

Practical session

TRANSFORMERS

• Magnetic fields, electromagnetic fields, transformer operation, step down and step up, construction, single and polyphase transformers, cooling, oils and coolants, efficiency, tap changers, voltage regulation, earthing of transformers

Practical session

ISOLATORS, FUSES AND CIRCUIT BREAKERS

• Isolation, electrical faults, fuses, isolation, switching, tripping, circuit breakers, components of circuit breakers, medium voltage circuit breakers

Practical session

ELECTRICAL ROTATING MACHINES – AC AND DC

• Basic principles, machines, DC motor operation, speed, flux and armature voltage, speed control, single phase AC motors, 3-phase induction motor, synchronous machines, torque versus speed, efficiency and power factor

Practical session

ELECTRICAL LIGHTING AND ILLUMINATION

• Incandescent lamps, high intensity discharge lamps, mercury vapour, metal halide lamps, fluorescent lamps, compact fluorescent lamps, LEDs, luminaire concepts, energy efficiency

Practical session

ELECTRICAL HEATING IN INDUSTRY

• Principles of heating, electrical heating, resistance heating, welding, electric arc furnaces, induction heating

Practical session

POWER ELECTRONICS AND APPLICATIONS

• Semi conductor devices, motor controllers, rectifiers, AC motors and soft starting, variable speed drives

Practical session

POWER QUALITY

• Power quality problems, voltage variations, overvoltage and undervoltages, voltage imbalances, voltage and frequency variations, interruptions and surges, lightning and harmonics, harmonic compensation

Practical session

POWER SYSTEMS PROTECTION

• Indigent and solid faults, need for protection, overloads, overvoltage and overcurrent, fuses, circuit breakers, relays, protection of equipment

Practical session

ELECTRICAL SAFETY AND NATIONAL ELECTRICAL CODES

• Key elements of National Electrical Codes (AS3000/NEC/CEC/SANS), electrical hazards, electrical shock, arc flash and burns, personal protective equipment, safety through better design and installation, work permits, authorisation personnel, training and first aid, legislation

Practical session

CUSTOMER INSTALLATIONS

• Metering and billing, tariff structures, connections

Practical session

THE ENTIRE ELECTRICAL PROJECT

• Design rules, specification, procurement, installation, commissioning, punchlist of defects, contractual disputes, certificate of compliance

Case study

THE ELECTRICAL ENGINEER/TECHNOLOGIST/TECHNICIAN

• The engineering team, roles of the team, management of the engineering team, leading the team

Load forecasting, planning and project evaluation

• Load forecasting principles, forward planning, supply and demand side management, evaluation of electrical projects

Modern developments

• The smart grid, substation automation and industrial IT, data communications (including wireless), cost of carbon/ emissions trading
INSPECTION, TESTING AND COMMISSIONING OF ELECTRICAL SWITCHBOARDs, CIRCUIT BREAKERS, PROTECTIVE RELAYS, CABLES AND PLCs

WHAT YOU WILL LEARN:

• Nuts and bolts of electrical inspection, testing and commissioning
• Detailed principles and rules for inspection, testing and commissioning of switchboards, switchgear, cabling and protection relays
• Selection of appropriate type and rating of switchgear and circuit breakers
• The different standards and specifications used for switchgear and circuit breakers
• Asset management of switchgear and protective relays
• Safe maintenance policies including safe working in switch rooms, indoor and outdoor substations

WHO SHOULD ATTEND:

• Design engineers
• Electrical engineers and technicians
• Electrical maintenance engineers, technicians and supervisors
• Electricians
• Field and service technicians
• Instrumentation engineers and technicians
• Plant operators
• Project engineers

And... Managers, engineers, technicians and electricians who work with switchgear, circuit breakers, switchboards and cabling who need to update their skills and knowledge in this critical area of inspection, testing and commissioning.
The Workshop

The overall focus of this workshop is on electrical inspection, testing and commissioning and will commence with a detailed examination of switchgear (and circuit breakers). Circuit breakers are critical components in electrical distribution systems and their operation significantly affects the overall operation of the system.

Protection relays are then discussed. These are used in power systems to maximise continuity of supply and are found in both small and large power systems from generation, through transmission, distribution and utilisation of power in plant, industrial and commercial equipment.

Day two will cover commissioning and periodic inspection of cables and their various failure modes and how to detect these faults. The often neglected topic of switchboards will be detailed next, followed by the interesting topic of interfacing to the control system (either PLCs or other control devices).

The course will be concluded with a number of practical case studies which will pull together the materials examined over the past two days.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:

• 31 short, punchy videos on switchgear, circuit breakers, protective relays and cables
• 32 short, practical design exercises on each topic using simulation software and calculators
• 4 case studies on switchgear, circuit breakers, protective relays and cables where you will work in small groups to solve real electrical engineering problems

Please bring a calculator to get maximum benefit.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

FUNDAMENTALS OF SWITCHGEAR
• Single line diagrams
• Typical construction – LV/MV and HV
• Active and passive network components
• Circuit breaker utilisation
• Fuse switches
• HV fuses in combination with and as alternatives to circuit breakers
• Auto-reclosers and auto-reclose operations

Practical Session

SPECIFICATION OF SWITCHGEAR
• Switchgear ratings – highest system and impulse withstand voltages, load and short circuit currents
• Simple and complex protection schemes
• Switchgear ancillaries, measurement CTs, VTs and relays
• Cable terminations
• Indoor and outdoor operation

Practical Session

SHORT CIRCUIT TESTING
• Symmetrical and asymmetrical breaking
• Make and break operations
• Understanding test oscillograms
• Case study – specification for a 132kV switchboard

Practical Session

SWITCHGEAR DIAGNOSTICS, TESTING AND MAINTENANCE
• Asset records
• Condition Based Maintenance (CBM)
• Reliability Centred Maintenance (RCM)
• Switchgear inspection methodologies
• Insulation deterioration
• Diagnostic techniques:
  - Partial discharge measurement and survey
  - Partial discharge – Transient Earth Voltage (TEV) monitoring
  - Partial discharge by acoustic methods
  - Timing tests
  - Termovision
  - Tan delta testing
  - Principles of circuit breaker maintenance
  - Contact maintenance and contact wipe
  - Oil testing
  - Maintenance of vacuum circuit breakers and SF6
  - Switchgear defects and defect control
  - Switchgear installations

Practical Session

POWER SYSTEM PROTECTION PRINCIPLES AND RELAYS
• Principles of protection
• Types of faults
• Types of protection systems
• Types of protective relays
• Electromechanical and static relays
• Numerical relays

Practical Session

CONFIGURATION OF NUMERICAL RELAYS
• Setting approach in conventional relays
• Configuration of relays
• Troubleshooting typical problems

CABLING COMMISSIONING AND PERIODIC TESTING
• Review of codes for testing
• Drum length checks
• Post installation checking
• Pre-commissioning and periodic tests
• Tests as tools for condition monitoring and early failure alarm
• HV tests using DC and very low frequency AC
• Partial discharge tests and mapping of results
• Dielectric dissipation factor measurements
• Micro destructive and non-destructive tests for life assessment
• Operation and maintenance of cables

Practical Session

CABLE FAILURE MODES AND FAULT DETECTION
• Types of failure
• Reasons for failure
• Fault location
• Electrical tests for detection of cable faults
• Safety issues in fault detection
• Analysis of failures

Practical Session

SWITCHBOARD INSTALLATION, INSPECTION AND COMMISSIONING
• Inspection
• Routine, type, acceptance and pre-commissioning tests
• High voltage equipment test techniques
• Commissioning procedures

Practical Session

INTERFACE TO CONTROL EQUIPMENT (PLCS)
• Overview of PLC
• PLC I/O modules
• Pre-commissioning tests
• Commissioning procedures
• Typical faults

Practical Session

CASE STUDIES OF TYPICAL PROBLEMS
• Improper circuit breaker trip unit and relay settings
• Motor overload protection
• Medium voltage distribution system installation problems
• Switchboard metering problems
• Emergency distribution problems
• Noisy transformers
• Incorrect earthing and neutrals
• And many others...
HIGH VOLTAGE ELECTRICAL COMPLIANCE AND SAFETY OPERATING PROCEDURES

WHAT YOU WILL LEARN:

- Knowledge of safety rules/regulations applicable in your workplace
- How to identify the electrical hazards and take steps to achieve zero risk
- Evolve enterprise safety policies and implement them by taking appropriate safety management steps
- Plan electrical installations with in-built safety measures
- Ensure safety through proper safety procedures in operation and maintenance
- Conduct safety audits in the workplace to detect systemic issues

WHO SHOULD ATTEND:

- Design engineers
- Electrical operators
- Maintenance technicians
- Plant electrical engineers
- Project engineers
- Testing and commissioning engineers and technicians
The Workshop

Employees performing operations and maintenance work on high voltage electrical transmission and distribution systems are exposed to a greater hazard than most other employees. In industry the majority of safety rules and regulations originated from the painful experience of workers who suffered serious injuries or even death. Therefore, rules should not be seen as a means of limiting our freedom, but should rather be looked upon as valuable advice to ensure safe working conditions. This training workshop covers the basic procedures in working safely on high voltage systems including the aspects of safety management and safety auditing.

Objectives
The workshop aims to impart a thorough overall knowledge of working safely on high voltage installations and the various related topics including:
- Safety legislation
- Electrical hazards and safety management
- Technical aspects of electrical safety
- Safety in operation and maintenance
- Importance of periodic inspection of electrical installations for ensuring safety
- Safety audits to detect shortcomings

The workshop will include hands-on practice in safety documentation such as development of switching plans and electrical access permits of different types.

Pre-requisites
- A fundamental knowledge of electrical engineering
- Some experience in operation and maintenance of electrical equipment and/ or electrical networks

On-Site Training

✔ SAVE over 50% by having an IDC workshop presented at your premises.
✔ Customise the training to YOUR workplace.
✔ Have the training delivered when and where you need it.

Contact us for a FREE proposal.

The Program

UK LEGISLATION, INCLUDING ON SHORE AND OFF SHORE REQUIREMENTS
- Health and Safety at Work Act
- PUWER regulations
- Electricity at Work Regulations
- Enforcement Management Model (EMM)
- Protocol on work related deaths
- Risk gap

OVERVIEW OF BASIC SAFETY REQUIREMENTS
- Risk, danger, shock and burn
- HV consequences
- Zero risk approach
- Elimination, substitution, control, PPE

MANAGEMENT ASPECTS
- Safety policy, objectives
- Risk assessments and method statements
- Competence
- Training and retraining
- Authorisation including levels of authorisation
- Authorising engineer
- Competent persons
- Authorised persons
- Senior authorised persons
- Communication
- Audit and review

EQUIPMENT ASPECTS
- Power system fundamentals
- Circuit breakers and switches
- Operating mechanisms
- Instrumentation, test equipment and testing points
- Standard rating factors, plain break / arc suppression systems
- Insulation types, vacuum, air, SF6
- Protection systems
- System earthing
- Commissioning procedures
- Test equipment

OPERATIONAL ASPECTS
- Rules, procedures and instructions
- Method statements, risk assessments etc
- Switching plan and possibility of back feeding etc
- Safety documents: permits to work, sanctions for test, limitation of access
- Duties of permit issuer and recipient
- Working party control
- Isolation, lockout / tagout
- Caution and danger notices
- Proof of dead
- Safety earthing

MAINTENANCE, INSPECTION AND TEST
- Specification for maintenance and inspection routines and frequencies

AUDIT AND REVIEW
- Internal or external audit of procedures, rules etc to ensure they are “fit for purpose”
- Safety document audit
- Inspection of equipment, locks, notices etc.
- Audit of persons, training records, authorisations etc.

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.
- Development of switching plans
- Operating mechanisms
- Permits to work
- Sanctions for test
- Working party control
- Abnormal event scenarios and how to remedy

To gain full value from this workshop, please bring your laptop/notebook computer.
HIGH VOLTAGE DESIGN AND INSTALLATIONS MASTER CLASS

WHAT YOU WILL GAIN:

• Update your knowledge on best practice and find practical solutions to your HV design and installations issues
• Network with experienced experts and your peers
• How to design to the AS 2067:2008 standard
• Learn how to plan a HV substation to meet the load demand, customer’s expectations, and site conditions
• Learn how to design a HV substation based on current engineering practices
• Team work to solve worked HV examples and case studies

WHO SHOULD ATTEND:

• Design engineers
• Electrical engineers
• Instrumentation engineers
• Electrical technicians
• Project engineers
• Plant operators
The Workshop

This intensive two-day master class addresses the AS 2067-2008 standard (substations and high voltage installations exceeding 1kV a.c.) in a practical applied manner.

This standard applies to all customer and utility high voltage installations and compliance is mandatory.

This course will extract the key elements of the standard and apply it via a series of case studies in the following structure:
- Planning
- Design
- Installation

Case Study Based

The case studies will cover different stages of planning and design of a large HV installation such as a transmission substation. You will need to have your calculator. You will cover the following key areas:
- Planning feasibility studies
- Load studies
- Fault studies
- Incoming HV supply
- Operational flexibility
- Busbar configurations
- Supply redundancy
- Cable sizing
- Overhead conductor sizing
- Earthing system
- Power system protection

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

✔ SAVE over 50% by having an IDC workshop presented at your premises.
✔ Customise the training to YOUR workplace.
✔ Have the training delivered when and where you need it.

Contact us for a FREE proposal.

The Program

STANDARD AS2067 – 2008 (SUBSTATIONS AND HV INSTALLATIONS)
- Scope and definitions
- Exclusions
- Status
- Contents
- Fundamental requirements
- Safety measures
  - Earthing systems
  - Insulation coordination
  - Basic insulation level (BIL)
  - Electric shock
  - Power frequency test

POWER SYSTEM PLANNING
- Planning criteria
  - Safety
  - Reliability
  - Flexibility
- Load forecasting
- Voltage selection
- Site conditions
  - IP class
  - Soil resistivity
- Security of supply
- Busbar configurations
- System studies
  - Load flow analysis
  - Fault calculations

EARTHING SYSTEM DESIGN
- Need for earthing
- Earthing electrodes
- Earthing mesh
- Equipotential bonding
- Static charges
- Lightning and its effects
- Earthing methods
  - Ungrounded
  - Solidly earthed
  - Resistance earthed (NER)
  - Impedance earthed
  - Resonant earthing (tuned reactor)
- Soil resistivity
- Touch potential
- Step potential
- Earthing of MV/LV installations
- Lightning protection

POWER SYSTEM PROTECTION
- Relay types
- Fault types
- Protection functions
- Protection criteria
  - Speed
  - Stability
  - Sensitivity
  - Simplicity
- Selectivity
- Current transformers
  - CT ratio
  - Burden
  - CT error
  - CT accuracy class
- Voltage transformers
  - VT ratio
  - VT error
  - VT accuracy class
- Protection techniques
  - IDMT
  - DT
  - High-set instantaneous
  - Directional protection
  - Differential protection
  - Distance protection
- Protection schemes
  - Feeder protection
  - Transformer protection
  - Line protection
  - Motor protection

OVERHEAD SYSTEM DESIGN
- Line design criteria
- Line definitions
  - Sag
  - Span
  - Slack
  - Swing of conductor
  - Conductor tension
- Overhead line design
  - Line conductor codes
  - Line conductor ampacity
  - Line conductor sizing
    - Line conductor fault capacity
    - Line capacity voltage drop

UNDERGROUND CABLE DESIGN
- Cable system criteria
  - Cable codes
  - Cable ampacity
  - Cable sizing
    - Derating factors
    - Cable fault capacity
    - Cable voltage drop

SUMMARY, OPEN FORUM AND CLOSING
HIGH VOLTAGE DESIGN AND INSTALLATIONS MASTER CLASS (UK)

WHAT YOU WILL GAIN:

- Update your knowledge on best practice and find practical solutions to your HV design and installations issues
- Network with experienced experts and your peers
- How to design to the BS EN 61936-1:2010 standard
- Learn how to plan a HV substation to meet the load demand, customer’s expectations, and site conditions
- Learn how to design a HV substation based on current engineering practices
- Team work to solve worked HV examples and case studies

WHO SHOULD ATTEND:

This is a master class for electrical engineers and technologists and associated disciplines involved in high voltage design, installation, inspection, testing and commissioning, e.g.:

- Design engineers
- Electrical engineers
- Instrumentation engineers
- Electrical technicians
- Project engineers
- Plant operators
The Workshop

This intensive two-day master class addresses the BS EN 61936-1:2010 standard (substations and high voltage installations exceeding 1kV a.c.) in a practical applied manner.

This standard applies to all customer and utility high voltage installations and compliance is mandatory.

This course will extract the key elements of the standard and apply it via a series of case studies in the following structure:

- Planning
- Design
- Installation
- Commissioning, Testing and Validation

As per the Scope Statement in Section 1 of the ‘Standard’ documents: ‘This standard provides minimum requirements for the design and erection of high voltage installations in systems with nominal voltages above 1 kV a.c. and nominal frequency up to and including 60Hz, so as to provide safety and proper functioning for the use intended’.

Case Study Based

The case study will cover all the typical design phases for a large industrial installation. The design phases could typically be described as: the conceptual design of the incoming HV supply and internal HV distribution (taking into account the plant’s requirements and need for operational flexibility and redundancy etc), the design of any aerial HV lines required, the design of any major underground cable circuits required, the design of substations including earthing systems required, selection of type of HV switchgear required, selection and design of the protection systems typically required.

This course is aimed at the private electrical installation designer. However, the topic HV design and installation could also be interpreted as possibly covering the electricity utility transmission and distribution sector (HV transmission and distribution network design) for which the HV design approach would be quite different, even though the technical fundamentals (and some of the technical standards such as BS EN 61936-1:2010) are the same. This will not be the focus of this presentation.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

STANDARD BS EN 61936-1:2010
(SUBSTATIONS & HV INSTALLATIONS)

- Scope & definitions
- Exclusions
- Status
- Contents
- Fundamental requirements
- Safety measures
  - Earthing systems
  - Insulation coordination
  - Basic insulation level (BIL)
  - Electric shock
  - Power frequency test

POWER SYSTEM PLANNING

- Planning criteria
  - Safety
  - Reliability
  - Flexibility
  - Load forecasting
  - Voltage selection
  - Site conditions
    - IP class
    - Soil resistivity
  - Security of supply
    - Busbar configurations
  - System studies
    - Load flow analysis
    - Fault calculations

EARTHING SYSTEM DESIGN

- Need for earthing
- Earthing electrodes
- Earthing mesh
- Equipotential bonding
- Static charges
- Lightning and its effects
- Earthing methods
  - Ungrounded
  - Solidly earthed
  - Resistance earthed (NER)
  - Impedance earthed
  - Resonant earthing (tuned reactor)
- Soil resistivity
- Touch potential
- Step potential
- Earthing of MV/LV installations
- Lightning protection

POWER SYSTEM PROTECTION

- Relay types
- Fault types
- Protection functions
- Protection criteria
  - Speed
  - Stability
  - Sensitivity
  - Simplicity
  - Selectivity
- Current transformers
  - CT ratio
  - Burden
  - CT error
  - CT accuracy class
- Voltage transformers
  - VT ratio
  - VT error
  - VT accuracy class
- Protection techniques
  - CT
  - fuse
  - IDMT
  - DT
  - High-set instantaneous
  - Directional protection
  - Differential protection
  - Distance protection
- Protection schemes
  - Feeder protection
  - Transformer protection
  - Line protection
  - Motor protection

OVERHEAD SYSTEM DESIGN

- Line design criteria
- Line definitions
  - Sag
  - Span
  - Slack
  - Swing of conductor
  - Conductor tension
- Overhead line design
  - Line conductor codes
  - Line conductor ampacity
  - Line conductor sizing
    - Line conductor fault capacity
    - Line capacity voltage drop

UNDERGROUND CABLE DESIGN

- Cable system criteria
  - Cable codes
  - Cable ampacity
  - Cable sizing
    - Derating factors
    - Cable fault capacity
    - Cable voltage drop

SUMMARY, OPEN FORUM AND CLOSING
FUNDAMENTALS OF OPERATION AND TROUBLESHOOTING OF EMERGENCY/STANDBY POWER GENERATION USING DIESEL GENERATORS

WHAT YOU WILL LEARN:

- To select and apply Diesel engines for emergency power requirements in your work place
- To choose appropriate ratings and fuel options
- To select and apply alternators, their excitation and protection systems
- To plan for auxiliary systems of the engine as a part of the package
- To formulate procedures for testing and commissioning of Diesel engine generators
- To be able to guide your team to operate and maintain Diesel engine generators

WHO SHOULD ATTEND:

- Plant electrical/mechanical engineers
- Design engineers
- Project engineers
- Testing and commissioning engineers and technicians
- Maintenance technicians (engine/electrical)
The Workshop

Industries require stable, reliable power supply. Sometimes this becomes difficult due to remote location of the industry or weak grid supply. Essential loads need to be provided with power supply from in-plant generators either to supplement the grid supply or as an emergency source for critical loads which can tolerate very little or no interruptions. Diesel engine generators are useful in these circumstances because of their simplicity, ease of maintenance and ability to run with different types of fuels. They can be started easily without external supply assistance, available in a variety of ratings and can be operated in parallel with other generators or with the supply grid if needed.

This training describes the principles of engines and generators starting with the fundamentals, discusses the options available and the constructional details of engines, the electrical alternators and auxiliary equipment in an easy to understand manner. The testing and commissioning of Diesel engine generators and their operation and maintenance aspects are also discussed.

An optional third day is also offered (refer to the separate outline given in this document) for those who wish to achieve a more in-depth knowledge of the engine-based power plants, operation of more than one engine generator in parallel and also synchronised to the utility grid.

Pre-requisites
- A fundamental knowledge of mechanical or electrical engineering
- Some experience in operation and maintenance of general machinery
- Planning plant installations

The Program

REFRESHER ON THE BASIC ELECTRICAL THEORY
- A brief history of electricity
- The static and dynamic forms of electricity
- Electricity differs from different electrical circuits
- Voltage, current, resistance and Ohm’s law
- DC and AC circuits-how they differ
- Ac amplitude-time curve-Why is it called a sine wave?
- Phasor - Introduction
- Reactance and impedance and Ohm’s law for ac circuits: Calculation examples
- Concept of power factor (displacement power factor)
- Circuit theory and applicable laws for solving problems of power flow in AC and DC circuits
- DC and AC sources

FORMS OF ENERGY AND CONVERSION-WHY ELECTRICITY IS A CONVENIENT ENERGY CARRIER
- Potential and kinetic energy as the main classification of energy forms
- Energy types based on the source such as fuel, chemical, nuclear and mechanical
- What is meant by energy carrier?
- Why is electricity the most preferred energy carrier?
- Points of comparison
- Law of energy conservation and laws of thermodynamics: Applications to power generation

ENGINES FOR POWER GENERATION LIQUID AND GASEOUS FUELS
- A brief historical perspective
- External combustion cycles (Otto, Diesel)
- External combustion engines-Spark and compression ignition types
- Industrial generating sets based on compression ignition cycle
- Fuels used: liquid and gas engines

DIESEL TECHNOLOGY AND CLASSIFICATIONS
- Basic Engine processes
- Dual Fuel Engines
- Speed Classifications
- Service Classifications

BASIC ENGINE DESIGN AND RATINGS
- Design characteristics and formulas
- Turbo charger
- Ambient conditions
- ISO ratings
- Performance and Efficiency
- Efficiency enhancements
- Engine speed
- Fuel combustion methods

FUEL OILS USED AND FUEL HANDLING SYSTEM
- Crude oil
- HSD, LDO and Heavy fuels
- Economics of fuel selection
- Pressure and temperature characteristics
- Viscosity characteristics
- Specific heat and temperature
- Viscosity conversion
- Specific fuel consumption
- Fuel filters and heaters
- Fuel nozzles and igniters
- Emission control
- Storage requirements
- Typical fuel system layouts and components

LUBE OIL SYSTEM
- Lube oil specification
- Lube oil consumption in diesel engines
- Typical Lube oil system layouts
- Viscosity and temperature
- Lube oil filters and heaters

BASICS OF AC SYNCHRONOUS GENERATORS AND ESSENTIAL COMPONENTS
- The basic electrical generator
- Components of the alternator
- Stator winding in alternators
- Rotor (field) windings
- Damper windings
- Slip rings
- Sources for supplying field current to rotor
- Rotary exciters
- Static exciters
- Brushless excitation
- Cooling components and methods of cooling

PROTECTION OF AC SYNCHRONOUS GENERATORS
- Failure modes of ac generator
- Stator winding protection-short circuits
- Stator winding protection-earth faults
- Differential (circulating current type) protection for windings
- Rotor winding protection-Single and double earth fault
- Negative sequence current protection
- Excitation failure and pole slip/out-of-step protection
- Over voltage protection of generators

DIESEL GENERATING SETS
- Coupling Requirements
- Skid mounting
- Layout requirements
- Standard Control panels
- Interconnection

OTHER COMPONENTS
- Starting methods
- Starting characteristics
- Battery sizing
- Step load requirements
- Standby requirements
- Auto start and auto transfer schemes
- Auto Transfer switches

TESTING AND COMMISSIONING
- Factory tests
- Pre-commissioning checks
- Pre-commissioning tests
- Performance monitoring
- Fuel and lube oil consumption checks
- Electrical system tests

OPERATION AND MAINTENANCE OF DIESEL GENERATING PLANTS
- Safety requirements
- Operation monitoring based on applications
- Philosophy of maintenance
- Maintenance techniques
- Maintenance planning and scheduling
- Spares and inventory management
- Maintenance tools
- Inspection
- Engine overhaul and repair
- Training
- Health monitoring
- Troubleshooting

SUMMARY, OPEN FORUM AND CLOSING
DIESEL POWER GENERATION PLANTS
WITH MULTIPLE MACHINES IN PARALLEL AND ON THE
ELECTRICAL POWER GRID

WHAT YOU WILL LEARN:

- To plan a power generation facility for your industry using diesel engine generators
- To plan telecontrol and protection equipment for the generation facility
- To achieve successful operation of multiple engine generators in parallel
- To configure a multi-engine generation system for operating in parallel with an external power network
- To apply engine based electromechanical UPS systems in large process industries

WHO SHOULD ATTEND:

- Plant electrical/mechanical engineers
- Design engineers
- Project engineers
- Testing and commissioning engineers and technicians
- Maintenance technicians (engine/electrical)
The earlier part of the course covered the fundamental principles of the diesel engine-generator set. This part will discuss the need for standby/emergency power generation in industries and the details of engine-based power stations. Achieving large standby capacities would call for multiple generating sets to be operated in parallel and at times synchronised with an external power source. The factors to be considered to achieve proper load sharing and also to safeguard against power grid abnormalities are discussed. A brief description of the engine-based uninterrupted power source is also included.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

DIESEL POWER GENERATING STATIONS
• Industrial applications
• Power generation plant applications
• Essential subsystems in a Engine based power plant
• Single and multiple sets
• Fuel storage requirements
• Air Intake system
• Exhaust system
• Auxiliary power requirements
• Typical power schemes
• Typical power plant layout

DIESEL GENERATOR MEASUREMENT AND CONTROLS
• Measurements and alarms
• Engine and generator control
• Auto operation modes
• Auxiliary system measurement and alarms
• Battery charger and alternator controls
• Telecontrol-Local and remote control
• Communication by RS232, Modbus, ModbusIP and Ethernet

POWER GENERATION APPLICATIONS IN INDUSTRY
• Need for in-plant generation
• Difference between standby, emergency and base load generation
• Black start capability in industrial generators
• Stand alone operation of a generator
• Alternator capability curves
• Speed governor as frequency controller
• Voltage regulation through excitation control
• Why multiple generators are often used?
• Multiple generators-Load sharing and voltage regulation

OPERATION WITH EXTERNAL POWER GRID
• Important aspects of operating generators in parallel with external sources
• Active power and power factor control
• Precautions against asynchronous closing
• Protection aspects against external earth faults
• Protection of tie line
• Directional protection requirements
• Protecting against external system problems
• Reverse power, frequency based and vector surge protection systems
• Islanding and load management after islanding
• Re-synchronisation with grid

ENGINE BASED UNINTERRUPTED POWER SUPPLY (UPS)
• Need for uninterruptible power in industries
• Static UPS as an option-its limitations
• Parallel operation as an alternative means of uninterrupted power
• Engine-based on-break power option and applications in industry
• Special features of engine-based (Rotary) UPS
• Advanced features of rotary UPS
• Configuration of a power distribution system with rotary UPS

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training
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PRACTICAL MAINTENANCE & TROUBLESHOOTING OF BATTERY POWER SUPPLIES

THE WORKSHOP:

This workshop provides you and your personnel with the knowledge and information required to perform their duties competently and safely in working with lead acid batteries. This workshop will encompass basic battery theory, types of batteries, installation, testing and maintenance.

WHO SHOULD ATTEND:

- Maintenance Personnel
- Supervisors
- Electrical and Instrumentation Technicians
- Health and safety personnel
- Purchasing personnel
- Maintenance and Plant engineers
Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

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The Program

INTRODUCTION
- Objectives of the course
- Basic Technical Concepts

HEALTH AND SAFETY ISSUES
- National and International Standards (eg BS 6133:1995)
- Regulations and Law

BASIC BATTERY THEORY
- How a battery works
- Battery Construction
- Manufacturing processes
- Failure Modes
- Terminology and design

TYPES OF BATTERIES
- Regulated Lead Acid
- Vented Lead Acid
- Nickel Cadmium
- Battery Ratings

BATTERY INSTALLATION
- New battery installation
- Receiving new battery shipments
- Working practices in compliance with BS 6133 and AS/NZ standards

INITIAL AND FLOAT CHARGING
- Different charging methods
- Correct Methods
- Importance of correct Float Voltages

ROUTINE TESTING PROCEDURES
- External Load Banks
- Other specialised test equipment

GENERAL MAINTENANCE AND REPORT DATA
- Maintenance to ensure long life and reliability
- Instruments: What is available and how to use them
- Routine care, maintenance and servicing
- Changing procedures
- Handling equipment
- Safety
- Inspection
- Data Interpretation
- Causes of Battery Failure
- Storage of batteries

DIAGNOSIS OF BATTERY CONDITION
- Recognising problems at an early stage
- Rectifying problems to ensure long life

BATTERY MONITORING SYSTEMS
- Float Voltage, charge and discharge currents
- Temperatures

DATA LOGGING AND INTERPRETATION
- Recording
- Interpreting test data

BATTERY PERFORMANCE PREDICTION
- Estimation and prediction of battery and life expectancy
- "Time to run"

SUMMARY, OPEN FORUM AND CLOSING

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STANDBY POWER AND ENERGY EFFICIENCY

YOU WILL LEARN HOW TO:

- Understand the level of failure-proofing that specific equipment may require
- Know the various available options of critical power supply systems
- Assess the various power supply options objectively
- Design a suitable power distribution system for critical power
- Specify the solution that is the best and most economical for your needs
- Establish an energy savings strategy for your installation

WHO SHOULD ATTEND:

- Distribution planning engineers
- Electrical and instrumentation engineers
- Plant engineers
- Automation engineers
- Control engineers
- Mechanical engineers
- Engineering managers
- Operators and technicians
- Anyone actively involved with implementing or optimising a critical power supply system
Ensuring a reliable power supply for your installation is probably one of your key tasks as an engineer, technician or manager especially with the current challenges of rolling black outs in South Africa. An unscheduled interruption can cause loss of production, immense damage and possibly accidents and loss of life. While it is impossible to guarantee 100% availability of power at all points in any system, vulnerable sections can be provided with alternative critical power supply equipment to ensure reliable power availability, thereby avoiding the problems of power interruption.

The key initial objective of the workshop is to go through the key steps in ensuring a reliable power supply to critical systems using various available options. The solutions can vary from the simple diesel generating set as standby sources to high-capacity UPS systems for large business premises. New technologies such as fuel cells have matured and are fast becoming mainstream solutions. Of course, all this comes at a price, which means that the solution must match the actual needs at a reasonable cost. We will discuss how to save dollars by finding the right solution to your needs so that you invest just what is needed and where it is needed.

Another major aspect is to ensure that critical power supply is itself very reliable. This will need suitable redundancies and a well-engineered multi-module system so that when the need arises the redundant modules cut-in and take over the load without any hitches. This workshop will also briefly look at the design issues involved in planning the distribution of critical power by deploying state-of-the-art control devices such as static transfer equipment.

Finally, strategies you can implement to optimise energy efficiencies at your facility will be examined. Reducing electric power usage results in reduced expenditure to the consumer. On a macro-level, it reduces power demand and avoids the need for power cuts and load shedding by the power supply agencies. It also reduces the capacity requirement and capital expenditure on standby power equipment. The workshop is concluded with the steps to take to optimise the energy efficiency of your installation.

If you are responsible for maintaining power availability in your facility, this workshop is something which you simply cannot afford to miss. And all you need is just invest three days of your time and listen to what our expert instructors have to say!

**Pre-requisites**

Working knowledge of electrical engineering and hands-on work with power distribution systems in a plant environment with critical processes is desirable. Real-life experience with critical power supply sources such as uninterrupted power supply (UPS) systems will further enable the workshop to be placed in context.

**The Program**

**MAIN FORMS OF ENERGY**

**ELECTRICAL ENERGY USAGE**

**ELECTRICAL POWER SCENARIO TODAY**

**CRITICAL POWER NEEDS AND SOLUTIONS**

**OVERVIEW OF CRITICAL POWER SUPPLY EQUIPMENT**

**DIESEL GENERATING SET (PART 1: ENGINES)**

**DIESEL GENERATING SET (PART 2: GENERATORS)**

**STATIC UPS BASICS**

**BASICS OF BATTERIES**

**CHARGING AND DISCHARGING OF BATTERIES**

**SELECTION AND SIZING OF BATTERIES**

**INSTALLATION OF BATTERIES**

**STATIC TRANSFER SYSTEMS FOR CRITICAL POWER SUPPLIES**

**EMERGING TECHNOLOGY FOR CRITICAL POWER APPLICATIONS: FUEL CELLS**

**WHAT IS ENERGY EFFICIENCY?**

**ENERGY EFFICIENT PRACTICES IN ELECTRICITY USE**

**ENERGY EFFICIENCY IN CLIMATE CONTROL (HVAC) APPLICATIONS**

**INTRODUCTION TO ENERGY AUDITS**

**SUMMARY, OPEN FORUM AND CLOSING**

**Practical Sessions**

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

*To gain full value from this workshop, please bring your laptop/notebook computer.*

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ELECTRICAL SUBSTATION AND SWITCHYARD DESIGN

YOU WILL LEARN HOW TO:

- Select an optimised location for a substation being set up to fulfil a given set of needs
- Choose the most appropriate configuration and type of substation for this requirement
- Design a detailed layout taking into account all essential aspects
- Develop a set of conditions for which detailed system studies need to be carried out
- Specify the equipment required based on the studies
- Design the individual subsystems for control and protection of the power system which the substation serves
- Design earthing and lightning protection systems to ensure safety of equipment and personnel in the event of abnormal system conditions such as faults and lightning events
- Design the required electrical interconnections to ensure correct functioning of the substation equipment
- Draw up a list of design inputs for building and structural design engineers
- Plan the support facilities required for the substation

WHO SHOULD ATTEND:

This course is aimed at engineers who are already working as electrical system designers as well as those who belong to any of the fields listed below and wish to prepare themselves for moving into the role of a substation designer.

- Utility engineers dealing with power transmission and distribution systems
- Electrical engineers involved in power generating plants with utility scale generators
- Electrical engineers in large industries who are associated with power distribution
- Consulting engineers involved in design of substations
- Contractors executing projects involving electrical HV substations
- Electrical commissioning engineers
The Workshop

Electrical substations form important nodal points in all power networks. Substations can be of various capacities, voltages, configurations and types depending on what is the application for which the substation is being designed. Location and layout of a substation present a number of challenges to the designer due to a large variety of options available to a designer. There are ever so many constraints too that need to be kept in mind; technical, environmental and naturally financial. Arriving at an optimum design within these constraints is as much an art as it is a science. Designing a substation which will operate with utmost reliability for at least three or four decades involves a thorough knowledge of the current state-of-the-art equipment, emerging technologies, the tools for presenting and evaluating all available options and a good appreciation of power system operation and maintenance. This course will present a comprehensive capsule of all the knowledge essential for a substation designer and walk the participants through the substation design process using a set of interlinked case studies.

Pre-requisites

- A good basic knowledge of electrical transmission and distribution equipment
- Experience in operating, maintaining and troubleshooting of substation equipment
- Some exposure to design will be an advantage but not essential
- A good theoretical background of electrical engineering and willingness to use and upgrade their numerical and computer skills
- A basic appreciation of the related engineering disciplines such as civil, structural and data communications

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The Program

ROLE OF SUBSTATIONS IN AN ELECTRICAL NETWORK, TYPES AND CONFIGURATIONS OF SUBSTATIONS
- Networks—an introduction
- Different voltages in a network
- Substation types on network nodes
- Substation types based on their position in the network
- Optimising the location of a substation
- Substation options: Outdoor air insulated, GIS, Indoor air insulated
- Configurations of HV substations based on their bus arrangement (typical SLD)
- Data on the industrial loads required for the design of the electrical supply substation
- Load assumptions for residential and commercial consumers
- Environmental issues in the location of a switchyard and mitigation measures

SYSTEM STUDIES REQUIRED FOR FINALISING EQUIPMENT RATINGS
- Load flow study (active/reactive loads)
- Short circuit study
- Harmonic flow
- Voltage profile and reactive power compensation
- Stability study

OVERVIEW OF SWITCHYARD EQUIPMENT AND THEIR ORDERING SPECIFICATIONS
- Main (primary) equipment
  - Busbars
  - Disconnectors
  - Circuit breakers
  - Instrument transformers
  - Lightning arresters
  - Power transformers
  - Structures
- Layout options
- Sectional and Safety clearances and their influence on the layout
- Design of busbars (strung tubular) and interconnections between equipment
- Interconnecting cables and use of marshalling kiosks

SUBSTATION EQUIPMENT FOR FAULT LIMITING, PFC AND HARMONIC CONTROL
- Need for and application of:
  - Fault limiting reactors
  - Power factor compensation equipment
  - Static VAR compensators
  - Harmonic filters
- Equipment design and selection of ratings
- Layout of these equipment in a switchyard

PROTECTION DESIGN FOR SUBSTATION
- Brief overview of protection
- Over current protection
- Protection coordination
- Protection of transformers
- Busbar protection
- Feeder protection
- Current transformers requirements for protection
- Equipment requirements for substation automation
- PLCC applications in protection and communication
- PLCC hardware and integrating them with the switchyard equipment

EARTHING SYSTEM AND LIGHTNING PROTECTION OF SWITCHYARDS
- Basics of functional and protective earthing
- Touch and step voltages in substations
- Earth grid and its role in safety
- Switchyard fence-why it should be a part of the earth grid
- Design of earth grid-basic considerations in conductor sizing and mesh spacing
- Pros and cons of including the control building within the switchyard earth grid
- Earth mat laying and welding
- Safety mesh at operating points
- Role of gravel layer in safety
- Transferred voltage hazards
- Planning isolation of outgoing services to avoid transfer voltage
- Basics of lightning and hazards
- Role of shield wire and lightning masts
- Typical configurations of lightning protection of switchyards
- Analysis of hazard using cone of protection and rolling sphere methods
- Selection of lightning arrestors-Types, class and ratings

SWITCHYARD CONTROL AND INTERLOCKING
- DC power requirements for switchyard equipment
- DC equipment configuration and specifications
- DC distribution for switchyard equipment
- Battery charging basis
- Space planning and related facilities for a battery installation
- AC auxiliary power for switchyard systems-loads which require ac power
- Possible source options
- AC auxiliary distribution for switchyard equipment and support systems
- Control scheme of disconnectors and circuit breakers
- Control interconnection approach
- Use of optical fibre-based control scheme
- Role and location of marshalling kiosks in different bays

SWITCHYARD-FACILITY PLANNING
- Site preparation, levelling
- Earth resistivity measurement and its role in design verification
- Civil works such as equipment foundations, cable trenches, control building, storm drains, transformer oil collection pit
- Structures and their design requirements
- Substation fence and physical security
- Surveillance
- Planning water requirements and supply arrangement
- Fire protection, lighting and ventilation of control room and other equipment

GAS INSULATED SWITCHGEAR (GIS) AS AN ALTERNATIVE TO OUTDOOR SWITCHYARD
- Why gas insulated substation?
- SF6 properties, advantages and environmental impact
- Typical substation configurations in SF6
- Indoor/outdoor options
- Gas safety considerations
- Equipment for handling SF6
- SF6 substation layout planning
- Cable terminations to SF6 equipment

SUMMARY, OPEN FORUM AND CLOSING

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UNDERSTANDING ELECTRICAL ENGINEERING AND SAFETY FOR NON-ELECTRICIANS

WHAT YOU WILL LEARN:

- Basic facts about electricity and its uses
- Operating principles of common appliances
- Protection of electrical circuits against faults
- Working on electrical circuits and troubleshooting
- What makes electricity unsafe and how to work safely

WHO SHOULD ATTEND:

- Civil, mechanical, chemical, mining engineers, technologists and technicians
- Managers who are involved with or work with staff and projects in electrical engineering
- Non-electrical engineers and technicians
- Non-electrical personnel who want to understand the broader picture
- Plant and facility engineers
- Procurement and buying staff
- Project managers
- Sales engineers
The Workshop

Electrical engineering is often considered to be a mysterious science, because electricity cannot be seen. However, we are all aware of its existence and usefulness in our daily lives. This workshop aims to take the mystery out of electrical engineering and give a good understanding of the fundamental principles of electricity. While many of us work on electrical systems, we do not fully appreciate the dangers, which we get exposed to when doing so. All it takes is a few simple precautions to avoid getting hurt. This workshop teaches you all about the dangers of careless handling of electrical appliances and prevention of electrical accidents.

This workshop is not meant for electrical engineers and other qualified technicians. It is for those who are not formally trained as electricians but often have to handle and maintain electrical appliances in the course of their work. The participants will have an opportunity to understand how the appliances they see everyday actually function. This workshop will deal with the subject with a minimum of theory while emphasizing on the practical, hands-on approach.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed. Some of these sessions will be in the nature of discussion groups and will take a specific topic related to the module for discussion.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

ELECTRICITY
- Electricity is a form of energy
- Static electricity
- Electrical cells and DC
- Voltage and current relationship - ohms law
- Power and energy relationship
- A simple circuit using DC (battery) source
- Electromagnetic generators (AC) - relation between magnetism and electricity
- Speed of rotation and frequency
- Single phase and 3-phase AC systems - basic facts
- Phase sequence

HOW IS ELECTRICITY DISTRIBUTED?
- A modern electrical power system
- Multiple voltage levels and transformers
- Substations
- Your local power utility
- Measurement of energy usage and tariff
- Conductors for carrying current (insulated versus bare)
- Receiving power from the utility
- Distribution within a facility
- Distribution boards
- Circuit breakers (ACB, MCCB, MCB, ELCB)
- Isolators and fuses

HOW IS ELECTRICITY USED?
- Electricity as an energy carrier
- Electricity is clean, easily controlled and instantaneous in action
- Lighting
- Heating
- Mechanical drive/motion and transportation
- Common examples of appliances

BASIC FACTS ABOUT ELECTRICAL APPLIANCES
- Lighting
- Light sources and their relative merits
- Filament lamps
- Metal halide lamps
- Fluorescent lamps and CFL
- Mercury and sodium vapor lamps
- Starters and their function
- Electric heaters
- Resistance heaters
- Heaters using high frequency methods (example: microwave)
- Electrical motors
- Pumps and compressors
- Cooling and refrigeration
- Transportation and lifting
- Control of electrical motors
- Difference between single phase and 3-phase motors
- Starting methods
- Speed-frequency relationship
- Speed control methods in AC motors
- Phase reversal and its effect on direction of rotation in 3-phase motors

ELECTRICAL FAULTS
- Basic faults in electrical circuits "an open connection or an unwanted connection"
- Insulation and its importance
- Reasons for failure
- Preventing overloads
- Overload protection by thermal relay, temperature protection etc.
- Faults due to insulation failure
- Short circuits
- Earth faults
- Short circuit protection
- Fuses
- Circuit breakers with magnetic releases
- Earth fault protection
- Earth leakage relay
- Fuses and breakers can protect too
- Open circuits and reasons
- Importance of proper terminations
- Danger of open circuit causing single phase operation of 3-phase motors
- Why is single-phasing dangerous to motors?
- Detection by single-phasing relays

WORKING ON ELECTRICAL CIRCUITS
- Why is work needed on electrical circuits?
- For maintenance
- For fault finding (troubleshooting)
- For testing
- Working with circuit energised (refer to relevant codes)
- Lamp changing
- Troubleshooting (measuring current flow or checking for voltage at specific points)
- Working with circuit switched off
- Procedures lock-out/tag-out
- Earthing a circuit for safety
- Checking that a circuit is dead
- Voltage tester (neon stick, single and two-lamp testers)
- Instruments used for troubleshooting
- Multimeters - what do they measure?
- Clip-on ammeter
- Continuity tester
- Insulation tester

ELECTRICAL SAFETY
- Dangers of electricity
  - Electric shock (direct and indirect)
  - Fall caused by electric shock
  - Arc flash and burns
- Role of PPE in safety
  - Examples of PPEs
- Avoiding shock danger
  - Safety while doing permitted live work
  - Safety while working on dead circuits
  - Role of protective earthing for safety during normal operation
- Arc flash dangers
  - Severe burns
  - Avoid live work except as permitted under codes
  - Use insulated tools
  - PPE for live work and for operations such as switching
- Codes and the need to follow them strictly
  - Australian Wiring Regulations; locally applicable code
- Electrical accidents and first-aid

SUMMARY, OPEN FORUM AND CLOSING
MASTER SERIES –
ELECTRICAL ENGINEERING

WHAT YOU WILL LEARN:

• Gain skills and know-how in the latest technologies in electrical engineering
• Gain a clear picture of the latest developments and future directions in electrical engineering from experts in the field
• Learn how to make reliable, well grounded and commercially viable technical, financial and management decisions in electrical engineering.
• Learn how successful electrical engineers communicate their vision and values to build up a super effective team.

WHO SHOULD ATTEND:

This Master Series course is designed for people from an electrical background. It has been developed for those whose time is limited and who work in a critical role or situations where a lengthy time away for study is impossible.

• Automation and process engineers
• Chemical and mechanical engineers
• Consulting engineers
• Electrical engineers and technicians
• Electrical technicians
• Energy management consultants
• Field technicians
• Graduate engineers
• Instrumentation and design engineers
• Maintenance engineers and supervisors
• Project and production managers
• Project engineers
The Workshop

The Electrical Engineering Master Series delivers a critical blend of knowledge and skills, covering technology in electrical engineering, industry analysis and forecasts, leadership, management and everything that is relevant to a modern electrical engineer. You will be exposed to four high impact days where you will not only hear from outstanding experts in each of the key areas but undertake practical hands-on sessions and exercises. This course is not intended as a substitute for a 4 or 5 year engineering degree or diploma or for an accomplished and experienced professional electrical engineer who is working at the leading edge of electrical practice in these varied fields. It is however, intended to be the distillation of the key skills and know-how in practical, state-of-the-art electrical engineering.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. Some of these sessions will be in the nature of discussion groups and will take a specific topic related to the module for discussion.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

SETTING THE SCENE
- Issues, timing, instructors and protocols to be followed during the exercises. Participants will be introduced to each other and their assigned team.

UNDERSTANDING ELECTRICAL DRAWINGS
- Engineering drawing for electrical engineers
- Symbols used in electro technology and governing standards
- Single line and 3-line diagrams
- Cabling and wiring drawings
- Layout drawings
- Advances arising from computer aided drafting (CAD)

ELECTRICAL POWER DISTRIBUTION FUNDAMENTALS
- Common distribution system alternatives
- Planning of power distribution system
- Fault level in electrical systems and their role in the choice of equipment
- Fault current evaluation of simple power distribution systems
- In-plant generation requirements and alternatives
- Distribution equipment sizing
- Power distribution system automation
- Maintenance and asset management in distribution systems

CIRCUIT BREAKERS AND SWITCHGEAR
- Circuit breaker basics
- Difference between isolator and circuit breaker
- Principle of arc quenching
- Maintenance components
- Enclosures for indoor use and IP ratings
- HV Circuit breakers
- Common types of HV circuit breakers (BOCB, MCCB, ABCB and SF6 CB)
- Outdoor construction examples
- Operating principles of different type of CBs
- Maintenance aspects of HV circuit breakers
- LV Circuit breakers
- Common types of LV circuit breakers (ACB, MCCB, Motor CB and Miniature CB)
- Selection of circuit breakers and switchgear, their ratings and specifications

POWER CABLES
- Introduction
- Basic theory
- Selection of cables and installation
- Joints and termination
- Jointing and termination practice
- Commissioning and periodic testing
- Failure modes and fault detection
- New trends in cable technology

EARTHING AND LIGHTING SURGE PROTECTION
- Electrical system earthing
- Earth electrode systems
- Earthing design of substations
- Lightning and protection against lightning
- Lightning protection of structures, electrical lines and substations
- Lightning protection of marine electrical systems
- Surge protection
- Electrical noise and mitigation role of earthing

POWER SYSTEM PROTECTION
- Need for protection
- Fuses
- Instrument transformers
- Tripping power source
- Relays and relay coordination
- Principles of unit protection
- Switchgear (busbar) protection
- Transformer protection
- Motor protection relays
- Generator protection

BUDGETING, ROI AND FINANCE OF ELECTRICAL PROJECTS
- Introduction
- Basic accounting concepts
- Budget preparation and control
- Understanding cash flow
- Estimation and costing
- Time value of money and discount rates
- Investment appraisal methods: DCF, Payback, NPV/IRR
- Capital budgeting
- Decision making
- Tax
- Risk and uncertainty

ELECTRICAL SAFETY AND WIRING REGULATIONS
- An Introduction to Electrical Safety
- Role of protective earthing in electrical safety
- Hazards due to electrical arcing and heating - 1
- Hazards due to electrical arcing and heating - 2
- Safety aspect in electrical design and selection
- Safe operation and maintenance
- Substation safety
- Safety in battery installations
- Organizational aspects of safety
- Australian regulations on safety

TESTING, TROUBLE SHOOTING AND MAINTENANCE OF ELECTRICAL ENGINEERING
- Fundamentals of testing
- Insulation testing
- High potential tests

- Oil testing
- TAN Delta testing
- Partial Discharge (PD) testing
- Impulse testing
- Transformer testing
- Cable testing

PROJECT MANAGEMENT OF ELECTRICAL PROJECTS
- Fundamentals of project management
- Time management
- Cost management
- Integrated cost and time management
- Construction contracts
- Management of the project team
- Risk management
- Contract law
- Project planning
- Application to instrumentation and control

PREPARATION FOR PRESENTATIONS
- Each team will prepare for the presentations on the next day. The instructors will spend time with each group to ensure that their materials are presented as effectively and practically as possible

ENERGY USE AND EFFICIENCY
- What is energy efficiency?
- Alternative energy sources
- Electrical energy generation/usage
- Energy efficient practices in electricity use
- Energy cost structures
- Introduction to Energy Audits

DELEGATE PRESENTATIONS
- Throughout the technical modules, participants operating in small teams, complete a series of exercises based on constructing a new plant. Time will be set aside to collate the exercises into a presentation
- During this session, each team will present its plans to the other teams

REVIEW OF EXERCISES AND CASE STUDY
- A review will be made on the exercises and submissions and builds on previous sessions. The instructor will participate here in the nature of discussion groups

FORECASTS AND PREDICTIONS
- Main technology trends
- Conflicting data
- How to resolve
- Technical skills squeeze
- Outsourcing
- The China challenge
- Market predictions

SUMMARY, OPEN FORUM AND CLOSING
MECHANICAL, ELECTRICAL AND INSTRUMENTATION ENGINEERING FOR NON-ENGINEERS

WHO SHOULD ATTEND:

- Administration staff
- Civil, mechanical, chemical, mining engineers, technologists and technicians
- Electrical contractors
- Finance, IT and accounting managers
- Human resources managers
- IT personnel
- Legal personnel
- Managers who are involved with or work with staff and projects in electrical engineering
- Non-electrical and mechanical engineers and technicians
- Non-electrical and mechanical personnel who want to understand the broader picture
- Non-engineering personnel
- Operators
- Plant and facility engineers
- Procurement and buying staff
- Project managers
- Sales engineers
- Senior managers

WHAT YOU WILL LEARN:

- Basic mechanical engineering concepts such as force, work, power, moments and torques
- The importance of common engineering material properties in relation to component life and failure
- The basics of electrical power engineering
- Practical steps in selection, installation and commissioning of electrical systems
- How to protect yourself and others from electrical hazards
- The fundamentals of instrumentation and process control
- The basics of Programmable Logic Controllers (PLCs) and SCADA systems
The Workshop

In two fascinating and intensive but easy-to-understand days you will learn the basic applied concepts of mechanical, electrical and instrumentation engineering. This will enable you to work more effectively with your engineering colleagues – no matter whether they are operators, tradespersons, technicians or engineers.

There are three main threads running through this course – initially mechanical engineering, then electrical engineering best practice and concluded with instrumentation (or industrial automation).

Mechanical engineering in simple terms deals with any equipment that moves; this is what makes it perhaps the most broad and diverse of engineering disciplines. The mechanical discipline essentially derives its breadth from the need to design and manufacture everything from small, even nano, individual devices, such as measuring instruments, to large systems such as machine tools and power plants.

The focus in electrical engineering is on the building blocks of electrical engineering, the fundamentals of electrical design and integrating electrical engineering know-how into the other disciplines within an organisation. Unnecessary theory will be minimised.

The dangers and risks from electrocution, shock, explosions and arc blast can never be eliminated but you can take definite steps to protect yourself and your co-workers.

The topics in instrumentation engineering commence with an introduction to instrumentation and measurement ranging from pressure, level, temperature and flow devices followed by a review of process control including the all important topic of PID loop tuning.

The Program

MECHANICAL
- Mechanical Engineering Basics
- Engineering Materials
- Gears and Bearings
- Mechanical Drives
- Fluid Engineering
- Heat Transfer
- Maintenance

Practical demonstration

ELECTRICAL
- Overview of the Electric Power Systems
- Basic Concepts
- Electrical Generation, Transmission and Distribution
- Electrical Measurements and Applications
- Earthing
- Transformers
- Power Quality
- Power Systems Protection
- Electrical Shock and Methods of Shock Prevention
- Hazards Due to Electrical Arcing and Heating

Practical demonstration

INSTRUMENTATION
- Introduction to Process Measurement
- Pressure Measurement
- Level Measurement
- Temperature Measurement
- Flow Measurement
- Fundamentals of Programmable Logic Controllers (PLCs)
- Introduction to SCADA Systems

Practical demonstration

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

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PRACTICAL
EARTHING, BONDING, LIGHTNING AND SURGE PROTECTION

YOU WILL LEARN HOW TO:

• Apply good earthing practice to your next installation
• Detail the applicable national standards
• Describe the purposes of earthing and bonding
• Apply the various methods of earthing electrical systems
• List the types of systems that cannot be earthed
• Describe what systems can be operated unearthed
• Correctly shield sensitive communications cables from noise and interference
• Apply practical knowledge of surge and transient protection
• Troubleshoot and fix earthing and surge problems
• Design, install and test an effective earthing system for electronic equipment
• Understand lightning and surges and how to minimise its impact on your facility
• Protect sensitive electronic equipment from surges and lightning

WHO SHOULD ATTEND:

• Building service designers
• Consulting engineers
• Data systems planners and managers
• Electrical and instrumentation technicians
• Electrical contractors
• Electrical engineers
• Electrical inspectors
• Electricians
• Instrumentation and control engineers
• Maintenance engineers
• Power system protection and control engineers
• Project engineers
• Safety professionals
The Workshop

Few topics generate as much controversy and argument as that of earthing and the associated topics of surge protection, shielding and lightning of electrical and electronic systems. Poor earthing practice can be the cause of continual and intermittent difficult-to-diagnose problems in a facility. This workshop looks at these issues from a fresh yet practical perspective and enables you to reduce expensive down time on your plant and equipment to a minimum by correct application of these principles.

This workshop is designed to demystify the subject of earthing and presents the subject in a clear, straightforward manner. Installation, testing and inspection procedures for industrial and commercial power systems will be examined in detail. Essentially this workshop is broken down into earthing, shielding and surge protection for both power and electronics systems. Earthing and surge protection for telecommunications and IT systems are examined in detail. Finally, the impact of lightning is examined and simple techniques for minimising its impact described.

The Program

**EARTHING BASICS**
- Basics of earthing
- Bonding
- Lightning and surge protection
- Static charges
- Shielding
- UPS systems and their earthing practice

**EARTHING OF POWER SYSTEM NEUTRAL**
- Unearthed and solidly earthed systems
- Impedance earther systems
- Resonant impedance earth systems

*Practical session: problem solving on calculation of charging current and neutral impedances*

**EQUIPMENT EARTHING**
- Shock hazards to the human body
- Earthing of equipment
- Operation of protective devices
- Thermal capacity of earthing wires
- Touch potential
- Induced voltages
- Multiple earthing connections
- Surge protection earthing

*Practical session: problem solving on safe touch voltage and sizing of earthing conductors*

**LIGHTNING AND ITS EFFECT ON BUILDINGS AND ELECTRICAL SYSTEMS**
- The incidence and probability of lightning strike
- Methods of lightning protection
- Planning for lightning protection
- Improvements to lightning protection
- Effects of lightning strike on overhead lines
- To protect or not to protect

*Practical session: problem solving on protection zones using attraction radii principle*

**STATIC ELECTRICITY AND PROTECTION**
- What is static?
- Generation of charge
- Common examples
- Energy of a spark
- Ignition capability of a spark
- Dangers of static buildup
- Control of static
- Assessment of risks and planning

*Practical session: problem solving on ignition due to spark energy*

**EARTH ELECTRODE SYSTEMS**
- Earthing electrodes
- Soil resistance
- Measuring soil resistivity
- Resistance of single rod electrodes
- Current carrying capacity of an electrode
- Measurement electrode resistance single and multiple rods
- Concrete encased electrodes
- Corrosion of electrode systems
- Maintenance of electrode systems
- Chemical electrodes

*Practical session: problem solving on earth resistivity, electrode resistance and current carrying capacity*

**SURGE PROTECTION OF ELECTRONIC EQUIPMENT**
- What is a surge?
- Bonding of different earthing systems
- Surges and surge protection
- Principles of surge protection
- Achieving graded surge protection
- Positioning and selecting surge protection

**ELECTRICAL NOISE AND MITIGATION**
- Definitions of electric noise
- Analysis and categories of noise
- Electrostatic coupling
- Electromagnetic coupling
- Shielded isolation transformer
- Insulated earth receptacle
- Zero signal reference grid
- Harmonics

**UPS SYSTEMS AND THEIR EARTHING PRACTICES**
- Power quality issues
- Abnormal voltage conditions
- Susceptibility and measures to handle voltage abnormalities
- Regulating transformers
- Standby sources
- Electro-mechanical UPSs
- Solid state UPSs
- Multiple redundant systems
- Selection of a UPS
- Earthing practices

*Practical session: case studies involving real life problems*

**CASE STUDIES**

**SUMMARY, OPEN FORUM AND CLOSING**

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# ELECTRONICS

## TRAINING WORKSHOPS

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PRACTICAL DIGITAL SIGNAL PROCESSING FOR ENGINEERS AND TECHNICIANS

THIS WORKSHOP WILL OFFER YOU:

- A clear understanding of Digital Signal Processing (DSP)
- Benefits and application of DSP technology to improve efficiency
- Frequency analysis of signals and the application of this knowledge
- Information about and actual design of digital filters
- Analysis of the performance of DSP systems
- Identification of the key issues in designing a DSP system
- An understanding of the features and capabilities of commercial DSP applications
- Current DSP technology

WHO SHOULD ATTEND:

- Communication System Engineers
- Electrical and Electronic Engineers
- Control System Engineers
- Instrumentation Engineers
- Electrical and Electronic Technicians
- Design Engineers
- Condition Monitoring Engineers and Technicians
The Workshop
Digital Signal Processing (DSP) is the capture, analysis and manipulation of an analogue signal by a digital computer. The integration of DSP software and hardware into products across a wide range of industries has necessitated the understanding and application of DSP by engineers and technicians.

Workshop Objectives
The introduction of DSP from a practical point of view using a minimum of mathematics. The emphasis is on the practical aspects of DSP, implementation issues, tips, tricks and pitfalls, and practical applications. Intuitive explanations and appropriate examples are used to develop a fundamental understanding of DSP theory. The workshop participant’s will gain a clear understanding of DSP technology in a variety of fields from process control to communications.

Some of the DSP techniques included in the workshop:
- Digital filtering for cleaning a signal from noise
- Discrete Fourier Transforms for finding a particular frequency component
- Correlation techniques to find a signal buried in noise
- Industrial control with digital controllers
- Instrumentation and test for better accuracy
- Vibration analysis for identifying frequency signatures
- Image and video processing for enhancing images
- Communications especially for filtering out noise

Practical Sessions
There are eight practical sessions designed to enhance the delegate’s understanding of the workshop. Most are software-based and make use of the widely used MATLAB software from Mathworks, Inc. Other sessions use the Texas Instrument DSP boards for experimentation.

- Introduction to MATLAB/SIMULINK and Signal Processing Toolbox
- Introduction to SIMULINK
- FIR Filter Design
- IIR Filter Design
- Filter Realisation
- Image Processing
- Sampling and Quantisation
- DSP Implementation

The Program
INTRODUCTION
- Terminology and motivation
- Why process digitally?
- A typical DSP system
- Some current application areas

DIGITAL-TO-ANALOG AND ANALOG-TO-DIGITAL CONVERSION
- Periodic sampling and aliasing
- Digital to analog converters
- Analog reconstruction
- Analog to digital converters

DISCRETE SIGNALS AND SYSTEMS
- Discrete-time signals: notation and representation
- Classification of discrete systems
- The concept of impulse response
- The concept of convolution
- Autocorrelation and cross-correlation of signals

FREQUENCY ANALYSIS OF DISCRETE SIGNALS
- Fourier series for periodic signals
- Discrete Fourier Transform (DFT) for non-periodic signals
- Understanding the DFT equation
- DFT properties
- The Inverse DFT
- The Fast Fourier Transform (FFT)
- Frequency analysis of discrete signals: use of windows and DFT results interpretation
- Fast computation of convolution using DFT
- Other related transforms

DSP APPLICATION EXAMPLES
- Digital waveform generators
- Speech modelling and synthesis
- Noise reduction and signal enhancement
- Image restoration
- Communications system

IIR DIGITAL FILTER DESIGN
- Review of classical filter approximation techniques
- Characteristics of IIR filters
- Design methods
- Design examples

FIR DIGITAL FILTER DESIGN
- Characteristics of FIR filters
- Design methods
- Design examples

DIGITAL FILTER REALISATIONS
- Direct form
- Hardware realisations
- Quantisation effects

COMMERICAL DSP HARDWARE
- Architectural difference between DSP chips and general purpose microprocessors
- Texas Instrument TMS320 family
- Motorola DSP56000 family
- Analog Devices ADSP-2100 family
- Choosing a DSP architecture
- DSP trends

PRACTICAL TOOLS FOR DSP SYSTEM DEVELOPMENT
- Simulation tools for algorithm development
- Software development tools
- Hardware development tools

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Instructor has excellent knowledge on the subject.
A. J. Pretorius

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PRACTICAL EMBEDDED CONTROLLERS: TROUBLESHOOTING AND DESIGN FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN:

- How to design, set up and program a complete embedded controller development system
- How to apply the latest techniques in programming these versatile devices
- Troubleshooting tips, tricks and traps for microcontrollers
- Installation techniques for microcontrollers
- How to fix problems due to electrical noise and interference
- How to design correctly the first time to avoid earthing and EMC problems.
- How to avoid the five most common problems in the design of Microcontrollers
- How to choose and configure the correct software

WHO SHOULD ATTEND:

This is not an advanced course but one aimed at engineers and technicians who want a solid grounding in the fundamentals from an expert in the area. You may already have been working in this area but want to get more out of your designs with some useful practical information which you can apply immediately when troubleshooting or performing your next design.

- Electronic Technicians & Engineers
- Instrumentation & Control System Engineers and Technicians
- Electrical Engineers & Technicians
- Project Engineers
- Design Engineers
- Technicians
- Process Control Engineers
- Systems Engineers
The Workshop

From microwave ovens to alarm systems to industrial PLC and DCS control systems, embedded controllers are controlling our world. The microcontrollers that are at the heart of these and many more devices are becoming easier and simpler to use. But when these devices fail the solution to the problem needs to be found and the repairs done quickly.

The Embedded Controllers: Troubleshooting and Design workshop will help the technician, engineer and even the most casual user understand the inter-workings of microcontrollers along with the most common problems and their solutions. Embedded controllers are used in most electronic equipment today. Embedded controllers are intelligent electronic devices used to control and monitor devices connected to the real world. This can be a Programmable Logic Controller (PLC), Distributed Control System (DCS) or a Smart Sensor. These devices are used in almost every walk of life today. Most automobiles, factories and even kitchen appliances have embedded controllers in them.

This two-day workshop covers all aspects of embedded controllers but focussing specifically on troubleshooting and design. The workshop covers design, specification, programming, installation, configuration and of course troubleshooting.

This hands-on workshop gives both the novice and experienced user a solid grasp of the basic principles enabling you to go away and apply the material learnt immediately to your application.

Workshop Objectives

The objectives are simply to give you a thorough grounding in the use of microcontrollers; thus enabling you to design your own system hardware and then to program it. Further to this it will also help you to troubleshoot, diagnose and fix faults on your microcontroller systems.

Practical Sessions

Groups of two attendees will be allocated a PC and microcontroller development board to develop complete projects. You will use internationally known software packages, chosen for their high profile and popularity in the industrial environment. You will develop your ability in working with Embedded Controller systems and reinforce the information learned in the workshop. You will learn first-hand how to set up and use the development system to build a complete working prototype project.

The Program

INTRODUCTION
- Introduction
- Microcontroller Introduction
- Microcontroller Design & Functions
- Assembly Language Programming
- Inputs & Outputs
- Data Communications
- Noise Reduction
- Grounding Solutions
- Installation Techniques

MICROCONTROLLER BASICS
- Introduction
- Number Systems - Binary, Hex, & Decimal
- Gates - AND, OR, XOR & NOT gates
- Accumulators, A, B & D
- Registers - X, Y & Z
- Communications - Synchronous & Asynchronous
- Power Systems - Resetting & Brownouts
- Crystals & Oscillators

INTRODUCTION TO PROGRAMMING THE MICROCONTROLLER
- Programming Structure & Specifications
- Addressing Modes
- Load, Stores & Transfers
- Arithmetic Operations
- Logical Operations
- Shifts & Rotates
- Index Registers & The Stack
- Condition Code Register
- Branches, Jumps, Interrupts & Calls
- Assembly Programming

INTRODUCTION TO MEMORY
- User Ram
- Buffalo Routines, Memory Map & Vectors
- Interrupts, Vectors & Pseudo-Vectors
- Control Registers
- EEPROM

INTRODUCTION TO INPUTS AND OUTPUTS
- Single Ended vs. Differential Inputs
- Digital Inputs
- Digital Outputs
- Analog Inputs
- Digital Control of Analog Devices
- Keypad Interfacing
- LCD Interfacing

DATA COMMUNICATIONS
- Introduction to Data Communication
- Basics of Serial Data Communication
- Open System Interconnection Model
- Modes of Communications
- RS 232
- RS 485
- Fibre Optic Cables
- Fieldbus Protocols used in Controllers

ELECTRONIC NOISE REDUCTION IN CONTROLLERS AND PCBs
- Introduction to Noise Reduction
- Conductive Coupled Noise
- Capacitive Coupled Noise
- Magnetic Coupled Noise
- EMC & Noise Reduction in PCB Design

EMC GROUNDING SOLUTIONS
- Introduction to EMC Grounding Solutions
- EMC Grounding
- EMC Grounding on a PCB
- Protecting Controllers from Lightning
- Microcontroller Equipment Ground
- Enclosure or Safety Ground

INSTALLATION AND TROUBLESHOOTING
- Introduction to Installation & Troubleshooting
- Connections - Screw, Crimp & Solder
- Cable Runs & Trays
- Cable Ties & Mounting
- Cooling, Heating & Air Conditioning
- Cable Run Wire Management
- Conduit Installation
- Troubleshooting Specifics
- Safety Considerations

CONCLUSION
- CPU Design & Functions
- Assembly Language Programming
- Memory
- Inputs & Outputs
- Data Communication
- Noise Reduction
- Grounding Solutions
- Installation Techniques

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PRACTICAL
EMC AND EMI CONTROL
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:
• Apply the relevant IEC Standards and relate to the European Directive which is now widely applicable worldwide
• Understand the issues surrounding EMC and the CE mark
• Determine the testing procedures and equipment used for measuring conformance to the standards
• Design for minimum emission and susceptibility
• Configure systems made up of a number of component sub-assemblies, for conformance
• Render older equipment conformant to new standards
• Maintain equipment in a compliant state after repair or servicing

WHO SHOULD ATTEND:
• Engineers and technicians involved in the design and manufacture of electrical and electronic equipment that produce electromagnetic disturbances and may be susceptible to electromagnetic interference
• Engineers and technicians involved with the maintenance and service of electrical and electronic equipment
• Those that need to ensure that goods conform to the required standards
• Those involved with the marketing and sale of goods that need to comply with the required standards
The Workshop

This Practical EMC/EMI Control (Electromagnetic Compatibility/Electromagnetic Interference) two-day workshop is a 'hands-on', 'how-to' course. It will show you in a practical and straightforward way how to understand and implement the relevant standards required to reduce and control electromagnetic disturbances and interference.

This workshop will enable you to measure equipment for conformity to standards and equip you to design and configure goods and systems for minimum emission and susceptibility. It will also equip you to render older equipment standard compliant and allow you to maintain compliance levels when repairing and servicing equipment.

Save on down-time and manufacturing delays with this practical EMC/EMI Control workshop.

Pre-requisites
Fundamental knowledge of basic mechanical plant and operation thereof.

Workshop Objectives

This practical workshop will offer you the most up-to-date knowledge to:
• understand the importance of EMC/EMI control
• know the routes to compliance
• relate to the relevant compliancy standards
• determine testing procedures and equipment for measuring conformance
• design equipment and goods for minimum emission and susceptibility
• configure systems for conformity
• render older equipment compliant
• maintain compliancy in equipment after repair and service

Practical Sessions

To ensure practical knowledge and experience, this workshop offers 5 practical sessions:
• RF emission measurement
• Harmonic emission measurement
• Susceptibility testing
• Designing for compliance
• Demonstration of effects of design practices

The Program

INTRODUCTION TO EMC
• Electromagnetic disturbances and their sources
• Electromagnetic susceptibility/immunity
• Coupling between source and victim
• Electromagnetic compatibility
• The need for harmonisation
• The European Directive
• Current standards
• Routes to compliance

EMISSION TYPES
• RF Emissions
• Harmonic injection into the mains
• Transients
• Standards
• Testing procedures
• Test equipment
Practical: RF Emission measurement
Practical: Harmonic emission measurement

INTERFERENCE COUPLING MECHANISMS

ELECTROMAGNETIC SUSCEPTIBILITY/IMMUNITY
• Relevant standards
• Testing procedures
Practical: Susceptibility testing

INTRODUCTION TO EMC
• RF radiation principles
• PCB design for reduced radiation
• Digital circuits
• Analog circuits
Practical: Demonstration

POWER SUPPLIES
• Harmonic minimisation
• Preventing transient interference/damage
Practical: Demonstration of effects of design practices

SYSTEM CONSIDERATIONS: INTERFACING TO OTHER EQUIPMENT
• Filtering
• Shielding
• Interconnecting

MANAGING THE EMC PROCESS
• Interfacing with management
• Interfacing with management and Quality Assurance

This has been a great eye opener and I wish I had done this sooner in my career.
Richard Paveley

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PRACTICAL
INDUSTRIAL ELECTRONICS
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Work effectively with common electric components and systems
• Troubleshoot problems (save on downtime)
• Multi-skill into electronics, to improve your employability
• Confidently carry out simple repair procedures for faults on printed circuit boards

WHO SHOULD ATTEND:

• Maintenance technicians, electricians, foremen and engineers
• Mechanical and chemical engineers, operators and personnel who need electronics knowledge
• All engineering, operations and management personnel who are directly or indirectly involved with electronic controls
• Those involved with the installing, programming, maintaining and purchasing of electronic control equipment
• Those involved with sales and installation of electronic products
• Anyone whose work requires the use of electronic equipment
The Program

INTRODUCTION
BASIC CONCEPTS
- Atomic structure
- Insulators, conductors and semiconductors
- Current, voltage, resistance, power
- Direct and alternating current
- Units and abbreviations

DISCRETE COMPONENTS
- Resistors, inductors and capacitors
- Transformers and bridge rectifiers
- JFETS and MOSFETS
- SCRs, DIACS and TRIACS
- LEDs
Practical session: Discrete components

CIRCUIT LAWS
- Ohm’s Law
- Kirchhoff’s Voltage Law
- Kirchhoff’s Current Law
Practical session: Circuit laws

AMPLIFIERS
- Small signal amplifiers
- Power amplifiers
- Amplifier frequency response
- Amplifier applications

OPERATIONAL AMPLIFIERS
- Op-amp parameters
- Negative and positive feedback
- Op-amp frequency response, stability and compensation
- Basic op-amp circuits
- Power supplies

USING TEST EQUIPMENT
- Current measurement
- Voltage measurement
- Analogue meters
- Digital meters
- Oscilloscopes
Practical session: Using test equipment

INDUSTRIAL PRACTICES
- Soldering aids
- Printed circuit boards preparation
- Component preparation
- Constructing a soldered joint
- Common defects in soldered joints
- Desoldering
- Safety in the work area
Practical session: Industrial practices

TROUBLESHOOTING
- Open circuits
- Short circuits
- Testing diodes, DIACS and TRIACS
- Testing BJTS, JFETS and MOSFETS
- Testing digital and linear components
- Components out of tolerance
- Troubleshooting, using circuit laws
Practical session: Troubleshooting

Enjoyable and will be of value in the workplace.
Barry Byrne

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PRACTICAL
SHIELDING, EMC/EMI, NOISE REDUCTION,
EARTHING AND CIRCUIT BOARD LAYOUT

YOU WILL LEARN HOW TO:

- Know why and how to earth a circuit effectively
- Efficiently diagnose noise problems
- Identify, design, manufacture and fix EMI/EMC problems
- Effectively design to filter at MHz frequencies
- Understand the four noise coupling mechanisms and minimise them
- Understand the function of the signal earth versus the signal return
- Earth a cable shield correctly
- Reduce DC power bus noise
- Select cables appropriately
- Know when to shield and when to filter
- Effectively earth mixed analog and digital signals
- Minimise pulse ringing and rounding problems
- Reduce earth loop noise
- Reduce emission and susceptibility problems
- Create a check list of items to ensure CE approval

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Electronics and systems engineers and technicians
- Consulting engineers
- Electrical engineers
- Project engineers
- Maintenance engineers
- Electrical contractors
- Safety professionals
- Consulting engineers
- Electricians
- Electrical inspectors
- Power system protection and control engineers
- Building service designers
- Data systems planners and managers
- Electrical and instrumentation technicians
- Mechanical engineers
- Printed circuit board designers
- Logic designers
- Signal integrity specialists
- CAD managers
- EMC specialists
- Design engineers
- Test engineers
- Technical managers
The Workshop

Any training class is a considerable investment in terms of cost and your time. You can’t afford to waste any of your precious time and you need to attend something that is useful and improves your productivity. After five years of presentation throughout the world, this workshop is well polished, practical and relevant.

The aim of this workshop is to help you identify, design, prevent and fix common EMI/EMC problems with a focus on earthing and shielding techniques. Learning how to fix earthing and shielding problems on the job can be very expensive and frustrating. Although it must be noted that most of the principles involved are simple, this course will give you the tools to approach earthing and shielding issues in a logical and systematic way.

This course focuses on the issues of interest to you if you are working in design, operation or maintenance of analog or digital systems involving sensors, data acquisition, process control, cables, signal processing, programmable logic controllers, power distribution, high speed logic etc. The circuit board layout section concentrates on design and layout of circuits and components on a printed circuit board. The overall focus is on useful design and systems issues; not about regulations and standards.

The idea is that you will take this material back with you to your work and apply the key principles immediately to your design and troubleshooting challenges.

Pre-requisites

Some working knowledge of basic electrical engineering principles is required, although there will be a revision at the beginning of the workshop. No prior EMC or electrical noise knowledge is necessary.

The Program

INTRODUCTION

- Fundamentals
- Interference sources
- EMI/EMC regulations

BASIC PRINCIPLES OF NOISE REDUCTION

- Importance of wiring inductance
- Bandwidth of pulse waveforms
- Noise coupling examples
- Common and differential modes
- Balanced circuits and common mode rejection

PRINCIPLES OF EARTHING

- What is “electrical earthing”?!
- Function of an earth
- Safety and EMI
- Analog/digital earthing
- Single point, multipoint, and hybrid earths
- Earth grid technique
- Isolated earthing technique
- Earth loops
- Earth loop noise reduction

DIAGNOSIS OF NOISE PROBLEMS

- Relating symptoms to causes
- Ringing, rounding and reflections
- Practical methods of diagnosis
- Noise coupling examples

NOISE REDUCTION TECHNIQUES

- Minimisation of bandwidth
- Best place to earth cable shield
- Reducing mutual inductance

POWER CIRCUITS AND POWER SUPPLIES

- Power quality and EMI
- Filters and transient protection
- Switch mode power supply design

INDUCTIVE AND CAPACITIVE SHIELDING

- Materials and limitations
- Openings and penetrations
- Enclosure design techniques
- Shielded racks and shielded rooms
- Magnetic fields
- Shielding design guidelines

REDUCTION OF ELECTROMAGNETIC COUPLING

- Requirements of EM containment
- EM shielding of cables
- Seams and apertures
- Shielding for ESD and RF
- To shield or to filter?

SELECTION OF THE RIGHT CABLE AND CONNECTOR

- Cable earthing
- Cable crosstalk
- Cable shielding and connectors

SIGNAL ROUTING AND LEAST IMPEDANCE

- Controlling layout inductance
- Signal integrity and EMC at the PCB level
- Hidden “transmitters” and “receivers” and “antennae”
- Trace routing
- Transmission line effects
- Termination

NOISE COUPLING MECHANISMS

- Magnetic causes of common mode current
- Capacitive causes of common mode current
- Identification of unintentional antennas
- Controlling of kHz current paths

CIRCUIT BOARD EARTHING ISSUES

- Identification of critical circuits
- Clock and reset circuits
- Embedded controllers and EMC
- On board power regulators
- Component placement
- I/O treatments
- Clock dithering

FILTERING CONDUCTED NOISE

- Series blocking and shunt diverting
- Filtering clock harmonics
- Reduction of filter mutual inductance
- Ferrite bead applications

DC POWER DISTRIBUTION AND DECOUPLING

- Ideal DC power bus
- Plane resonances and field containment
- Reduction of capacitor inductance
- Isolation of split power planes

COMPONENT PLACEMENT AND LAYER STACKUP

- Optimal connector location and pin assignments
- Lateral segregation by DC voltage
- Layer stack up alternatives

CHASSIS, CABLE AND SYSTEM ISSUES

- HF design at connection/chassis interface
- Reduction of chassis and cable resonances

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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POWER ELECTRONICS AND SWITCH MODE POWER SUPPLY

YOU WILL LEARN HOW TO:

• Demonstrate a sound understanding of how switch mode power supplies (SMPS) operate
• Correctly select components for a switch mode power supply design
• Select the right switch mode topology for a given application
• Understand PWM and what controller to select for a given application
• Design an input stage for a switch mode power supply and correctly evaluate EMI/RFI
• Apply power transistors correctly to SMPS design
• Correctly apply high frequency transformers and select the appropriate design (including an example push - pull design application)
• Design an output section of a SMPS
• Evaluate the performance and stability of a SMPS design
• Perform a complete analysis of the noise generated by the design (EMI/RFI)
• Make an accurate assessment of the heat-sink requirements to ensure reliable operation
• Design a SMPS that complies with safety standards

WHO SHOULD ATTEND:

• Application Engineers
• Product Designers
• Component Suppliers
• Instrument for Control Engineers
• Electrical and Electronic Maintenance Technicians and Supervisors
• Sales Engineers
• Product Managers
• Technicians
• Service Technicians
The Workshop

Power electronic circuits have revolutionised almost every device that we use today from PCs to TV’s, microwave ovens and heavy industrial drives.

Switch mode power supplies (SMPS) have thus become an important part of equipment design in all types of industrial equipment and an understanding of the different types and designs has become essential for reliable operation of complex equipment.

This workshop gives you a fundamental understanding of the basic components that form a SMPS design. You will understand how the selection of components affects the different performance parameters and operation of the SMPS. Typical practical applications of the SMPS in industry will be discussed.

The concluding section of the workshop gives you the fundamental tools in troubleshooting SMPS designs confidently and effectively.

Even though the focus of the workshop is on the direct application of this technology, you will also gain a thorough understanding of the problems that can be introduced by SMPSs such as harmonics, electrostatic discharge and EMC/EMI problems.

Pre-requisites

A fundamental knowledge of basic electrical concepts would be useful.

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The Program

INTRODUCTION

BASIC CONCEPTS
- Introduction to Power Electronics Circuits
- Basic principles of PSU circuits
- Power Supply specifications
- Linear and SMPS comparison
- SMPS block diagram

TOPOLOGIES
- Non-isolated topologies
- Isolated topologies
- Comparison of topologies
- Choice of topology based on power supply specifications

IC PWM CONTROLLERS
- PWM controller review
- UC3825 block diagram
- The speed critical path
- High speed complementary blocks
- Glue or remaining blocks

THE INPUT SECTION
- Component selection and design criteria
  - Input rectifiers
  - Input filter capacitors
  - AC or DC Input line filters for RFI suppression
  - Input filter interaction with SMPS
- Input protective devices
  - Inrush current
  - Input transient voltage protection

POWER TRANSISTORS
- Transistor selection
- Gate/base drive considerations and circuits
- Design considerations for safe operating of transistor
  - Transistor losses
  - Ripple current
  - Derating factors
- Switch Protection circuits

HIGH-FREQUENCY TRANSFORMERS
- Basic transformer theory
- Core material and geometry selection
- Design of a power transformer for a converter
- Losses and temperature rise
- Winding techniques

THE OUTPUT SECTION
- Output rectification and filtering
- Power Rectifier Characteristics
- Output Power Inductor design
- Output Filter Capacitor Design

STABILITY IN SMPS
- Transfer functions
- Criteria for stability
- Control to output gain
- Design compensation network
- Loop stability measurements

EMI-RFI CONSIDERATIONS
- Noise specifications
- RFI sources in SMPS
- Filters for RFI suppression

POWER SUPPLY ELECTRICAL SAFETY STANDARDS
- Construction requirements
  a. Spacing requirements
  b. Dielectric test
  c. Insulation resistance
- Transformer construction
  a. Insulation
  b. Dielectric strength
  c. Insulation resistance
  d. Temperature rating

HEAT-SINKING
- The thermal equation
- Selecting a heat-sink
- Custom heat-sink

SMPS TROUBLESHOOTING
- Safety guidelines
- Test equipment
- Safe discharge of capacitors in SMPS
- SMPS failure modes
- General SMPS troubleshooting approach
- Initial post-repair testing
- Some general SMPS repair comments
- Periodic or pulsing outputs

SUMMARY, OPEN FORUM & CLOSING

“Very good summary. Should have done it years ago!”
D. Lane

The presentation was excellent and of great value.
Julian Dalesio
PRACTICAL TROUBLESHOOTING OF ELECTRONIC CIRCUITS FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Recognise and efficiently troubleshoot common electronic component and circuit problems
• Demonstrate the construction and operation of common electronic components
• Utilise common electronic terminology
• Effectively apply the principles of analog meters, digital meters and oscilloscopes
• Identify electronic component symbols
• Identify components and read their values
• Implement procedures for the testing of electronic components
• Confidently carry out simple repair procedures for the correction of faults on printed circuit boards

WHO SHOULD ATTEND:

• All those who wish to be able to multi-skill into electronics
• Maintenance technicians, electricians, foremen and engineers
• All engineering, operations or management personnel who are directly or indirectly involved with electronics controls
• Those involved with the installing, programming, maintaining and purchasing of electronic control equipment
• Those who want to improve their understanding and capabilities in electronic technology
• All those involved with sales and installation of electronic products into industry
The Workshop

This workshop will teach you how to recognise and efficiently troubleshoot common electronic component and circuit problems. The workshop will give you a solid understanding in common electronic terminology and symbols, as well as the construction and operation of common electronic components. The general troubleshooting process is explained, followed by a brief study of various hand tools and electronic test and measuring instruments. You will learn to implement procedures for the testing of electronic components as well as carry out simple repair procedures for the correction of faults on printed circuit boards with confidence.

Practical Sessions

This is a practical, hands on workshop enabling participants to work through practical exercises which reinforce the concepts discussed.

On-Site Training

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The Program

INTRODUCTION

BASIC CONCEPTS
- Current, voltage, resistance, power
- Units and abbreviations
- Direct and alternating current

DISCRETE COMPONENTS, PART 1
- Resistors, inductors and capacitors
- Transformers and bridge rectifiers
- Diodes and bipolar junction transistors
- JFETS and MOSFETS
- SCRs, DIACS and TRIACS
- LEDs

CIRCUIT LAWS
- Ohm’s law
- Kirchhoff’s voltage law
- Kirchhoff’s current law

AMPLIFIERS
- Small signal amplifiers
- Power amplifiers
- Amplifier frequency response
- Amplifier applications

TESTING IN ELECTRONIC CIRCUITS
- Equipments / devices used in testing
  - (ex. logic analyser, spectrum analyser, multimeter, oscilloscope, ICR meter, DVM, MDA, AWG etc.)

DEVICE TROUBLESHOOTING
- Diode, transistor, resistor, capacitor, op-amp, thermocouple, microprocessors, multivibrator, thermister, switch, PLD, FLASH, RS-232, PCI bus, transmission lines etc

DESIGN TROUBLESHOOTING FOR DIGITAL AND ANALOG SYSTEMS
- Moving from analog to digital
- Measuring signal and noise in high-speed digital and analog circuits
- Design troubleshooting

LOGICAL TROUBLESHOOTING
- Component level troubleshooting
- Board level troubleshooting
- System level troubleshooting

POWER SUPPLY
- Introduction
- Power delivery input impedance
- Linear power supply

PCB TESTING
- PCB design techniques
- SMT technology
- Soldering and desoldering techniques
- Practical tips and tricks for PCB design
- Solder flux and heat sink
- Troubleshooting strategies
- Special tools, clips, cleaners, sprays, extension, scope probes

SAFETY ASPECTS
- Generic precautions
- Specific precautions
- Safety steps at installation time

SUMMARY, OPEN FORUM AND CLOSING

The Program

FAILURE ANALYSIS AND PREVENTION IN ELECTRONIC CIRCUITS
- Failure symptoms
- Failure causes
- Failure types
- General preventive measures

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INFORMATION TECHNOLOGY

TRAINING WORKSHOPS

Industrial Network Security for SCADA, Automation, Process Control and PLC Systems ........................................... 4.1
Practical Fundamentals of E-Manufacturing, Manufacturing Execution Systems (MES) and Supply Chain Management.......................................................................................................................... 4.3
SNMP Network Management: The Essentials........................................................................................................... 4.5
Practical Android App Development......................................................................................................................... 4.7
Cybersecurity for Automation, Control, and SCADA Systems (Using the ANSI/ISA-62443 Standards)............... 4.9
INDUSTRIAL NETWORK SECURITY
FOR SCADA, AUTOMATION,
PROCESS CONTROL AND PLC SYSTEMS

YOU WILL LEARN HOW TO:

- Apply the fundamental concepts of industrial network security to your SCADA and automation systems
- Conduct a preliminary analysis of your industrial networks and prepare to withstand and anticipate attacks and apply defences
- Discuss the issues of industrial network security competently with your associates in IT and vendors
- Understand and be able to construct a secure robust Local Area Network
- Learn how to plan and design your networks better
- Analyse and construct a typical firewall

WHO SHOULD ATTEND:

If you are using any form of communication system this workshop will give you the essential tools in securing and protecting your industrial networks whether they be automation, process control, PLC or SCADA based. It is not an advanced workshop – but a hands-on one. Anyone who will be designing, installing and commissioning, maintaining, securing and troubleshooting TCP/IP and intra/internet sites will benefit including:

- Design engineers
- Electrical engineers
- Engineering managers
- Instrumentation engineers
- Network engineers
- Network system administrators
- Technicians
**The Workshop**

This workshop will give you a fundamental understanding of security in effective industrial networking and data communications technology. It will also present you with the key issues associated with security in industrial communications networks and will assist managers, system operators and industrial data communications specialists in setting up secure systems.

One completion of the workshop you will have developed a practical insight into how to achieve optimum industrial network security for your organisation.

Topics covered include: introduction and terminology; firewalls; authentication, authorisation and anonymity; remote access to corporate networks; cryptography; VPN's; data security; desktop and network security; security precautions in a connected world; and internet security.

**Pre-requisites**

A basic working knowledge of industrial communications and applications is useful.

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**Practical Sessions**

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

*To gain full value from this workshop, please bring your laptop/notebook computer.*

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**On-Site Training**

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**The Program**

**INTRODUCTION**

• Background to workshop
• Overview of basic concepts

**DANGERS**

• Hackers
• Viruses
• Denial-of-service
• Information leakage
• File manipulation
• Database access
• Elevation of privileges
• Spoofing
• SYN flooding
• Router attacks
• Sniffing

**SECURITY POLICIES AND ADVISORY SERVICES**

• Corporate policies
• CERT
• Audits
• Threats
• Vulnerabilities
• Countermeasures
• Disaster recovery

**PHYSICAL SECURITY**

• Physical and logical access to networked equipment
• Network segmentation

**AUTHENTICATION**

• Authentication basics
• Client-side certificates
• Passwords
• Smart cards
• Tokens
• Biometrics
• PAP
• CHAP
• RADIUS
• TACACS/TACACS+

**ENCRYPTION**

• Symmetrical encryption schemes (DES, RC4)
• Public-key encryption schemes (RSA)
• Certificate Authorities (CAs)

**PROXIES/FIREWALLS**

• Basic firewall operation
• Natural Address Translation (NAT)
• Firewall types (IP filtering, stateful inspection, proxy, DMZ)

**INTRUSION DETECTION SYSTEMS (IDSS)**

• Types
• Deployment

**ROUTER SECURITY**

• Administrator access
• Firmware upgrades
• Logging
• Access Control Lists (ACLs)

**SWITCH SECURITY**

• Administrator access
• Port based MAC address management
• ACL filtering
• Virtual LAN (VLAN) implementation

**VPNS**

• Virtual Private Network (VPN) concept
• Tunnelling
• L2TP
• IPSec
• SOCKS 5

**WIRELESS LANS**

• Encryption and authentication - current problems and developments
• IEEE 802.1x
• WEP
• WZC
• WPA
• AES
• LEAP
• EAP-TLS
• EAP-TTLS

**SUMMARY, OPEN FORUM AND CLOSING**
PRACTICAL FUNDAMENTALS OF E-MANUFACTURING, MANUFACTURING EXECUTION SYSTEMS (MES) AND SUPPLY CHAIN MANAGEMENT

YOU WILL LEARN HOW TO:

• Identify and model enterprise and business automation system hierarchies
• Use internationally recognised process and system design concepts
• Identify and design E-Manufacturing and Supply Chain components
• Financially motivate projects and measure improvement after installation
• Determine the best integration model to use for your company
• Manage software projects, system integrators and software vendors
• Manage behavioural change during system implementations to reduce disruption
• Choose objectively between different software and technology providers
• Make sense of vendor marketing techniques and ploys
• Differentiate between data summation/transformation/communication tools and tools driving business processes within the plant

WHO SHOULD ATTEND:

• CEOs and CFOs
• Finance Managers
• E-Commerce Managers
• IT Managers
• Business Managers
• Strategy Managers
• Operations Managers and Engineers
• Production Managers and Engineers
• Senior Process Engineers
• Network and Telecommunications Managers
**The Workshop**

**WHAT IS E-MANUFACTURING, MES AND SUPPLY CHAIN MANAGEMENT?**

Supply Chain Management involves the optimisation of the way in which a company plans the production of goods or services, procures raw materials from various suppliers, manufactures the goods or services, delivers it to customers and handles returns.

E-Manufacturing starts with an order for a product and then encompasses the entire manufacturing cycle of the product. Manufacturers need a highly responsive supply chain and manufacturing system to ensure that they meet the high expectations of their customers who, in today's economy, demand absolutely the best service, price, delivery time and product quality.

Manufacturing Execution Systems (MES) provide up-to-the-minute mission-critical information about production activities across the factory and supply chain via communications networks (e.g. Local Area Networks), resulting in the optimisation of activities throughout all aspects of the manufacturing process. MES accomplish this task by guiding, initiating, responding to, and reporting on plant activities in real time, by using current and accurate data. This rapid response to changing conditions, together with a focus on reducing non-profitable activities, lead to more efficient plant operations and processes.

MES reduces cycle times, levels of Work in Progress (WIP), data entry time, paperwork and scrap. It also improves utilisation of plants, capacity, process control, quality, arrangement of plant activities, tracking of orders and customer service.

Research figures show that manufacturers have been able to achieve the following improvements through MES:

- an average reduction of manufacturing cycle time by 45%
- an average reduction of data entry time by 75%
- an average reduction of WIP by 24%
- an average reduction of paperwork by 61%
- an average reduction of lead time by 27%
- an average reduction of paperwork and blueprint losses by 56%
- an average reduction of product defects by 18%

Implementation of MES invariably results in improved returns on production assets, on-time delivery, faster inventory turnover, larger net profits (through increased cost reduction) and improved cash flow.

**Pre-requisites:**

An elementary understanding of business and manufacturing operations processes. No specific knowledge of software is required.

---

**The Program**

**INTRODUCTION TO AUTOMATION SYSTEMS**

- History of process control and accounting systems
- Development of manufacturing execution systems
- Systems architecture

**BUSINESS PROCESS DESIGN CONCEPTS AND CONSIDERATIONS**

- Introduction to Eli Goldratt's Theory of Constraints and the impact on business automation
- Introduction to the Supply Chain Council's SCOR model
- Understanding the AMR Research's REPAC model (Ready, Execute, Process control, Analyse, Co-ordinate) and its application during business process mapping and system design
- Introduction to S88 Batch Control standard and potential impact on business management and process control systems

**DEFINITION AND PRACTICAL APPLICATION OF E-MANUFACTURING AND SUPPLY CHAIN PROCESSES**

- Customer relations management
- Procurement management
- Logistics planning and optimisation
- Material returns management
- Resource allocation and status
- Operations/detail scheduling
- Dispatching production units
- Document control
- Data collection/acquisition
- Labor management
- Quality management
- Process management
- Maintenance management
- Product and material storage
- Product tracking and genealogy
- Performance analysis

**PROJECT MOTIVATION AND BENEFIT QUANTIFICATION, THE WHY’S AND HOW’S**

- Project portfolio management
- Business case tools
- Benefit base-line design
- Post-implementation benefit evaluation/ review

**BUSINESS AND PROCESS MODELING TOOLS ANALYSIS**

- Examples of modeling tools available
- Concepts and assumptions used by the tools
- Advantages and disadvantages of the various tools

**SYSTEM INTEGRATION MODELS AND CONCEPTS**

- Introduction to the S95 integration standard
- Integration vs. interfacing
- The 8 types of systems integration

**MANAGING SOFTWARE PROJECTS**

- Determining the scope
- Maintaining the project scope and managing changes/additions
- Project life-cycle
- Ensuring milestone delivery
- Testing cycle
- Implementation considerations

**SYSTEM IMPLEMENTATION AND CHANGE MANAGEMENT CONSIDERATIONS**

- Industry misconceptions for system implementation effort
- Resistance to change, culture change and training
- Human behavior vs. performance measurement
- Behavioral change process and why it is essential
- Making behavioral change measures and audits part of performance measurement systems

**PRODUCT AND VENDOR EVALUATION METHODOLOGY**

- Identifying the requirements
- Developing the measurement methods and selection criteria
- Preparing the vendors
- Facilitating the demonstration
- Reporting the results

**MES AND SUPPLY CHAIN PRODUCTS OVERVIEW**

- Examples of packaged products available:
  - IDP
  - Aspentech
  - Wonderware
  - Simatic IT
  - ABB
  - OSI
  - Honeywell
  - Intellution, etc.
- Concepts and assumptions used by the various products
- Advantages and disadvantages of the various products

**SUMMARY, OPEN FORUM AND CLOSING**

idc@idc-online.com • www.idc-online.com
SNMP NETWORK MANAGEMENT: THE ESSENTIALS

WHAT YOU WILL LEARN:

- You will understand the structure and operation of SNMP
- You will use SNMP to identify faulty devices
- You will use RMON to analyse remote network information
- You will interpret and explain MIB I and MIB II (Public/Private/Proprietary)
- You will track the important variables on your network
- You will install and configure a typical Network Management Package

WHO SHOULD ATTEND:

- CEOs and CFOs
- Finance Managers
- E-Commerce Managers
- IT Managers
- Business Managers
- Strategy Managers
- Operations Managers and Engineers
- Production Managers and Engineers
- Senior Process Engineers
- Network and Telecommunications Managers
The Workshop

This workshop will give you a fundamental understanding of security in effective industrial networking and data communications technology. It will also present you with the key issues associated with security in industrial communications networks and will assist managers, system operators and industrial data communications specialists in setting up secure systems.

One completion of the workshop you will have developed a practical insight into how to achieve optimum industrial network security for your organisation.

Topics covered include: introduction and terminology; firewalls; authentication, authorisation and anonymity; remote access to corporate networks; cryptography; VPN’s; data security; desktop and network security; security precautions in a connected world; and internet security.

Pre-requisites
A basic working knowledge of industrial communications and applications is useful.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

INTRODUCTION
• What is Distributed Network Management?
• The Need for Network Management
• Proprietary vs. Open Approach to Network Management
• Elements of A Network Management Architecture
• The OSI Model Revisited
• What is SNMP?
• SNMP Functions and Components
• The SNMP Model
• SNMP History

REVISION OF SUPPORTING NETWORK TECHNOLOGY
• TCP Stack Overview and Layer Responsibilities
  - Process/Application Layer
  - Host-to-Host Layer
  - Internet Layer
  - Network Interface Layer
  - Transmission Control Protocol (TCP)
  - User Datagram Protocol (UDP)
  - Internet Protocol (IP)
  - Ethernet

SNMP OVERVIEW
• What is Simple Network Management Protocol?
• The SNMP Model
• Manageable Objects
• Management Information Base (MIB)
• Object Identifiers
• The SNMP Protocol
• SNMP Agents
• Abstract Syntax Notation1 (ASN.1)
• Basic Encoding rules (BER)

SNMP v1 DETAILS
• Module, Object and Type Definitions
• Object Names
• Network Management Relationships
• Accessing (Identifying and Communicating) Object Instances
• SNMP Protocol Data Units (PDUs)
  - Get Request
  - Get Next Request
  - Set Response
  - Trap Response
• MIB Structure
• MIB Tables
• MIB Groups
• MIB Definitions
• MIB Examples
• Private MIBs

USING SNMP
• Network Management System Implementations (OpenView, Solstice, etc)
• Remote Monitoring
  - What is RMON?
  - RMON MIB Extensions
  - RMON2
• Web-Based Network Management (X.700)
  - Configuration Management
  - Accounting Management
  - Performance Management
  - Security Management
  - Fault Management

PRACTICALS
• Set up Ethernet + TCP/IP network with SNMP clients installed on Windows platforms.
• Quick revision of using a protocol analyser to capture packets on network.
• View MIBs on a router (e.g. Cisco)
• Use the Protocol Analyser to capture the various SNMP commands (Set Request/Get Request/Get Next Request/Get response)
• Install and set up a typical Network Management Package (CastleRock).
• Simulate various scenarios and use the Network Management Software to diagnose what is happening.

SNMP v2
• Background
• Structure
• Textual Conventions
• Changes from SNMPv1
• PDUs
  - GetRequest
  - GetNextRequest
  - Response
  - SetRequest
  - GetBulkRequest
  - InformRequest
  - SNMPv2-Trap
  - Report
• Transport Mappings
• SNMPv2 over UDP
• The SNMPv2 MIB (MIB-II)
• MIB-II Extensions
• SNMPv2 Security
• SNMPv1 and SNMPv2 Co-existence

SNMP v3
• Background
• Changes from SNMPv2
• Documentation
• Architecture
• Message Formats
• SNMPv3 MIB Modules
• SNMPv1, SNMPv2 and SNMPv3 Co-existence

SUMMARY, OPEN FORUM AND CLOSING
WHAT YOU WILL LEARN:

- Ability to create your own Android “Apps”
- Industrial app development focus: Monitor and control equipment!
- Learn easy to understand basic and advanced concepts
- Step-by-step practical app development
- Tips and tricks for publishing and distributing your app
- Being current with innovative trends in technology
- Skill in using existing app open source code (Don’t re-invent the wheel)
- Tuition from an expert
- Do’s and don’ts of app development

WHO SHOULD ATTEND:

This course is designed for individuals who want to understand and build techniques required to develop and apply Android applications to industrial and other environments as productively and economically as possible. No previous programming skills or development know-how required. Individuals with a drive for innovation and interest in staying ahead of the curve with modern resources would also benefit, including those involved in:

- Automation
- Consulting
- Control and instrumentation
- Control systems
- Design
- Electrical installations
- Instrumentation
- IT
- Maintenance
- Process control
- Process development
- Project management
- Sales and marketing
- SCADA and telemetry systems
The Workshop

Ever thought, “There should be an app for this!”? Have you ever wanted to create an app for reading and controlling your equipment? Especially for those in the hard to reach remote areas? With the free and open Android development tools, and the right know-how, you can do it! This course will empower you with the skills and know-how.

Apps, mobile phones and tablets have become extensions of the standard human machine interfaces and have become tools for everyday use. The market is flooded with new and advancing technology, aiming to release more and more capable and smarter devices. The Android operating system has become one of the world’s largest and most widely used mobile touchscreen operating system. It is popular for its ease of use, open-source nature, Google backing and support. However, the operating system only serves as the foundation; the true power and functionality sits with the applications (apps) running on the system. Hence, these apps enable most high-tech devices to interface with the real world, the internet, and ultimately, the end user.

Apps now feature across most technical and engineering fields, especially as the ever developing general connectivity within industrial systems. The convergence of Ethernet into control, monitoring, I/O, motion, safety and security type systems has brought about unlimited information access. Industry is moving to advanced automation and human-machine-interfaces in environments such as: oil and gas, water/waste water management, factories and production lines, fire detection control systems, power stations, home automation, building management, health care, transportation and mining.

Companies use apps for an infinite range of scenarios; from improvement in embedded systems, communication access, visualisation methods, Manufacturing Execution Systems (MES) general SCADA or simply marketing product ranges using catalogues. Skills and understanding in app development have become crucial for future career development.

Practical Sessions

You will undertake practical sessions using the Android Development Kit software provided for a thorough step-by-step tutorial on app development. You will also have access to remote labs, with the software installed, for further development after the course.

The practical app developed throughout will focus on reading and displaying measurements and sending control signals using buttons and menus. It will have various entry fields, drop down lists and On/Off Control states. These values and states will be called from local SQLite database within the app. It will connect with a real-world I/O interface, for receiving measurements, and sending control signals.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION
• Background on Android: history of app development
• Why? Features, framework

ENVIRONMENT SETUP
• Basic setup of the Android SDK (ADK) and Eclipse

STARTING OUT
• New project template
• Basic layout
• AVD (virtual device)
Practical session: “Hello world”

USER INTERFACE DESIGN
• Basic user interface layout
• String resource
• Text field
• Buttons and images
Practical session: User input, button and image

CODING AND BEHAVIOUR
• Attributes and methods
• Stacks and states
• Action response, intent, activity
• Event handler
Practical session: Text-type-send-display; switching between two images representing open/close control action

ANDROID RESOURCES AND FEEDS
• Framework classes
• Errors and debugging
• Permissions, strings, values and layout
• Image, dimension, style, theme, menu, and colour
Practical session: Toggle silent mode using AudioManager; data feeds from web or external devices

CREATING HOME SCREEN WIDGETS
• Intent, IntentService and pending intents
• BroadcastReceiver and AppWidgetProvider
• Widget layout, Metadata and Manifest
Practical session: App created previously turned into home screen widget

MULTI-DEVICE SUPPORT AND TABLET DEVELOPMENT
• Languages, screen size and screen density
• Landscape design
• Tablet layouts and fragments
• Platform versions and localisation
Practical session: App layout improved

LONG-RUNNING PROCESSES
• Lifecycle call-backs, active status, and passive status
• UI threads and update
• Handler/Bundle and Adapters
• Start, pause, resume
Practical session: Add progress dialogues, refresh buttons, spawn threads, feed handlers

PERSISTENT DATA STORAGE
• Data storage media and user permissions
• SQLite database, create, manage and queries
• Loaders and implementation
• Save files
Practical session: Create device/component DB for list selection

MENU DESIGN, LISTS AND ADAPTERS
• List-based menu structures
• Context menu
• ListFragment,
• User actions
Practical session: List design

MULTI-PANE UI
• Multi-screens
• Layout and navigation
• Pass data and CRUD
Practical session: Multi-pane UI development (Control/Display panes)

PUBLISHING TO PLAY STORE
• Android Package file (APK)
• Digital signatures
• Google Play developer profile
• Pricing (paid and free)
• Screenshots

REAL-WORLD INPUT / OUTPUT PRACTICAL
• Connecting and setup of Android supported hardware
• Reading inputs – displayed using text
• Transmitting outputs – sent using on/off buttons

USER INPUT
• EditText views
• Date and time pickers
• Alert dialog
• Validation
Remote practical session: Modify and improve user input text in App

RELATIVE LAYOUT; CONTACTS LIST; ALARM MANAGER
• Replacing linear with relative
• Contact selection, update and action
• Alarm manager schedule, permissions and alarms
Remote practical session: Making app relative

STATUS-BAR UPDATES; PREFERENCES FRAMWORK; ADVANCED GRAPHICS
• Status bar, actions and notifications
• Preference screens and preference activity
• Image buttons and 9-patch image stretching
Remote practical session: Notifications, preferences and images

LEVERAGING GELOCATION AND MAPPING CAPABILITIES
• Plotting positions on Google Maps
• Establishing location through GPS, Cell-ID and WiFi

FURTHER POSSIBLE ADVANCED TOPICS
• Content sharing, connectivity and cloud
• Multimeda
• Graphics and animation
• User info and location
• Interaction and engagement
• Security and privacy
• Sample applications and development tools
• Publishing, distribution and Marketing

SUMMARY, OPEN FORUM AND CLOSING

idc@idc-online.com • www.idc-online.com
CYBERSECURITY FOR AUTOMATION, CONTROL, AND SCADA SYSTEMS
(USING THE ANSI/ISA-62443 STANDARDS)

YOU WILL LEARN HOW TO:

• Discuss the principles behind creating an effective long term program security
• Interpret the ANSI/ISA99 industrial security guidelines and apply them to your operation
• Define the basics of risk and vulnerability analysis methodologies
• Describe the principles of security policy development
• Explain the concepts of defence in depth and zone/conduit models of security
• Analyse the current trends in industrial security incidents and methods hackers use to attack a system
• Define the principles behind the key risk mitigation techniques, including anti-virus and patch management, firewalls, and virtual private networks

WHO SHOULD ATTEND:

If you are using any form of communication system this workshop will give you the essential tools in securing and protecting your industrial networks whether they be automation, process control, PLC or SCADA based.

This course is required for the ISA99/IEC 62443 Cybersecurity Fundamentals Specialist Certificate Program.

Anyone who will be designing, installing and commissioning, maintaining, securing and troubleshooting industrial networked sites will benefit including:

• Design engineers
• Electrical engineers
• Engineering managers
• Instrumentation engineers
• Network engineers
• Network system administrators
• Technicians
The Workshop

The move to using open standards such as Ethernet, TCP/IP, and web technologies in supervisory control and data acquisition (SCADA) and process control networks has begun to expose these systems to the same cyberattacks that have wreaked so much havoc on corporate information systems. This course provides a detailed look at how the ANSI/ISA99 standards can be used to protect your critical control systems. It also explores the procedural and technical differences between the security for traditional IT environments and those solutions appropriate for SCADA or plant floor environments. This workshop will assist managers, system operators and industrial data communications specialists in setting up secure systems.

Topics covered include: introduction and terminology; electronic security; threat sources; understanding the current industrial security environment; how cyberattacks happen; creating a security program; risk analysis; addressing risk with security policy, organization, and awareness; addressing risk with selected security counter measures; addressing risk with implementation measures; monitoring and improving the CSMS.

Pre-requisites
A basic working knowledge of industrial communications and applications is useful.

Classroom/Laboratory Exercises:
- Develop a business case for industrial security
- Conduct security threat analysis
- Investigate scanning and protocol analysis tools
- Apply basic security analysis tools software

Includes ISA Standards:
- ANSI/ISA-62443-3-3 - Security for industrial automation and control systems: System security requirements and security levels (A $260 Value!)

Recommended Resource:
ISA Text: Industrial Network Security by David J. Teumin

The Program

INTRODUCTION
- Background to workshop
- Overview of basic concepts
- Concepts of physical, operational, and electronic security;
- Defining Cyber Security relating to industrial automation and control systems

TERMINOLOGY, CONCEPTS, MODELS AND METRICS
- Discuss IEC/TS 62443-1-1
- Terminology, Concepts and models
- Understanding the Current Industrial Security Environment

SECURITY BASICS
- Networking Basics Part 1
- Networking Basics Part 2
- Industrial Networking
- Network Security Basics
- Network types
- ISO/OSI reference models
- IP addressing
- IT vs. Industrial Control System differences.
- Address security
- Firewalls
- Segmentation
- Encryption
- Secure protocols
- Intrusion detection.

SECURITY MANAGEMENT PROGRAM
- Creating an ICS Security Management Program
- ISA-62443-2-1
- How to create a security program for control systems
- “Cyber Security Management System” (CSMS)
- Elements and requirements:
  - Risk Analysis
  - Addressing the Risk with CSMS
  - Monitoring and Improving the CSMS

DESIGNING / VALIDATING SECURE SYSTEMS
- Understand how to apply security levels
- Security Lifecycle
- Identify risks and significance
- Study Qualitative/Quantitative risks
- Risk assessments
- Identifying threats
- Security level (SL) definitions

DEVELOPING SECURE PRODUCTS AND SYSTEMS
- Software Security Assurance (SSA)
- Control System Security Layers of Responsibility
- Incorporating security
- Integration of security at the various phases of the development lifecycle
- ISA Security Compliance Institute (ICSI)
- ISASecure Certification

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

✔ SAVE over 50% by having an IDC workshop presented at your premises.
✔ Customise the training to YOUR workplace.
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PRACTICAL FUNDAMENTALS OF CHEMICAL ENGINEERING

YOU WILL LEARN HOW TO:

• Understand the fundamentals of chemical engineering
• Do simple specifications of pumps and heat exchangers
• Understand mass transfer phenomena including agitation scale-up
• Perform simple process calculations
• Troubleshoot process equipment and provide fixes
• Contribute to process design activities
• Understand process drawings and link them to plant operation
• Apply safety guidelines to a process or chemical plant
• Understand basic chemical engineering jargon and terminology

WHO SHOULD ATTEND:

This workshop will be appropriate for the following professionals:

• Process development engineers
• Industrial engineers
• Electrical engineers
• Mechanical engineers
• Civil engineers
• Control and instrumentation engineers
• Plastics and material engineers
• Maintenance engineers
• Food scientists
• Environmental engineers
• Environmental technicians
• Chemists
• Chemical plant operators
• Maintenance supervisors
• Laboratory technicians
• Shift tradespeople
This workshop aims to cover the fundamental concepts of chemical engineering and provide you with a solid working knowledge associated with it. If you are a non-chemical engineer this course will enable you to confidently talk to and work effectively with chemical engineers and process equipment. Many technical professionals today find themselves working with large-scale chemical processes even though they do not have formal training in chemical engineering. This workshop intends to fill this gap and provide you with this knowledge in the chemical engineering fundamentals and the ability to apply this knowledge to specify, design, operate, maintain and trouble-shoot chemical processes.

Pre-requisites
An elementary understanding of engineering concepts such as fluid flow, heat and mass transfer is useful; however a revision will be undertaken at the commencement of the course. Please bring your scientific calculator for solving problems during the practical sessions.

Practical Sessions
This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. There are twelve practical design sessions throughout the workshop.

Practical sessions include:
- Simple physical reaction
- Simple chemical reaction
- Ideal gas law: how temperature changes in gases can cause pressure changes in gases
- Simple heat transfer: how heat flows from high temperature to low temperature
- Change in density of boiling fluids: boiling fluid has a lower density than a non-boiling fluid
- Pressure of two different density liquids: lower density fluid needs a greater height to create the same pressure gradient as a higher density fluid
- Natural convection evaporation: how evaporation of a fluid below its boiling point can occur, and how it cools
- Sublimation: how some components can go from vapour to solid without making a liquid
- Simple mass transfer: how a concentration driving force works, and to see the effect of temperature
- Density: how a density can change buoyancy
- Endothermic reaction: how a chemical reaction can lower temperature
- Exothermic reaction: how a chemical reaction can raise temperature

To gain full value from this workshop, please bring your laptop/notebook computer.

INTRODUCTION: THE CHEMICAL PROCESS UNDERSTANDING A PROCESS FLOW SHEET
- Process Flow Diagrams (PFDs)
- Piping and Instrumentation Diagrams (P&IDs)
- Process legends used in flow sheets

STOICHIOMETRY
- Dimensions and units
- Processes and process variable
- Process data representation and analysis
- Basic chemical calculations
- Material and energy balance
- Combustion

HEAT TRANSFER AND ITS APPLICATIONS
- Heat transfer by conduction in solids
- Principles of heat flow in fluids
- Heat transfer to fluids with and without phase change
- Radiation heat transfer
- Heat-exchange applications
- Evaporation

MASS TRANSFER AND ITS APPLICATIONS
- Equilibrium-stage operation
- Distillation
- Leaching and extraction
- Introduction to multi component distillation
- Principles of diffusion and mass transfer between phases
- Gas absorption
- Humidification operations
- Adsorption
- Drying of solids

HEAT AND TEMPERATURE
- Biological
- Kinetics
- Acid-base reaction
- Solution and equilibrium
- Ideal gas

FUNDAMENTALS
- Thermodynamic properties of pure fluids
- Thermodynamic properties of pure vapor
- Kinetics of exothermic and endothermic reactions
- Equilibrium
- Chemical reaction equilibrium
- Thermodynamics of flow processes
- Conversion of heat into work by power cycles
- Refrigeration and liquefaction
- Thermodynamic analysis of processes

CHEMICAL KINETICS
- Basic definitions
- Kinetics of homogenous reactions
- Interpretation of batch reactor data
- Introduction to reactor design
- Single ideal reactors
- Design for single reactions
- Design for multiple reactions
- Temperature and pressure effects
- Non-ideal flow
- Mixing of fluids
- Introduction to design for heterogeneous reacting systems
- Fluid - particle reactions
- Fluid - fluid reactions
- Solid - catalyst reactions
- Reactivating catalysts

PROCESS EQUIPMENT DESIGN
- Design considerations
- Storage vessels
- Pressure vessels
- Reactors
- Heat exchangers
- Evaporators and crystallisers
- Distillation and fractionation equipments
- Agitators
- Filters
- Dryers
- Process hazards and safety measures
- Fundamentals of computer aided design

PROCESS CONTROL AND INSTRUMENTATION
- Quantities of measurement
- Process instrumentation
  - Temperature
  - Pressure
  - Level
  - Flow

PROCESS ECONOMICS
- Investment and profitability
- Accounting and cost control
- Manufacturing - cost estimation
- Fixed and capital cost estimation

SUMMARY, OPEN FORUM AND CLOSING
HANDLING CHEMICALS AND CHEMICAL PROCESSES - TIPS, TRICKS AND TOOLS

YOU WILL LEARN HOW TO:

• Gain the valuable know-how used by chemical engineers to troubleshoot chemical processes and process equipment
• Understand process design activities
• Design a simple plant from the ground upwards
• Understand the role of safety in a Process or Chemical Plant
• Understand the fundamentals of Chemistry, Chemical Processing and Chemical Engineering
• Understand chemical formulae, equations and process calculations
• Get an overview of Thermodynamics, Fluid mechanics and Heat transfer applications
• Understand mass transfer phenomena
• Perform simple process calculations
• Get a first hand look at a chemical disaster and learn how to avoid this

WHO SHOULD ATTEND:

• Process Development Engineers
• Industrial Engineers
• Electrical Engineers
• Mechanical Engineers
• Civil Engineers
• Control and Instrumentation Engineers
• Plastics & Material Engineers
• Maintenance Engineers
• Food Scientists
• Environmental Engineers
• Environmental Technicians
• Chemists
• Chemical Plant Operators
• Maintenance Supervisors
• Laboratory Technicians
• Shift Tradespeople
The Workshop

This will provide you with practical knowledge (including tips, tricks and tools) covering the fundamentals of Chemistry, Chemical and Process engineering. It will greatly assist you in communicating more effectively with your chemical engineering colleagues. In industry, handling chemicals is considered a hazardous occupation. Chemical engineers are a trained set of specialists who have spent years in understanding the nature and behavior of chemicals and chemical process systems. If you are a non-chemical engineer we aim at bringing this knowledge to you in a two-day interactive workshop.

Pre-requisites
An elementary understanding of engineering concepts such as fluid flow, heat and mass transfer is useful; however a revision will be undertaken at the commencement of the course.

Please bring a pocket calculator for solving problems during the practical sessions.

Workshop Objectives

At the end of this workshop, participants will be familiar with the following aspects:
1. The fundamentals of Chemistry and Chemical Engineering (using practical tips and tools) with regards to:
   • Stoichiometry & Reaction Kinetics
   • Thermodynamics
   • Heat Transfer
   • Mass Transfer & Fluid Flow
   • Unit Operations
   • Process Control
2. Quick tips in understanding Process Design considerations for:
   • Pumps
   • Heat Exchangers
   • Reactors
   • Agitators
   • Filtration Equipment
3. Practical application of the Principles involved in Design and Process revamp
4. Troubleshooting various Processes and Process Equipment
5. Understanding why safety is of paramount importance - troubleshooting a real-life disaster

Practical Sessions

• Chemical formulae and equations
• Designing a chemical processing unit
• Troubleshooting a chemical disaster

The Program

DAY ONE

INTRODUCTION: CHEMISTRY, CHEMICAL PROCESSING AND CHEMICAL ENGINEERING

STOICHIOMETRY
• Dimensions and Units
• Processes and Process Variable
• Process Data Representation and Analysis
• Basic Chemical Calculations
• Material Balance without chemical reactions
• Material Balance with chemical reactions
• Energy Balance
• Combustion

CHEMICAL KINETICS
• Basic definitions
• Kinetics of homogenous reactions
• Interpretation of batch reactor data
• Introduction to reactor design
• Single ideal reactors
• Design for single reactions
• Design for multiple reactions
• Temperature and Pressure effects
• Non ideal flow
• Mixing of fluids
• Solid-catalyst reactions
• Reactivating catalysts

FLUID MECHANICS
• Fluid statics and its applications
• Fluid-flow phenomena
• Basic equations and fluid flow
• Transportation & Metering of fluids
• Agitation & Mixing

HEAT TRANSFER & ITS APPLICATIONS
• Heat transfer by Conduction in solids
• Principles of heat flow in fluids
• Heat transfer to fluids without phase change
• Heat transfer to fluids with phase change
• Radiation heat transfer
• Heat-exchange applications
• Evaporation

MASS TRANSFER AND ITS APPLICATIONS
• Equilibrium-stage operation
• Distillation, Leaching & Extraction
• Introduction to Multi component distillation
• Principles of diffusion and Mass transfer between phases
• Gas absorption
• Humidification operations
• Adsorption
• Drying of solids

DAY TWO

CHEMICAL ENGINEERING THERMODYNAMICS
• Fundamental quantities
• First Law of Thermodynamics
• Volumetric properties of pure fluids
• Heat Effects
• Second law of Thermodynamics
• Thermodynamic properties of fluids
• Thermodynamic properties of homogenous mixtures
• Phase Equilibria
• Chemical reaction equilibrium
• Thermodynamics of flow processes
• Conversion of heat into work by power cycles
• Refrigeration & Liquefaction
• Thermodynamic analysis of processes

UNDERSTANDING A PROCESS FLOW SHEET
• Process Flow Diagrams (PFD’s)
• Piping and Instrumentation Diagrams (P&ID’s)
• Process Legends used in flow sheets

PROCESS EQUIPMENT DESIGN
• Design considerations
• Storage Vessels
• Pressure vessels
• Reactors
• Heat Exchangers
• Evaporators and Crystallisers
• Distillation and Fractionation Equipments
• Agitators
• Filters
• Dryers

PROCESS CONTROL AND INSTRUMENTATION
• Quantities of Measurement
• Process Instrumentation
  - Temperature
  - Pressure
  - Level
  - Flow

SAFETY, THE ENVIRONMENT AND THE CHEMICAL INDUSTRY
• The Bhopal Chemical Disaster
• Long term effects of chemical pollution

Practical Sessions

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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TRAINING WORKSHOPS

Practical Analytical Instrumentation in On-Line Applications ................................................. 6.1
Practical Alarm Management for Engineers and Technicians ..................................................... 6.3
Practical Programmable Logic Controllers (PLCs) for Automation and Process Control .......... 6.5
Practical Batch Management & Control (Including S88) for Industry ...................................... 6.7
Practical Boiler Control and Instrumentation for Engineers and Technicians .............................. 6.9
Practical Data Acquisition using Personal Computers and Standalone Systems ..................... 6.11
Practical Industrial Flow Measurement for Engineers and Technicians .................................. 6.13
Practical Hazops, Trips and Alarms ............................................................................................. 6.15
Practical Hazardous Areas for Engineers and Technicians ....................................................... 6.17
Practical Instrumentation for Automation and Process Control .............................................. 6.19
Practical Intrinsic Safety for Engineers and Technicians ............................................................ 6.21
Practical Tuning of Industrial Control Loops ............................................................................ 6.23
Practical Motion Control for Engineers and Technicians ........................................................... 6.25
Practical Fundamentals of OPC .................................................................................................. 6.27
Practical Process Control ........................................................................................................... 6.29
Practical Process Control and Tuning of Industrial Control Loops .......................................... 6.31
Practical SCADA and Telemetry Systems for Industry ............................................................... 6.33
Practical Safety Instrumentation and Emergency Shutdown Systems for Process Industries .... 6.35
Practical Industrial Programming using 61131-3 for Programmable Logic Controllers (PLCs) .. 6.37
Practical Control Valve Sizing, Selection and Maintenance ...................................................... 6.39
Best Practice in Process, Electrical and Instrumentation Drawings and Documentation .......... 6.41
Practical Distributed Control Systems (DCS) for Engineers and Technicians .......................... 6.43
Fundamentals of Industrial Automation ................................................................. 6.45
Practical Troubleshooting of Data Acquisition and SCADA Systems .................. 6.47
Installation, Calibration and Maintenance of Electronic Instruments .................. 6.49
RFID Tagging: Features and Applications .......................................................... 6.51
Practical Industrial Troubleshooting of Instrumentation, Electrical and Process Control for Engineers and Technicians ................................................................. 6.53
Practical Hazops for Engineers and Technicians .................................................. 6.55
Practical SCADA Systems for Industry ................................................................. 6.57
Practical Machine Vision Applications for Industry ............................................. 6.59
Practical Advanced Process Control for Engineers and Technicians .................. 6.61
Practical Industrial Safety, Risk Assessment and Shutdown Systems for Industry .... 6.63
Introduction to the Selection, Installation, Commissioning and Maintenance of Fiscal Flow and Metering Equipment ................................................................. 6.65
Measurement and Control for Non-Instrument Personnel .................................... 6.67
Programmable Logic Controllers (PLCs) and SCADA Systems ............................. 6.69
Practical Drives, Motors and PLCs for Engineers and Technicians ....................... 6.71
Practical Troubleshooting and Problem Solving of PLCs and SCADA Systems .... 6.73
Practical Flow Essentials .................................................................................. 6.75
Fundamentals of Instrumentation, Process Control, PLCs and SCADA for Plant Operators and other Non-Instrument Personnel ......................................................... 6.77
Fundamentals of Practical Building Automation Systems (BAS) ......................... 6.79
Design of Industrial Automation Functional Specifications for PLCs, DCSs and SCADA systems ................................................................. 6.81
Practical Remote Engineering, Mechatronics and Robotics for Engineers and Technicians ................................................................. 6.83
Instrumentation Engineering for Oil and Gas Facilities ...................................... 6.85
Practical IEC 61850 for Substation Automation for Engineers and Technicians .... 6.87
Hazardous Areas and ATEX Awareness for Technical and Non-technical Staff .... 6.89
One-day Refresher Training: Electrical Equipment for Practical Hazardous Areas for Engineers and Technicians (Outside Europe) ................................................. 6.91
One-day Refresher Training: Electrical Equipment for Practical Hazardous Areas for Engineers and Technicians (Within Europe) ................................................. 6.93
Master Series: Instrumentation and Control ....................................................... 6.95
Integrated Programming, Maintenance, Troubleshooting and Optimisation of the Drill Monitor System (DMS) ................................................................. 6.97
Specifically tailored for those without a chemical background, this workshop has been designed to take the mystery out of on-line analytical measurement and explain it in terms that are easily applied in the workplace.

**WHAT YOU WILL LEARN:**

- The basics of chemistry and how to read chemical formulae
- How analytical chemistry is applied in industrial control
- To improve your understanding and capabilities in on-line analytical chemistry
- How to troubleshoot problems in the measurement of pH, conductivity, turbidity, hygrometry, DO and chlorine

**WHO SHOULD ATTEND:**

For many years, chemical measurement has remained the preserve of the analytical chemist. Increasingly, on-line analytical measurement is being applied in on-line process control and is therefore rapidly becoming the responsibility of the instrumentation and control technologist.

- Electricians
- Technicians
- Senior Operators
- Project Engineers
- Design Engineers
- Systems Engineers
- Electrical Engineers
- Consulting Engineers
- Maintenance Engineers
- Process Control Engineers
- Instrumentation Sales Engineers
- Instrumentation and Control Engineers
The Workshop

On-line analytical measurement has become an integral part of process control measurement. As a result, a working knowledge of analytical measurement is now a prerequisite for anyone working with process instrumentation and control. The two-day workshop will 'demystify' the world of analytical measurement and equip you with the knowledge required to understand, identify and confidently troubleshoot On-Line Analytical Measurement Instrumentation in Process Control.

This workshop will offer you the vital knowledge that you need to multi-skill, reduce downtime, save your company money and secure your value in the workplace.

Workshop Objectives

This practical, hands-on workshop introduces on-line analytical measurement to anyone who needs to understand industrial and chemical analysis techniques used in process control. This workshop offers you the most up-to-date knowledge to allow you to:

- recognise and efficiently troubleshoot a wide variety of industrial analytical measuring instruments
- understand the construction and operation of the most important analytical instruments
- understand chemical technology
- effectively apply the principles of chemical analysis to industrial instrumentation
- identify chemical formulae and symbols
- implement procedures for testing and calibration of analytical instruments
- multi-skill with colleagues within your industry

Practical Sessions

There are a total of five practical, hands-on sessions that aim to give you the confidence and experience you need to work with and troubleshoot analytical instruments. These practical sessions are:

- Basic chemistry
- pH measurement
- Conductivity measurement
- Dissolved oxygen
- Colorimetry

The Program

**BASIC CHEMISTRY**

- Elements, compounds and mixtures
- Properties of elements
- Formation of ions
- Bonding
- Chemical formulae and equations
- Atomic weight
- Molar concentrations
- Acids and bases

**ELECTROCHEMICAL CELLS**

- Electrode potentials
- Simple voltaic cell
- Polarisation
- Daniell cell
- Electrolytic bridges
- Electrochemical series

**PH MEASUREMENT**

- Definition of pH
- Measurement of pH
- The measuring electrode
- The reference electrode
- Nernst equation
- Temperature effect
- Antimony electrode
- Sources of errors
- Calibration

**MEASUREMENT OF REDOX**

- Applications
- Calibration/checking procedure

**CONDUCTIVITY MEASUREMENT**

- Ionic mobility
- Cell construction and constant
- Temperature compensation
- Conductivity measurement of high purity water
- 4-electrode sensor
- Installation
- Sensor maintenance
- Preventative maintenance
- Troubleshooting
- Applications

**TURBIDITY MEASUREMENT**

- Interaction between light and matter
- Absorptiometers
- Nephelometers
- Practical on-line systems
- Calibration
- Applications

**HYGROMETRY**

- Vapour pressure and humidity
- Partial vapour pressure
- Relative humidity
- Hygrometric instruments
- Hygrometric calculations

**DISSOLVED OXYGEN MEASUREMENT**

- Measuring cells
- Calibration
- Installation and troubleshooting
- Electrode maintenance and storage

**TOTAL FREE CHLORINE MEASUREMENT**

- Basic chlorine chemistry
- Measuring principle and systems
- Calibration
- Applications

**ON-LINE COLORIMETRY AND TITRATION**

**ON-LINE GAS CHROMATOGRAPHY**

Enlightening

Trevor Jones

On-Site Training

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PRACTICAL ALARM MANAGEMENT FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Design and create a consistent and effective alarm philosophy for your installation
- Recognise and deal with human problems in interfacing to alarm systems
- Apply the ergonomic design factors to a good alarm system
- Analyse alarm data for root causes of problems and to improve your operation
- Benchmark your alarm system performance
- Develop and apply a consistent alarm philosophy across your installation
- Improve your plant reliability and operator effectiveness with a top notch alarm philosophy

WHO SHOULD ATTEND:

- Anyone involved in the installation, design and support of alarm systems
- Design engineers
- Electrical and instrumentation technicians
- Electrical engineers
- Instrumentation and control system engineers
- Instrumentation technologists and engineers
- IT managers working with networks
- Maintenance engineers and supervisors
- Operations managers
- Plant engineers
- Process control designers and systems engineers
- Process control engineers and technicians
- Process engineers
- Production engineers
- Project engineers
- Systems engineers
The Workshop

It is 6.00 in the evening after a hot summer’s afternoon and the shift has just changed over. The control room has been rather quiet through the day with the odd alarm punctuating the serene silence. In fact this plant has been a truly contented baby with no major problems for over 18 months since it was commissioned. Apart from the inevitable mechanical wear and tear associated with a new plant. Suddenly there is an explosive roar outside and the control room door bursts open with the shift foreman dripping with sweat shouting: “We’ve just lost Unit 3, I’m not sure what is happening…can you tell me what is going on?” Within seconds the alarms start pouring in. The operator starts to systematically work his way through the overview displays trying to identify what is going on. But he is slowly overwhelmed by the sheer number of alarms which are flitting across the screen so fast that he cannot even read them. And Unit 3 is now starting to lurch into a dangerous state with pressures, flows and temperatures well outside acceptable operating ranges. So it looks like an immediate shutdown of the plant is going to be required with some very unhappy customers over the next few weeks.

Was there any other approach possible?

Hopefully this is not the scenario on your plant; but could this just perhaps happen? Does your alarm system ensure the operator stays unerringly focussed on the source of the problem or is there a possibility that he may not be relevant to the immediate problem?

It is important that throughout the plant that a consistent philosophy is adopted for alarms and that your operators are not distracted from the main ball game of operating the plant.

This workshop will give you the necessary information to ensure that your alarm system is well designed and provides your operators with the best picture of the operations of the plant. The workshop focuses on simple and practical information for personnel ranging from operators all the way up to supervisors, engineers and managers.

There are nine practical sessions in the design of alarm systems throughout the workshop, these ensure that you can apply the information gained in the training to your own plant and systems.

Pre-requisites

Some background in working with SCADA and process control systems would be useful to maximise your benefit from this workshop.

The Program

INTRODUCTION

SAFETY EXAMPLES OF SYSTEMS

• Why alarm systems need to be managed?

Practical Exercise

FUNDAMENTAL PRINCIPLES OF ALARM SYSTEM MANAGEMENT

• Philosophies of alarm management

Practical Exercise

DESIGN OVERVIEW

• Human and ergonomic factors
• Structure of good alarm system
• Safety Integrity Level (SIL)

Practical Exercise

DEFINITION OF STRATEGY

Practical Exercise

MEASUREMENT OF THE ALARMS

• Audit the current alarm status

Practical Exercise

ANALYSE THE ALARMS

Practical Exercise

Design of Alarm Systems

Practical Exercise

Measurement of Performance

Practical Exercise

Management of Improvement Program

• Alarm review
• Elimination of spurious alarms
• Process alarms
• Intermittent and fleeting alarms
• Control of modifications

Practical Exercise

Hazops and Alarms

• Establish a strategy

Practical Exercise

Tie It All Together

• The way forward
• Summary of key concepts

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Nine Practical Sessions focussing on the design of Alarm Systems throughout the two days will ensure that you can apply the information from the course to your system.

To gain full value from this workshop, please bring your laptop/notebook computer.

““

The course was well presented. Excellent Instructor.

J. Pollock

On-Site Training

✓ SAVE over 50% by having an IDC workshop presented at your premises.
✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.

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PRACTICAL PROGRAMMABLE LOGIC CONTROLLERS (PLCs) FOR AUTOMATION AND PROCESS CONTROL

YOU WILL LEARN HOW TO:
- Specify PLC hardware and installation criteria
- Describe PLC software structure
- Write medium level PLC programs (using ladderlogic)
- Troubleshoot a typical PLC system
- Specify PLC systems

WHO SHOULD ATTEND:
- Process control operators
- Shift electricians
- Trades staff working with or near PLCs
- Instrumentation and control engineers
- Electrical engineers
- Design engineers
- Consulting engineers
- Instrumentation technicians
- Process control engineers
- Engineering managers
- DCS personnel
The Workshop

This workshop is designed to benefit you with practical up-to-date information on the application of PLCs for the automation and process control of plants and factories. It is suitable for people who have little or no exposure to PLCs, but expect to become involved in some or all aspects of PLC installation. It aims to give practical advice from experts in the field, to assist you to correctly plan, program and install a PLC with a shorter learning curve and more confidence.

While the workshop is ideal for electricians, technicians and engineers who are new to PLCs, much of the workshop and additional material in the extensive manual will be of value to those who already have some basic skills, but need a wider perspective for larger and more challenging tasks ahead. The accompanying manual includes contributions from a number of experts and will become a valuable reference in your work. The information contained in this workshop advances from the basics to challenge even the most experienced engineer in the industry today.

Pre-requisites
A basic electrical knowledge would be useful but is not essential.

Practical Sessions
This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training
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The Program

INTRODUCTION
• Introduction to PLCs
• A brief history of PLCs
• Alternative control systems – where do PLCs fit in?
• Why PLCs have become so widely accepted
• Lingering concerns about PLCs

FUNDAMENTALS OF PLC HARDWARE
• Block diagram of typical PLC
• PLC processor module – memory organisation
• Input / output section – module types
• Power supplies

FUNDAMENTALS OF PLC SOFTWARE
• Methods of representing logic
  - Boolean algebra
  - Instruction code
  - Graphical presentation: functional logic diagrams, ladder logic
• Fundamental ladder logic instruction set
• Comparison of different manufacturers
  - Memory and data representation
  - Instruction code

USING LADDERLOGIC FOR SIMPLE DIGITAL FUNCTIONS
• The basic rules
• Comparison with relay ladder diagrams
• The concept of the “scan” and how to apply it
• Infinite fan-out
• Contact “normal” states
• Positive and negative logic
• Basic boolean functions
• The usefulness of De Morgan’s Law

USING REGISTERS (WORDS)
• Number systems
• Types of register data
  - Timers
  - Counters
  - Bit shift / rotate
• Table functions
  - Register (matrix) logic functions

GOOD PROGRAMMING HABITS
• Keeping track of addresses and data used
• Looking ahead – how will programs be maintained
• Practical methods to improve program quality
  - Organisation of code
  - Through documentation
  - Simplifying changes

GOOD INSTALLATION PRACTICE
• Location of hardware
• Good wiring practice
  - Cable spacing
  - Power distribution
  - Wire numbering
• Reducing noise and interference
• Screening and shielding
• Earthing and grounding

ADVANCED CONTROL WITH PLCs
• The concept of reusable logic - examples: drive logic, alarm handling
• Use of advanced programming functions
  - Matrix logic
• Table functions and indirect addressing
• Examples: simple display driver

BATCH PROCESSES AND SEQUENTIAL CONTROL
• Remembering the program state
• Creating a “stepper”
• Step advance
• Fault detection and recovery
• Operator intervention
• Multiple recipes or alternate paths
• Sequential function charts

PID CONTROL
• The importance of timing and scan time
• When PID is not always appropriate:
  - Intermittent measurements
  - Long transport delays

SAFETY PROGRAMMABLE SYSTEMS
• Why regular PLCs should not be used for safety functions
• Programmable electronic logic solvers
• Safety certification
• Certified programming systems
• Application examples
• Growth of networked safety devices and certified networks
• Integrated safety systems

DATA COMMUNICATIONS
• Interface standards, RS-232, RS-422/423, RS-485
• Protocols, Modbus and DH+
• Local area networks, Ethernet and token bus
• Monitoring communication links and simple watchdog timers

INTRODUCTION TO IEC 61131-3
• Concepts
• Common elements
• Programming languages: structured text
• Function block diagrams
• Ladder diagrams
• Instruction list
• Sequential function chart

OPC
• Introduction to OPC
• What is OPC?
• Architecture

SYSTEM CHECKOUT AND TESTING
• Development and verification of code
• Factory acceptance testing
• Testing procedures
• Emulating missing hardware
• Emulating process responses

SUMMARY, OPEN FORUM AND CLOSING
YOU WILL LEARN HOW TO:

- Automate batch processes using the appropriate standards and techniques
- Design a batch manufacturing control system for new or upgrade projects using principles supported by the ISA S88 standard
- Obtain guidance in the integration of batch control systems with manufacturing information systems
- Design and specify instrumentation and batch controls in modules leading to complete unit operations
- Carry out the detailed design of batch control operations including the sequencing and interlocking functions
- Develop batch operations into complete recipe based production systems
- Evaluate the choices in the range of batch control system products.
- Avoid the pitfalls of not having the batch control system package match your requirements

WHO SHOULD ATTEND:

- Engineers and technicians in process or control/instrument fields who are involved in batch process control projects
- Production Supervisors or Managers interested in developing improved batch management techniques through the use of automation systems
- System Integrators seeking to provide a design service to clients
- Those in businesses that have automated batch manufacturing as a part of their production activity
- Instrumentation and Design Engineers
- Chemical Engineers
- Process Engineers
- Project Engineers
- Field Technicians
- Electricians
- Electrical Engineers
- Design Engineers
- Electrical Technicians
- Plant Operators
**The Workshop**

This workshop shows you how to:

- structure the activities of batch control into easy to understand tasks
- choose, design and manage an automated batch management control system
- save your business time and money by choosing and designing the correct, and therefore efficient batch process control system

The workshop is presented in learning modules. At the end of each module we will examine the way in which the particular feature we have built contributes to the overall scheme. The scheme can be simple or it may be a complete manufacturing scheme integrated to a sales operation.

For example we will examine situations such as:

- businesses where the weekly tally of sales is collected into a shopping list for the factory production campaign
- how the plant responds quickly to the shopping list
- how we report back on what was actually produced
- how we report on batch numbers
- tracing which batch tanks were used
- identifying if a tank was contaminated
- how do we know which products to recall?

Historically batch control systems were designed in individual ways to match the basic arrangement of plant equipment. They lacked the ability to convert to new products without having to modify the control systems. These schemes did not lend themselves to recipe based operations or to integration with manufacturing management systems.

This workshop concentrates on getting the building bricks right and arranging the structures into flexible schemes suitable for automated batch management, e.g. being able to work in response to new recipes that use the same plant equipment in different combinations.

The material in this workshop aligns with current practices in the automation of batch processes, including the drive for integration with MES and ERP products from major IT product companies. References and examples will be drawn from DCS/PLC batch control products in the market place.

**Workshop Objectives**

This workshop is designed for you to:

- be able to plan, structure and manage a batch manufacturing project
- gain a basic knowledge of the S88 standard and be aware of critical design issues in batch control systems
- have a basic knowledge of current technologies in batch control and how to utilise them in the implementation stages of a project
- be able to plan for growth into a production management facility with ERP integration potential

Your knowledge of batch control system fundamentals, will assist you to avoid the expensive mistake of choosing the incorrect package for your business requirements.

**The Program**

**WORKSHOP OUTLINE AND OBJECTIVES**

- Identification of batch processes, characteristics and examples
- Background to the demand for integrated batch systems
- Overview of batch systems engineering
- Introduction to Standards: ISA S88 and IEC 849/BS 7716

**IDENTIFY AND DEFINE PHYSICAL MODELS**

- We begin with a hypothetical but typical process in batch manufacturing
- Presentation of a typical P&ID with several units linked to supply systems
- Show how this is structured into elements, equipment modules, units, cells and trains using the physical models technique in S88
- Show how well structured batch plants can save on equipment costs

**IDENTIFY AND DEFINE PROCESS MODELS, ACTIONS, OPERATIONS AND STAGES**

- Relationship between physical and process models
- A unit operation example based on the typical P&ID shown in the first practical session

**IDENTIFY AND DEFINE PROCEDURAL MODELS**

- Sequence steps, phases, operations and unit procedures
- Introduction to co-ordination control

**THE CONCEPTS OF EQUIPMENT ENTITIES**

- The relationship between procedural control, physical model and procedural model
- Explanation of basic control, procedural control and co-ordination control
- This concept illustrated by using the example process
- Show how batch control is built up around the common, functional entities of control modules, equipment modules and units

**INTRODUCTION TO RECIPES**

- The use of recipes to define all requirements for batch manufacture of a given product
- The concepts of master and control recipes
- Using and creating recipes
- How to hide the complexities of unit operations and create flexibility for the production team

**BATCH MANUFACTURING BASICS**

- Batch numbering, tracking and reporting
- Batch planning and scheduling

**BATCH & SEQUENCE PROGRAMMING FUNDAMENTALS**

- Practical techniques for batch control elements
- Implementation of valve elements, motor controls, interlocks and permits etc.
- Interactions with continuous process sections

**PRACTICAL TECHNIQUES IN SEQUENCE CONTROL DESIGN**

- How to capture the need, design the operation and document it for programming into PLC/DCS
- Practical methods for functional specifications; flowcharts and structured format
- Defining equipment and process states using transition diagrams
- Dealing with sequencing problems such as alarms, holds, aborts and restarts

**INTERFACING TO THE OPERATOR AND THE SUPERVISOR**

- Display screens for recipes, monitoring of sequence operations, trouble shooting and maintenance
- Illustrations using currently available software packages

**BATCH MANAGEMENT ISSUES**

- Introduction to batch control activities and activity models as described in ISA S88
- Practical problems in batch management
- Ownership issues and conflict
- Using command structures to resolve problems

**PRACTICAL BATCH CONTROL TECHNOLOGIES**

- Overview of DCS/PLC architectures
- Examples of current products
- Integration of batch control systems to production management and ERP systems
- ERP requirements as inputs to batch production
- Sending process quality and production reports back to ERP

**PRACTICAL SOFTWARE PROJECT PLANNING AND IMPLEMENTATION**

- What to look for in batch software packages
- Batch control software products
- Overview of S88 compliant packages
- Examples and demonstrations of key features from existing vendor packages

**Pre-requisites**

A basic knowledge of electrical engineering principles and concepts will be an advantage.
PRACTICAL BOILER CONTROL AND INSTRUMENTATION
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Understand the objectives of the principal boiler control functions
- Recognise and understand typical boiler control diagrams and their design intentions
- Contribute to the setting up and tuning of boiler control loops
- Identify principles and design concepts governing:
  - Boiler feed water control
  - Furnace draft measurement and control
  - Steam demand and firing rate control
  - Main steam and reheat steam temperature control
  - Flue gas analysis and fuel combustion trimming controls
- Importance of boiler safety control and start-up interlocks
- Explore advanced control strategies for improved boiler plant efficiency

WHO SHOULD ATTEND:

- Senior boiler plant operators, repairers and installers
- Control system engineers
- Instrumentation engineers and technicians
- Boiler plant commissioning engineers
- Mechanical engineers and technicians
- Operation, maintenance, inspection and repair specialists
- Design engineers
- Consulting engineers
The Workshop

This 2-day workshop introduces the basic practices of controls systems and safety controls for industrial steam generating boilers. It focuses on the control and safety requirements applicable to most types of boilers from small gas-fired units to large multi-fuel installations. The workshop will provide training in how control and instrumentation is designed to manage the main variables such as drum water level, furnace draft, combustion fuel and air conditions. Burner management systems are introduced with their principal features including flame safety systems. The essential safety requirements for boilers and burners are identified and the corresponding safety interlocks are explained as practical solutions in accordance with the latest safety standards.

Pre-requisites

Fundamental knowledge of basic boiler plant and operation thereof and some understanding of control systems.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

ESSENTIALS OF BOILER PROCESSES

• Objective of boiler controls
• Overview of boiler types
• Boiler processes in block diagrams to show keys inputs and output variables
• Hazards of boiler operations
• The main control functions in boiler furnaces

REVIEW OF PROCESS CONTROL AND INSTRUMENTATION RELEVANT TO BOILERS

• Principles of sensors and transmitters with examples of boilers
• Closed loop control principles including feedback, feedforward, ratio and limiting.
• Control system hardware and software tools.
• Safety instrumented controls and the impact of IEC 61511
• Instrumentation diagrams and symbols per ISA and SAMA
• Distributed control systems and the separation of safety systems

FEEDWATER AND DRUM LEVEL CONTROL

• Performance requirements: Level, quality, stability
• Characteristic responses of drum level
• Level control solutions, 1,2 and 3 element types
• Level measurement problems and practices
• Drum level safety systems

FURNACE AIR AND DRAFT CONTROLS

• Performance requirements; pressures and temperatures
• Characteristic responses and means of control
• Pressure measurement methods and the pressure profile
• Temperature control and the impact of dew point
• Protection against implosion

COMBUSTION CONTROLS

• The combustion process and its requirements for efficiency and safety
• Coal, oil and gas firing types
• Stoichiometric air and excess air requirements
• Fuel-air ratio control and its measurements
• Firing rate controls and cross limiters for improving dynamic response
• Methods for measurements of boiler efficiency using analysers
• Application of optimising controllers

BURNER MANAGEMENT SYSTEMS

• Safety and performance requirements of pulverisers, burners and igniters
• Furnace safety standards and regulations
• Flame monitors and flame failure detection
• Start up protection and sequencing
• Furnace supervisory controls and shutdown systems

STEAM TEMPERATURE CONTROL

• Superheater and attemperator arrangements
• Essential control requirements
• De-superheater controls

STEAM PRESSURE AND BOILER LOAD CONTROLS

• Pressure and flow response characteristics
• Single boiler load control
• Multiple boiler installations and load sharing controls

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL DATA ACQUISITION USING PERSONAL COMPUTERS AND STANDALONE SYSTEMS

YOU WILL LEARN HOW TO:

- Install and configure a data acquisition system
- Choose and configure the correct software
- Apply state of the art approaches in design of data acquisition systems
- Configure data communications systems
- Avoid the common pitfalls of designing a data acquisition system

WHO SHOULD ATTEND:

- Instrumentation and control system engineers
- Electrical engineers
- Project engineers
- Design engineers
- Technicians
- Process control engineers
- Maintenance engineers
- Systems engineers
- DCS Personnel
The Workshop

Pre-requisites
Basic electrical knowledge would be useful.

Practical Sessions
This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION
• What is data acquisition and control
• Fundamental principles of data acquisition and control systems
• Typical PC based applications

ANALOG AND DIGITAL SIGNALS
• Classifications of signals
• Sensors and Transducers
• Temperature Transducers (RTD / Thermocouples / Silicon IC’S)
• Strain Gauges
• Single Ended and Differential Systems
• Noise and Interference
• Sources and Types of Noise
• Field Wiring and Noise Considerations
• Ground Loops
• Common Mode Voltages and CMRR
• Earthing and Isolation Techniques to Reduce Noise
• Cable Shielding and Earthing

SIGNAL CONDITIONING
• Classification of signal Conditioning Hardware
• Distributed I/O (Two wire Transmitters / Digital Transmitters)
• Signal Conditioning Functions
• Instrumentation Amplifiers
• Filters for Signals (Low Pass / Band Pass / High Pass / Butterworth)
• Isolation and Overvoltage Protection

LAB VIEW SOFTWARE PRACTICAL

PLUG IN DATA ACQUISITION BOARDS
• Advantages of plug in systems
• Typical Analog to Digital (A/D) boards
• Analog Input Circuitry (Multiplexers / Amplifiers / Sample and Hold)
• Analog to Digital Board specifications
• Single Ended vs Differential Signals
• Resolution / Dynamic range / Accuracy of A/D boards
• Sampling Rate and Nyquist Theorem
• Preventing Aliasing
• Sampling Techniques (Channel Scanning / Simultaneous Sampling / Block Mode Operations)
• Speed versus Throughput
• Typical Digital to Analog (D/A) boards
• Digital I/O boards
• Interfacing Digital I/O
• Electromechanical vs Solid State Relays
• Practical considerations in the use of digital I/O boards
• Counter/Timer I/O boards

RS-232 / RS-485 SERIAL DATA COMMUNICATIONS STANDARDS
• RS-232 Hardware Interface
• RS-485 Hardware Interface
• Multipoint Systems
• Serial Interface Converters
• Communication Protocols
• Error Detection
• Trouble shooting Serial Data CommunicationsDISTRIBUTED AND STANDALONE CONTROLLERS / DATA LOGGERS
• Choice between External and Internal Systems
• Hardware Structure of Standalone Devices
• Software and Firmware Design
• Practical applications of Data Loggers
• How to minimise communication Bottlenecks
• Practical applications of Data Loggers
• How to minimise communication Bottlenecks

CITEC PRACTICAL

IEEE-488 SYSTEMS
• IEEE-488.1 / IEEE-488.2 and SCPI Specifications
• Hardware Configuration
• Device Types (Controllers / Listeners/ Talkers)
• Basic Communications
• Advanced Communications
• Multiple Device Communications
• Problem Diagnosis
• System Specification

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL
INDUSTRIAL FLOW MEASUREMENT FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Describe and compare important existing technologies in flow measurement
- Explain the critical fundamentals of flow measurement
- Specify and design flow measurement systems
- Troubleshoot and install flow instrumentation systems
- Avoid common errors in the installation of flow meters
- Describe and specify emerging technologies

WHO SHOULD ATTEND:

Those in the design, implementation and upgrading of industrial control systems and:

- Instrumentation and control engineers
- Control technicians
- Data systems planners and managers
- Electrical engineers
- Building service designers
- Electricians
- Automation engineers
- Electrical and instrumentation technicians
- Maintenance engineers
- Energy management consultants
- Process engineers
- Power system protection and control engineers
The Workshop

Practical Industrial Flow Measurement is suitable for the engineer, electrician, technician, rafts-person, operator and others who require practical, specialist knowledge for selecting and implementing flow measurement systems.

This workshop is ideal for cross-skill training. The two-day course focuses on typical real-world applications. Close attention is given to special installation considerations and application limitations when selecting and installing different flow instruments.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

BASIC PROPERTIES OF FLUIDS
- Basic fluid properties
- Non-Newtonian fluids
- Velocity profiles
- Reynolds number
- Flow measurement
- Mass flow rate
- Multi-phase flows

POSITIVE DISPLACEMENT METERS
- Introduction
- Sliding vane
- Oval gear meters
- Lobed impeller
- Oscillating piston
- Nutating disc

INFERENTIAL METERS
- Turbine meter
- Woltman meter
- Propeller type
- Impeller meters
- Installation recommendations

OSCILLATORY FLOW METERS
- Primary devices
- Sensors
- Application guidelines for vortex flow metering
- Avoiding problems

DIFFERENTIAL PRESSURE METERS
- Basic theory
- Orifice plate
- Tapping points
- Venturi tube meter
- Venturi and flow nozzles
- The Dall tube
- Target meter
- Pitot tube
- Point averaging
- Elbow
- Troubleshooting

VARIABLE AREA METERS
- Operating principle
- Floats
- Metering tube

ELECTROMAGNETIC FLOWMETERS
- Measuring principle
- Construction
- Conductivity
- Field characterisation
- Measurement in partially filled pipes
- Empty pipe detection
- Field excitation
- The pulsed D.C. field
- Bipolar pulse operation
- Meter sizing

ULTRASONIC FLOWMETERS
- Doppler method
- Transit time meter
- Flow profile
- Frequency difference
- Clamp on instruments
- Velocity of sound measurement
- Factors influencing the velocity of sound
- Summary
- Advantages
- Disadvantages
- Application limitations

MASS FLOW MEASUREMENT
- The Coriolis force
- A practical system
- Multiple phase flow
- Density measurement
- Lob arrangement
- Straight through tube
- Application in the food industry
- Applications in the chemical industry
- Summary of Coriolis mass measurement
- Thermal mass meters

OPEN CHANNEL FLOW MEASUREMENT
- The Weir
- The flume
- Level measurement
- Linearisation

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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Good structure, touches on all the relevant issues.
Roel Staubebach

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YOU WILL LEARN:

- The hazard study life cycle and safety life cycle models
- Principles and procedures of Hazop studies
- Hazard analysis methods and application of fault tree analysis
- Protection system principles based on alarms and trips
- Introduction to functional safety standards IEC 61508 and IEC 61511
- The concept of safety integrity levels and methods for determination of SIL targets
- How to convert Hazop outputs into safety requirements specifications
- To use the latest software tools for Hazops

WHO SHOULD ATTEND:

- Process plant engineers, technicians and supervisors involved in new plant projects or in the modification or upgrading of existing plants
- Loss prevention officers, trainee Hazop team leaders
- Plant managers, project managers and planners seeking an awareness of the role of Hazops in overall safety management
- Instrument and electrical engineers, process control engineers and system integrators who are likely to be participants in Hazops or who will be asked to engineer safety control systems
- Commissioning engineers and plant supervisors, process maintenance technicians
The Workshop

INTRODUCTION TO HAZARD STUDIES
- Introduction to hazards and risks
- Safety management principles; risk assessment and risk reduction
- Concepts of ALARP and Tolerable Risk
- Regulatory frameworks and examples from EU, USA, Australia, RSA
- Methods of identifying hazards
- Methods of assessing hazards

PLANNING AND LEADERSHIP OF HAZOP STUDIES
- Relationship to project phases
- Preparatory work
- Roles and responsibilities of the hazop team
- Duties of the study leader

Practical exercise: Hazop team trial study and report

HAZARD STUDIES AT LEVEL 1 AND LEVEL 2
- Life cycle model for hazard study levels
- Hazard study 1: Concept and definition phase: methods
- Hazard study 2: Design and development phase. Tools and checklists

Practical exercise: Level 2 hazard study example.

RISK REDUCTION MEASURES
- The concept of "Equipment under Control"
- Failures of operators and control systems as contributors to hazards
- Layers of protection
- Process and operational safety measures
- The role of alarms in safety, principles of alarm management
- Safety instrumented protection systems, principles of separation.
- The role of hazops in defining alarms and trips

HAZARD STUDIES AT LEVEL 3: HAZOP METHOD
- Introduction to IEC 61822: Application guide for hazop
- Hazop study procedure for the design & development phase
- Purpose, context and outcomes of the hazop
- Principles of guide word examination procedure
- Design representation and selection of elements for study
- Study procedure and examples

Practical Exercise: Trial hazop study and recording of results

The Program

HAZARD ANALYSIS METHODS
- Principles of FEMA
- Principles of Fault Tree Analysis (FTA)

Practical exercise: Fault tree analysis for process control problem

KEY FACTORS IN THE CHOICE OF PROTECTION SYSTEMS
- Technology choices and their implications for cost
- Programmable safety systems and certification of equipment
- Issues of reliability and redundancy
- SIL ratings versus cost
- Nuisance trips versus safety availability

EXERCISE IN CONVERTING HAZOP OUTPUT TO ALARM AND TRIP REQUIREMENTS
- Examples of requirements specifications
- Examine and use the latest software tools available for:
  - Hazard study worksheets
  - Lifecycle records
  - Determination of SIL ratings
  - Calculation of trip system reliabilities

Practical exercise: Hazop report and specification outputs

Scope of the Workshop

The workshop describes the role of hazard studies in risk management and then proceeds with basic training in Hazop techniques. The concepts of risk reduction and some techniques of hazard analysis are introduced at this stage. Training in alarm and trip systems concentrates on features that are relevant to project teams at the Hazop study stages. These include the practical implications and costs of calling for trips and the often-confusing subject of safety integrity levels (SILs) and how they are determined.

A number of practical exercises support the training information and allow participants test their understanding of the material provided in the training manual.

Practical Sessions

There are six practical exercises which you will undertake over the two days.

On-Site Training

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PRACTICAL HAZARDOUS AREAS FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Demonstrate a good understanding of the terminology used with hazardous areas
• Design and install safe working systems in hazardous areas
• Assist in hazardous area classification
• Detail the types of apparatus that can be used in a given hazardous area
• Demonstrate a good understanding of the basic hazards associated with electricity near flammable gases and vapours
• Explain the types of equipment that can be used
• Understand safety and operational aspects of hazardous areas
• Understand system limitations in using hazardous areas protection
• Detail the key areas of the national codes of practice
• Understand the basics of explosion protection to IEC standards

WHO SHOULD ATTEND:

Anyone involved in design, specification, installation, commissioning, maintenance or documentation of industrial instrumentation, control and electrical systems, including:

• Tradespersons working in Potentially Explosive Atmospheres (PEAs)
• Electrical and instrument tradespersons
• Instrumentation and control engineers
• Electrical engineers
• Instrumentation technicians
• Design engineers
The Workshop

This workshop provides you with an understanding of the hazards involved in using electrical equipment in potentially explosive atmospheres. It is based on the international IEC79 series of standards that are now replacing the older national standards. Installation utilising Explosion-Protected (Ex) equipment can be expensive to design, install and operate. The wider approaches described in these standards can significantly reduce costs whilst maintaining plant safety.

The associated terminology and its correct use are explained throughout the workshop. It covers area classification, selection of explosion protected electrical apparatus as well as describing how protection is achieved and maintained in line with these international requirements. Standards require that engineering staff and their management are trained effectively and safely in hazardous areas and this workshop is designed to help fulfil that need.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

BACKGROUND TO HAZARDOUS AREAS
- Explosion consequences
- Nature of hazards
- Definition of hazardous area
- Flammability concepts
- Ignition sources
- Properties of gases, vapours, mists and dusts
- Introduction to types of protection

CLASSIFICATION SYSTEMS
- Source of release
- Area classification into zones
- Equipment (apparatus) grouping
- Temperature classification and ambient rating
- Summary of principles of Ex protection
- Equipment protection levels

TYPES OF PROTECTION
- Definitions
- Principles
- Application of:
  - Flameproof: Ex d
  - Increased safety: Ex e
  - Pressurisation: Ex p
  - Intrinsic safety: Ex i
  - Non-incendive: Ex n
  - Oil filling: Ex o
  - Powder filling: Ex q
  - Encapsulation: Ex m
  - Special: Ex s

EARTHING AND BONDING
- Basic principles
- Earthing requirements
- Static protection
- Lightning protection
- Noise and interference control
- Requirements for IS systems
- System earthing approach

CODE OF PRACTICE FOR SELECTION AND INSTALLATION OF EX EQUIPMENT
- Application of code of practice
- General requirements for all types of protection
- Documentation requirements and the verification dossier
- Cabling
- Overview of requirements for individual Ex protection types
- Dust installations overview

INSPECTION AND MAINTENANCE REQUIREMENTS
- Inspection and maintenance definitions
- Types of inspection
- Initial detailed pre-commissioning
- Inspection regimes and documentation
- Record keeping

FAULT FINDING AND REPAIRS OF EX EQUIPMENT
- Planned maintenance
- Use of tools
- Procedures
- Safe methods
- Test equipment suitability

STANDARDS, CERTIFICATION, CERTIFICATES, MARKING AND APPROVALS
- Authorities
- Marking and identification
- Component certification
- Equipment certification
- Systems certification
- Systems descriptive documentation (for Ex i)

ATEX DIRECTIVES
- Introduction and explanation (European requirements)
- Non-electrical ignition-capable equipment protection
- ATEX marking
- DSEAR (UK) requirement summary

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL INSTRUMENTATION FOR AUTOMATION AND PROCESS CONTROL

YOU WILL LEARN HOW TO:

• Specify and design instrumentation systems for pressure, level, temperature and flow
• Correctly select and size control valves for industrial use
• Predict and avoid the problems with installing measurement equipment
• Troubleshoot instrumentation systems and control valves
• Isolate and rectify instrumentation faults
• Describe most of the major technologies used for instrumentation and control valves

WHO SHOULD ATTEND:

• Design engineers
• Electrical engineers
• Electrical technicians and technologists
• Electricians
• Experienced fixed plant operators
• Graduate engineers
• Instrumentation engineers
• Project engineers
The Workshop

This workshop is for engineers and technicians who need to have a practical knowledge of selection, installation and commissioning of industrial instrumentation and control valves. In many respects a clear understanding and application of these principles is the most important factor in an efficient process control system. You can only achieve excellent control of your processes when your instrumentation provides the correct information. This would involve the design, specification and implementation of control and measurement equipment.

The workshop focuses on real applications, with attention to special installation considerations and application limitations when selecting or installing different measurement or control equipment.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Practical sessions include:

PRESSURE
- Hydrostatic pressure
- Pressure sensors in pipe with isolation valve, check response and accuracy
- Compare gauge, absolute and differential pressures
- Pressure calibration

LEVEL
- Point detection with level probes, vibrating and conductive
- Level measurement with capacitive probe
- Ultrasonics, configure, test and commission

TEMPERATURE
- Temperature response and accuracy
- RTD, 2/3/4 wire comparison
- T/C, ref. junction, grounded, sheathed
- T/C, extension leads compared with compensation leads

SIMULATION
- The basis of signal simulation
- Transmitter simulation
- Transducer simulation

CALIBRATION
- The basis of transmitter calibration
- Zero and span adjustment
- Performance – accuracy and error calculations

VALVE SIZING (SOFTWARE)
- Valve selection and sizing
- Inherent characteristics
- Process, material or other considerations

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION TO PROCESS MEASUREMENT
- Basic measurement concepts
- Definition of terminology
- Measuring instruments and control valves as part of the overall control system
- Pressure, level, temperature and flow overview
- Overview of control valves

PRESSURE MEASUREMENT
- Principle of pressure measurement
- Pressure sources
- Pressure transducers and elements
- Specifications
- Installation considerations
- Impact on the overall control loop
- Future technologies

LEVEL MEASUREMENT
- Principles of level measurement
- Simple sight glasses
- Buoyancy tape systems
- Hydrostatic pressure
- Ultrasonic measurement
- Radiation measurement
- Electrical measurement
- Density measurement
- Installation considerations
- Impact on the overall control loop
- Future technologies

TEMPERATURE MEASUREMENT
- Principles
- Thermocouples
- Resistance Temperature Detectors (RTDs)
- Thermistors
- Liquid in glass, filled, bimetallic
- Pyrometers
- Installation considerations
- Impact on the overall control loop
- Future technologies

FLOW MEASUREMENT
- Principles of flow measurement
- Open channel flow measurement
- Oscillatory flow measurement
- Magnetic flow measurement
- Positive displacement
- Ultrasonic flow measurement
- Mass flow measurement
- Installation considerations
- Impact on the overall control loop
- Future technologies

CONTROL VALVES
- Principles of control valves
- Control valve types
  - Globe valves, cage valves, butterfly valves, ball valves
- Control valves selection
- Control valve bodies
- Control valves characteristics/trim
- Control valve noise and cavitation
- Actuators and positioners operation
- Valve calibration and stroking
- Installation considerations
- Impact on the overall control loop
- Future technologies

PROCESS CONSIDERATIONS
- Transmitters
- Noise
- Materials of construction

INTEGRATION OF THE SYSTEM
- Calculation of individual instrument error and total error for the system
- Integration of the pressure, level, temperature and flow systems
- Integration of new smart subsystems with data communication links
- Testing and commissioning of the subsystems

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL INTRINSIC SAFETY FOR ENGINEERS AND TECHNICIANS

Gain a solid understanding of Intrinsic Safety techniques supported by hands-on practical exercises

YOU WILL LEARN HOW TO:

• Design and install safe working systems using Intrinsic Safety (IS)
• Explain the fundamentals of IS
• Apply the national and international standards
• Identify the vital issues of grounding and bonding IS systems
• Fault find IS problems
• Obtain hands-on practical experience with the IS systems

WHO SHOULD ATTEND:

• Instrumentation and control technicians and engineers
• Design engineers
• Electrical technicians and engineers
• Instrument technicians
• Engineering managers and supervisors

Technology Training that Works
The Workshop

This practical, intensive, two-day workshop explains the application concepts of explosion protection using Intrinsic Safety (IS or 'Ex '). This is with reference to British, European and International Standards that define, for the certification and use of electrical 'apparatus'. Where electrical equipment is used in 'Potentially Flammable Atmospheres', the IEC79 Series of International Standards are now emerging to provide a global approach to hazardous area plant safety. This workshop covers IS as the preferred technique for instrumentation applied to industrial plant Inputs/Outputs in hazardous areas. The principles of IS do not change since these are based on the laws of physics, however, the implementation of IS is open to interpretation and causes some conflict as the subject is still seen as 'a black art'.

The workshop aims to widen the understanding of this technique by explaining the basic rules within the context of their application. Engineers and technicians working in hazardous process control and instrumentation areas must have an understanding of the close integration between the safety and operational aspects of Intrinsic Safety (IS) as a protection technique in order to specify, design and maintain systems. The workshop is designed to explain the theory of IS and its close integration with operational signal transfer. You will gain a greater understanding of IS loop concepts as a basis for working with measurement and control loops using standard and custom IS solutions. Defining and applying the correct terminology will assist you in communicating and documenting important safety details.

Pre-requisites: Fundamental grounding in basic electrical concepts.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

Excellent Instructor
A. van den Berg

The Program

BACKGROUND TO HAZARDOUS AREAS
• Explosion consequences
• Definition of hazardous area

REVIEW OF PLANT AREA AND APPARATUS CLASSIFICATION SYSTEMS
• Properties of gasses
• Protection requirements
• Zones and definitions
• Apparatus grouping definitions

PRINCIPLES OF INTRINSIC SAFETY
• Background and history
• Energy limiting concept
• Gas ignition curves
• Hazardous area apparatus
• Simple apparatus
• Safe area associated apparatus and interfaces
• Barriers and isolators
• Systems concepts

APPLICATIONS
• Introduction to applications
• Status inputs

OTHER METHODS OF PROTECTION
• Separation: Ex p, o, q, m
• Construction: Ex n, e
• Containment: Ex d
• Special: Ex ia
• Design: Ex i (ia and ib)

APPLICATIONS
• Analogue inputs
• High level
• Systems

EARTHING AND BONDING
• Basic principles
• Requirement for IS systems
• Noise and interference control
• System earthing approach

STANDARDS AND CERTIFICATION/APPROVAL
• Authorities
• Marking

INSTALLATION
• Relevance of codes of practice
• Interpretation of IEC79-14

FAULTEINDING AND COMMISSIONING
• Safe methods
• Earthing requirements
• Common problems
• Loop testing
• Repairs

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL TUNING OF INDUSTRIAL CONTROL LOOPS

WHAT YOU WILL LEARN:

- Fundamentals of tuning loops - both open and closed loop
- How to recognise the key characteristics of process plant from a control perspective
- Significance of dead time and transfer lags
- PID controller behaviours
- How to troubleshoot and identify problems
- Differences between ideal/real/interacting/non-interacting controllers
- Combination of control modes to use
- How to tune more control loops in less time with effective results
- Practical rules of thumb for tuning systems
- Ziegler Nichols and Lambda Tuning
- How to recognise configuration deficiencies
- Optimum amount of filtering or dampening to apply to the measurement
- How control valves impact on control loop performance
- How to solve problems such as valve hysteresis, stiction and non-linearities
- How to tune complex loops ranging from cascade to feedforward
- When to use derivative control for the best tuned loop

WHO SHOULD ATTEND:

- Automation engineers
- Consultants
- Control and instrumentation engineers
- Electrical engineers
- Electricians
- Electronic engineers
- Energy management consultants
- Facility managers
- Mechanical engineers
- Installation and maintenance technicians
- Technicians
The Workshop

This workshop is designed to train you and/or your staff, in the configuration and tuning of industrial control loops using a minimum of mathematics and formulas. Controllers need to be carefully matched to the process to work optimally; this matching procedure is called tuning. Controllers that are not correctly configured and tuned will not perform optimally and will not reduce variability in the process as they should.

The aim of this workshop is to provide and/or enhance the skills required to configure and tune a controller for optimum operation. An optimally tuned process loop is critical for a wide variety of industries ranging from food processing, chemical manufacturing, oil refineries, pulp and paper mills, mines and steel mills. Although tuning rules are designed to give reasonably tight control, this may not always be the objective. Some thought needs to be given when retuning a loop as to whether the additional effort is justified as there may be other issues which are the cause of the poor control. These issues will be discussed in some detail in the workshop. At the end of this workshop you will have the skills to troubleshoot and tune a wide variety of process loops.

Pre-requisites

Basic knowledge of instrumentation and process plant would be useful.

Please bring a calculator (or computer) and pen along to the course to assist with the calculations.

Simulation Exercises

Throughout the workshop, simulation software is used to simulate real loops and to give you real hands-on exercises in a safe practice environment. You will see the simulated process output respond to your input and configuration changes on the loop controller. You will reinforce and apply the concepts learnt using real field test data in simulation.

To gain full value from this workshop, please bring your laptop/notebook computer.

Instructor extremely well presented, professional and well versed on the subject.

Excellent.

Glen Saunders

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PRACTICAL MOTION CONTROL FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Design and troubleshoot a complete motion control system
- Apply new knowledge of servos to motion control applications
- Troubleshoot servo systems
- Size and select the appropriate drives/amplifiers/servos/steppers for your application
- Apply the concepts of load, inertia, force and real time to motion control problems
- Understand concepts such as backlash, static/running friction, resolution, stiffness, speed and torque
- Design and troubleshoot six basic motor types for motion control

WHO SHOULD ATTEND:

- Control and instrumentation engineers and technicians
- Instrumentation and control engineers/technicians
- Electrical engineers
- Process control engineers
- Electronic engineers
- System integrators
- Designers
- Design engineers
- Systems engineers
- Test engineers
The Workshop

This workshop is designed for personnel who need to apply motion control technology as productively and economically as possible.

This practical course initially examines the basic building blocks and design tools to implement motion control systems. Fundamental concepts of load, inertia, force and real time will be discussed.

The various factors such as performance limitations and costs that impact the selection of electro hydraulic, pneumatic, electromechanical technologies are discussed.

Servo basics are then examined in considerable detail giving you the practical tools in which to work with these systems.

The electrical and mechanical characteristics important in tying together the drive and motor to the mechanical device are then reviewed from a practical perspective.

The basic motors used in motion control such as DC and AC motors, stepper and servo motors and their applications, are also examined. These motors range from small instrumentation motors to robust AC induction motors and to the stepper motors used in open loop control.

Pre-requisites

A basic working knowledge of electrical engineering concepts is useful but not essential as there will be brief revision at the commencement of the class. Please don’t forget to bring a scientific calculator!

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

FUNDAMENTALS OF MOTION CONTROL
• Definition of motion control
• Fundamental concepts
• Engineering practices and techniques

MOTION CONTROL TECHNOLOGIES
• Hydraulics
• Pneumatics
• Electromechanical

MOTION CONTROL SYSTEM LOOPS
• Open and closed systems
• Block diagrams
• Implementation of a control system
• Event controlled systems
• PID controls

SELECTION OF THE FEEDBACK
• Analog vs digital and incremental vs absolute feedback
• Resolution and bandwidth considerations

PHYSICS OF MECHANICAL LOADS
• Brief overview of concepts

MECHANICAL TRANSFORMATION DEVICES
• Reflecting loads through the transformer
• Other transforming devices
• Gears
• Conveyors - elevators
• Inertia at the shaft
• Belts and pulleys

NON LINEAR LOAD TRANSFORMATION
• Equivalent mass
• Mass polar moment of inertia
• Parallel axis theorem
• Spring-inertia resonance method of determining inertia empirically
• In position holding force load resonance

LOAD/SYSTEM ANALYSIS
• Motor/load considerations
• Stability/bandwidth considerations
• Inertia calculations
• Estimating design alternatives
• PWM vs analog vs linear

SERVO BASICS
• Basic gain equations
• Selecting system components of a servo system
• Criteria for motor
• Criteria for amplifier
• Criteria for encoder
• Criteria for coupling
• Criteria for controller
• Command generation
• Feedback
• Type 0, 1, 2 servos
• Bode diagrams made easy
• Predicting servo response
• Characteristics of a motor for servos

SERVO RESPONSES
• Sinusoidal inputs
• Step inputs
• Performance prediction
• Importance of gain setting
• Feedforward
• Type 2 systems
• PID in a servo
• Stability criteria in a servo
• Load effects on stability
• S curves and their application

INTRODUCTION TO BASICS OF DRIVES
• DC/AC - analog/digital
• Drive classifications
• Drive motor characteristics
• Drive motor equations
• Amplifiers and types
• Compensating techniques
• Drive speed and acceleration
• Drive thrust and torque
• Drive inertia considerations
• Drive ratios

ADVANCED CONSIDERATIONS OF DRIVES
• Performance, stiffness, resolution, friction
• Duty cycle
• Drive sizing

OPERATION OF ELECTRIC MOTORS
• Types of motors
• DC motors (permanent/armature/field/commutation/brush vs brushless)
• AC motors (induction/synchronous/universal)
• Stepper motors (indexers/sequencers/microstepping)
• Miscellaneous types
• Characterising motors (torque-speed/data sheets)

MOTORS
• Brush AC motors
• AC induction motors
• Brushless DC motors
• Stepper motors
• Linear motors: commutation, performance, figures of merit, data sheets, motor drivers, applications

MULTI AXIS CONTROL
• Splines, circles and linear motion co-ordination
• Multi axis data handling - software

LATEST DESIGN APPLICATIONS AND TECHNIQUES
• Solving your real time systems motion control problem
• Position control
• Linear motion and circular motion
• Master/slave control
• Electronic gearing
• Dual loops to eliminate backlash
• Feedback
• Tension control systems

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL FUNDAMENTALS OF OPC

YOU WILL LEARN HOW TO:

• Describe what OPC is and how to apply it to your applications
• Understand why OPC is such a robust solution
• Understand OPC Data Access 3.0
• Describe the key components of OPC
• Understand DCOM
• Describe the key features of OPC
• Configure a simple application to display data from the plant floor
• Build a simple SCADA system and supporting components using OPC
• Enhance your existing legacy control system networks to use OPC
• Learn why you need to demand OPC in your products
• Migrate your process data seamlessly into your MS Office applications

WHO SHOULD ATTEND:

If you are using any form of automation or communication system or are applying PCs/PLCs/SCADA systems, this workshop will give you essential tools in working with OPC. This is not an advanced workshop – but a hands-on practical experience. Among those that will benefit by attending are:

• Process Control and Instrumentation Engineers
• Process Control and Instrumentation Technicians
• Design Engineers
• Network Engineers
• Electrical Engineers
• Engineering Managers
• Network System Administrators
The Workshop

OPC has come a long way in making the engineers’ dream of plug and play compatibility in automation engineering achievable. OPC is an industry-wide standard that breaks this proprietary lock by allowing open connectivity based on the principles adapted from widely accepted and applied Microsoft Windows integration standards. OPC capabilities have been demonstrated in many practical applications and it is now a well-established approach for different competing manufacturers. It is now easily considered to be the standard interface in the windows environment. If you are serious about reducing your costs of installing and maintaining your automation systems you need to use OPC.

If you have only briefly heard about OPC and want to get to grips with its tremendous power and apply this to your plant and application, then this workshop will give you the necessary tools. You will receive a valuable overview of OPC and understand why it is the standard of choice for data access in automation systems. You will be exposed to the exercises which reinforce the concepts you will be exposed to in the class and in a practical manner.

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. To gain full value from this workshop, please bring your laptop/notebook computer.

Practical Sessions

The Program

CONCEPTS AND DEFINITIONS
- Classes and objects
- Clients, servers and client/server interaction
- OLE
- DDE and NetDDE
- ActiveX
- .NET

OPC OVERVIEW
- What is OPC?
- Problems addressed by OPC
- The OPC logical object model
- OPC data (sources, formats, etc)
- OPC client/server relationships
- Current OPC specifications

COM AND DCOM
- What is COM?
- COM basics
  - Classes
  - Interfaces
  - Components (proxy/stub files, wrappers)
  - Globally Unique IDs (GUIDs)
  - OPC registry entries (ProgID, ClassID, ApplID, CatID)
  - OPC client/server interaction (in-process, local, remote)
  - Setting up DCOM (programmatically or declaratively)

OPC DA SPECIFICATION (3.0)
- Functional description
- Logical object model (OPCServer, OPCGroup, OPCItem)
- Typical server and client structures
- Read/write methods (synchronous, asynchronous, refresh, subscription)
- Data source (cache, device)
- OPCServer interfaces and methods
- OPCGroup interfaces and methods
- Group and item properties
- Server configuration procedure

OTHER OPC SPECIFICATIONS
- OPC common information
- OPC alarms and events
- OPC batch
- OPC data exchange (DX)
- OPC historical data access
- OPC security
- OPC XML-DA

COMMUNICATIONS ISSUES
- Networking protocols
- LANs, WANs
- OSI Model
- Network infrastructure (Ethernet)
- ‘Transports’ (TCP/IP)

TROUBLESHOOTING
- DCOM protocol stack
- Physical and data link layer problems
- Network and transport layer problems
- COM/DCOM-related problems
- Client/server-related problems
- Simulation and conformance testing
- Error codes

PRACTICAL EXERCISES
- Setting up network (IP addresses, subnet masks, default gateways)
- Connecting simple clients to a SCADA system
- Setting up an OPC server
- Data export to Excel
- Generating and importing tag lists in CSV format
- Graphical (drag and drop) clients
- AE client/server interaction
- Validating servers
- Setting up DCOM to enable OPC clients and servers to interact across a network
- Tunnelling (across local network and the Internet)

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL PROCESS CONTROL

YOU WILL LEARN HOW TO:

- Understand the fundamentals of process control and new techniques
- Tune PID control loops
- Correct stability problems
- Understand cascade loops and feed-forward control
- Identify and correct problems with dead time in the process

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Building service designers
- Automation engineers
- Control technicians
- Electrical technicians
- Instrumentation technicians
- Process operators
- Electrical engineers
- Electricians
- Maintenance engineers
- Process engineers
- Consulting engineers
- DCS personnel
- Energy management consultants

Those involved in the design, implementation and upgrading of industrial control systems.
The Workshop
This practical two-day workshop covers all the essentials of process control and tools to optimise the operation of your plant and process, including the ability to perform effective loop tuning.

Practical process control is aimed at engineers and technicians who wish to have a clear, practical understanding of the essentials of process control and loop tuning, as well as how to optimise the operation of their particular plant or process. These persons would typically be primarily involved in the design, implementation and upgrading of industrial control systems. Mathematical theory has been kept to a minimum with the emphasis throughout on practical applications and useful information.

Pre-requisites
Knowledge of basic electrical concepts would be useful.

Practical Sessions
This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program
BASIC CONTROL CONCEPTS
• Typical manual control
• Feedback and feed-forward control
• Block diagrams

INTRODUCTION TO SENSORS AND TRANSMITTERS
• Selection and specification of devices
• Pressure transmitters
• Flow meters
• Level transmitters
• Temperature sensors

INTRODUCTION TO CONTROL VALVES
• Basic principles
• Rotary control valves
• Ball valves
• Control valve characteristics and specifications

BASIC PRINCIPLES OF CONTROL SYSTEMS
• On/off control
• Modulation control
• Principle of closed loop control
• PID control modes

STABILITY AND CONTROL MODES OF CLOSED LOOPS
• Cause of instability in control loops
• Change of stability through PID control modes
• Methods to improve stability
• Principles of closed loop control tuning

DIGITAL CONTROL PRINCIPLES
• Principle of incremental control algorithms
• Identifying control blocks in the time and frequency domain
• Multiple outputs through digital algorithms

IDEAL PID VS REAL PID
• Non-field-interactive or ideal PID
• Field-interactive or real PID
• Distinguish between process noise and instability
• Selection of ideal or real PID

TUNING OF CLOSED LOOP CONTROL
• Tuning constants calculation according to Ziegler and Nichols
• Open loop tuning procedure
• Closed loop tuning procedure
• Damped oscillation tuning method
• Fine tuning of practical control loops
• Tuning considerations for controllers with saturation and non-saturation output limits

Practical Session
CASCADE CONTROL
• Equation types for cascade control
• Initialisation and PV – tracking
• Use of multiple outputs in cascade control
• Tuning procedure for cascade control

Practical Session
FEED-FORWARD CONTROL
• Feed-forward balance – a control concept
• Tuning procedure for feed-forward control

Practical Session
COMBINED FEEDBACK AND FEED-FORWARD CONTROL
• Concept of combined control with incremental algorithms
• Tuning procedure for combined control

Practical Session
LONG DEAD-TIME IN CLOSED LOOP CONTROL
• The problem of long dead-time in closed loops
• Use of process simulation for process variable prediction
• Tuning procedure for control loops with long dead-time

Practical Session
ALARM HANDLING AND PROCESS SECURITY

PRINCIPAL APPLICATIONS
• Tools of statistical process control
• PLC systems
• Stand alone loop controllers

Practical Session
EXPERT SYSTEM AND MODEL BASED SELF TUNING CONTROLLERS
• Basis auto tuning
• Expert system control
• Model based adaptive control

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL PROCESS CONTROL AND TUNING OF INDUSTRIAL CONTROL LOOPS

WHAT YOU WILL LEARN:

- Understand the fundamentals of process control
- Fundamentals of tuning loops - both open and closed
- Get the best PID settings
- Troubleshoot to achieve optimally tuned control loops
- Apply step-by-step descriptions of the best field-proven tuning procedures
- Typical procedures for troubleshooting tuning problems
- Tune more control loops in less time with consistently excellent results
- Apply the practical rules of thumb for tuning systems
- Determine the minimum settling time for a control loop
- Know the optimum amount of filtering or dampening to apply to the measurement
- Know why and how to size valves for best control loop performance
- Handle problems such as valve hysteresis, stiction and non-linearities
- Tune complex loops ranging from cascade to feedforward
- When to use derivative control for the best tuned loop
- Understand cascade loops and feedforward control
- Identify and correct problems with dead time in the process

WHO SHOULD ATTEND:

- Instrumentation and Control Engineers
- Process Control Engineers
- Mechanical Engineers and Technicians
- System Integrators
- Consultants
- Operators Monitoring and Controlling Processes
- Installation and Maintenance Technicians
- Energy Management Consultants
- Electrical Engineers
- Electricians
- Automation Engineers
The Workshop

This workshop is designed to give you a solid understanding of the essentials of process control and skill you and/or your staff, in the latest procedures for the tuning of industrial control loops using a minimum of mathematics and formulas. A clear review of the principles and essentials of process control is given thus allowing you to gain the skills to tune a wide variety of controllers.

Tuning controllers is an exact science that requires precise configuration of the process controller using the correct procedures.

The aim of this workshop is to provide and/or enhance the skills required to tune a controller for optimum operation. An optimally tuned processed loop is critical for a wide variety of industries ranging from food processing, chemical manufacturing, oil refineries, pulp and paper mills, mines and steel mills. Although tuning rules are designed to give reasonably tight control, this may not always be the objective. Some thought needs to be given when retuning a loop as to whether the additional effort is justified as there may be other issues which are the cause of the poor control. By the end of this workshop you will have the skills to troubleshoot and tune a wide variety of process loops.

Pre-requisites

This is not an advanced course, but one aimed at the fundamentals. Basic electrical concepts and some knowledge of instrumentation would be useful.

Simulation Exercises

Throughout the workshop, simulation software is used to simulate real loops and to give you a minimum of twelve real hands-on exercises in a safe practice environment. You will see the simulated process output respond to your input and configuration changes on the loop controller. You will reinforce and apply the concepts learnt using real field test data in simulation.

The Program

BASIC CONTROL CONCEPTS
- Typical manual control
- Feedback and feedforward control
- Block diagrams

INTRODUCTION TO INSTRUMENTATION
- Selection and specification of devices
- Pressure measurement
- Flow measurement
- Level measurement
- Temperature measurement

INTRODUCTION TO CONTROL VALVES
- Basic principles
- Rotary control valves
- Ball valves
- Characteristics and specifications

FUNDAMENTALS OF PROCESS
- Processes, controllers and tuning
- PID controllers - P, I and D modes of operation
- Load disturbances and offset
- Speed, stability and robustness
- Gain, dead time and time constants
- Process noise
- Feedback controllers
- How to select feedback controller modes

FUNDAMENTALS OF TUNING
- Open loop characterisation of process dynamics
- Default and typical settings
- General purpose closed loop tuning method
- Quick and easy open loop method
- Fine tuning for different process types
- Simplified lambda tuning

THE DIFFERENT TUNING RULES
- Ten different rules compared
- Tables of typical tuning settings
- When to use them when not to use them
- Rules of thumb in tuning

TUNING OF VALVES
- Hysteresis
- Stiction

Pre-site Training

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PRACTICAL SCADA AND TELEMETRY SYSTEMS FOR INDUSTRY

FOCussING ON:

- Fundamentals of SCADA Systems
- Communication Protocols & Standards
- Essentials of OPC applied to SCADA
- Wireless and Radio Standards for Telemetry
- SCADA System Security

WHAT YOU WILL GAIN:

- A fundamental understanding of SCADA systems
- A knowledge of the key industrial communication protocols
- How to set up industrial data communications networks
- The different industrial communications networks used
- How to troubleshoot typical SCADA and telemetry systems
- The essentials of OPC as applied to SCADA systems
- How to design and install radio & wireless links for SCADA systems
- How to effectively apply SCADA system security

WHO SHOULD ATTEND:

- Instrumentation and Control Engineers
- Process Control Engineers
- Electrical Engineers
- Consulting Engineers
- Design Engineers
- Control Systems Sales Engineers
- Maintenance Supervisors
- Control System Application Engineers
- Project Engineers
- Technicians
- Plant Engineers
- IT Personnel
The Workshop

SCADA has traditionally meant a window into the process of a plant or gathering of data from devices in the field, but now the focus is on integrating this process data into the actual business and using it in real time. The emphasis today, is on using Open Standards such as communication protocols (eg IEC 60870, DNP3 and TCP/IP) and 'off-the-shelf' hardware and software to keep the costs down. This comprehensive two day workshop covers the essentials of SCADA systems and telemetry and radio/wireless communications.

A selection of case studies is used to illustrate the key concepts with examples of real world working SCADA systems in the water, electrical and processing industries. This workshop will be an excellent opportunity to network with your peers as well as gain significant new information and opportunity to network with your peers. Although the emphasis of the workshop will be on practical industry topics highlighting recent developments using case studies and the latest application of SCADA technologies the fundamentals of SCADA systems will be covered. The workshop is aimed at those who want to be updated on the latest developments in SCADA systems and want to get a solid appreciation of the fundamentals of SCADA and Telemetry design, installation and troubleshooting.

The Program

**FUNDAMENTALS OF SCADA**
- Terminology and overview
- SCADA system hardware
- Communication architecture

**SCADA SOFTWARE**
- Industry standard protocols
- Displays and MMI’s
- Configuration of SCADA systems
- Best practice configuration of alarms
- Rules for SCADA design

**SCADA COMMUNICATION PROTOCOLS AND STANDARDS**
- RS-232/RS-485
- Industrial Ethernet
- Industrial protocols such as Modbus
- TCP/IP
- IEC 60870 and DNP3 SCADA protocols
- Substation automation protocols

**OPC AND SCADA SYSTEMS**
- Essentials of OPC
- Implementation of an OPC server and client
- Practical demonstration

**SECURITY AND RISK MANAGEMENT**
- Introduction and terminology
- Firewalls
- Authentication, authorisations and anonymity
- Remote access to SCADA systems
- Security precautions

**RADIO AND WIRELESS BASICS**
- Fundamentals of propagation
- Selection of frequency bands
- Equipment - transmitters
- Cabling - coaxial/audio/signal
- Implementation and design
- Spread spectrum
- Duplication and diversity
- Path loss calculations and multipathing

**REVIEW OF WIRELESS LAN SYSTEMS: IEEE 802.11**
- Specifications
- System components
- Antennas
- Topologies
- Modes: infrastructure, ad hoc
- IP roaming
- Security issues

**SATELLITE SYSTEMS**
- Basic technology
- Analog and digital types
- Operation/downlinks and uplinks
- Practical implementation

**LINE OF SITE MICROWAVE**
- Point to point and multipoint
- Equipment/dishes and antennas

**PERFORMANCE ANALYSIS**
- Availability and reliability/BER testing
- Complete systems testing

**SCADA AND TELEMETRY INFRASTRUCTURE**
- Base stations and repeaters
- Location and mast selection
- Cabling/power distribution
- IP and temperature rating of equipment
- Lightning and surge protection

**FUTURE TRENDS**

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**Practical Sessions**

Practical sessions include:
- constructing a simple SCADA system
- operating the SCADA system
- radio telemetry path loss design exercise
- performing an intermodulation products calculation
- Bit Error Rate analysis

**On-Site Training**

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Excellent.
Andre van Zyl

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PRACTICAL
SHUTDOWN AND TURNAROUND
MANAGEMENT
FOR ENGINEERS AND MANAGERS

WHAT YOU WILL GAIN:

- Describe typical turnaround management techniques
- Co-ordinate a simple turnaround project from planning to execution and handover
- Co-ordinate the personnel in a shutdown and turnaround project
- Apply shutdown best practices and planning
- Build an effective maintenance project plan for shutdowns
- Use critical paths to identify risks and manage these risks effectively
- Plan to meet deadlines and complete turnaround projects within budget and on time
- Manage resources effectively on a turnaround project
- Develop the personal skills critical to effective turnaround project management
- Organise and improve performance to create a productive and competent team

WHO SHOULD ATTEND:

- Project Engineers
- Engineering Professionals
- Shutdown Managers and Co-ordinators
- Maintenance Planning Managers
- Cost Control Staff
- Construction Superintendents
- Technical Personnel
- Maintenance/Supervisory Managers
- Project Team Members in: manufacturing, process industries, research & development, utilities, local authorities
The Workshop

The engineering world is littered with examples of poor shutdowns with massive overruns in costs and problems in resource planning. Performing an effective shutdown is an example of applying many of the principles of good Project Management with some important exceptions which are outlined in the workshop. This workshop gives you an excellent review of shutdown management from the perspective of someone who has done it from the trenches. There are many case studies of successful shutdown projects to ensure that you get the latest and most up to date information to successfully apply to your next project no matter what position you hold.

Pre-requisites

A basic knowledge of maintenance management on a Plant would be useful but is not essential.

“This course offers a layout of updated systems and modern trends to keep ahead.

Chris Standish

The Program

FUNDAMENTALS OF SHUTDOWNS AND TURNAROUNDS

- Overview & Introduction
- Structure of Shutdown Plan
- Critical Ingredients of Good Shutdown Management
- Typical Problems
- Co-ordination Issues
- Success Stories
- Not So Successful Stories

PLANNING AND SCHEDULING

- Management Plan & Procedures
- Scheduling Maintenance Activities
- Monitoring & Control Techniques
- Backlog Management Techniques
- Planning for the Shutdown
  - People
  - Materials
  - Work Permits & Isolation
- The Actual Shutdown
  - Implementation
  - Test & Acceptance
  - Variations to Contract
  - Progress Reviews & Deadlines
  - Tracking of Work
  - Controlling Time and Costs
- Post Shutdown
  - Reporting Systems
  - Review of Reports
  - Audit of Work Done
  - Punchlists

MAINTENANCE CONCEPTS

- Measurement & Improvement of Maintenance Performance
- Maintenance Audits

HUMAN RESOURCES

- Management of Contractors & Incentives
- Management of Claims
- Variations to Claims
- Liaison Between Teams
- Organisational Charts
- Motivation & Team Building
- Training of Contractors
- Quality Control of Human Resources

MATERIALS & EQUIPMENT PLANNING

- Definition of Equipment & Materials
- Interfaces Between Different Equipment Packages
- Lead Times
- Off Site Construction & Suppliers
- Variations to Scope

PRINCIPLES OF ENGINEERING PROJECT MANAGEMENT FOR SHUTDOWNS

- Overview of the Project Environment
- Project Life Cycle & Phases
- Project Organisations
- Project Definitions
- Case Study: An Exercise in Developing a Work Breakdown Structure

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TIME MANAGEMENT OF SHUTDOWNS

- Critical Path Method of Schedule Analysis
- Precedence Method of Schedule Analysis
- Presentation of the Schedules
- Resource Analysis
- Monitoring & Reporting Achieved Progress
- Selection of Software
- Case Study - Application of the Precedence Method Analysis Technique

COST MANAGEMENT OF SHUTDOWNS

- Cost Estimation
- Budget Preparation
- Financial Control
- Change Control
- Cost Reporting
- Value Management
- Case Study - Preparation of a Project Cost Report

RISK MANAGEMENT OF SHUTDOWNS

- Risk Management Defined
- Risk Identification
- Risk Analysis
- Risk Management Responses

QUALITY IN SHUTDOWN MANAGEMENT

- Definition of Quality & Management
- Quality Program
- Project Quality Assurance
- Quality Procedures
- ISO 9000

INTRODUCTION TO CONTRACT LAW ON SHUTDOWNS

- Legal System
- Essential Elements of Contracts
- Factors Destroying the Legal Force of Contracts
- Termination of Contracts
- Breach of Contracts
- Liquidated Damages
- Techniques to Ensure Completion of Shutdown Contracts Without “Going Legal”

PROJECT PLANNING SESSION

Work in teams to develop and document an outline Project Plan for a defined Shutdown Project

CASE STUDIES

- Manufacturing Plant
- Offshore Platform
- Oil Refinery
- Power Plant

CONCLUSION

- After the Shutdown - Continuous Improvement
- Elimination of Problems and Bottlenecks
- Planning the Next Shutdown - Retaining Data
PRACTICAL INDUSTRIAL PROGRAMMING USING 61131-3 FOR PROGRAMMABLE LOGIC CONTROLLERS (PLCS)

WHAT YOU WILL LEARN:

• To confidently work with the generic standard IEC 61131-3 for industrial programming
• To effectively utilize IsaGraf programming software to program PLCs
• To understand the concepts and common elements concerning the IEC 61131-3 programming model
• To program using languages such as: structured text, function blocks, ladder diagrams, instruction lists and sequential function charts
• To troubleshoot sequencing problems
• To boost productivity and enhance software quality

WHO SHOULD ATTEND:

For anyone who needs to program Programmable Logic Controllers (PLCs) using the standard developed by the International Electrotechnical Commission (IEC) which is now being used worldwide by most major PLC manufacturers.
The Workshop

PLCs have become part of the backbone of industrial automation. The International Electro-technical Commission (IEC) has developed a standard set of programming languages for industrial PLCs. The success of these languages can be measured by the large number of major PLC manufacturers who are developing products that are 61131-3 compliant. IEC 61131-3 is becoming the standard of choice in many industries, and will boost productivity and enhance software quality. If you master the subject today, your programming knowledge will be applicable across brands well into the future. This knowledge is vital for personal career development.

The aim of this intensive two-day course is to go beyond the basic concepts and introduce you to the practical techniques and applications of 61131-3. We cut across apparent differences wherever PLCs are used and introduce standards that are widely applicable.

If you ever need to program PLCs or just understand more about their capabilities, then this course is for you. The course is pitched at an intermediate level suitable for anyone with some experience with PLCs. If you are a trainee engineer, graduate, control systems engineer, technician, or senior operator you will gain essential knowledge that will significantly enhance existing knowledge of PLCs.

Workshop Objectives

At the completion of this course participants will be able to:
- Confidently work with this emerging generic standard for industrial programming
- Effectively utilize typical industrial programming software to program PLCs
- Explain important concepts and common elements concerning the IEC 61131-3 programming model
- Program in the following languages:
  - Structured text
  - Function blocks
  - Ladder diagrams
  - Instruction lists
  - Sequential function charts
- Troubleshoot sequencing problems by differentiating application issues from sequencing issues

Practical Sessions

PLCs have become an integral part of industrial automation and it is for this reason that there are 5 practical exercise sessions in this workshop. This is to give you the vital hands-on experience you need to confidently work with 61131-3 and OPC in your workplace.

The Program

INTRODUCTION
- What is IEC 61131-3?
- Why the need for IEC 61131-3?
- Deficiencies of current ladder logic
- IEC 61131-3 main features
- IEC 61131-3 major benefits
- Other components of IEC 61131-3

IEC 61131-3 CONCEPTS
- I/O interfaces
- Communication interfaces
- System interfaces
- IEC 61131-3 PLC software model main elements:
  - Configuration
  - Resource
  - Programs
  - Tasks
- Mapping software model to real systems

COMMON ELEMENTS
- Character set
- Identifiers
- Data types elementary: integer, floating point, date and time, strings, boolean and generic
- Data types derived: structured, enumerated and array
- Variables: input, output, input/output, global, external, directly represented and access
- Functions: numerical, bit string, boolean, comparison and bit string
- Program: usage and instances
- Resources and tasks: usage, scheduling - non pre-emptive and pre-emptive
- Configuration

PROGRAMMING LANGUAGE: STRUCTURED TEXT
- Language
- Assignment statements
- Expressions
- Operators
- Statements: calling FBs, conditional and iteration

PROGRAMMING LANGUAGE: FUNCTION BLOCK (FB) DIAGRAMS
- Methodology
- Signal flow
- Feedback paths
- Execution control: jumps and labels
- Network evaluation rules

PROGRAMMING LANGUAGE: LADDER DIAGRAMS
- Concepts
- Symbols
- Methodology
- Connecting FBs
- Execution control: jumps and labels
- Network evaluation rules

Practical Session: Programming using ladder diagrams

PROGRAMMING LANGUAGE: INSTRUCTION LIST
- Language structure
- Instruction semantics: modifiers
- Comparison and jump operators
- Calling FBs

Practical Session: Programming using instruction list

PROGRAMMING LANGUAGE: SEQUENTIAL FUNCTION CHART
- Chart structure
- Main features
- Steps
- Transitions
- Actions
- Rules of evaluation

Practical Session: Programming using Sequential function chart

TYING IT ALL TOGETHER PROJECT
- Complete programming project

CONCLUSION
- Workshop review and discussion

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PRACTICAL CONTROL VALVE SIZING, SELECTION AND MAINTENANCE

YOU WILL LEARN:

• What happens inside a control valve
• The difference between cavitation and flashing
• Choked flow
• Simple calculations to determine CV values
• How to recognise severe service applications
• The types of control valves and relative advantages
• The different characteristics and specifying seat leakage rates
• Size actuators for linear and rotary applications
• The advantages of pneumatic, hydraulic and electric types
• How to select materials for bodies, trims, packing boxes, and gaskets
• Computer sizing programs
• Failure modes for control valves
• New approaches to troubleshooting

WHO SHOULD ATTEND:

• Consulting engineers
• Control valve specialists
• Electrical engineers
• Instrumentation and control engineers and technicians
• Maintenance engineers, technicians and planners
• Plant safety specialists
• Process control engineers
• Project engineers
• Systems engineers
The Workshop

It is claimed that the majority of control valves throughout the world have not been correctly sized and that large numbers operate on manual mode. Whether this is true or not is difficult to establish but we do know that the method of sizing and selecting a control valve for a specific application is generally not well understood. Although there are many factors that need to be taken into account the subject is not difficult to understand if dealt with in a logical manner.

Many maintenance problems result from people treating the symptoms of a problem rather than tackling the true cause - a basic understanding of the principles is all that is usually needed to solve the problem for good. This practical, hands-on workshop is designed to maximise knowledge retention and understanding. It provides an opportunity for participants to discuss with the presenter and others, specific problems and appropriate solutions. All delegates take away a detailed and comprehensive copy of the material presented; therefore minimal note taking is encouraged to ensure maximum delegate participation and attention.

Pre-requisites

No specialist knowledge or skills are required – only a technical background so that there is an understanding for such factors as the difference between pressure and force. In fact this workshop is a good introduction to someone who has had no dealings with control valves in the past as well as an important refresher workshop for control valve specialists who benefit from the back-to-basics approach.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop please bring your laptop/notebook computer.

The Program

INTRODUCTION TO CONTROL VALVE THEORY
• Introduction and definitions
• Energy types
• What happens inside a control valve
• Cavitations and flashing
• Choked flow
• Valve co-efficient CV

DIFFERENT TYPES OF CONTROL VALVES
• Globe valves
• Butterfly
• Eccentric disk
• Ball
• Rotary plug
• Diaphragm and pinch

CHARACTERISTICS
• Equal percent
• Linear
• Quick opening
• Selection method

HIGH PRESSURE DROP APPLICATIONS
• Cavitations control and elimination
• Low noise
• Diffuser plates
• Chokes
• Disk stack technology
• Pressure balanced trim

VALVE SIZING EXAMPLES OF HIGH PRESSURE DROP APPLICATIONS USING COMPUTER PROGRAMS
• Water – pump bypass
• Steam – turbine bypass
• Gas – pressure reducing
• Oil – choke valve

ACTUATORS
• Pneumatic
• Hydraulic
• Electric
• Sizing on rotary valves and linear valves
• Mounting considerations
• Manual over-rides
• Accessories

POSITIONERS
• Basic principles
• Conventional pneumatic
• Conventional electro-pneumatic
• Smart positioners
• Feedback options

PNEUMATIC CIRCUITS
• Volume tank fail system
• Fail fix
• Volume boosters

MATERIALS
• Body materials and pressure ratings
• Trim and packaging
• Guides and gaskets

QUALITY STANDARDS
• ASME
• NACE
• ISO 9000/2000
• PED
• NAMUR

INSTALLATION AND MAINTENANCE
• Installation, commissioning and routine maintenance
• Fault finding
• Modes of failure

SUMMARY, OPEN FORUM AND CLOSING

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BEST PRACTICE IN
PROCESS, ELECTRICAL AND
INSTRUMENTATION DRAWINGS
AND DOCUMENTATION

Includes: Standards, Masters, Specifications,
Templates, Drawings, Schedules & Diagrams

YOU WILL LEARN HOW TO:

- Define and use process flow diagrams, P&IDs, instrument lists, specification forms, logic diagrams, location plans, installation details and loop diagrams
- Understand process control devices and the symbols used to define them
- Define and specify vendor criteria for the production of plant documentation to the order of the company
- Use specifications to control the design scope of the project
- Understand the purpose of a HAZOP in the development of a plant
- Implement and manage drawing plant modifications from conception to completion
- Be aware of the ISA standards available to assist you in developing and understanding instrument and control documents
- Understand the scope, responsibility and interaction of each discipline in the completion of a project or plant modification

WHO SHOULD ATTEND:

- Instrumentation and Control Engineers & Technicians
- Electrical Engineers and Electricians
- Project Engineers
- Telecommunications Engineers & Technicians
- Process Control Engineers
- Consulting Engineers
- Maintenance Engineers & Technicians
- Production Controllers
- Project Managers
- Drawing Office Staff
The Workshop

This two-day hands-on workshop concentrates on demonstrating how a thorough knowledge and understanding of how the plant works from a drawing and documentation perspective will greatly enhance your ability to maintain and enhance the operation of the plant. You will learn to diagnose problems and suggest solutions on a plant you have never seen. Too often plant modifications that are instituted fix the symptom instead of the underlying problem, this workshop will show you why it is so important to keep looking at the plant documentation as a whole in order to solve the problem. You will also learn how to create documentation using simple standards and specifications as well as custom design a solution for your own plant. Disciplines covered include process, electrical and instrumentation and numerous practical exercises allow the application of knowledge gained to reinforce the principles. This is not an advanced course but focusing on the basic practical principles.

Practical Sessions

**Practical Session 1** - Mechanical Drawings
- Mechanical projections and sections drawing to get a feel for the main issues with drawing

**Practical Session 2** - Ladder Logic and Control
- Ladder logic development and tying this into the control circuits and hard wiring

**Practical Session 3** - Process and P&IDs
- Process flow diagram, process description and P&ID execution

**Practical Session 4** - Instrumentation Drawings
- Production of instrument index, loop list, loop drawings, I/O lists and Trip/Alarm schedule

**Practical Session 5** - Electrical Drawings
- Take the ladder logic drawings earlier and draw the electrical schematic for a typical main and control circuits of a cooling fan

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

**INTRODUCTION TO PLANT DESIGN, OPERATIONS AND MAINTENANCE DOCUMENTATION**
- Introduction
- Standards - a history and overview
- Drawing office and company standards

**BASIC CIRCUITS AND COMPONENTS**
- Power supply and protection
- Relays and contacts
- Switches
- Ladder logic
- Fail safe design

**PROCESS DIAGRAMS**
- Process block diagram
- Process flow diagram
- Process description including scheduling
- Utility flow diagram and developing from flow diagrams
- Piping and instrumentation diagrams
- P&ID standards, definition and use
- P&ID symbols
- P&ID layout, design and construction
- Cooling water plant study
- Hazardous area considerations

**INSTRUMENTATION DOCUMENTATION**
- Overview of instrument schedules, drawings and diagrams
- Purpose and target audience of each document
- Defining loop masters - loop layout
- Reading instrumentation documentation
- Wire numbering
- Logic diagrams - definition, use and interpretation
- Instrument specifications

**ELECTRICAL DOCUMENTATION**
- Load lists
- Single line diagrams
- Schematic and control diagrams
- Cable schedules and routing drawings
- Point to point schedules
- Lighting layouts
- Installation details
- Electrical specifications

**Practical Session**

**VENDOR PACKAGES**
- Panel wiring diagram
- Combined E&I disciplines
- Panel schematics
- Panel layout
- Document supply specification
- Maintenance specification

**Practical Session**

**CHANGE CONTROL**
- Request for change
- HAZOP RCM analysis and configuration management
- ISO 9002

**Practical Session**

**SUMMARY, OPEN FORUM AND CLOSING**

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PRACTICAL DISTRIBUTED CONTROL SYSTEMS (DCS) FOR ENGINEERS AND TECHNICIANS

WHAT YOU WILL LEARN:

- Fundamentals of the architecture and operation of Distributed Control Systems (DCSs)
- How to design the overall DCS and process control system
- Techniques to specify DCSs
- Methods to optimise the performance of your plant
- Understanding of the key ergonomic issues in design of operator displays
- How to apply advanced control strategies to your plant control system
- More effective use of your existing DCS process control capabilities
- How to design and create a consistent and effective alarm philosophy for your installation
- How to recognise and deal with human problems in interfacing to alarm systems

WHO SHOULD ATTEND:

- Process Control Engineers and Technicians
- Automation Engineers
- Operations Managers
- Operators and Control Room Personnel
- Metallurgists
- Production Engineers
- Process Engineers
- Plant Engineers
- IT Managers working with Networks
- Electrical Engineers
- Project Engineers
- Electrical and Instrumentation Technicians
- Maintenance Engineers and Supervisors
The Workshop

This workshop will cover the practical applications of the modern distributed control system (DCS). Whilst all control systems are distributed to a certain extent, there is a definite merging of the concepts of DCS, Programmable Logic Controller (PLC) and SCADA and despite the rapid growth in the use of PLCs and SCADA systems, some of the advantages of a DCS can still be said to be:

Integrity: The expected process down-time caused by a conventional DCS is significantly less than with using a SCADA/PLC. One incident in a refinery can cost more than the difference in price between a DCS and SCADA/PLC. Reasons for this would include redundancy, fault tolerance, diagnostic alarming on I/O errors, system design, and others.

Engineering time: A small SCADA/PLC system is easy to design and configure. As the system grows bigger, the effort involved to properly design and configure the system grows exponentially, and also the risks that things can go wrong. To design and implement a single loop PID controller in a SCADA/PLC system is easy and quick. To design and implement the base layer control on a refinery using a SCADA/PLC system can be challenging without a highly skilled team of industrial automation engineer and technicians.

Abnormal Situation Management and Intelligent Alarm Management is a very important DCS issue that provides significant advantages over PLC and SCADA systems. Few DCSs do justice to the process; in terms of controlling for superior performance - most of them merely do the basics and leave the rest to the operators. Operators tend to operate within their comfort zone; they don’t drive the process "like Schumacher drives his Ferrari". If more than one adverse condition developed at the same time and the system is too basic to act protectively, the operator would probably not be able to react adequately and risk a major deviation. Operators have little feedback on their own performance and exceptional adverse conditions are often not handled as well as they should be. Why are DCSs generally so under utilised? Often because the vendor minimises the applications software development costs to be sure of winning the job, or because he does not know enough about the process or if it is a green-field situation, enough could not be known at commissioning time but no allowance was made to add the missing functionality during the ramp-up phase.

This workshop examines all these issues and gives suggestions in dealing with them and whilst by no means exhaustive, provides an excellent starting point for you in working with DCSs.

Practical Sessions

• Specification of a DCS
• Configuration of a typical DCS control loop using a typical plant problem
• Design of an alarm system
• Advanced process control - configuration and testing

The Program

INTRODUCTION

SUMMARY OF TYPICAL DISTRIBUTED CONTROL SYSTEMS

DCS VERSUS SCADA VERSUS PLCs
• Comparison
• The smart instrument as the key component in a DCS system

DCS SYSTEM ELEMENTS
• Main differences between a distributed control system and PLC/SCADA systems
• Requirements of the operator interface within the DCS
• Layout of a DCS system with data highway communications paths
• Redundancy in the DCS

DATA COMMUNICATIONS IN A DCS
• Overview of DCS and SCADA Communications (field/operator/long distance)
• Network topologies
• Foundation Fieldbus
• Profibus
• Devicenet
• Industrial Ethernet
• Routers, switches, hubs
• TCP/IP
• Industrial Network security
• Links to MES and ERP

THE BASIC CONTROLLER
• Identification of the PCBs, which make up the controller
• Function of the central processing unit (CPU)
• The types of memory
• Discrete and logic control
• Sequential and batch control

BASIC DCS CONTROLLER CONFIGURATION
• Control modes available within each controller slot
• Tracking and initialisation in control slots used for cascade control
• Control algorithms
• The use of diagnostics

PROGRAMMING OF DCS SYSTEMS
• Block configuration
• IEC 61131-3 "open" programming languages (structured text, function block, ladder, sequential)
• Tips and tricks in programming

THE OPERATOR INTERFACE
• The operators process 'window'
• The various operator display configurations
• The requirement for keyboard entry of data
• Ergonomic requirements in the operator environment

ALARM SYSTEM MANAGEMENT FOR DCSs
• Philosophies of alarm management
• Human and ergonomic factors
• Structure of good alarm system
• Safety Integrity Level (SIL)
• Design of alarm system
• Measurement of performance

DISTRIBUTED CONTROL SYSTEM REPORTING
• Alarm reporting, types of alarms generated and acceptance of alarms
• The different types of logs and reports which can be configured on a DCS system
• Data history use in logs, reports and trend displays

DISTRIBUTED CONTROL SYSTEM CONFIGURATION
• The organisation of system data files
• Data configuration procedures necessary for setting up the DCS area database
• The need for different security levels attached to various operating parameters
• Configuration control procedures adopted to ensure data integrity

ADVANCED CONTROL STRATEGIES

MAINTENANCE CONSIDERATIONS
• Maintenance requirements of system and system elements
• The requirements for in-built diagnostics and for maintenance diagnostic routines
• The requirements for installation of UPS system
• Recovery of a DCS following a power outage

THREE TYPICAL APPLICATIONS

SUMMARY AND CLOSURE

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FUNDAMENTALS OF INDUSTRIAL AUTOMATION

WHAT YOU WILL LEARN:

• An appreciation of the latest developments in industrial automation
• Cutting edge best practice in instrumentation, PLCs, PACs
• Update on fieldbus, industrial ethernet and industrial wireless
• Review of current SCADA practice
• Best practice in industrial automation
• A clear understanding of the acronyms and terminology used

WHO SHOULD ATTEND:

This course is aimed at you if you are interested in gaining an overall appreciation and general understanding of industrial automation and control technology.

• Engineering managers
• Mechanical and electrical engineers
• Instrumentation engineers
• Maintenance engineers, supervisors and technicians
• Sales engineers
• Programmers
• Project leaders and managers
• IT managers
• Process engineers
• Production managers and engineers
• Business managers
The Workshop

The elements of an industrial control system form part of an interconnected web using Ethernet, Fieldbus and wireless. Information is effortlessly transferred from an instrument to the SCADA terminal on a boardroom table. In this workshop real life examples from current control system technologies are used to give you the latest background in current vendor solutions. The material is presented in an easy to understand practical way enabling you to apply the concepts quickly and effectively to your next automation project.

Once you have completed the course you should have a good overall understanding of how to harness the power of industrial automation and to deal with contractors and experts working in the area. This will result in quicker ability to make decisions on the best way forward resulting in a quicker time to design, install and commission industrial automation equipment and, naturally, reduced costs.

Practical Sessions

The course is made highly interactive with short clips of videos, practical design exercises, and practical hands-on sessions with simulation software to demonstrate the key concepts.

To gain full value from this workshop, please bring your laptop/notebook computer.

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The Program

INTRODUCTION
• Objectives of course
• Road map for the course
• History and background
• Building blocks of industrial automation
• Digital control
• Hierarchy and pyramid of control (sensor to boardroom)

INSTRUMENTATION
• Sensors
• Instrumentation
• Actuators and valves
• Fieldbus
• Impact of Fieldbus and wireless PLCs, PACs, DCSs AND SCADA SYSTEMS
• Programmable Logic Controllers (PLCs)
• Programmable Automation Controllers (PACs)
• Operator panels
• Distributed Control Systems (DCSs)
• Supervisory and Control and Data Acquisition Systems (SCADA)
• Soft PLCs
• Standard programming languages (IEC 61131-3)

INDUSTRIAL DATA COMMUNICATIONS
• Essentials of data communications (OSI layers)
• Essentials of RS-232/RS-485
• Fieldbus and DeviceNet systems
• ASi-bus
• Profibus
• Foundation fieldbus
• Industrial ethernet and TCP/IP
• Industrial versus commercial ethernet
• Industrial wireless
• Battle of the application layers
• Industrial network security
• OPC

PROCESS CONTROL
• PID control
• Cascade control
• Advanced process control
• Implementation of control

FROM SCADA TO BUSINESS SYSTEMS
• Manufacturing Execution Systems (MES)
• S88 batch language
• System integration models and concepts - S95 standard

SUMMARY
• Tying all the components together
• A view of the future
PRACTICAL TROUBLESHOOTING OF DATA ACQUISITION AND SCADA SYSTEMS

YOU WILL LEARN HOW TO:

• Install and configure a data acquisition system
• Choose and configure the correct software
• Apply state of the art approaches in design of data acquisition systems
• Configure data communications systems
• Avoid the common pitfalls in designing a data acquisition system

WHO SHOULD ATTEND:

• Electronic Engineers
• Instrumentation and Control System Engineers
• Electrical Engineers
• Project Engineers
• Design Engineers
• Technicians
• Process Control Engineers
• Systems Engineers
This two-day workshop covers all aspects of data acquisition and control using a PC and data loggers, including design, specification, programming, installation and configuration. Both the novice and experienced user will gain a solid grasp of the principles and practical implementation of interfacing the PC and standalone instruments to real world signals. Upon completion of the workshop you will have a thorough understanding of PC based data acquisition systems and will be able to design, specify, install, configure and program data acquisition systems quickly and effectively. In addition, the workshop aims to cover the industrial communications standards that are used with instruments today.

**Aims**

Personal computers have become a popular and affordable platform from which to perform data acquisition and control for a variety of industrial and scientific applications. Data acquisition with the PC enables one to log and control a variety of real world signals such as pressure, flow and temperature and to interface to various standalone instruments.

This practical workshop will equip you with the knowledge and expertise to configure an efficient and effective data acquisition and control system using a PC and standalone instruments. You will learn various simple approaches to the design of data acquisition systems and choice of software, hardware and analysis tools.

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**The Workshop**

**INTRODUCTION**
- Data acquisition and control
- Fundamental principles of data acquisition and control systems
- Typical PC based applications

**ANALOG AND DIGITAL SIGNALS**
- Sensors, transducers and temperature transducers
- Strain gauges
- The difference between single ended and differential systems
- Earthing and isolation techniques to reduce noise
- Cable shielding and earthing

**SIGNAL CONDITIONING**
- The different types of signal conditioners
- Signal conditioning functions and signal filtering
- Isolation and over voltage protection

**THE PC FOR REAL TIME WORK**
- The different data transfer methods
- Streaming of data to hard disk

**PLUG IN DATA ACQUISITION BOARDS**
- Typical analogue to digital (A/D) boards
- Single ended vs differential signals
- Analogue to digital (A/D) board specifications
- Capturing high speed transient data
- Principles of data sampling
- Speed vs throughput of data
- Typical digital to analogue (D/A) boards
- Input/Output (I/O) boards
- Counter/timer I/O boards
- Practical considerations with use of digital I/O boards

---

**RS-232/RS-485 SERIAL DATA COMMUNICATIONS STANDARDS**
- RS-232 hardware interface
- Principles of RS-232 handshaking
- RS-485 hardware interface
- Communication protocols (e.g. Modbus)
- Error detection
- Troubleshooting serial data communications systems

**CONTROLLERS AND DATA LOGGERS**
- Hardware structure of standalone devices
- Practical applications of data loggers
- How to improve communication bottlenecks
- IEEE-488 SYSTEMS
- IEEE-488.1/IEEE-488.2 and SCPI specifications
- Hardware configuration
- Device types (controllers/listeners/talkers)
- Basic communications
- Advanced communications

**INDUSTRIAL ETHERNET AND TCP/IP**
- Configuring an Ethernet system
- Troubleshooting TCP/IP and Ethernet
- Connecting Ethernet based instruments and data loggers to a PC
- Tips and tricks with Ethernet

**UNIVERSAL SERIAL BUS (USB)**
- Concept and practice
- USB explained
- Benefits for data acquisition and communications

**REVIEW OF THE COURSE AND QUESTIONS**
INSTALLATION, CALIBRATION AND MAINTENANCE OF ELECTRONIC INSTRUMENTS

YOU WILL LEARN HOW TO:

• Apply correct practice to installation, calibration and maintenance of instruments
• Calibrate electronic transmitters and controllers
• Configure instruments correctly to vendor instruction sheets
• Apply intrinsic safety techniques to instrumentation installation
• Maintain instruments correctly
• Connect instrument wiring correctly
• Predict and avoid the problems with installing measurement equipment
• Troubleshoot, isolate and fix electronic instrumentation problems
• Specify instrument and loop documentation requirements and standards to vendors
• Fault find with drawings
• Design and install safe working systems in hazardous areas
• Apply ISO 9000 to maintenance practices
• Effectively apply the principles of analog meters, digital meters and oscilloscopes
• Carry out simple repair procedures for the correction of faults on instrument systems where possible

WHO SHOULD ATTEND:

• Design engineers
• Electrical engineers
• Electrical technicians and technologists
• Electricians
• Experienced electrical tradespersons and artisans
• Experienced fixed plant operators
• Graduate engineers
• Instrumentation engineers
• Project engineers
**The Workshop**

This workshop is designed for engineers and technicians from a wide range of abilities and backgrounds and will provide an excellent introduction and hands-on experience in installation, calibration, commissioning and maintenance of electronic instrumentation. The workshop is initiated with coverage of the basics on electrical measurements and some tips and tricks. Instrument performance and calibration principles are then covered with rules for calibrating transmitters. Hereafter the procedures for calibrating and installing smart transmitters are covered. Typical documentation requirements for instruments are examined with a focus on instrument data sheets, P&ID's and wiring diagrams. During the life span of any plant, a multitude of different vendors will supply plant modifications and equipment as the plant is continuously enhanced. The quality of the documentation produced will vary enormously with each new supplier. Instruments in hazardous areas are then discussed on integration of the entire system and testing and commissioning procedures for instruments detailed.

**Pre-requisites**

A knowledge of fundamental electrical concepts would be useful.

**Practical Sessions**

**Basic Measurements**
- Measure and troubleshoot voltage, current, resistance problems
- Open and short circuit tips and tricks

**Simulation**
- The basis of signal simulation
- Transmitter simulation
- Transducer simulation

**Calibration**
- The basis of transmitter calibration
- Zero and span adjustment
- Performance – accuracy and error calculations

**Fieldbus and Digital Transmitter**
- Configure
- Re-range
- Perform digital trim

**PID Feedback Loops**
- Wire up and install a PID feedback loop
- Check the loop out
- Tune the loop

**The Program**

**MAINTENANCE**
- Corrective/preventive/predictive
- Troubleshooting
- Meaning of ISO 9000 and 9001

**ELECTRICAL MEASUREMENTS**
- Use of multimeter
- Voltage/current and resistance measurement
- Analog and digital meters
- Oscilloscopes
- Current to voltage conversion
- Multiple loop devices
- Diodes and resistors
- Soldering and component preparation
- Open and short circuits
- Testing of diodes/DIACS/TRIACS
- Components out of tolerance
- Isolation and earthing

**INSTRUMENT PERFORMANCE**
- Basic measurement and control concepts
- Accuracy/range/hysteresis/linearity/repeatability/response/dead time
- Zero/span
- Process dynamics
- Specifications

**CALIBRATION PRINCIPLES**
- Block diagrams
- Standards for calibration
- Five point calibration
- Charts

**FUNDAMENTALS OF PROCESS MEASUREMENT**
- Basic measurement concepts
- Definition of terminology
- Measuring instruments and control valves as part of the overall control system
- Pressure, level, temperature and flow overview
- Overview of control valves

**CALIBRATION OF TRANSMITTERS**
- Shop calibration
- Electro pneumatic calibrators
- In-shop or field
- Temperature – calibration (RTD/thermocouples)

**PID CONTROLLERS**
- Direct/reverse acting
- P, I and D control
- Spanning and range
- Instrument/controller and process gains

**SMART AND FIELDBUS TRANSMITTERS**
- Operation
- Configuration
- Reranging
- Characteristics
- Trimming

**TRANSUCERS AND TRANSMITTERS**
- Fundamentals
- Calibration
- Interfacing to instrument

**INSTRUMENT DOCUMENTATION AND P&ID’S**
- Control loops on the P&ID
- Instrument lists
- Wiring diagrams
- Schedules and lists
- Data sheets
- Loop diagrams
- Standards and symbols

**HAZARDOUS AREAS**
- Explosion consequences
- Definition of hazardous area
- Classification of apparatus
- Apparatus grouping and temperature
- Principles of Ex protection
- Requirements for IS systems
- Noise and interference control
- Earthing requirements
- Static protection
- Lightning protection

**MAINTENANCE, FAULT FINDING AND REPAIRS OF EX EQUIPMENT**
- Planned maintenance
- Use of tools
- Procedures
- Safe methods
- Test equipment suitability

**STANDARDS, CERTIFICATION, MARKING AND APPROVAL**
- Authorities
- Marking and identification
- Apparatus certification

**INTEGRATION OF THE SYSTEM**
- Calculation of individual instrument error and total error for the system
- Integration of the pressure, level, temperature and flow systems
- Integration of new smart subsystems with data communication links
- Procedures
- Testing and commissioning
- Start up

**SUMMARY, OPEN FORUM & CLOSING**

**On-Site Training**

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RFID* TAGGING - FEATURES AND APPLICATIONS

* Radio Frequency Identification

You will learn how to:

- Apply RFID technology to your next project
- Understand the strengths and weaknesses of the technology
- Detail the physics and electronics behind RFID
- Specify RFID system components and types of tags
- List types of RFID communication system and frequency ranges
- Design and install a simple RFID system
- Understand transmission and collision avoidance techniques employed in RFID
- Describe a typical transmitting sequence
- Distinguish between the various types and workings of transponders and antenna
- Explain RFID standards and current regulations
- Appreciate the middleware requirements and their integration with varied business applications
- Detail the cost involved to set up a RFID system
- Undertake a RFID implementation study from case study examples
- Gain hands-on experience in setting up, testing and running a RFID system using notebook computers and RFID demo-kits

Technology Training that Works
RFID is one of the fastest growing technologies in the automatic data collection industry. The widespread use of RFID in such varied applications as electronic article surveillance, animal tagging and high volume logistics supply has resulted in low prices of the tags. It is conceivable with the affordability of tags that they can be permanently used to identify foodstuffs and clothing items. There are still a number of questions raised about issues such as cost and in particular privacy. This 2-day workshop will cover all the essential aspects of RFID systems to not only provide you with a broad understanding of its technology but also the various types of applications and uses where it can be applied to.

The workshop will provide an overview of RFID technology, explain the physics and electronics driving this technology whilst also focusing on communication protocols, industry standards and security issues. It also covers software requirements, middleware and integration with various business applications and practices. Implementation strategies and challenges, cost analysis, market opportunities and the road-ahead will be discussed throughout the 2 days.

The workshop provides hands-on training in setting up, testing and running a RFID system using notebook computers and RFID demo-kits. These sessions will explore identifying components, studying the characteristics of RFID transponders, antenna, their limitations and troubleshooting.

Case studies are shown throughout the 2 days to give you a practical understanding of its application to industry.

Pre-requisites
Basic knowledge of electrical and electronics concepts useful. Knowledge of data communications and applications are desirable, but not essential.

**The Workshop**

**The Program**

**INTRODUCTION**
- RFID - an overview
- Genesis of an idea - history of RFID
- RFID in 1990s
- RFID promises: stepping into 21st century
- RFID limitations
- Patents
- What's happening today?

**NUTS & BOLTS: PART 1**
- Revisit physics and electronic fundamentals
- Antenna Maps
- RFID - system components
- RFID - types of communication: radio frequency and range
- System handshake - a typical transmitting sequence
- Data modulation
- Data encoding
- Transmission & collision
- Evolving RFID standards
- Definitions & acronyms
- Case study

**NUTS & BOLTS: PART 2**
- Transponder apparatus and system
- Remotely powered transponder
- Remotely powered transponder having a dipole antenna array
- Passive encoding microwave transponder
- Identification system using coded passive transponders
- Passive transponder apparatus for use in an interrogator - responder system
- Electronic detection and identification system
- Essentials of troubleshooting exercise

**TYPICAL BUSINESS CASE STUDY/SUCCESS STORIES: PART 1**
- Case studies

**Who Should Attend**
- Engineers and Technicians working with or required to implement a RFID system, including:
  - Test Engineers
  - Software Engineers
  - System Integrators
  - Designers
  - Electronic Technicians
  - Consulting Engineers
  - Design Engineers
  - Plant Managers
  - Systems Engineers
  - Electricians

- Those involved with the installing, programming, maintaining and purchasing of electronic control equipment
- Those who want to improve their understanding and capabilities in electronic technology
- Those involved with sales and installation of electronic products into industry

**MARKET OPPORTUNITIES & PRODUCTS**
- Market analysis & survey: case study and costs
- Major players/products

**INSTALLATION/TROUBLESHOOTING**
- Installation of a RFID system: Practical sessions in setting up, testing and running a RFID system using notebook computers and RFID demo-kits
- Troubleshooting of a RFID system

**TYPICAL BUSINESS CASE STUDY:**

**ROAD AHEAD**
- Research projects
- Innovative products for the home
- Future vision
- Ethics & privacy issues

**SUMMARY, OPEN FORUM AND CLOSING**

**On-Site Training**

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PRACTICAL INDUSTRIAL TROUBLESHOOTING OF INSTRUMENTATION, ELECTRICAL AND PROCESS CONTROL
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Evaluate industrial processes
- Competently diagnose fault conditions
- Accurately interpret drawings and documentation
- Reliably explain the nature of faults, how they should be repaired and how the system should be tested on completion
- Troubleshoot communication links using test equipment and available software packages - IDC’s Protocol Analysis Tool (PAT). Free copy of this tool for all delegates
- Demonstrate a working knowledge of how instrumentation and control systems are interfaced
- Compile concise fault analysis reports and make recommendations to prevent recurrence

WHO SHOULD ATTEND:

This workshop is designed for personnel with a need to understand the techniques required to use and apply industrial fault finding, troubleshooting and repair technology as productively and economically as possible. This includes technicians and artisans involved with:

- Consulting and design
- Control and instrumentation
- Control systems
- Electrical and instrumentation installations
- Maintenance supervisors
- Maintenance technicians
- Process control
- Process development
- Project management
- SCADA and telemetry system
This interactive workshop uses a systems approach to troubleshooting and is designed to encourage delegates to take a new look at the methodology of faultfinding and rectification on their plant. Having covered the types of equipment, we look at first line troubleshooting, then the advanced level and finally work through some typical examples.

The first step is to get to grips with the processes and relevant process variables, then to look at their measurements and the basics of the systems that control them. Before embarking on the look-feel-listen-decide sequence, we pause for a while to consider aspects of safety; at the plant, equipment, component and personal levels. Troubleshooting basics covers the systematic approach to information gathering, fault diagnosis and decision-making. Emphasis is placed on gathering relevant information and using it to prove where the fault isn’t; thereby eliminating false decisions and “red herrings”.

Having implemented the right solution, we then look at how to learn from the experience and prevent a recurrence. ‘First level’ troubleshooting will help in localising the faulty module or sub-system and narrow it down to a set of possible components. The ‘advanced’ chapters will cover more details/expert level investigation and will address the component level and, more importantly, a validation of the decision taken at the first level troubleshooting; verifying if it requires a component change - incorrect decisions at this stage having significant cost implications.

Taking the case of an apparent PLC fault, the first level troubleshooting can eliminate the PLC from the actual fault condition and pin-point the section of plant where the real fault may be located; typically a range of 5 to 10 components. The advanced section will focus more on tracing faults to the final component and might require using more sophisticated equipment, and/or debugging. The point is that if the PLC programming was correctly commissioned, it will not be the cause of the problem.

Similarly, first line motor faults can be related to individual motors, drive circuitry, relays, switches, etc. The advanced troubleshooting will cover tracing the fault to the specific IC or other drive component, such as a thyristor or fuse. In some cases, a re-calibration of the drive might also be required. The assumption here is that most faults can be traced to fuses, misaligned components, loose connections, etc wrong. This can be addressed by first line troubleshooting. If the fault goes beyond this and is caused by a faulty component, it needs to be verified by a person with more expertise. Rarely is incorrect configuration or malfunction of the actual problem.

Emphasis is placed on the diagnostician’s dependence on accurate drawings and documentation and the need to be able to correctly interpret the facts contained in drawings and documentation. Clients often feel the same way about these problems; where components are being replaced more on an ad-hoc basis, so causing unnecessary wastage and plant down-time.

Delegates will be encouraged to bring typical troubleshooting problems to the workshop and to discover a more cost-effective way of resolving their problems, thereby saving them time, whilst saving their plant from unnecessary wastage and down-time.

Pre-requisites
A basic working knowledge of industrial electrical, instrumentation and communications applications is useful.

The Workshop

This is a practical, hands on workshop enabling participants to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

Practical Sessions

This is a practical, hands on workshop enabling participants to work through practical exercises which reinforce the concepts discussed.

On-Site Training

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The Program

BASICS
• Processes
• Process variables
• Measurement
• Control systems basics
• Matters of safety
• Decision making
• Troubleshooting basics
• Feedback to prevent a recurrence
• Examples of personal experience

PLC TROUBLESHOOTING
• Types of PLC’s in use
• System architecture
• Communication strategies
• Strategic use of documentation to aid fault location and diagnosis
• Actual PLC fault identification
• Examples of typical fault conditions, diagnosis and repair

SENSORS AND MEASURING DEVICES
• Overview of sensor types
• Voltage, current and frequency/pulse interfacing
• Using the P&I Diagram and loop schematics to aid fault location
• Testing, repair, replacement and re-commissioning of devices
• Examples of typical fault conditions, diagnosis and repair

ACTUATORS AND DRIVES
• Overview of actuators and drive types
• Control strategies
• Communication and power interfacing
• Examples of typical fault conditions, diagnosis and repair

ELECTRICAL SYSTEMS
• Overview of MV power systems, cabling, transformers and switching, shielding and grounding
• Motors and Motor Control Centres (MCCs)
• Variable Speed Drive (VSD) suites
• Lighting and small power systems
• Examples of typical fault conditions, diagnosis and repair

COMMUNICATIONS AND NETWORK TROUBLESHOOTING
• Overview of process plant communications and network strategies
• Interfacing problems and systems fault location
• Examples of typical fault conditions, diagnosis and repair

TROUBLESHOOTING TOOLS AND INSTRUMENTS
• Overview of appropriate tools and test equipment
• Safe and effective use
• Calibration of test equipment
• Examples of how fault conditions can be incorrectly diagnosed

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL HAZOPS* FOR ENGINEERS AND TECHNICIANS

*Hazard and Operability Studies

WHAT YOU WILL LEARN:

- The principles of hazard and operability studies
- Planning and timing of HAZOP studies as part of safety management
- How to structure your plant operations into parts for study
- How to generate and test deviations from design intent
- Strengths and weaknesses of the HAZOP approach
- Optimum team selection and information gathering
- Format of workshop records, recommendations and risk ranking
- Tips on leadership styles
- Follow-up reporting and closeout of actions
- Safety instrumented systems and how they relate to HAZOP
- Hazard analysis methods of FMEA and fault trees

WHO SHOULD ATTEND:

- Process engineers, plant engineers, technicians and supervisors involved in new projects or in the modification or upgrading of existing plants
- Trainee HAZOP team leaders
- Loss prevention officers
- Plant managers, project managers and planners seeking an awareness of the role of HAZOP in overall safety management
- Instrument and electrical engineers, process control engineers and system integrators who are likely to be participants in HAZOP or who will be asked to engineer safety control systems
- Commissioning engineers, plant supervisors and process maintenance technicians
The Workshop

This two-day workshop concentrates on awareness training for managers, engineers and technicians in the practical application of hazard and operability studies (known as HAZOP). HAZOP is widely used for identifying hazards in an industrial process and for assessing the potential consequences where there are risks of harm to persons, the environment or to assets.

The HAZOP technique is recommended by professional engineering institutions, government regulators and insurance companies and is one of the principle risk management tools. HAZOP is applied at both the design stage and throughout the life of a process plant, where it supports the safety management and (where applicable) the validation of the plant safety case. HAZOP is also an essential technique when reviewing modifications and upgrades to existing plant.

This workshop introduces the basics of the HAZOP technique and discusses its relationship with other safety (risk) management tools. HAZOP can be applied to any process industry, onshore or offshore, including oil and gas, mining, chemical or other processing industries. The relationship between HAZOP and other risk management techniques such as HAZID, hazard analysis, FMEA, fault tree analysis and the Safety Integrity Levels (SIL) of instrumented systems will also be demonstrated. This workshop will be of interest to a variety of managers and to most engineering disciplines.

Workshop examples include the design of new process plant and modifications to existing process plant. It involves the study of process flow-sheets and Process and Instrumentation Diagrams (P&IDs). Hazard studies interact closely with process design and safety engineering solutions in the critical stages of engineering projects. Understanding these interactions assists engineers and technicians to plan their work efficiently and to contribute effectively to the reduction of risks in the workplace.

The HAZOP techniques and safety system practices described in this workshop are based on the latest international practices including the guidelines in IEC 61822 for HAZOP studies.

The Program

INTRODUCTION
• Workshop outline and objectives
• References to guides and standards
• Glossary of terms

INTRODUCTION TO HAZOP
• Outline of HAZOP method
• Scope of study
• Timing and purposes

HAZARD STUDIES AND RISK MANAGEMENT
• The need for quality assurance in hazard studies
• The process hazard study lifecycle and the six levels of studies
• Principles of risk management
• Legal requirements for hazard studies, US and EU regulatory frameworks

TYPICAL HAZOP WORKSHOP
• Step by step introduction to the activities of a HAZOP workshop
• Timing and duration of the study
• Documents required
• Team membership and duties
• Outline of the examination phase
• Recording, reporting and follow up

EXAMINATION PHASE METHODS
• Defining the system and selecting the parts for study
• Elements and parameters
• Generating deviations with guidewords and a matrix
• Guideword examination procedures and responses
• Worked examples of continuous and batch process studies
• Control HAZOPS
• Software tools for the examination and reporting phases

PLANNING AND LEADERSHIP OF HAZOPS
• Organising the study, planning, scoping and objectives
• The team leader’s skills and duties
• Essential members of the team and their roles
• Conducting the study sessions, dealing with problems
• Using additional checklists for operability
• Contents of the HAZOP study report
• Tips for the facilitator

FROM HAZOPS TO SIL
• The relationship between hazard studies and safety instrumented systems
• Risk reduction concepts and the risk matrix
• Concepts of tolerable risk and the ALARP principle
• Layers of protection
• The role of safety instrumented systems in risk reduction
• The meaning of SIL and how it relates to safety and cost
• SIL determination methods and the input from HAZOPS

HAZARD ANALYSIS METHODS
• The reasons for hazard analysis
• Failure modes and effect analysis method
• Fault tree and event tree analysis methods
• Adding risk reduction measures to the fault tree

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

There are six practical exercises, which you will undertake, some of them in groups, all intended to provide experience in hazard studies and hazard analysis.

To gain full value from this workshop, please bring your laptop/notebook computer.

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PRACTICAL SCADA SYSTEMS FOR INDUSTRY

WHAT YOU WILL LEARN:

• The fundamentals of SCADA systems
• The essentials of SCADA software configuration
• Tricks and tips in installation of SCADA systems
• The essentials of telecommunications links
• The use of industrial Ethernet in SCADA systems
• SCADA network security issues
• How to troubleshoot SCADA systems

WHO SHOULD ATTEND:

This workshop is designed to benefit engineers and technicians who are involved in specifying, commissioning and debugging industrial SCADA systems but who have little previous experience in this field.

It is also of particular benefit to personnel involved in areas of design, specification, installation, commissioning, maintenance and documentation of industrial control and instrumentation systems where used, this includes:

• Instrumentation and Control Engineers
• Process Control Engineers
• Electrical Engineers
• Consulting Engineers
• Design Engineers
• Control Systems Sales Engineers
• Maintenance Supervisors
• Control System Application Engineers
• Project Engineers
• Technicians
• Plant Engineers
• IT Personnel
**The Workshop**

SCADA has traditionally meant a window into the process of a plant or gathering of data from devices in the field, but now the focus is on integrating this process data into the actual business and using it in real time. The emphasis today, is on using open standards such as communication protocols (eg DNP3, MODBUS, and TCP/IP) and 'off-the-shelf' hardware, such as industrial Ethernet to keep the costs down. This comprehensive two day workshop covers the essentials of SCADA systems.

The topics covered on the two days are as follows:

**Day One** gives an introduction to SCADA systems then focuses on the SCADA system hardware and software, including alarm management and Human Management Interface (HMI) issues. This is followed by a review of the RS-232/RS-485 interface standards and the MODBUS and DNP3 protocols.

**Day Two** gives a review of Industrial Ethernet, TCP/IP and MODBUS/TCP. The role of Open Process Control (OPC) in plant SCADA systems is also discussed. This is followed by discussion of network security, SCADA historians and troubleshooting issues. This workshop will be an excellent opportunity to network with your peers as well as gain significant new information and techniques for your next SCADA project.

Although the emphasis of the workshop will be on practical industry topics highlighting recent developments using case studies and the latest application of SCADA technologies the fundamentals of SCADA systems will be covered. The workshop is aimed at those who want to be updated on the latest developments in SCADA systems and want to get a solid appreciation of the fundamentals of SCADA design, installation and troubleshooting. The comprehensive workshop manual covers other topics for your reference, including Fieldbus systems, maintenance, system specification, installation and commissioning issues. It also includes various case studies and design exercises.

**Pre-requisites**

Fundamental knowledge of SCADA.

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**On-Site Training**

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**The Program**

**INTRODUCTION**

- Communication architectures
- Communication philosophies

**OVERVIEW OF SCADA SYSTEMS**

- Hardware alternatives (RTU/PLC etc)
- Communication concentrators
- Communication alternatives

**SCADA SYSTEM HARDWARE**

- Hardware components
- Operation and selection issues

**SCADA SYSTEM SOFTWARE**

- SCADA software functions
- Response times
- Redundancy issues
- Specification and configuration issues

**SCADA ALARM MANAGEMENT**

- Alarm layout and organisation
- Alarm priorities
- Alarm processing and reporting

**HUMAN MANAGEMENT INTERFACE (HMI)**

- Ergonomic factors
- HMI organisation
- HMI screen design

**COMMUNICATION PROTOCOLS**

- RS-232/RS-485 interface standards
- MODBUS protocol
- DNP 3.0 protocol

**INDUSTRIAL ETHERNET**

- Fundamentals
- Redundancy

**TCP/IP**

- Configuration
- Troubleshooting utilities

**MODBUS TCP**

- Overview

**OPEN PROCESS CONTROL (OPC)**

- Overview

**SCADA NETWORK SECURITY**

- Security issues
- SCADA firewall configuration

**SCADA HISTORIAN**

- Archiving plant data
- Data access

**TROUBLESHOOTING ISSUES**

- Problem isolation
- Testing methodology
- Noise issues
- Communications testing

**REVIEW AND QUESTIONS**

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**Practical Sessions**

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. Each day has many practical sessions designed to apply and reinforce the theory concepts.

**Day One**

1. Configure alarms on Citect SCADA system
2. HMI screen design using Citect SCADA package
3. MODBUS RTU communication
4. Configure SCADA master communications using Citect

**Day Two**

1. Setup Ethernet network and configure TCP/IP
2. Ethernet troubleshooting utilities and protocol analysis
3. Setup and monitor MODBUS/TCP communication
4. Use OPC client to access data
5. Troubleshooting exercise

*To gain full value from this workshop, please bring your laptop/notebook computer.*
PRACTICAL
MACHINE VISION APPLICATIONS
IN INDUSTRY

WHAT YOU WILL LEARN:

- The fundamentals of image processing and machine vision
- How to develop a simple machine vision system
- How to select cameras, lighting, frame grabbers and software
- How to assess resolution requirements
- Best practice in alignment and calibration procedures
- Identification and correction for sources of error
- Designing for harsh industrial applications
- Configuring of a machine vision system
- Selection of optimal lighting to achieve best contrast
- How to apply the best optics to achieve optimal resolution
- How to do a simple design for high-speed real time performance
- Troubleshooting simple machine vision problems
The Workshop

Machine vision has progressed in leaps and bounds since the disappointments in the eighties with tremendous results achievable today. Nowadays, machine vision systems are highly effective and a key part of many industrial systems ranging from mineral processing to manufacturing. The fundamentals of image processing and machine vision are covered in the beginning to give everyone a solid foundation to work from. The workshop commences with an examination of optics and lighting - as the experts say - machine vision is easy if you can get a good image into the system.

You will be shown how to select and design lighting to achieve the best contrast. The selection of cameras, frame grabbers and vision appliances are next covered in practical detail. Finally, you will be shown how to select and integrate all the varying components into a professional and working system.

The workshop will be presented with minimal use of mathematics and extensive use of practical concepts and applications. There will be extensive use of practical hands-on exercises ranging initially from illustrating the key concepts of image processing to setting up a complete working machine vision system. This experiential hands-on approach will ensure that you maximise your learning experience on this workshop.

However, despite the advances in technology don’t expect your machine vision to have the versatility and brilliance of a human... yet. But if you apply the key concepts in this workshop to your machine vision application, you should have a reliable and effective solution.

Practical Sessions

- Fundamentals of image processing (five exercises)
- Lighting optimisation (one exercise)
- Camera set up
- Frame grabber set up
- Calibration
- Configuration of software program
- Troubleshooting of machine vision system
- Integration into complete system

The Program

INTRODUCTION
- Overview of workshop
- Systems approach to machine vision
- Machine vision vs image processing
- Human and computer vision
- Basics of image processing
- Pattern recognition
- Practical Fast Fourier Transforms
- Filtering
- Inverse filtering
- Seeing problem
- Colour properties and the eye
- Colour properties of image input and output devices

DIGITAL IMAGE PROCESSING BASICS
- Fast Fourier Transform
- Digital Fast Fourier Transform
- Sampling theory
- Aliasing
- Bits and pixels
- Trade-offs
- Demonstrations

MACHINE VISION SYSTEM COMPONENTS
- Lighting, filters and optics
- Image sensor (camera)
- Image processor and analysis (frame grabber, vision processor, computer, image analysis software and interpretation)
- Mechanical interface (part conveyor/feeder)
- An example of a machine vision system

LIGHTING
- Why is lighting critical?
- Lighting techniques
- Light sources
- Beyond visible spectrum-IR and UV radiation
- Laser light in machine vision
- Use of strobe lighting in machine vision
- Placement of sources
- Effect of stray and ambient light
- Enhancing the object to eliminate stray light
- Filters and their use
- Optical devices for image enhancement

CAMERAS AND SENSORS
- CMOS and CCD sensors
- CEPD arrays
- Color vs monochrome applications
- Charge transfer device and charge injection device
- 3D sensing applications
- Sensor positioning
- Sensors for difficult environment
- Speed vs resolution
- Types of cameras
- Camera viewpoint
- Field of view
- Resolution evaluation
- Selection of a lens

IMAGE PROCESSING
- Real time processing
- Precision and accuracy
- Selection of frame grabber and vision appliance
- Frame grabbing
- Use of multiplexing
- IEEE 1394 ‘FireWire’ serial bus standard interface
- Image processing for dummies
- Image analysis
- - Common algorithms
- - Enhancing the image
- - Blob analysis
- - Pattern matching
- - Optical character recognition
- - Read bar codes and data matrix
- - Perform measurements
- - Overlay graphics
- Basic approach of image representation and processing software applications
- Interactive image processing for system prototyping
- High speed vs real time approaches
- Selection of software packages

EXTERNAL INTERFACE
- Function of external interface
- Input and output
- Object presentation
- Physical tolerances
- Handling special objects
- Flexible, articulated and semi-fluid
- Actions after image processing
- Interfacing through Programmable Logic Interface
- Interfacing machine vision with industrial robots
- Industrial challenges - heat, cold, vibration and EMI/EMC issues

CONSTRUCTING A MACHINE VISION SYSTEM
- Selecting an application for machine vision implementation
- - Perceived value addition
- - Cost justification
- - Alteration in process line
- Building a system with off-the-shelf components
- Integration requirements
- Buying turn-key solutions
- Obsolescence and expandability issues
- Budgeting

TYPICAL APPLICATIONS
- Application profiles
- Component inspection
- Pharma applications
- Packaging applications
- Road inspection using vehicle mounted sensors
- 3D application examples
YOU WILL LEARN HOW TO:

- Understand the essentials of Advanced Process Control (APC)
- Grasp the key differences between the various technologies
- Perform simple APC design strategies and implementations
- Be able to perform PID control
- Troubleshoot simple APC problems
- Identify processes suited to APC

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Process control engineers
- Senior technicians
- Automation engineers
- System integrators
- Electrical engineers
- Chemical engineers
- Chemical plant technologists
- Process engineers
In today’s environment, the processing, refining and petrochemical business is becoming more and more competitive and every plant manager is looking for the best quality products at minimum operating and investment costs. The traditional PID loop is used frequently for much of the process control requirements of a typical plant. However, there are many drawbacks in using these, including excessive dead time which can make the PID loop very difficult (or indeed impossible) to apply.

Advanced Process Control (APC) is thus essential today in the modern plant. Small differences in process parameters can have large effects on profitability; get it right and profits continue to grow; get it wrong and there are major losses. Many applications of APC have payback times well below one year. APC does require a detailed knowledge of the plant to design a working system and continual follow up along the life of the plant to ensure it is working optimally. Considerable attention also needs to be given to the interface to the operators to ensure that they can apply these new technologies effectively as well.

Pre-requisites
Basic electrical concepts are necessary and it is strongly advised that students attend the IDC “Practical Process Control” class before attending this ‘advanced’ course.

Practical Sessions
This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training
✓ SAVE over 50% by having an IDC workshop presented at your premises.
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JUSTIFICATION OF ADVANCED CONTROL
• Advanced versus classical control
• Advanced on-line control versus statistical process control
• Comparison of pay back time on various examples of applications in real plants

Practical exercise 1: Model representation

FUNDAMENTALS OF PROCESS CONTROL
• Processes, controllers and tuning
• PID controllers – P, I and D modes off operation
• Load disturbances and offset
• Speed, stability and robustness
• Gain, dead time and time constants
• Process noise
• Feedback controllers

Practical exercise 2: PID loop tuning parameters refresher

FUNDAMENTALS OF TUNING PID LOOPS
• Open and closed loop tuning
• Ziegler Nichols
• Fine tuning for different process types
• Lambda tuning
• Ten different rules compared
• Cascade systems
• Feedback control
• Deadtime
• Models and disturbances

Practical exercise 3: Loop tuning refresher (both open-loop and closed-loop)

INTERNAL MODEL CONTROL (IMC)
• Open loop model of the process in parallel with the process
• Control system in two blocks
• Equivalence with a classical controller
• Disturbances rejection and control
• IMC and delays
• IMC and feed forward (measured disturbances rejection)

Practical exercise 4: IMC controller

MODEL PREDICTIVE CONTROL (MPC)
• Single input / output versus multivariable control
• Example on a binary column causality graph
• Constraints and planning ahead before acting
• Different notions of models
• Action model - measured disturbances model
• Unmeasured disturbance models
• Reference trajectories
• Example of a quality blender control system

Practical exercise 5: MPC controller representation

MPC: MODEL REPRESENTATIONS
• State space representation
• Transfer function representation
• Impulse response representation
• Various mathematical formulations

Practical exercise 6: MPC controller interaction calculation

MPC: MODEL IDENTIFICATION
• Identification requires a good knowledge of the unit
• Black box models / grey box models
• Causality graph of the unit
• What to identify?
• How? Step responses - pseudo random binary signals
• Exercises of identification on various types of petrochemical units

Practical exercise 7: MPC controller calculation programming and setup

MPC: OBSERVERS
• Overall formulation
• Purpose of observers in control algorithm based on state / space representation
• Innovation on measured output - estimation of the state
• Study of Kalman algorithm

Practical exercise 8: Gain scheduling

MPC: CONTROL
• Overall formulation
• Hard constraints on manipulated variables
• Set values and soft constraints on control variables
• The notion of horizon

Practical exercise 9: Feed forward

REFERENCE MODELS
• Handling setpoints on controlled variables
• Measured disturbances rejection
• Unmeasured disturbances rejection
• Handling soft constraints on controlled variables
• Rejection of disturbances

Practical exercise 10: Ratio control

CONTROL FORMULATION PROBLEM
• Quadratic criterion versus geometric control
• Importance of the horizon length
• Use of the weight matrix
• Handling output constraints along the horizon
• Projection of measured and unmeasured disturbances along the horizon
• Final quadratic problem formulation and resolution
• Off-line pre-processing
• On-line calculations

Practical exercise 11: Decoupling circuits (both feed forward as well as inverting)

MPC STEADY STATE OPTIMISATION
• Degrees of freedom and rationale for optimisation
• Economic output submitted setpoint
• Slogans to maximise or minimise
• Bridge from optimisation to control
• Reachable targets for economic variables
• Interpretation of the horizon for economic variables
• Change of the control formulation problem

Practical exercise 12: Dead time compensation (using formulae as well as a Smith Predictor)

APPLICATION OF THE THEORY TO THE CONTROL OF TWO DIFFERENT UNITS ON A PROCESS SIMULATOR
• Complete application (identification, controller design, control and optimisation)

Practical exercise 13: Cascade control, using PV tracking and initialisation
PRACTICAL INDUSTRIAL SAFETY, RISK ASSESSMENT AND SHUTDOWN SYSTEMS FOR INDUSTRY

The design, installation and application of reliable safety instrumentation and shut-down systems, incorporating new standards, current practices and practical solutions

WHAT YOU WILL LEARN:

- Practical know-how and ‘real-world’ applications
- Detailed, up-to-date, functional safety instrumentation practices
- The knowledge to plan and participate in hazard and risk assessment studies
- The knowledge to implement and operate safety systems
- Design and implementation skills for quality assurance in safety systems
- The knowledge to specify and critically evaluate safety systems
- Techniques to help ensure high reliability and maintenance of safety systems

WHO SHOULD ATTEND:

- Design, installation and maintenance engineers and technicians in the process industries
- Engineering firms
- Instrumentation and control engineers and technicians
- Managers and sales professionals employed by end users
- System consultants
- System integrators
This workshop is not to be missed and could save your business a fortune in possible accident costs and lost production, as well as the potential for devastating accidents. Reliable, well-engineered safety systems are essential for protection against destruction and loss of life.

The safety instrumentation and shut-down systems workshop is an intensive, practical and valuable two-day course. We offer you the most vital, up-to-date information and practical know-how to enable you to participate in hazard studies and specify, design, install and operate the safety and emergency shut-down systems in your plant using international safety practices.

This workshop will provide you with a broad understanding of the latest safety instrumentation practices and their applications to functional safety in manufacturing and process industries. This workshop is not to be missed and could save your business a fortune in possible downtime and financial loss.

Pre-requisites
Fundamental knowledge of electrical engineering is required.
INTRODUCTION TO THE SELECTION, INSTALLATION, COMMISSIONING AND MAINTENANCE OF FLOW AND FISCAL METERING EQUIPMENT

WHAT YOU WILL LEARN:

• Fundamentals and concepts of fiscal metering
• Custody transfer metering in practice and commercial implications
• Operating procedures
• Field instruments
• Properties of fluids
• Different types of flow meters
• How to select, install, maintain and operate fiscal meters correctly
• How to troubleshoot, repair fiscal metering devices
• Practical knowledge about fiscal metering in practice

WHO SHOULD ATTEND:

• Automation engineers
• Chemical engineers
• Consulting engineers
• Control engineers
• Design engineers
• Electrical engineers
• Instrument fitters
• Maintenance engineers
• Mechanical engineers
• Operations and production engineers
• Process control technicians
• Project engineers and managers
The Workshop

The workshop on fiscal metering is for engineers and technicians who require a practical knowledge of selection, installation and commissioning of fiscal metering. A clear understanding of fundamentals and concepts of fiscal metering and its commercial implications is an important factor in an efficient implementation of fiscal metering system. You can only achieve excellent and reliable fiscal metering when your field instrumentation provides the correct information.

It is for those primarily involved in achieving effective results for the industrial processes they are responsible for. This would involve the design, specification and implementation of control and measurement equipment. The workshop focuses on practical applications, with special attention to installation considerations and application limitations when selecting or installing different measurement or control instruments for fiscal metering.

Training Methodology

The latest educational methods and strategies will be employed. The workshop is designed to maximise delegate benefit from the outset. Questions are encouraged throughout. This provides opportunities for participants to discuss with the presenter and others, specific problems and appropriate solutions. All delegates take away a detailed and comprehensive copy of the material presented, therefore minimal note taking is encouraged to ensure maximum delegate participation and attention. Practical hands-on training ensures knowledge retention.

Pre-requisites

No specialist knowledge or skills are required – only a technical background so that there is an understanding for such factors as the difference between pressure and force. In fact this workshop is a good introduction to someone who has had no dealings with relief valves in the past as well as an important refresher course for control valve specialists who benefit from the back-to-basics approach.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION TO FISCAL METERING
- Introduction
- Concepts and practice of custody transfer metering
- Fundamentals of fiscal metering
- Commercial implications of fiscal metering

FIELD INSTRUMENTS
- Theory of functionality of field instruments
- Processing of data received from field instruments
- Calculation methods used for fiscal quantities
- Metering algorithms
- Processing of fiscal data
- Calibration
- Application of standards and re-certification of systems and instruments

OPERATING PROCEDURES
- Fiscal metering in practice
- Startup
- Shutdown
- Operating conditions
- Fault conditions and mismeasurements
- Limitations

BASIC PROPERTIES OF FLUIDS
- Basic fluid properties
- Non-newtonian fluids
- Velocity profiles
- Reynolds number
- Flow measurement
- Mass flow rate
- Multi-phase flows

FLOW METERS
- Positive displacement meters
- Inferential meters
- Oscillatory flow meters
- Differential pressure meters
- Variable area meters
- Electromagnetic flowmeters
- Ultrasonic flowmeters
- Mass flow measurement
- Open channel flow measurement

INSTALLATION MAINTENANCE AND REPAIRS
- Installation
- Commissioning
- Maintenance
- Fault diagnostics and troubleshooting

DOCUMENTATION
- Documentation procedure
- Documentation control

On-Site Training

✔ SAVE over 50% by having an IDC workshop presented at your premises.

✔ Customise the training to YOUR workplace.

✔ Have the training delivered when and where you need it.

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MEASUREMENT AND CONTROL
FOR NON-INSTRUMENT PERSONNEL

WHAT YOU WILL GAIN:

• A fundamental understanding of industrial automation
• An introduction to instrumentation and measurement
• The key know-how to converse regarding your plants key functions
• An ability to configure/understand simple PLC and SCADA systems
• An ability to work with and comprehend plant documentation such as P&IDs

WHO SHOULD ATTEND:

Anybody with an interest in gaining know-how in the full range of fundamentals of instrumentation, measurement, process control, PLC’s, SCADA and P&ID documentation. This can range from the plant secretary, to operators, trades personnel (artisans), procurement staff, technicians, engineers from other backgrounds/disciplines, such as mechanical, electrical and civil. Managers who are keen to understand the key workings and the future of their plants.

Technology Training that Works
The Workshop

Have you ever wondered about getting a thorough introduction to the fundamentals of instrumentation, automation and control; thus allowing you to do work and perform simple tasks in the area? The current challenges presented by the world economy mean that automation is more critical than ever before.

This workshop represents a tremendous opportunity to grab expertise in all the key areas of the fast growing area of industrial automation. Presented by an expert in the area but who is obsessed with getting the key chunks of know-how and expertise across to you in simple understandable bits which you can immediately apply to your job. This is most definitely not a boring lecture style presentation but an intensive learning experience where you will walk away with real skills as a result of the hands-on practical exercises, calculations, case studies and group sessions to ensure across to you in simple understandable bits which you can immediately apply to your job. This is most definitely not a boring lecture style presentation but an intensive learning experience where you will walk away with real skills as a result of the hands-on practical exercises, calculations, case studies and group sessions to ensure across to you in simple understandable bits which you can immediately apply to your job.

The topics covered commence with a solid introduction to instrumentation and measurement ranging from pressure, level, temperature and flow devices. There is a formal review of process control including the all important topic of PID loop tuning and good practice in setting up your own system. There is also focus on valves with a review of the different valves and operating characteristics. SCADA and PLC systems are covered with an examination of both hardware and software, supplemented by writing your own PLC program. The all important topic of industrial data communication networks are also examined. Finally, the course is rounded off with a hands-on review of reading and interpreting simple plant documentation such as P&ID’s so that you can see and understand the operation of the plant in your mind through the documentation.

The workshop is all presented in easy to understand practical English. All you need to benefit from this workshop is a basic understanding of mathematics and electrical theory. Contact us for comprehensive pre-course reading and preparation if you are unsure about your level of understanding.

It is not an in-depth workshop but one covering a wide range of topics in industrial automation to give you an overview and practical understanding of the key concepts. Nevertheless, a lot of material is covered, with the intent to give you an overview and practical understanding of the concepts and equipment, and how they all come together to create an efficient and safe control environment in instrumentation, process control, SCADA, PLC’s and control valves.

The Program

**INSTRUMENTATION**
- Introduction to process measurement
- Pressure measurement
- Level measurement
- Temperature measurement
- Flow measurement
- Process considerations
- Integration of the system

**PROCESS CONTROL**
- Fundamentals of loop tuning
- Fundamentals of tuning
- The different tuning rules
- Tuning of valves
- Automated tuning
- Simple tuning of more complex systems
- Good practice

**CONTROL VALVES**
- Introduction to control valve theory
- Different types of control valves
- Characteristics
- High pressure drop applications
- Use of computer program for valve sizing
- Examples of high pressure drop applications
- Actuators
- Positioner
- Pneumatic circuits
- Materials
- Quality standards
- Installation/maintenance

**SCADA AND PLCs**
- Background to SCADA
- SCADA systems hardware
- SCADA systems software
- Human Machine Interfaces (HMI)’s
- Introduction to PLCs
- Fundamentals of PLC hardware
- Fundamentals of PLC software
- Using Ladderlogic for simple digital functions
- Good installation practice
- Landline media
- Wide Area Network (WAN) technologies
- Local Area Networks (LANs)
- Industrial communications protocols
- SCADA network security
- Troubleshooting and maintenance
- Project management of SCADA systems

**THE ROLE OF PLANT DOCUMENTATION, STANDARDS AND SPECIFICATIONS**
- Drawing types and standards
- Piping and Instrument Diagrams (P&ID)
- Instrumentation
- Electrical
- Pneumatics and hydraulics
- Ladderlogic
- Electro pneumatic circuits
- Explanation of acronyms

**SUMMARY, OPEN FORUM AND CLOSING**

**Practical Sessions**

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. Practical sessions include:
- **Develop basic hydraulic, electrical and pneumatic drawings**
- **Develop P&ID drawings for pressure, temperature, flow and level loops**
- **Detail the documentation for typical instruments**
- **Proceed through development of a full plant set of drawings from flow diagrams and process description to P&ID, electrical, hydraulic and pneumatic symbols**
- **Use software to undertake these typical tasks**

To gain full value from this workshop, please bring your laptop/notebook computer.

**On-Site Training**

- **✓** SAVE over 50% by having an IDC workshop presented at your premises.
- **✓** Customise the training to YOUR workplace.
- **✓** Have the training delivered when and where you need it.

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PROGRAMMABLE LOGIC
CONTROLLERS (PLCs)
AND SCADA SYSTEMS

WHAT YOU WILL LEARN:

- Fundamentals of SCADA systems
- Essentials of SCADA software configuration
- Tricks and tips in installation of SCADA systems
- Essentials of data communications
- Use of Industrial Ethernet in SCADA systems
- OPC and SCADA systems
- SCADA network security issues
- How to troubleshoot SCADA systems
- Specifying PLC hardware and installation criteria
- Describe PLC software structure
- How to write medium level PLC programs (using ladder logic)
- Troubleshooting a typical PLC system
- Specifying PLC systems

WHO SHOULD ATTEND:

- Instrumentation and Control Engineers
- Electrical Engineers
- Design Engineers
- Consulting Engineers
- Instrumentation Technicians
- Process Control Engineers
- Engineering Managers
The Workshop

SCADA has traditionally meant a window into the process of a plant and / or a method of gathering of data from devices in the field. Today, the focus is on integrating this process data into the actual business, and using it in real time. In addition to this, today’s emphasis is on using Open Standards, such as communication protocols (eg. IEC 60870, DNP3 and TCP/IP) and ‘off-the-shelf’ hardware and software, as well as focusing on keeping the costs down. PLCs continue to gain in popularity. This comprehensive workshop covers the essentials of SCADA and PLC systems, which are often used in close association with each other. A selection of case studies are used to illustrate the key concepts with examples of real world working SCADA and PLC systems in the water, electrical and processing industries. This workshop will be an excellent opportunity to network with your peers, as well as to gain significant new information and techniques for your next SCADA / PLC project.

Although the emphasis of the workshop will be on practical industry topics highlighting recent developments, using case studies, the latest application of SCADA, PLC technologies and fundamentals will be covered. The workshop is aimed at those who want to be updated on the latest developments in SCADA and PLC systems and want to get a solid appreciation of the fundamentals of their design, installation and troubleshooting. You will benefit by gaining practical up-to-date information on the application of PLC and SCADA systems to the automation and process control industries. It is suitable for people who have little or no exposure to PLCs, but expect to become involved in some or all aspects of PLC and SCADA installation.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

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The Program

INTRODUCTION
• Introduction and brief history of PLCs
• Alternative control systems - where do PLCs fit in?
• Why PLCs have become so widely accepted
• Lingering concerns about PLCs

FUNDAMENTALS OF PLC HARDWARE
• Block diagram of a typical PLC
• Processor module - memory organisation
• Input and output section - module types
• Power supplies

BACKGROUND TO SCADA
• Fundamentals and definition of terms
• Comparison of SCADA, DCS, PLC and smart instruments
• Typical SCADA installations

SCADA SYSTEM HARDWARE
• Comparison of SCADA, DCS, PLC and smart instruments
• Remote Terminal Unit (RTU) structure
• Analog and digital input/output modules
• Application programs
• PLCs used as RTUs
• Master site structure
• Communications architectures
• Point-to-point and point-to-multipoint systems
• System reliability and availability
• Configuration of a master station

FUNDAMENTALS OF PLC SOFTWARE
• Methods of representing logic - boolean, algebra, instruction code and graphical presentation
• Fundamental ladder logic instruction set
• Comparison of different manufacturers, memory and data representation and instruction code

USING LADDER LOGIC FOR SIMPLE DIGITAL FUNCTIONS
• The basic rules
• Comparison of relay ladder diagrams
• The concept of the ‘scan’ and how to apply it
• Infinite fan-out
• Contact ‘normal’ states
• Positive and negative logic
• Boolean functions
• The usefulness of DeMorgan’s Law

USING REGISTERS (WORDS)
• Number systems, counters, types of register data, counters, bit shift and rotate, table functions and register (matrix) logic functions

SCADA SYSTEMS SOFTWARE
• Components of a SCADA system
• Software - design of SCADA packages
• Configuration of SCADA systems
• Building the user interface
• Connecting to PLCs and other hardware

SCADA NETWORK SECURITY
• Introduction
• Authentication and encryption
• SCADA firewalls
• Firewall architectures and guidelines

GOOD PROGRAMMING HABITS
• Keeping track of addresses and data used
• Looking ahead - how will programs be maintained?
• Practical methods to improve quality, organisation of code, documentation and simplifying changes

GOOD INSTALLATION PRACTICE
• Location of hardware
• Good wiring practice
• Cable spacing, power distribution and wire numbering
• Reducing noise and interference
• Screening and shielding

ADVANCED CONTROL WITH PLCS
• The concept of reusable logic
• Examples: drive logic and alarm handling
• Use of advanced programming functions
• Matrix logic
• Table functions and indirect addressing
• Example: simple display driver

PID CONTROL
• The importance of timing and scan time
• When PID is not always appropriate:
  - Intermittent measurements
  - Long transport delays

SAFETY PROGRAMMABLE SYSTEMS
• Why regular PLCs should not be used for safety functions
• Programmable electronic logic solvers
• Safety certification
• Certified programming systems
• Application examples
• Growth of networked safety devices and certified networks
• Integrated safety systems

DATA COMMUNICATIONS AND NETWORKING
• Background to cables
• Noise and interference on cables
• Twisted pair cables and fibre optic cables
• Public network provided services

INDUSTRIAL COMMUNICATIONS PROTOCOLS
• RS-232 interface standard
• RS-485 interface standard
• Fieldbus; Modbus; DNP3.0

INTRODUCTION TO IEC 61131-3
• Concepts
• Common elements
• Programming languages: structured text
• Function block diagrams

SCADA NETWORK SECURITY
• Introduction
• Authentication and encryption
• SCADA firewalls
• Firewalls architectures and guidelines

LOCAL AREA NETWORKS (LANS)
• Ethernet networks: industrial Ethernet
• TCP/IP
• LAN connectivity: bridges, routers and switches
• Redundancy options
• Web based Industrial SCADA
• Wireless: OPC

idc@idc-online.com • www.idc-online.com
PRACTICAL
DRIVES, MOTORS AND PLCs
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Demonstrate a sound understanding of how motors work, specifically the induction motors
• Demonstrate a sound understanding of how AC Variable Speed Drives (VSD's) work
• Install VSD's properly
• Select the right VSD for a given application
• Troubleshoot VSD's competently
• Competently explain how flux-vector control works for drive applications
• Identify the protection and control system requirements for VSD's
• Understand architecture of PLC and its associated components and systems
• Interface VSD's with PLCs
• Understand the causes of motor burnout
• Deal effectively with VSD harmonics and EMC/EMI problems

WHO SHOULD ATTEND:

This workshop is designed for personnel who want to understand the utilise variable speed drives and PLC's for energy efficient application comprising of motor driven systems. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting. Typical personnel who would benefit are:

• Electrical maintenance technicians and supervisors
• Instrument and control engineers
• Instrument technicians
• Maintenance personnel
• Mechanical engineers
• Plant engineers
• Process control engineers
• Operations personnel
• Service technicians
The Workshop

This workshop gives you a fundamental understanding of all the three components of a complete drive system, the VSD, motor and the PLC. There is a good coverage as well on installation and commissioning, operation and maintenance and troubleshooting of these devices.

Besides, the criteria behind selection of components of a drive system for optimum operation are also covered in details. Typical practical applications of VSDs in process control and materials handling, such as those for pumping, ventilation, conveyers, compressors and hoists are covered as examples.

On completion of the workshop the participants would get significant insight and understanding on the working of these essential components of the drive mechanism. They would be able to better utilise the existing system or introduce the new and more efficient ones working on the discussed technologies at their work places. The accompanying manual includes simple but appropriate and highly effective technical content along with suitable examples on wide areas of topics relevant to variable speed drives, motors and Programmable Logic Controllers.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. 

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

THE BASIC CONCEPTS
- Variable Speed Drives (VSD) – their utilities in industry
- Commonly used parameters associated with drives
- VSD for speed control and energy saving
- Basics of electrical machines
- AC power system
- PLC basics
- PLC and process interaction

MECHANICAL, HYDRAULIC AND ELECTRICAL TYPE OF VSDs
- Types of variable speed drives
- Mechanical variable speed drives
- Hydraulic variable speed drives
- Electrical variable speed drives

3-PHASE AC MOTORS; THEORY, CONSTRUCTION AND MAINTENANCE
- Fundamentals of 3-phase AC motors
- Operating principles; 3-phase AC motors
- 3-phase wound rotor motors
- 3-phase synchronous motors
- 3-phase induction motors
- Induction motor equivalent circuit
- Selection of motor

POWER ELECTRONIC CONVERTERS
- Terminology and definitions; power electronics
- Components of power electronic converters
- Power diodes
- Power thyristors
- Commutation in electronic device switching
- Power electronic rectifiers (AC/DC converters)
- Gate commutated inverters (DC/AC converters)
- Gate controlled power electronic devices

ELECTRICAL PROTECTION OF VSD COMPONENTS
- AC converter protection circuit
- Operator information and fault diagnostics
- Protection of electric motors
- Temperature; the critical parameter to monitor
- Current sensor for thermal overload protection
- Thermal overload protection – direct temperature sensing

VSD CONTROL SYSTEMS
- The overall control system
- Control system power supply
- The DC bus charging control system
- The PWM rectifier for AC converter
- VSD control loops
- Vector control of AC drives
- Closed-loop field oriented vector drives
- Speed feedback from motor

ELECTROMAGNETIC COMPATIBILITY
- The electromagnetic interference
- Sources of electromagnetic interference
- Harmonics on the supply side of AC converters
- Power factor and displacement factor
- Voltages and current on the motor side of the PWM

SELECTION OF AC CONVERTERS
- Important parameters considered for selection
- The basic selection procedure
- The loadability factor
- The characteristics of machine load
- The requirements for starting and stopping motor of VSD
- Selecting motor and converter of correct specification
- Summary of selection
- Retrofitting electronic VSD

INSTALLATION AND COMMISSIONING OF VSD COMPONENTS
- Installation and environment requirements
- Power supply connections and earthing requirements
- Installing controls of AC drives
- Control wiring of VSD’s
- Commissioning of VSD’s

PLC ARCHITECTURE
- The processor unit
- The PLC power supply
- The PLC programming device
- The memory system
- Digital input output interaction
- Analog I/O interaction
- Digital input output modules
- Connecting analog input output systems to PLC

BASICS OF PLC PROGRAMMING
- Introduction to PLC programming
- PLC programming steps
- PLC programming languages
- Commonly used logical instructions in PLC programming
- Timers and counters
- Program flow control instructions
- Data load/transfer instructions
- Arithmetical (math) instructions
- Working example of PLC programming; drive application

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL TROUBLESHOOTING AND PROBLEM SOLVING OF PLCs AND SCADA SYSTEMS

YOU WILL LEARN HOW TO:

- Quickly interpret, isolate and fix common hardware problems related to PLC input/outputs
- Troubleshoot PLC software (especially ladderlogic)
- Identify typical SCADA problems and fix them
- Safely make changes to a system without overriding machine safety or personnel safety programming
- Make temporary fixes to a program to test out new components or ideas
- Identify and fix electrical noise, earthing and power problems
- Identify and fix PLC/SCADA data communications problems
- Network with your peers on their automation troubleshooting

WHO SHOULD ATTEND:

- Operators
- Electricians
- Design engineers
- Project engineers
- Instrumentation technicians
- Trades staff working with PLCs
- Electrical, control and instrumentation engineers
- IT technicians and IT staff
- Plant engineers

And those who want to achieve a good proficiency in troubleshooting their PLC and SCADA systems.
The Workshop

The objective of this workshop is to help you troubleshoot, and identify, prevent and fix common PLC and SCADA problems. The emphasis is on practical hard hitting information that goes beyond typical theory, focusing unerringly on providing you with the necessary skills to solve your problems whether it is a PLC, SCADA system, or indeed communications system linking the two together. The automation system on your plant underpins your entire operation. It is thus critical that you have the knowledge and tools to quickly identify and fix problems as they occur to ensure you have a safe, secure and productive system. No compromise is obviously possible here. This workshop distils all the tips and tricks learnt over many years.

The first step in PLC troubleshooting is to decide if the problem is internal to the processor or in the I/O system. Experience shows that more than 80% of all PLC malfunctions come back to problems with I/O modules or field equipment (or indeed wiring). Problems that can be traced back to an I/O module (and specific input) or usually external field components; whilst internal PLC problems often result in large scale failure or erratic behaviour on the part of the PLC.

The content of the workshop brings everyone up to date by briefly reviewing PLC and SCADA systems and then examining in a logical step-by-step fashion with hands-on exercises (both PLCs and simulation software to get to the problems quickly) PLCs and SCADA systems. The key industrial communications problems are briefly covered.

The Program

INTRODUCTION TO PLCs AND SCADA SYSTEMS
• PLC block diagram of components
• PLC processor module and memory organisation
• PLC input/output modules
• SCADA hardware
• Power supplies
• Good installation practice

Practical Session

FUNDAMENTALS OF PLC SOFTWARE
• Methods of representing logic
• Boolean algebra
• Instruction code
• Graphical representation: functional logic diagrams and ladderlogic
• Ladderlogic instruction set (coils and contacts/timers/counters)
• Advanced instructions (program flow/ arithmetic/data transfer and PID)
• Start-up/shutdown and fault routines
• Good programming habits
• Comparison of different manufacturers

Practical Session

SCADA SOFTWARE
• Communication architectures
• HMI interface
• SCADA software blocks
• SCADA alarm management

Practical Session

INDUSTRIAL DATA COMMUNICATIONS SYSTEM
• Roadmap of different standards
• RS-232/RS-485
• Profibus and DeviceNet
• Industrial Ethernet
• TCP/IP
• Modbus

Practical Session

BASICS OF TROUBLESHOOTING AND DIAGNOSING EQUIPMENT
• Common symptoms, problems and solutions
• How to quickly identify likely causes
• Overall basic steps
• Communications issues
• Earthing, shielding and noise

Practical Session

PLC TROUBLESHOOTING ROAD MAP
• Review of the key PLC troubleshooting issues

Practical Session

PLC POWER AND EARTH
• Visual inspection
• Measuring voltages
• Power supply test
• AC ripple on DC power supplies
• Batteries testing
• EMI/RFI impacts
• Earthing and screening/shielding

Practical Session

TROUBLESHOOTING PLC INPUTS/OUTPUTS
• Internal memory status against the field activity
• Digital input status
• Output modules and power supply
• Fuses
• Forcing outputs ON and OFF
• Leaky inputs and outputs
• Isolation problems
• You have located the problem - what to do now?
• Tracking down intermittent problems

Practical Session

TROUBLESHOOTING PLC ANALOG INPUT/OUTPUTS
• Isolated and non-isolated inputs
• Ranges of analog inputs
• Forcing analog output ranges
• Filtering and isolation issues

Practical Session

MISCELLANEOUS HARDWARE ISSUES
• Processor problems
• What to do if you don’t have the right replacement
• Are you sure you have the right problem?!
• Confirmation that the system is indeed operating correctly
• Other troubleshooting tips and tricks

Practical Session

PLC SOFTWARE ISSUES
• How to return the program to its original state
• Modifying an existing program
• Modifying a program to trap problems

Practical Session

SCADA TROUBLESHOOTING ROAD MAP
• Review of the key SCADA troubleshooting issues
• SCADA system troubleshooting
• PLC/SCADA interfacing problems

Practical Session

HUMAN MACHINE INTERFACE (HMI)
• Configuration of database points
• Troubleshooting I/O database

SCADA ALARM CONFIGURATION ISSUES
• Configuration of alarms

SCADA TO PLC INTERFACE ISSUES
• Drivers, protocols, throughput issues

KEY INDUSTRIAL DATA COMMUNICATIONS PROBLEMS AND TROUBLESHOOTING
• Cabling and hardware (switches/routers/ converters)
• Fibre optics
• Noise and interference
• RS-485 issues
• Industrial Ethernet
• TCP/IP
• Modbus

Practical Session

INSTALLATION AND COMMISSIONING
• Control room
• MCC requirements
• Installation of equipment
• Loop testing

Practical Session

TOOLKIT SUMMARY OF KEY PROBLEMS TO LOOK FOR
• 23 common problems with PLCs and SCADA systems
• What to do and how to fix them

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL FLOW ESSENTIALS

YOU WILL LEARN HOW TO:

- Design and configure simple flow-based control systems
- Tune Flow Control loops
- Confidently work with different flow instrumentation systems
- Specify flow meters
- Troubleshoot and install flow instrumentation
- Size and select different control valves
- Deal with cavitation and flashing
- Troubleshoot control valves
- Work with basic fiscal metering concepts

WHO SHOULD ATTEND:

- Automation engineers
- Building service designers
- Chemical and mechanical engineers
- Consulting engineers
- Control technicians
- Control valve specialists
- Data systems planners and managers
- DCS personnel
- Design engineers
- Electrical engineers
- Electrical technicians
- Electricians
- Energy management consultants
- Instrumentation and control engineers
- Instrumentation technicians
- Maintenance engineers, technicians and planners
- Measurement technician
- Operations and production engineers
- Plant safety specialists
- Power system protection engineers
- Process engineers and managers
- Process operators
- Project engineers
- Systems engineers
The Workshop

This workshop is focussed 100% on flow from process control, tuning, flow instrumentation, control valves to fiscal metering. An introduction is given to the complete flow control system and methods of tuning flow loops followed by an examination of the different flow instruments with an emphasis on typical real-world applications. Close attention is given to special installation considerations and application limitations when selecting and installing different flow instruments. It is claimed that the majority of control valves installed have not been correctly sized and that large numbers also operate in manual mode. We thus focus on the correct method of sizing and selecting a flow control valve. The course is rounded off by an examination of fiscal metering with a simple valve. The course is rounded off by an introduction to what can be a complex but critical subject involving revenues of millions of dollars.

Mathematical theory has been kept to a minimum and the focus is on practical design, installation, commissioning, troubleshooting and maintenance issues all focused entirely on flow issues.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

✓ SAVE over 50% by having an IDC workshop presented at your premises.
✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.

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The Program

BASIC CONTROL CONCEPTS
- Typical manual control
- Feedback and feed-forward control
- Block diagrams

BASIC PRINCIPLES OF CONTROL SYSTEMS
- On/off control
- Modulation control
- Principle of closed loop control
- PID control modes

TUNING OF CLOSED LOOP CONTROL
- Tuning constants calculation according to Ziegler and Nichols
- Open loop tuning procedure
- Closed loop tuning procedure
- Damped oscillation tuning method
- Fine tuning of practical control loops
- Tuning considerations for controllers with saturation and non-saturation output limits

CASCADE CONTROL
- Equation types for cascade control
- Initialisation and PV – tracking
- Use of multiple outputs in cascade control
- Tuning procedure for cascade control

PRINCIPLES OF FLOW MEASUREMENT
- Basic fluid properties
- Velocity profiles
- Multi-phase flows

POSITIVE DISPLACEMENT METERS
- Sliding vane
- Oval gear meters
- Lobe impeller
- Oscillating piston

INFERENTIAL METERS
- Turbine meter
- Venturi meter
- Propeller type
- Impeller meters

DIFFERENTIAL PRESSURE METERS
- Venturimeter meter
- Venturi and flow nozzles
- Orifice plate
- The Dall tube
- Pitot tube
- Elbow

VARIABLE AREA METERS
- Operating principle

ELECTROMAGNETIC FLOW METERS
- Construction

ULTRASONIC FLOW METERS
- Doppler method
- Transit time meter

MASS FLOW MEASUREMENT
- The Coriolis force
- Multiple phase flow
- Density measurement
- Thermal mass meters

OPEN CHANNEL FLOW MEASUREMENT
- The Weir
- The flume
- Level measurement

INTRODUCTION TO CONTROL VALVE THEORY
- Introduction and definitions
- Energy types
- What happens inside a control valve
- Cavitations and flashing
- Choked flow
- Valve co-efficient CV

DIFFERENT TYPES OF CONTROL VALVES
- Globe valves
- Butterfly
- Eccentric disk
- Ball
- Rotary plug
- Diaphragm and pinch

CHARACTERISTICS
- Equal percent
- Linear
- Quick opening
- Selection method

HIGH PRESSURE DROP APPLICATIONS
- Cavitations control and elimination
- Low noise
- Diffuser plates
- Chokes
- Disk stock technology
- Pressure balanced trim

VALVE SIZING EXAMPLES OF HIGH PRESSURE DROP APPLICATIONS USING COMPUTER PROGRAMS
- Water – pump bypass
- Steam – turbine bypass
- Gas – pressure reducing
- Oil – choke valve

INSTALLATION AND MAINTENANCE
- Installation, commissioning and routine maintenance
- Fault finding
- Modes of failure
FUNDAMENTALS OF INSTRUMENTATION, PROCESS CONTROL, PLCs AND SCADA FOR PLANT OPERATORS AND OTHER NON-INSTRUMENT PERSONNEL

WHAT YOU WILL LEARN:

• The fundamentals of instrumentation and process control
• The basics of PLCs and SCADA systems
• An ability to troubleshoot simple problems with instruments, PLCs and SCADA systems
• An ability to understand simple plant documentation such as P&IDs
• How to work effectively with your instrumentation plant colleagues

WHO SHOULD ATTEND:

Anybody with an interest in gaining know-how in the full range of instrumentation, process control, PLCs, SCADA and P&ID documentation.

This can range from operators, trades personnel, procurement staff, sales staff, technicians and engineers from other backgrounds/disciplines, such as mechanical, electrical and civil. Even the plant secretary who is keen to have a good understanding of the key concepts would benefit.

Managers who are keen to understand the key workings and the future of their plants would also benefit from this workshop.
The Workshop

The topics covered commence on day one with an introduction to instrumentation and measurement ranging from pressure, level, temperature and flow devices followed by a review of process control including the all important topic of PID loop tuning. Day two is occupied with PLC and SCADA systems where the important topic of industrial data communication networks are also examined – again from a very simple understandable point of view. Finally, the workshop is rounded off with a hands-on review of reading and interpreting simple plant documentation such as P&IDs so that you can see and understand the operation of the plant through the documentation. You will leave this workshop with a strong understanding of the key concepts in instrumentation, process control, SCADA and PLCs.

Pre-requisites

The workshop is presented in easy to understand practical language. All you need to benefit from this workshop is a very basic understanding of mathematics and some electrical theory. Contact us for comprehensive pre-course reading and preparation if you are unsure about your level of understanding.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed. Practical sessions include:

- **Twelve hands-on practical instrumentation, PLC and SCADA labs with real equipment to demonstrate the basics**
- **Twelve simple instrumentation design exercises using software and calculators**
- **Two case studies undertaken in groups of your colleagues in assessing real situations with instrumentation and industrial automation**

In addition to working with real instruments, we will also make extensive use of video clips, visual effects and simulation software to help you in the understanding of the key concepts.

To gain full value from this workshop, please bring your laptop/notebook computer.

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**The Program**

**INTRODUCTION**
- Overview of instrumentation and control
- Key building blocks of PLCs and SCADA systems
- Outline of the workshop

**INTRODUCTION TO PROCESS MEASUREMENT**
- Basic measurement concepts
- Definition of terminology
- Measuring instruments and control valves as part of the overall control system

**PRESSURE MEASUREMENT**
- Principle of pressure measurement
- Pressure transducers and elements

**LEVEL MEASUREMENT**
- Principles of level measurement
- Simple sight glasses
- Hydrostatic pressure
- Ultrasonic measurement
- Electrical measurement
- Density measurement

**TEMPERATURE MEASUREMENT**
- Principles of temperature measurement
- Thermocouples
- Resistance Temperature Detectors (RTDs)
- Thermistors

**FLOW MEASUREMENT**
- Principles of flow measurement
- Open channel flow measurement
- Oscillatory flow measurement
- Magnetic flow measurement
- Positive displacement
- Ultrasonic flow measurement
- Mass flow measurement

**FUNDAMENTALS OF PROCESS LOOP TUNING**
- Processes, controllers and tuning
- PID controllers
- Gain, dead time and time constants
- Process noise
- General purpose closed loop tuning method

**INTRODUCTION TO CONTROL VALVES**
- Introduction
- Definition of a control valve
- Cavitation
- Flashing

**DIFFERENT TYPES OF CONTROL VALVES**
- Globe valves, butterfly, eccentric disk, ball, rotary plug, diaphragm and pinch

**FUNDAMENTALS OF PLCs**
- Introduction to PLCs
- Alternative control systems – where do PLCs fit in?
- Why PLCs have become so widely accepted

**FUNDAMENTALS OF PLC HARDWARE**
- Block diagram of typical PLC
- PLC processor module – memory organisation
- Input / output section – module types
- Power supplies

**FUNDAMENTALS OF PLC SOFTWARE**
- Methods of representing Logic
- Ladder Logic basics
- The basic rules for programming
- Simple PLC programs

**INTRODUCTION TO SCADA SYSTEMS**
- Fundamentals
- Comparison of SCADA, DCS, PLC and smart instruments
- Typical SCADA installations
- Definition of terms

**SCADA SYSTEMS HARDWARE**
- Fundamentals
- Comparison of SCADA, DCS, PLC and smart instruments
- Typical SCADA installations
- Definition of terms

**SCADA SYSTEMS SOFTWARE**
- Fundamentals
- Components of a SCADA system
- Software – design of SCADA packages
- Configuration of SCADA systems
- Building the user interface

**BASICS OF DATA COMMUNICATIONS BETWEEN PLC AND SCADA SYSTEMS**
- Twisted pair cables
- Fibre optic cables
- Public network provided services
- Industrial Ethernet
- TCP/IP
- Fieldbus
- Modbus
- LAN connectivity: bridges, routers and switches
- SCADA network security

**DRAWING TYPES AND STANDARDS**
- Understanding diagram layouts and formats
- Cross references
- P&IDs fundamentals

**CONCLUSION**
- Summing up and revision of key concepts
- The future

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FUNDAMENTALS OF PRACTICAL BUILDING AUTOMATION SYSTEMS (BAS)

WHAT YOU WILL LEARN:

- How Building Automation Services (BAS) operate and are controlled, monitored and maintained
- Type of systems used in the HVAC industry i.e. pneumatic, electric, electronic, Direct Digital Controls (DDC)
- How to identify the key building blocks of a BAS
- Why DDC and BAS systems are so popular and user friendly
- How to undertake design, installation and commissioning of a simple BAS
- How to generate a point schedule
- Simple troubleshooting procedures for a BAS
- How to describe the key codes and standards relating to a BAS
- How to program and configure a simple BAS
- The essentials of web based access to your building operation, monitoring and fault finding and maintenance options
- How to troubleshoot and work with SCADA systems
- How to implement simple energy efficiency strategies

WHO SHOULD ATTEND:

- Control and instrumentation engineers and technicians
- Design engineers
- Maintenance engineers, technicians and staff
- Plant engineers
- Mechanical engineers and technicians
- Operation, inspection and repair managers, supervisors and technicians
A Building Automation System (BAS) is a computerised intelligent network of electronic devices that is used to control and monitor the mechanical, lighting and security systems in a building. It is sometimes referred to as an intelligent building system. It is most often used for control of heating, ventilation and air conditioning (HVAC) systems. A BAS can result in a dramatic reduction in building energy and maintenance costs. Building automation systems can also monitor other parameters such as temperature, air pollution levels, fire alarm status and building integrity. Most of the underlying networks underpinning a BAS comprise a primary and secondary bus which connect high-level controllers with lower level devices which interface to the digital and analog input/outputs.

After an initial overview of the topic, the first day of the workshop covers controllers, industrial networks, lighting, air handlers, water systems and the central plant. The second day provides you with a solid understanding of heating, ventilation, air conditioning (HVAC) and the associated electrical systems. You will also be exposed to alarms and security, room automation and the vital topic of energy efficiency. The workshop is concluded with the interesting topic of SCADA systems where all the building information is brought together. Throughout the workshop you will learn the essentials in installing, commissioning and troubleshooting individual components and systems.

Practical Sessions

We (and you) know that no matter how good the instructor is (and ours are very good!), no one learns from listening to a lecture. The best way of learning and gaining real skills is a high level of interaction with your peers and your instructor and also in undertaking hands-on exercises which relate to the real practical world. Hence we have a busy and enjoyable schedule of useful activities to help you really learn, including:

- 25 short, punchy videos on BAS
- 32 short, practical design exercises on each topic using simulation software and calculators
- 4 case studies on operating and commissioning a BAS where you will work in small groups to solve real electrical engineering problems

Please bring a calculator to get maximum benefit.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

✓ SAVE over 50% by having an IDC workshop presented at your premises.
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The Program

**INTRODUCTION**
- What is building automation?
- Why building automation is required
- Direct Digital Controls (DDC)
- Predecessors to DDC controls
- Overall topology
- Key building blocks
- Industrial networks
- Overview of the course

**CONTROLLERS**
- Different types
- Programmable Logic Controllers/System
- Network controllers
- Terminal unit controllers
- Connectivity with networks
- Configuration and programming
- Troubleshooting of controllers
- Web enabled controllers (AspectFT)

**INDUSTRIAL NETWORKS**
- Different systems
- Proprietary versus non proprietary systems
- BACnet (ASHRAE)
- LonTalk (Lon works)
- Wireless (Zigbee)
- Industrial Ethernet
- Remote control
- Configuration and troubleshooting

**OCCUPANCY**
- Occupied/unoccupied/morning warm-up and night-time setback
- Monitoring and corrective action in case of inadequate fresh air, other pollutants in occupied areas
- Requirements of BAS

**LIGHTING**
- Automated systems
- Demand response

**AIR HANDLERS**
- Air handling units
- Constant volume
- Variable volume
- Variable volume hybrid units
- Typical control set ups and monitoring requirements

**CENTRAL PLANT**
- Operation and troubleshooting of chillers, boilers, cooling towers, pumps

**WATER SYSTEMS**
- Chilled water system
- Condenser water system
- Hot water system

**HVAC CONTROLS AND INSTRUMENTATION**
- Sensors and elements
- Pneumatic, hydraulic, electric, electronic, direct digital controls
- Two position control
- PID control
- DDC control
- Parameters to be controlled (temperature supply and return air)
- Preheat and humidification (winter air conditioning)
- Cooling, dehumidification and reheat control (summer air conditioning)
- Face and by-pass control
- All year round air conditioning system
- Zone control system

**ALARMS AND SECURITY**
- Temperature sensors
- Differential pressure sensors
- Status alarm (e.g. pumps)
- Valve actuators
- Carbon monoxide and carbon dioxide sensors
- Refrigerant sensors
- Current sensors
- Fire suppression and alarm sensors

**ROOM AUTOMATION**
- Corporate boardrooms/presentation suites
- Videoconferencing/video projectors
- Lighting control system
- Public address systems

**ENERGY EFFICIENCY**
- Costs of fuels
- Energy performance
- Energy audit of your building
- Case studies

**THE SCADA (OR HMI) SYSTEM FOR BAS/DDC SYSTEMS**
- Basic implementation
- Troubleshooting
- Application of ASHRAE
- Features
- Remote control and monitoring
- Basic HMI, small facility HMI, large facility HMI

**THE WORKSHOP**

- IDA Technologies on short, exercises studies schedule activities useful on
- 25 enjoyable practical world. Hence we have a busy and
- your instructor and also in undertaking
- best way of learning and gaining real skills is
- no one learns from listening to a lecture. The
- instructor is (and ours are very good!)
- We (and you) know that no matter how good
- hands-on exercises which relate to the real
- practical world. Hence we have a busy and
- enjoyable schedule of useful activities to help you really learn, including:
- 25 short, punchy videos on BAS
- 32 short, practical design exercises on each topic using simulation software and calculators
- 4 case studies on operating and commissioning a BAS where you will work in small groups to solve real electrical engineering problems

Please bring a calculator to get maximum benefit.

To gain full value from this workshop, please bring your laptop/notebook computer.

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DESIGN OF INDUSTRIAL AUTOMATION FUNCTIONAL SPECIFICATIONS FOR PLCs, DCSs AND SCADA SYSTEMS

YOU WILL LEARN HOW TO:

- Detail the key requirements for a Functional Design Specifications (FDS)
- Define the key components for a FDS for an industrial automation system (SCADA/PLC/ PAC and DCS*)
- Define the data communications and networking requirements
- Detail the Graphical User Interface (GUI) requirements
- Define the requirements for system reliability and availability
- Describe the other issues (such as security and operator involvement) to be covered in the FDS

*These widely used acronyms are: SCADA – Supervisory Control and Data Acquisition System; PLC – Programmable Logic Controller; PAC – Programmable Automation Controller; DCS – Distributed Control System.

WHO SHOULD ATTEND:

- Consulting engineers
- Design engineers
- Electrical engineers and technicians
- Industrial automation engineers and technicians
- Instrumentation and control engineers, technologists and technicians
- Maintenance engineers, technicians and staff
- Mechanical engineers and technicians
- Operation, inspection and repair managers, supervisors and engineers
- Plant engineers
- System specifiers
The Workshop

The workshop will be useful to both specifiers and implementers and will provide a theoretical grounding as well as a practical guide for preparing a control system functional specification for implementation on Industrial control systems consisting of PLC (Programmable Logic Controllers), HMI (Human Machine Interfaces/SCADA devices) or DCS (Distributed Control Systems).

Pre-requisites

You do not need to be able to program a PLC or configure a SCADA system however a basic understanding of these systems will be beneficial. Workshop participants are encouraged to bring along their laptop computers since the workshop will include several exercises which can be done electronically. A basic word processor such as MS Word or Open Office will help with the completion of the exercises.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

Throughout this hard hitting one day course; you will undertake 8 projects/practical exercises. These are listed in the program and will be done in groups. Each group will give a short presentation at the end of the day.

To gain full value from this workshop, please bring your laptop/notebook computer.

“This is the best technical briefing/training course I have ever attended. Instructor and attendees are fully involved throughout.”

Colin Jenkins
TAS Engineering Consultants

The Program

FUNCTIONAL SPECIFICATION INTRODUCTION
- Overview of a Functional Design Specifications (FDS)
- The terms and abbreviations
- Naming conventions and standards
- Control philosophy needed in guiding the FDS
Practical session: Control philosophy outline

STANDARDS AND CONVENTIONS
- Discussion of relevant standards
- Definitions, tagging and naming conventions
Practical session: Tagging and naming

SCADA/PLC/DCS
- Process control approaches and their philosophies
- Discussion of SCADA/PLC/DCS systems
- PLC coding concepts - IEC 61131-3
Practical session: PLC coding

REMOTE TERMINAL UNIT (RTUS)
- Introduction to RTU
- Standards involved for an RTU design
- Defining devices for data acquisition
Practical session: RTU specification

DATA COMMUNICATION REQUIREMENTS
- Options for different communication media
- Suitability of protocols and relevant standards
- RS-485/Ethernet/DNP3/IEC 61850
Practical session: Specification of data communications systems

GRAPHICAL USER INTERFACE (GUI) REQUIREMENTS
- Process diagrams, modern trends and alarm systems
- Alarms including colour coding, audio indicators and others
- Different kinds of reporting
Practical session: Definition of a GUI

SECURITY ASPECTS
- Relevance of security for SCADA systems
- Philosophy and different approaches for security
Practical session: Security specifications

WRAPPING UP
- Review of a complete FDS
- Pitfalls, tips and tricks
Practical Session: Building a complete FDS – from earlier sessions

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

✔ SAVE over 50% by having an IDC workshop presented at your premises.
✔ Customise the training to YOUR workplace.
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PRACTICAL REMOTE ENGINEERING, MECHATRONICS AND ROBOTICS FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Design, build and troubleshoot simple mechatronics systems
• Explain robot mechanics and dynamics without excessive mathematical abstraction
• Implement simple pneumatic, hydraulic valve and actuator-based systems
• Select the appropriate electrical and electro-mechanical drives and actuators for your application
• Design basic analog and digital systems, and simulate them with SPICE software
• Develop machine vision software applications (with RoboRealm)
• Write BASIC-type programs (using PICAXE) for a Microbric robotic vehicle
• Write simple ladder programs for a PLC and simulate them with LogixPro
• Select and interface appropriate sensors for your applications
• Detail basic practical power distribution systems
• Understand the basics of serial (RS-232/485) and Ethernet networking
• Develop software for an industrial robot arm, using RoboLogix

WHO SHOULD ATTEND:

Anyone who wants to gain solid knowledge of the key elements of mechatronics to improve their work skills and to further their job prospects:

• Asset management engineer
• Automation engineers
• Chemical engineers
• Consulting engineers
• Data logging engineer
• Design engineers
• Electrical engineers, technologists, technicians and electricians
• Electronic engineer
• Electro mechanical engineer
• Energy management consultants
• Instrument and process control technicians

• Instrument fitters and instrumentation engineers
• Maintenance engineers and supervisors
• Mechanical engineer
• Plant engineer
• Process engineer
• Process monitoring and plant systems engineer
• Production managers
• Project engineer and managers
• Software engineer
• Systems engineer
• Technologists

Even those who are highly experienced in industrial automation may find it useful to attend some of the topics to gain know-how in a very concentrated but practical format.
Today's markets are extremely competitive and engineers are continuously engaged in a struggle to produce complex systems with a high level of reliability and performance, yet at a relatively low price. Much of this demand is brought about by the rapidly-evolving microprocessor technology. In order to survive in this highly-competitive environment, developers have to integrate several technologies.

Mechatronics is the answer to this dilemma. It is an interdisciplinary field of engineering and integrates several technologies such as mechanical subsystems, sensors, actuators, instrumentation subsystems, computers, microcontrollers, PLCs and software. It therefore provides the basis for the integration process, right from the earliest stages of the design process.

Mechatronics is the key to modern video and CD disk drives, camcorders, avionics, aircraft fly-by-wire, computerised fuel injection for motor vehicles, anti-lock braking systems, and smart weapons such as military drones used for aerial reconnaissance purposes. In the process automation field, mechatronics systems are also found in diverse applications such as smart conveyer lines and assembly-line robots.

As with Ethernet networking and wireless (Wi-Fi), the integration of technologies in engineering applications as embodied in mechatronics is upon us, and is here to stay. It is, furthermore, evolving at an exponential rate that will, in a decade from now, probably make some of today's technologies look like museum artefacts. This makes it almost mandatory for everyone in the engineering world to become familiar with the underlying principles and technologies embodied in mechatronics.

**Practical Labs and Exercises**

Twelve exercises taking 55% of the workshop time

- Analog circuit simulation using Multisim SPICE
- Digital circuit simulation using Micro-Cap SPICE
- Image processing using RoboRealm
- PLC ladder programming and simulation, using LogiXPro
- PICAXE software development for Microbric robotic vehicle
- Robot arm program development using Robologix simulator
INSTRUMENTATION ENGINEERING
FOR OIL AND GAS FACILITIES

WHAT YOU WILL LEARN:

• Skills and competencies in instrumentation oil and gas engineering
• Knowledge of the latest technologies in Instrumentation oil and gas engineering
• Key techniques in operating your facility to the highest level of safety and in protecting the environment
• Decades of real experience distilled into the course presentations and materials
• Guidance from real Instrumentation oil and gas experts in the field
• Hands-on, practical knowledge from the extensive experience of instructors, rather than the theoretical information from books and colleges
• Networking contacts in the oil and gas industry

WHO SHOULD ATTEND:

This course is ideal for you if you are seeking expertise in the oil and gas business and are an:

• A recent graduate instrumentation or mechanical engineer
• Chemical engineer
• Fire and gas engineer
• Instrument and control systems engineer
• Instrument and process control technician or technologist
• Instrument fitter
• Mechanical engineer

Even if you are highly experienced you will find this a great way to become familiar with the oil and gas technology as quickly as possible.
The Program

INTRODUCTION – SETTING THE SCENE IN OIL AND GAS E&I ENGINEERING
- Fundamentals of instrumentation, measurement and process control engineering

INSTRUMENTATION AND CONTROL
- General instrumentation standards in oil and gas
- Process instrumentation
- Calibration, installation and maintenance of instruments
- Process control basics
- Control valves sizing, selection and maintenance (including pressure relief valves)
- Programmable Logic Controllers
- SCADA systems
- Distributed control systems
- Industrial data communications (including Fieldbus and industrial Ethernet)
- Safety instrumentation and emergency shutdown systems for oil and gas (IEC 61511 and IEC 61508) – basic introduction
- Wellhead and flowline control – control systems
- Emergency wellhead blowout controls

SPECIALISED APPLICATIONS IN OIL AND GAS
- Power generation
- Cathodic protection
- Compressor control (including surge control)
- Drilling control systems and instrumentation
- Subsea instrumentation and control systems
- Pig launcher/receiver systems
- Critical flare knock out drum controls and instrumentation
- Flare flame front generator and ignition monitoring system
- Distributed control systems

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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✔ Customise the training to YOUR workplace.
✔ Have the training delivered when and where you need it.

Contact us for a FREE proposal.

Practical Sessions

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To gain full value from this workshop, please bring your laptop/notebook computer.

“Excellent presentation of a complex subject in a very short period.”

Terry Hailstones
PRACTICAL
IEC 61850 FOR SUBSTATION
AUTOMATION
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

• Explain the basic scope and outline of IEC 61850 (including Revision 2)
• Describe the IEC 61850 hardware architecture for substation automation
• Use the IEC 61850 data model to specify a substation automation system
• Use the IEC 61850 model as data integration platform
• Specify the most appropriate networking components for substation automation
• Perform device independent system specification and engineering
• Create SSD, ICD, IID and SCD files
• Create, capture and analyse GOOSE messages

WHO SHOULD ATTEND:

This workshop is designed for personnel with a need to understand the techniques required to use and apply IEC 61850 to substation automation, hydro power plants, wind turbines and distributed energy resources as productively and economically as possible. This includes engineers and technicians involved with:

• Consulting
• Control and instrumentation
• Control systems
• Design
• Maintenance supervisors
• Electrical installations

• Process control
• Process development
• Project management
• SCADA and telemetry systems
**The Workshop**

Older (‘legacy’) substation automation protocols and hardware/software architectures provided basic functionality for power system automation, and were designed to accommodate the technical limitations of the technologies available at the time. However, in recent years there have been vast improvements in technology, especially on the networking side. This has opened the door for dramatic improvements in the approach to power system automation in substations.

The latest developments in networking such as high-speed, deterministic, redundant Ethernet, as well as other technologies including TCP/IP, high-speed Wide Area Networks and high-performance embedded processors, are providing capabilities that could hardly be imagined when most legacy substation automation protocols were designed.

IEC61850 is a part of the International Electro-technical Commission (IEC) Technical Committee 57 (TC57) architecture for electric power systems. It is an important new international standard for substation automation, and it will have a significant impact on how electric power systems are designed and built in future. The model-driven approach of IEC61850 is an innovative approach and requires a new way of thinking about substation automation. This will result in significant improvements in the costs and performance of electric power systems.

This workshop provides comprehensive coverage of IEC 61850 and will provide you with the tools and knowledge to tackle your next substation automation project with confidence.

**Pre-requisites**

A basic working knowledge of data communications in general, or some exposure to Ethernet and TCP/IP, would be useful but is not essential.

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**The Program**

**INTRODUCTION**
- 7-layer communication model
- 8th layer as data
- Network topologies
- Utility Communication Architecture (UCA)
- Client/server concept
- Publish/subscribe concept
- Key features of IEC 61850
- IEC 61850 vs. DN3 and IEC 60870

**SCOPE and OUTLINE of IEC 61850**
- General functional requirements (Parts 3, 4 and 5)
- Definition of abstract services (Part 7.2)
- Abstraction of data objects (Part 7.4)
- Common Data Classes (CDC) (Part 7.3)
- Mapping of abstract data objects and services onto the Manufacturing Messaging Specification (MMS) (Part 8.1)
- Mapping of Sample Measured Values onto serial links (Part 9.1)
- Mapping of Sample Measured Values onto ISO/IEC 8802-3 (IEEE 802.3/Ethernet)

**IEC 61850 SUBSTATION ARCHITECTURE**
- Merging Units (MUs)
- Station Bus
- Process Bus

**ETHERNET COMMUNICATION WITHIN SUBSTATIONS**
- Physical Interfaces (10/100/1000 Mbps)
- Media (copper, multi-mode fibre, single mode fibre)
- Media access (full duplex vs. CSMA/CD)
- MAC (L2) addressing: broadcasting, multicasting, unicasting
- Frame (packet) structure
- Differences between ISO/IEC 8802-3, ISO/IEC 8802.3 Ethertype, and ISO/IEC 8802.2 LLC
- Bridges/switches
- VLANs
- Port-based vs. tagged VLANs
  - IEEE802.1p port prioritisation
  - IEEE802.1Q VLAN
- Time synchronisation
  - IEEE 1588
  - SAE AS6892
- Network redundancy
  - Redundant star
  - Redundant ring
  - Spanning tree protocols
  - Parallel Redundancy Protocol (IEC 62439-3)

**TCP/IP AND RELATED CONCEPTS**
- IP (L3) addressing: IPv4 vs. IPv6
- Subnet masks and default gateways
- Basic routing concepts
- Routers
- Ports/sockets
- TCP connections
- TCP vs. UDP

**WAN COMMUNICATIONS ISSUES**
- Reliability, determinism and speed issues
- Multi-Protocol Layer Switching (MPLS)
- IP over Dense Wavelength Division Multiplexing (IPoDWDM)
- MPLS Traffic Engineering – Fast Reroute over IP over Dense Wavelength Division Multiplexing (MPLS TE-PRR over IPoDWDM)
- IEEE 802.1Qav – Forwarding and Queuing Enhancements for Time-Sensitive Streams

**DATA MODELING APPROACH**
- The information model (IEC 61850-7-x and IEC 61400-25)
- The information exchange services and mappings (IEC 61850-7-2 and 8-1)
- Physical devices
- Logical devices
- Data elements
- Common Data Class (IEC 61850-7-3)

**COMMUNICATION PROFILES**
- Sampled Values (SV) multicast
- Generic Object Oriented Substation Event (GOOSE)
- GOOSE messages over L2
- GOOSE messages over L3 (IEC 61850-90-5)
- Generic Substation Status Event (GSSS)
- Time Sync (SNTP/GPS/IRIG-B)
- Manufacturing Message Specification (MMS)
- Application of and comparison between profiles

**MAPPING OF IEC 61850 TO COMMUNICATION PROFILES**
- Abstract Communication Service Interface (ACSI)
- Mapping of IEC61850 to MMS
- Object mapping
- Service mapping

**CONFIGURATION**
- Configuration of IEDs
- IEC 61850-6 Substation Configuration Language (SCL)
- Software tools

**CONFORMANCE AND TESTING**
- Documentation and process
- Assessment process
- Tools
- Testing methods
- Interpretation of Compliance Certificates

**RECENT DEVELOPMENTS**
- IEC 61850 Edition 2
- Object models for hydro power plants, wind turbines and Distributed Energy Resources (DER)
- Mapping of IEC 61850 on DN3 and IEC 60870-5-101-104
- The use of IEC 61499 (Distributed Function Blocks) in conjunction with IEC 61850
- Exchanging synchrophasor data between PMUs, PC/DCs, WAMAPAC and control centre applications: IEC/TR 61890-5-5:2012(E)
- Communication with the control centre based on IEC 61850 and Harmonisation with CIM

**SUMMARY, OPEN FORUM AND CLOSING**

**Practical Sessions**

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.
HAZARDOUS AREAS AND ATEX AWARENESS
FOR TECHNICAL AND NON-TECHNICAL STAFF

WHAT YOU WILL LEARN:

- Hazardous area terminology
- Consideration of sources of ignition
- Flammability concepts of gasses, vapours, mists and dusts
- Zoning, equipment groups and temperature class
- Equipment identification, certification and labelling/marking
- European Directives (ATEX Directives; DSEAR in the UK)
- The basic principles of explosion protection
- Basic considerations for non-electrical equipment
- Requirements for inspection and maintenance including initial and routine inspections

WHO SHOULD ATTEND:

Anyone and everyone who encounters hazardous areas at any level, according to the ATEX Directives and the DSEAR, requires at least a basic understanding of the risks and the management of those risks in order that they should not be compromised by the actions of these personnel. This course is aimed at providing a substantially non-technical introduction suitable for senior management right through to operators. This includes:

- Chemical engineers
- Control engineers
- Electrical engineers
- Electrical and instrument trades-persons
- Instrumentation engineers
- Process engineers
- Supervision and management staff
- Security and cleaning staff
- Technicians
- Trades-persons working in potentially explosive areas
The Workshop

This workshop is designed to provide delegates with an appreciation of the requirements of explosion protection applied to hazardous areas. It defines the terminology, promoting clarity of use in communications between technical and commercial departments within organisations and between organisations involved. The subject matter covered focuses on how the requirements of the ATEX Directives (and the DSEAR that is applied in the UK) are to be met in order to aid management, technicians and engineers in the understanding of the necessary organizational and technical measures taken to ensure safety.

Pre-requisites

Delegates will only require a very basic understanding of physics for the workshop to be of greatest benefit. No previous knowledge of hazardous area installations is required.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

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On-Site Training

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The Program

INTRODUCTION
• Explosion consequences
• The fire triangle
• Risk assessment concepts applied and IEC60079 Standards and Codes of Practice

UNDERSTANDING FLAMMABILITY, COMBUSTION AND EXPLOSION
• Ignition sources
• Properties of flammable gases, vapours, mists and dusts

ZONES AND DEFINITIONS
• Definition of hazardous area terminology
• Classification of apparatus
• Equipment grouping and temperature rating

PRINCIPLES OF TYPES OF PROTECTION
• Electrical equipment protection IEC60079: Ex d, e, i, p, and n
• Others types: Ex m, o, q and s: use in combination
• Non-electrical equipment protection to EN13463: fr, d, g, c, b, p and k

EQUIPMENT CERTIFICATION
• Marking and identification
• Component certificates
• Equipment certificates
• Systems certification

PLANT OWNER/USER OF EX EQUIPMENT
• Introduction to Codes of Practice
• Equipment selection procedure
• General requirements of Installation and Inspection
• Maintenance and permits to work
• Repairs

ATEX DIRECTIVES
• Equipment category and grouping
• Essential safety and health requirements
• ATEX compliance marking
• Self certification and verifying conformity
• Workers directive summary

DANGEROUS SUBSTANCES AND EXPLOSIVE ATMOSPHERES REGULATION (UK)
• DSEAR: Application of ATEX and Chemical Agents Directive in the UK
• Summary of employers responsibilities

SUMMARY, OPEN FORUM AND CLOSING
ONE-DAY REFRESHER TRAINING
ELECTRICAL EQUIPMENT
FOR PRACTICAL HAZARDOUS AREAS
FOR ENGINEERS AND TECHNICIANS
(OUTSIDE EUROPE)

YOU WILL LEARN HOW TO:

• Describe recent developments in Hazardous areas
• Comply with the Requirements of IEC 60079
• Work safely in Hazardous Areas
• Design and install safe working systems in hazardous areas
• Explain the terminology used with hazardous areas
• Assist in hazardous area classification
• Detail the types of apparatus that can be used in a given hazardous area
• Explain the types of equipment that can be used
• Detail system limitations in using hazardous areas protection
• Detail the key areas of the national codes of practice

WHO SHOULD ATTEND:

Anyone involved in design, specification, installation, commissioning, maintenance or documentation of industrial instrumentation, control and electrical systems, including:

• Electrical and instrument tradespersons
• Electrical engineers
• Instrumentation and control engineers
• Design engineers
• Instrumentation technicians
• Tradespersons working in Potentially Explosive Atmospheres (PEAs)
The Workshop

This workshop provides you with an understanding of the hazards involved in using electrical equipment in potentially explosive atmospheres. This refresher workshop is suitable for you if you have a good understanding of the requirements for electrical equipment in hazardous areas (if not, contact us for further suggestions). It is based on the international IEC60079 series of standards that are now replacing many of the older national standards. Installation utilising Explosion-Protected (Ex) equipment can be expensive to design, install and operate. The wider approaches described in these standards can significantly reduce costs whilst maintaining plant safety.

The associated terminology and its correct use are explained throughout the workshop. It covers area classification, selection of explosion protected electrical apparatus as well as describing how protection is achieved and maintained in line with these international requirements. Standards require that engineering staff and their management are trained effectively and safely in hazardous areas and this workshop is designed to help fulfil that need.

The IEC 60079 Requirements

The International Standard IEC 60079.14 (Electrical Equipment for explosive atmospheres) requires that the design, construction, maintenance, testing and inspection of installations covered by these standards shall be carried out only by competent persons. The competent person's training must include instruction and experience on the various types of protection and installation practices, relevant rules and regulations and on the general principles of area classification.

It is a requirement of this standard that appropriate continuing training shall be undertaken on a regular basis; as the standards and regulations are constantly being modified and improved.

You will receive a IDC Technologies Certificate after successful completion of the training materials and training assignments. The instructor will assist you in successfully completing this one-day course.

In conclusion, it should be noted that no training course provider can confer any level of competence on an engineer, technician or tradesperson. The IECex competence scheme is aimed at personal competence; but does not absolve the employer from responsibility in assessing competence in the workplace (under the requirements of ATEX).

The Program

**BACKGROUND TO HAZARDOUS AREAS**
- Definition of hazardous area
- Flammability concepts
- Ignition sources
- Properties of gases, vapours, mists and dusts

**CLASSIFICATION SYSTEMS**
- Area classification into zones
- Equipment (apparatus) grouping

**TYPES OF PROTECTION**
- Definitions
- Principles
- Application of:
  - Flameproof: Ex d
  - Increased safety: Ex e
  - Pressurisation: Ex p
  - Intrinsic safety: Ex i
  - Non-incentive: Ex n
  - Oil filling: Ex o
  - Powder filling: Ex q
  - Encapsulation: Ex m
  - Special: Ex s

**EARTHING AND BONDING**
- Basic principles
- Earthing requirements
- Static protection
- Lightning protection
- Noise and interference control
- Requirements for IS systems
- System earthing approach

**CODE OF PRACTICE FOR SELECTION AND INSTALLATION OF Ex EQUIPMENT**
- Application of code of practice
- General requirements for all types of protection
- Documentation requirements and the verification dossier
- Cabling
- Overview of requirements for individual Ex protection types
- Maintenance and repair

**INSPECTION AND MAINTENANCE REQUIREMENTS**
- Inspection and maintenance definitions
- Types of inspection
- Initial detailed pre-commissioning
- Inspection regimes and documentation
- Record keeping

**BREAKDOWNS - FAULT FINDING AND REPAIRS OF Ex EQUIPMENT**
- Planned maintenance
- Use of tools
- Procedures
- Safe methods
- Test equipment suitability

**STANDARDS, CERTIFICATION, CERTIFICATES, MARKING AND APPROVALS**
- Authorities
- Marking and identification
- Component, equipment and systems certification
- Systems descriptive documentation (for Ex i)
- ATEX Directives (Europe)

**SUMMARY, OPEN FORUM AND CLOSING**

**Practical Sessions**

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. The practical sessions will comprise exercises in which you will solve typical practical problems in groups. Videos of the key concepts will also be provided. There will be two assignments where you will test your knowledge gained during the one day workshop.

To gain full value from this workshop, please bring your laptop/notebook computer.

Note: Hazardous Area Classification will only focus on zones and divisions. Details will be provided on where the IECEx standards can be found. In addition, the IEC 60079.10 is there for a detailed review; but is outside the scope of this intensive one day session. ATEX is not required in Australia and many other countries (but is naturally critical in Europe).

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ONE-DAY REFRESHER TRAINING
ELECTRICAL EQUIPMENT FOR PRACTICAL HAZARDOUS AREAS
FOR ENGINEERS AND TECHNICIANS
(WITHIN EUROPE)

YOU WILL LEARN HOW TO:

- Describe recent developments in Hazardous areas
- Comply with the Requirements of IEC 60079
- Work safely in Hazardous Areas
- Design and install safe working systems in hazardous areas
- Explain the terminology used with hazardous areas
- Assist in hazardous area classification
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- Detail system limitations in using hazardous areas protection
- Detail the key areas of the national codes of practice

WHO SHOULD ATTEND:

Anyone involved in design, specification, installation, commissioning, maintenance or documentation of industrial instrumentation, control and electrical systems, including:

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It is a requirement of this standard that appropriate continuing training shall be undertaken on a regular basis; as the standards and regulations are constantly being modified and improved.

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The Program

BACKGROUND TO HAZARDOUS AREAS
• Definition of hazardous area
• Flammability concepts
• Ignition sources
• Properties of gases, vapours, mists and dusts

CLASSIFICATION SYSTEMS
• Area classification into zones
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  - Oil filling: Ex o
  - Powder filling: Ex q
  - Encapsulation: Ex m
  - Special: Ex s

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• General requirements for all types of protection
• Documentation requirements and the verification dossier
• Cabling
• Overview of requirements for individual Ex protection types
• Dust installations overview

INSPECTION AND MAINTENANCE REQUIREMENTS
• Inspection and maintenance definitions
• Types of inspection
• Initial detailed pre-commissioning
• Inspection regimes and documentation
• Record keeping

BREAKDOWNS - FAULT FINDING AND REPAIRS OF Ex EQUIPMENT
• Planned maintenance
• Use of tools
• Procedures
• Safe methods
• Test equipment suitability

STANDARDS, CERTIFICATION, CERTIFICATES, MARKING AND APPROVALS
• Authorities
• Marking and identification
• Component, equipment and systems certification
• Systems descriptive documentation (for Ex i)

ATEX DIRECTIVES (EUROPE)
• Introduction and Explanation
• Non-electrical ignition – capable equipment protection
• ATEX marking
• DSEAR (UK) requirement summary

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. The practical sessions will comprise exercises in which you will solve typical practical problems in groups. Videos of the key concepts will also be provided. There will be two assignments where you will test your knowledge gained during the one day workshop.

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NOTE: Hazardous Area Classification will only focus on zones and divisions. Details will be provided on where the IECEx standards can be found. In addition, the IEC 60079.10 is there for a detailed review; but is outside the scope of this intensive one day session. ATEX is not required in Australia and many other countries (but is naturally critical in Europe). Hence, ATEX compliance marking needs to be understood because it appears on many products. The ATEX Equipment Category equates to the equipment protection level concept and the significance of gas/dust use etc. In the UK many installations have equipment installed to BS5345 and that includes BS889 and 229 equipment. We also have other BS and EN’s that require explanation in context so we believe that, whilst explaining the principles, the differences in application and standards will need to be included for the country in which the course is delivered (naturally related to the particular interests of the course participants).
MASTER SERIES: INSTRUMENTATION AND CONTROL

WHAT YOU WILL LEARN:

• Gain a clear picture of the latest developments and future directions in control and instrumentation from experts in the field
• Make reliable, well grounded and commercially viable technical, financial and management decisions in the control and instrumentation business
• Understand how successful control and instrumentation engineers communicate their vision and values to build up a super effective team

WHO SHOULD ATTEND:

This master series course is for those from a control and instrumentation background. It has been developed for those whose time is limited and who work in a critical role or situations where a lengthy time away for study is impossible. Those who would benefit most include:

• Automation engineers
• Chief engineers
• Control and instrumentation engineers
• Electrical engineers
• Engineering managers
• Process control engineers
• Senior technologists and technicians
• Superintendents
About the Master Series

This is four hard hitting days of intensive training, the instrumentation and control master series has proved an outstanding success. It delivers a critical blend of knowledge and skills, covering technology in control and instrumentation, industry analysis and forecasts, leadership and management – everything that is relevant to a modern control and instrumentation engineer. You will be exposed to four high impact days where you will hear from an outstanding expert and undertake practical hands-on sessions and exercises.

A key element of the master series is the ongoing case study conducted throughout the four days that pitches the delegates (in teams of four each) against each other in the design costing of a state-of-the-art plant. The case study is exciting, intense, useful and fun. You will however require every ounce of ingenuity to come up with control and instrumentation solutions appropriate to the design of this process plant.

SESSIONS WILL COVER THE FOLLOWING KEY AREAS:

• Setting the scene
• Industrial data communications and wireless
• Safety instrumentation and machinery safety
• Process control
• Advanced process control
• HAZOPs
• Budgeting, ROI and finance of I&C projects
• Industrial network security
• Hazardous areas and intrinsic safety
• SCADA and PLC systems
• Project management of I&C projects
• Preparation for presentations
• Latest instrumentation developments
• Case study of design of a real process plant
• Forecasts and predictions

The I&C master series is split into three focused areas of learning which are all linked together through the case study of Hi-Tech Inc’s plant:

1. MARKET AND INDUSTRY INTELLIGENCE
   A review of where control and instrumentation engineering is heading with forecasts on trends in equipment, technologies employed and personnel.

2. MANAGEMENT AND BUSINESS
   Good management, financial and business skills are provided in these modules. These highly practical interactive sessions provide you with solid skills in this often neglected area for control and instrumentation engineers.

3. TECHNOLOGY AND ENGINEERING
   A solid overview of the latest trends in instrumentation and control technology and how to take advantage of these.

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<td>HAZOPs</td>
<td>Project management and management of C&amp;I projects</td>
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<td>Budgeting, ROI and finance of C&amp;I projects</td>
<td>Preparation for presentations</td>
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The Program

SETTING THE SCENE

I&C STANDARDS, DRAWINGS AND DOCUMENTATION

PROCESS CONTROL

ADVANCED PROCESS CONTROL

INDUSTRIAL DATA COMMUNICATIONS AND WIRELESS

SAFETY INSTRUMENTATION AND MACHINERY SAFETY

HAZOPS

BUDGETING, ROI AND FINANCE OF I&C PROJECTS

HAZARDOUS AREAS AND INTRINSIC SAFETY

SCADA, PLC AND DCS SYSTEMS

PROJECT MANAGEMENT OF I&C PROJECTS

PREPARATION FOR PRESENTATIONS

INSTRUMENTATION AND VALVE DEVELOPMENTS

DELEGATE PRESENTATIONS

REVIEW OF EXERCISES AND CASE STUDY

FORECASTS AND PREDICTIONS

SUMMARY, OPEN FORUM AND CLOSING

Case Study

Deciding on the overall strategy:
Considering all the factors involved when deciding upon overall technology strategy. In bringing the elite of the control and instrumentation industry together for four hard hitting days of intensive training, the instrumentation and control master series has proved an outstanding success. It delivers a critical blend of knowledge and skills, covering technology in control and instrumentation, industry analysis and forecasts, leadership and management – everything that is relevant to a modern control and instrumentation engineer. You will be exposed to four high impact days where you will not only hear from outstanding experts in each of the key areas but undertake practical hands-on sessions and exercises.

On-Site Training

✓ SAVE over 50% by having an IDC workshop presented at your premises.
✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.

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INTEGRATED PROGRAMMING, MAINTENANCE, TROUBLESHOOTING AND OPTIMISATION OF THE DRILL MONITOR SYSTEM (DMS)

WHAT YOU WILL LEARN:

• Be able to describe the hardware and software architecture of the DMS:
• Describe the hardware (Unitronics Vision 120, wiring and sensors) and software (ladder logic programming)
• Be able to apply know-how on programming the DMS
• Have learnt how to efficiently troubleshoot and maintain a typical DMS
• Have the skills to write simple DMS ladderlogic programs
• Be able to competently install wiring of inputs/outputs from the DMS to sensors

WHO SHOULD ATTEND:

• Consulting engineers
• Design engineers
• DCS personnel
• Electrical engineers
• Engineering managers
• Instrumentation and control engineers
• Instrumentation technicians
• Process control engineers
• Process control operators
• Shift electricians
• Trades staff working with or near PLC's
The Workshop

This intensive workshop is aimed at assisting you – the engineer and technician working with the DMS in applying an integrated approach to maintaining, troubleshooting and programming the OPLC units. The OPLC (Operator Interface Programmable Logic Controller) operates in the same way as a normal PLC but has a Liquid Crystal Display (LCD) incorporated into the front panel. The V120 OPLC incorporates 10 digital inputs 2 analogue inputs and 6 relay outputs. By means of the use of an extender module, further inputs can be input to the OPLC. This is done through an IO-ATC8 which allows the connection of eight 4-20 mA input channels. The OPLC is programmed using a Windows based ladder logic. This ladder logic programs the manner in which the OPLC scans the inputs, processes the data collected from the inputs, then produces outputs by either switching on relays, or displaying text or graphics on the LCD display.

Pre-requisites
A basic electrical knowledge would be useful but is not essential and some background in working with Allen Bradley PLC-5's and SLC-500's.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed. Over 65% of the workshop time is spent on practical sessions and will focus on:
- Configuring and programming a DMS and testing its operation
- Troubleshooting sensors, wiring and DMS code
- Configuration and programming DMS Operator screen

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION
- Fundamentals of operation of DMS
- Block diagram of typical DMS system (processor/memory/I/O)
- Power Supplies

DMS HARDWARE
- Planning of program
- Program layout
- Data structure
- I/O addressing
- Processor status registers
- Fundamental instruction set
  - Bit (e.g. coils) and word type instructions
  - Timers and counters
  - Comparison operators
  - Data handling operations
  - Program control
  - Editing a program
  - Documentation of a program
- Communications (RS-232/Cell phone)

DMS SENSORS
- Location, wiring and operational description of:
  - Key switch
  - Engine air filter front
  - Engine air filter rear
  - Compressor air filter
  - Low fuel
  - Alternator fail
  - Engine coolant level
  - Compressor oil filter
  - Low water injection water
  - Hydraulic oil temp high
  - Hydraulic oil filter bypass
  - Engine oil temp high
  - Low hydraulic oil level
  - Compressor oil temp high
  - Engine oil pressure low
  - Engine coolant temp high

GOOD INSTALLATION PRACTICE
- Location of hardware
- Good wiring practice
  - Cable spacing
  - Power distribution
  - Wire numbering
- Reducing noise and interference
- Screening and shielding
- Earthing and grounding

GOOD PROGRAMMING HABITS FOR DMS
- Keeping track of addresses and data used
- Looking ahead – how will programs be maintained
- Practical methods to improve program quality
  - Organisation of code
  - Thorough documentation
  - Simplifying changes

DMS OPERATOR INTERFACE
- Creation of simple graphic displays
- Configuring of alarms
- Organising display data
- Linking displays

TROUBLESHOOTING DMS, SYSTEM CHECKOUT AND TESTING
- Typical tips and tricks
- Development and verification of code
- Testing procedures
- Discrete I/O
- Analog I/O
- I/O channel and power supplies
- Processor problems

SUMMARY, OPEN FORUM AND CLOSING

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## MECHANICAL ENGINEERING

### TRAINING WORKSHOPS

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YOU WILL LEARN HOW TO:

- Maintain and troubleshoot HVAC systems
- Understand and apply the psychrometric chart
- Design for good air quality
- Perform basic load calculations
- Initiate an effective inspection and maintenance program
- Minimise forced outages and prevent serious damage to HVAC equipment
- Provide an overview of the legislative requirements plus the essential steps and responsibilities for the maintenance and repair of HVAC systems
- Outline the technologies available for the efficient energy management using HVAC systems

WHO SHOULD ATTEND:

- Maintenance engineers, technicians and staff
- Plant engineers
- Operation, inspection and repair managers, supervisors and engineers
- Mechanical engineers and technicians
- Design engineers
- Electrical engineers and technicians
- Consulting engineers
The Workshop

This workshop is designed for engineers and technicians from a wide range of abilities and backgrounds and will provide an excellent introduction to the fundamentals of heating, ventilation and air-conditioning. It commences with a review of psychrometric charts and then examines the factors that influence design choices, indoor air quality, load calculations and heating/ventilation and air-conditioning systems. Numerous tips and tricks throughout the course make it very practical and topical to your applications.

Pre-requisites

Fundamental knowledge of basic mechanical plant and operation thereof.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION TO HVAC
• General
• Principles of thermodynamics
• Laws of thermodynamics
• Fundamentals of heat transfer
• Fundamentals of fluid flow
• Temperature and its measurement
• Pressure and temperature relationship

PSYCHROMETRY
• Introduction to psychrometry
• The properties of air
• Psychrometric charts
• Air conditioning and psychrometric systems
• Psychrometric charts as a tool for analysis for A/C performance

REQUIREMENTS OF COMFORT AIR CONDITIONING
• Thermodynamics of the human body
• Air purification methods
• Role of clothing
• Temperature and humidity in high heat load
• Inside and outdoor design criteria
• Ventilation and ventilation standards
• Design of ventilation systems
• Air distribution systems
• Air diffusion and performance
• Air purification methods

HEATING AND COOLING LOAD CALCULATION PROCEDURE
• Design considerations
• Load components
• Design criteria – indoor and outdoor
• Heatload components
• Miscellaneous heat sources
• Fresh air loads
• Design of air-conditioning systems
• Heat gains: transmission, solar, infiltration

HVAC SYSTEMS
• All air, all water, air water systems
• Heat systems
• Steam heating systems
• Electric heat systems
• Components of the air conditioning systems in practice

CONSTANT VOLUME SYSTEMS
• System concepts
• Different configurations

VARIABLE AIR VOLUME SYSTEMS
• System concepts
• Different Variable Air Volume (VAV) systems

DUCT DESIGN, AIRFLOW AND ITS DISTRIBUTION
• Pressure gradient diagrams
• Duct sizing and design

INSULATION OF AIR-CONDITIONING SYSTEMS
• Properties of insulating materials
• Factors affecting thermal conductivity
• Heat transfer through insulation
• Economical thickness of insulation
• Insulated systems
• Importance of relative humidity for the selection of insulation

AIR-CONDITIONING EQUIPMENT
• Packaged units
• Split systems
• Chillers
• Boilers
• Pumps
• Cooling towers
• Adiabatic coolers
• Capacity assessment and selection
• Air filters
• Humidifiers
• Dehumidifiers
• Fans and blowers
• Grills and registers

REFRIGERATION
• Methods of refrigeration
• Air refrigeration systems
• Vapor compression and absorption refrigeration systems
• Refrigerants
• Refrigeration equipment

CONTROLS AND INSTRUMENTATION
• Definitions
• Sensors and elements
• Pneumatic and hydraulic controls
• Electrical and electronic controls
• Two position control
• PID control
• Parameters to be controlled (temperature supply and return air)

TYPICAL CONTROL SYSTEMS
• Preheat and humidification control (winter air-conditioning)
• Cooling, dehumidification and reheat control (summer air-conditioning)
• Face and by-pass control
• All year round air-conditioning system
• Zone control system

INSTALLATION, COMMISSIONING OPERATION, TESTING AND MAINTENANCE
• HVAC equipment
• Duct work and air outlets
• Electrical and controls
• Insulation and commissioning process
• Other service operations
• Economics
• Operational activities
• Do's and don'ts

FAULT FINDING AND TROUBLESHOOTING FAULTS
• Improper adjustments and settings
• Poor design and installation
• Equipment failure
• Limitations in operation
• Troubleshooting tools

TROUBLESHOOTING TOOLS (ELECTRICAL AND MECHANICAL)
• DOE (Design Of Experiments)
• FTA (Fault Tree Analysis)
• Cause and effect diagrams

GREEN HOUSE EFFECT AND FUTURE REFRIGERANTS
• Applications
• Smart buildings

ENERGY CONSERVATION AND ENERGY MANAGEMENT
• Costs of fuels
• Typical rate schedules
• Effects on total fuel bill
• Cost-in-use
• Energy performance
• Contracts and incentive programs

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL
BOILER PLANT
OPERATION AND MANAGEMENT
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN:

- How to install, operate, maintain and manage boiler plants
- Steam and combustion processes
- Safe boiler operation techniques
- How to use existing technologies to reduce pollution and emission levels
- How to achieve peak boiler plant efficiencies
- Identify and troubleshoot boiler problems quickly and efficiently

WHO SHOULD ATTEND:

- Senior boiler plant operators, repairers and installers
- Boiler plant construction managers
- Plant engineers
- Operation, maintenance, inspection and repair managers, supervisors and engineers
- Mechanical engineers and technicians
- Design engineers
- Insurance company inspectors
- Consulting engineers
The Workshop

The boiler plant operation and management workshop is an intensive, highly practical two day workshop. You will gain the most up-to-date information and practical understanding of the installation, operation, maintenance and management of boiler plants. The workshop will give you the ability to recognise and solve boiler problems simply, easily and with confidence. At the end of this workshop participants will be able to:

- Identify the various types of boilers
- Use essential terms and understand their key applications
- Describe the typical characteristics of fuels fired
- Perform basic combustion and process calculations
- Recognise the impact fuels have on the boiler heat transfer surfaces
- Describe the ancillary equipment associated with steam boiler plants and their integral role in the safety of the boiler
- Discuss the correct operation, control sequences and procedures for the safe operation of a typical fire-tube boiler plant
- Outline the applicable pressure part design codes and explain their influence on boiler pressure parts sizing, inspection and non-destructive examination
- Initiate an effective inspection and maintenance program
- Minimise forced outages and prevent serious damage to boiler equipment
- Provide an overview of the legislative requirements plus the essential steps and responsibilities for the repair of boilers
- Recognise the importance of and implement the procedures for the protection of a boiler during cold storage
- Outline the technologies available for the reduction of emission levels and the applicable international legislative controls

Pre-requisites

Fundamental knowledge of basic mechanical plant, and operation thereof.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION
- Types of package boilers and their applications
- Boiler components, terminology and definitions

Practical assignment (workshop)

FUEL COMBUSTION AND THE STEAM GENERATION PROCESS
- Overview of the boiler heating and steam generation process
- Influence of the fuel type on the boiler design operation
- Firing appliances
- Basics to theory of combustion
- Thermal efficiency
- Fireside deposits and corrosion

Practical exercises (calculations)

BOILER AUXILIARY PLANT
- Water treatment plant and dosing
- Feedwater pumps
- Valves and steam traps
- Piping
- Fans
- Economisers and heat recovery equipment
- Flue gas cleaning and dust removal

Practical exercises (quiz questions)

OPERATION AND CONTROLS
- Boiler instruments and their purpose
- Typical P&I diagrams for coal and oil/gas fired units
- Control systems and system operating philosophy
- Operational sequences and procedures
- Safety equipment and interlocks
- Safety procedures and emergencies
- Operating records and logs
- Typical operational problems, the reason for the problems and 'trouble shooting'

Practical exercises (workgroup)

PRESSURE CONTAINING COMPONENTS
- Basics to codes calculation theory and assumptions
- Overview of design parameters for shell, furnace, plates and tubing
- Importance of pressure part inspection

Practical assignment (exercise and quiz questions)

PLANNING AND MANAGING BOILER MAINTENANCE
- Critical importance of maintenance policies and programs
- Setting up an inspection program
- Types of boiler inspections
- Involvement of the Authorised Inspection Authority (AIA)
- Maintenance information and procedures
- Developing a preventive maintenance program
- In-house versus contractor repair maintenance

Practical assignment (workshop)

MANAGING BOILER REPAIRS AND MODIFICATIONS
- When does a boiler repair become a boiler modification?
- Importance of historical records
- Understanding the legislative requirements
- Steps to be taken when a 'defect' is identified
- Responsibility of the boiler owner
- Responsibility of the boiler repair contractor
- The AIA and their inspection points

Practical assignment (workshop)

COLD STORAGE OF A BOILER
- Clearly establishing the storage period
- Storage period and critical preservation steps
- Storage instructions and procedures
- Consequences of no storage plan

Practical exercises (quiz questions)

EMISSION CONTROLS AND ENVIRONMENTAL CONSTRAINTS
- Types of emissions for different fuels fired
- Methods used for controlling boiler flue gas emissions
- Effectiveness of various types of cleaning equipment
- What emission levels are specified in international standards or legislation?

Practical exercises (quiz questions)

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PRACTICAL
CLEANROOM TECHNOLOGY AND FACILITIES
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN:

• About contamination control, improving yield, product quality and performance
• The importance of cleanrooms in improving product yield in today's manufacturing climate
• The Cleanroom concepts, how to design, operate and maintain cleanrooms
• Techniques for the control of air temperature, air humidity, vibration, static electricity, particle levels and other contaminants
• The maintenance and work practices allowed in Cleanrooms
• The utility and service requirements for Cleanrooms
• The statutory codes safety, fire and environmental practices
• The codes and legislation used for regulation of Cleanroom design and operation
• About Hi Purity Water - its uses, generation and distribution
• Techniques for waste water treatment
• About personal safety work practices and general behaviour in a Cleanroom

WHO SHOULD ATTEND:

• Engineers & Technicians
• Process Engineers
• Operators
• Project Engineers
• Electronic Engineers
• Scientists
• Production Engineers
• Research Engineers
• Maintenance Personnel
• Data Storage Personnel
• All personnel who work in a controlled environment
• All personnel involved with the design and maintenance in and around a controlled environment
The Workshop

Contamination can cause a variety of problems to materials, processes and products and it is for this reason that cleanrooms are becoming a regular feature of modern industry in its battle to control contamination. With the demand for higher productivity and reliability of the manufacturing process and the ever-increasing miniaturisation of equipment, Cleanrooms have become integral to the success of the manufacturing process. It is essential for productivity that people are trained to work with Cleanroom technology and facilities. An effective Cleanroom requires the effective functioning of many different and complex systems. It is imperative that these dynamic systems are operated and maintained correctly so that their interaction creates a stable controlled environment.

This workshop will not only teach you how to create a Cleanroom but also how to effectively operate, maintain and work within this controlled environment. This workshop will help you manage your cleanroom investment more efficiently thereby increasing your productivity through greater product yields.

Pre-requisites
A fundamental knowledge of basic mechanical issues.

Workshop Objectives

After attending this workshop you will know how to:

- Work in a controlled environment
- Handle, store and use hazardous materials, wet chemicals and gases
- Increase your product yield
- Understand different Cleanroom concepts
- Control contamination from interfering with the production of your product and its end-use performance
- Codes and legislation governing the design and operation of Cleanrooms
- Hi Purity Water; its uses, generation and distribution
- Waste water treatment
- Personnel safety practices in the Cleanroom environment

Practical Sessions

Practical sessions include:

- Air balance calculations
- Heat load calculations
- Particle loadings

To gain full value from this workshop, please bring your laptop/Notebook computer.

The Program

OVERVIEW OF CLEANROOM TECHNOLOGY
- The need for a Cleanroom
- History of Cleanrooms
- Cleanrooms and the semi-conductor industry
- Cleanrooms and the pharmaceutical industry
- Overview of the wafer fabrication process
- The Cleanroom as a system and unit operations

CLEANROOM CONTROLLED ENVIRONMENT CONCEPTS
- Cleanroom basics
- Particulate standards
- Gas and vapour standards
- Contamination

MICRO CONTAMINATION (PARTICULATE)
- The nature of particulate contamination
- Particulate contamination flow
- Particulate contamination sources
- Particulate transport
- Particle retention
- Contamination monitoring/identification for particulate contamination

CREATING A CLEANROOM
- Construction materials
- Construction practices (Protocols)
- Air flow (basics)
- Typical Cleanroom layout/configurations
- Designing for Cleanroom class level

FACILITIES & SERVICES
- Electrical systems
- Power conditioning
- Compressed air
- Air conditioning
- Air wet side
- Air dry side

VIBRATION
- External vibration sources (natural and man-made)
- Internal vibration sources

CLEANROOM CODES & LEGISLATION
- Fire protection
- Smoke removal

HI PURITY WATER GENERATION & DISTRIBUTION
- The use of ultra-pure water
- Raw water constituents
- Water quality standards
- Hi Purity Water Systems: typical block diagrams

PRODUCTION MATERIALS
- Bulk Chemical Storage and Distribution Systems (BCDS)
- Hazardous production materials
- The safe storage, handling and use of wet chemicals and gases
- Personal protective equipment (PPE)
- Wet chemicals (bulk and specialty)
- Gases (bulk and specialty)

WASTETREATMENT
- Waste water plant
- Acid waste neutralisation plant
- Hydrofluoric acid waste treatment
- Phosphoric acid waste treatment

PEOPLE & CONTAMINATION
- Apparel
- The use of apparel
- Work practices and general behaviour
- Cleanroom facilities & practices
- Typical specification sheets

Exceeded my expectations.
Chris Barlow

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PRACTICAL LUBRICATION ENGINEERING FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN:

• How to choose the best lubricant for your application
• How to better understand and manage lubricants
• How to use lubricants effectively in a proactive maintenance program
• When to select grease or oil as the lubricant of choice
• Best practices for oil draining, flushing and charging
• How to write equipment lubrication procedures
• How to handle lubricants in pumps and reservoirs
• The truth about aftermarket additives and oil conditioners
• How to best store lubricants and handle them effectively
• The latest techniques which are dramatically different to those of 10 years ago
• How to extend the life of your lubricants
• Troubleshooting techniques to deal with lubricants effectively in the future

WHO SHOULD ATTEND:

• Supervisors & Foremen
• Consulting Engineers
• Process Technicians
• Mechanical Engineers
• Design Engineers
• Plant Engineer-Managers & Supervisors
• Plant Operations & Maintenance Personnel
• Predictive Maintenance Professionals
• Artisans & tradespeople
• Facilities Engineers & Managers
The Workshop

The Lubrication Fundamentals workshop is a comprehensive, highly practical and interactive two-day course. With a bewildering selection of thousands of lubricant types, base stocks, additive packages and viscosity grades to choose, how do you know which one is right for your machine.

After attending this course and interacting with your fellow students and instructor, you will have the tools to and knowledge to understand the key properties of lubricants and how to select the right one for your applications.

Modern lubrication programs have dramatically changed from the old methods that have been passed down through the generations. If you aren’t using the right lubricant at the right time, in the right place, in the right quantity you could in fact be doing more harm than good and losing the opportunity to save your firm thousands of dollars with an effective lubrication program. This workshop collects together the strategic knowledge of many practising professionals in this area and gives you the best practice to work with.

You will have an opportunity to discuss Lubricant management, design-applications, operations, maintenance and management issues and be provided with the most up-to-date information and best practice in dealing with the subject. Towards the end of the workshop, you will have developed the skills and ability to recognise and solve lubricant problems in a structured and confident manner.

Pre-requisites

A basic knowledge of mechanical engineering principles as applied to lubricants would be useful. However, this is not essential as it will be revised at the beginning of the workshop.

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The Program

INTRODUCTION & BACKGROUND
Discuss briefly the composition of lubricants, crude oil derived lubricants and synthetic lubricants.

TRIBOLOGY
• The cause of friction, heat, the result of friction, what causes wear
• The types of lubrication: - fluid and hydro-dynamic lubrication - boundary lubrication
• The characteristics of the lubricant under different operating conditions e.g. material surfaces, temperature conditions, load and viscosity of the lubricant
• Different types of lubricants for different applications

THE PROPERTIES OF LUBRICANTS
• Viscosity
• Flashpoint and Volatility
• Oxidation and thermal stability
• Demulsibility
• Foaming and gas solubility
• Corrosion prevention
• Compatibility

LUBRICATING OIL ADDITIVES
• Oxidation inhibitors
• Rust and corrosion inhibitor
• Pour point depressants
• Viscosity inhibitor (VI) improvers
• Anti-wear additives
• Extreme pressure (EP) additives
• Anti-foam additives
• Detergents and dispersants additives
• Demulsifiers and Emulsifiers
• Tackiness additives

TYPES OF LUBRICANTS

GREASES AND GREASE LUBRICATION
• Grease characteristics
• Lubrication grease classification
• Choice of grease
• Grease types and performance
• Grease application and trouble-shooting
• Roller bearing lubrication

INTERNAL COMBUSTION LUBRICANTS
• Petrol and diesel engines
• The choice of lubricant by engine type
• Lubricant classification
• Plain bearing lubrication

AUTOMOTIVE DRIVE LINE LUBRICATION
• Viscosity classifications
• Automatic transmission fluid

HYDRAULIC SYSTEMS AND FLUIDS
• Hydraulic systems
• Viscosity of the lubricant
• Chemical stability
• Fire resistance
• Anti-wear
• Anti-rust
• Anti-foam

MISCELLANEOUS LUBRICATION
• Steam Turbine Pumps and Motor Lubrication
• Air Compressor Lubrication

LUBRICATION SYSTEMS

FILTRATION
• Contamination fundamentals
• Contamination generation
• Cleanliness control
• Filter fundamentals
• Filter performance and testing
• Flashing

CONDITIONS ASSESSMENT OF ROTATING MACHINERY
• Monitoring techniques
• Vibration analysis
• Oil analysis

TRIBOLOGY ROOT CAUSES OF FAILURES
• Fluid contamination control
• Leakage stability
• Fluid chemical stability
• Temperature stability
• Wear stability

STORAGE
• Safety Issues
• Shelf Life
• Contamination Potential

CLOSING AND SUMMARY

“Good subject well presented.”
Brian Barton
PRACTICAL
SAFE LIFTING
PRACTICE AND MAINTENANCE

THIS WORKSHOP COVERS:

• Advanced Lifting Equipment Safety
• Slinging, inspection and safe use of lifting equipment
• Guides to implementing a total safe lifting program in your plant & operation
• Selection, safe use and maintenance of lifting equipment
• Practical Safe slinging and basic rigging practice
• Types, selection and features of lifting equipment used
• Management of a total safe lifting program
• Your lifting equipment - legal or lethal?

WHO SHOULD ATTEND:

• Maintenance and Project Managers
• Plant Engineers and Technicians
• Artisans and Apprentices
• Rigging Personnel and Contractors
• Inspectors of Lifting Equipment
• Safety Officer and Loss Control Personnel
• Health and Safety Representatives
• Plant Foreman and Supervisors
• Lifting Equipment Operators
• Lifting Equipment Service Providers
• Lifting Equipment Sales Engineers
The Workshop

This very timely workshop has been put together by an expert in the area of lifting practice and equipment who has observed and studied the problems in working with loads. In two concentrated days you will have the distillation of his experience of over 30 years in this sometimes dangerous and demanding field. Lifting Equipment refers to both the lifting tackle as well as Lifting Machines.

This is a practical participative workshop using sample slings and components; new and old to practically demonstrate features and correct use. Videos and postcards in the workshop room are used to reinforce the material covered in the comprehensive 250 page manual which will act as a reference for your work for years to come. Case studies throughout the workshop which emphasise past experience give you a solid practical bias to the workshop. You will also do simple calculations on various lifting and loading situations. It should be emphasised that all loads are dangerous - a 50 kg load will kill or maim a 5 tonne load if dropped from a 1 metre distance. Safety is not negotiable; therefore this workshop drives home the point that if you use correct lifting equipment correctly and safely, your operators and personnel are well trained and in compliance with the local legislation as well as with a Total Safe Lifting program you will have a productive work force.

This course is not a replacement for that of a full rigger’s course but it will teach you in two days what most people will take years to learn and make you a far safer and more productive person on the shopfloor.

Pre-requisites

A basic working knowledge of mechanical lifting problems. Please bring your calculator along to do simple calculations for some of the practical exercises.

Workshop Objectives

At the end of this workshop you will be able to:

- Maintain Safe Lifting Practice in your factory and plant
- Describe the do’s and don’ts of Lifting
- Demonstrate substantial cost savings in less damage and risk in lifting equipment
- Demonstrate practical compliance with the local Legal requirements
- Demonstrate compliance with the your responsibilities of the LAW
- List the elements of a Total Safe Lifting Program and how to implement this plan
- Demonstrate the load - estimation, balance, centre of gravity, angles, load ratings, mass of various bodies, safe attachment
- Ensure proper safe maintenance of Lifting Equipment
- Design and create your own Code of Practice for Lifting Equipment
- Ensure that your lifting equipment is always in a safe working condition
- Identify and fix Safety Hazards with Lifting Equipment
- Understand the limitations of your Lifting Equipment

The Program

INTRODUCTION

- Safe Lifting Statement
- Why training is essential
- Lifting pyramid triangle

FUNDAMENTAL PRINCIPLES OF SAFE LIFTING PRACTICE

- Common causes of accidents
- Employers responsibilities
- Operators responsibilities
- Suppliers responsibilities
- Suppliers Risk Assessment of product
- The Lift - General Procedure
- A 20 point guide in planning and conducting the lift
- Elements of a Total Safe Lifting Program (TSLP)
- Lifting Equipment Definitions. Pm 20

BASIC RIGGING PRACTICE

- Fundamentals

LEGAL REQUIREMENTS

- Applicable Legislation
- Industry: OHS Act, DMR 18
- Mines: Minerals Act
- Practical implementation of these regulations
- All regulations in the Acts, and how these regulations need to be implemented in practice

THE LOAD

- Load estimation
- Centre of gravity
- Balance
- Angles
- Load ratings. Trigonometric and Uniform methods.

CRANE SIGNALS

LIFTING TACKLE (I.E. CHAIN, STEEL WIRE ROPE AND TEXTILE WEBBING)

- Comparisons of types
- Features and benefits of types
- Typical applications
- Sling configurations

CHAIN SLINGS

- Qualities of chain
- Types of chain
- Specifications
- Traceability
- Heat treatment
- Protective coatings
- Configurations of slings
- Certification
- Markings
- Inspection
- Safe and correct use
- Storage and maintenance

Calculation Exercise

STEEL WIRE ROPE SLINGS

- Rope construction
- Types of ropes
- Splices
- Types of slings
- Accessories
- Correct and safe use
- Inspection of ropes
- Storage and maintenance

Calculation Exercise

TEXTILE SLINGS

- Types of textile fabric used
- Types of slings i.e. endless roundslings and flat woven webbing slings
- Identification and marking
- Typical Applications
- Specifications, identification and markings
- Stitching
- Colour coding
- Safe and correct use
- Inspection and maintenance

Calculation Exercise

SLING COMPONENTS

- Hooks
- Shackles
- Terminal fittings
- Eye bolts
- Plate clamps
- Lifting points
- Correct and safe use, identification, markings and quality

Calculation Exercise

LIFTING MACHINES

- Types and use i.e. hand and electric chain hoists, lever hoists, cable winches, pendant controlled overhead cranes
- Correct and safe use
- Inspection procedures for various types
- Records and maintenance

Calculation Exercise

SUMMARY AND CONCLUSION
PRACTICAL PUMPS - DESIGN, OPERATION AND MAINTENANCE FOR CENTRIFUGAL AND POSITIVE DISPLACEMENT PUMPS

YOU WILL LEARN HOW TO:

- Identify the various types of centrifugal pumps
- To use relevant pump terminology and understand their key applications
- Understand pump characteristics and interpret pump curves
- Perform a number of pump calculations
- Describe ancillary equipment associated with pumping circuits
- Draw up the correct operation, controls and procedures for operating pump systems
- Understand more about safety with pump systems and the management of risk
- Define pump reliability in terms of availability, criticality and wear characteristics
- Understand pump efficiency in terms of capital costs, maintenance costs and life cycle costs
- Understand the elements considered in selecting the right pump for a specific application
- Tackle issues relating to mechanical shaft seals failures
- Understand about pump drive options, alignment and pump drive sources
- Confidently test and commission pump sets
- Understand about condition monitoring of pumps and to optimise pump performance

WHO SHOULD ATTEND:

- Plant operations and maintenance personnel
- Plant engineers, managers and supervisors
- Process control engineers and supervisors
- Consulting engineers
- Maintenance engineers and technicians
- Pump sales and applications personnel
- Pump users
- Pump service contractors
The Workshop

This is a comprehensive, highly practical and interactive two-day workshop. You will have an opportunity to discuss pump construction, design applications, operations and maintenance issues and be provided with the most up-to-date information and best practice in dealing with the subject. You will develop the skills and ability to recognise and solve pump problems in a structured and confident manner.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

This course is excellent for Technicians, Workshop Managers and Engineers.

L. Pike

On-Site Training

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✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.

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The Program

INTRODUCTION
• Terminology
• Pump definition and types
• Pump materials and components
• What constitutes a good centrifugal pump?
  Practical tutorial

INTRODUCTION TO MECHANICAL SEALS
• Single and dual seal types
• Design considerations to address specific applications
• Troubleshooting failed mechanical seals

PUMPABLE FLUID CHARACTERISTICS
• Impact of:
  - Head
  - Density
  - Viscosity
  - Temperature
  - Corrosiveness
  - Erosion
  Practical tutorial

THE PUMP AFFINITY LAWS
• The interaction between:
  - Head
  - Flow
  - Power draw
  - Implications of performance changes
  - System resistance

HYDRAULIC FORCES
• Axial forces
• Radial forces
• Effect of forces on component life

A TYPICAL PUMP CIRCUIT
• Effects on pumping
• Head
• Velocity
• Resistance
• Forces
• Expansion, contraction and vibration
• Environment
  Practical tutorial

TYPES OF PUMPS AND MATERIAL SELECTION
• Design considerations to address specific applications
• Material selection based on process fluid specifications: hazardous, density, viscosity, temperature, corrosiveness, erosion
  Practical tutorial

PUMP DRIVES
• Pump drives:
  - Close coupled
  - Direct driven
  - Belt driven
  - Variable speed drives
  - Canned
  - Couplings
  - Alignment
  - Power sources
  Practical tutorial

CONTROLS/SELECTION AND INSTALLATION
• Pump controls and instruments: safety and volume controls
• Pump selection:
  - Performance data
  - System flow resistance
  - Stability
• Pump installation issues:
  - Foundations and bases
  - Pipe connections
  - Vibration and force isolation
  - Environmental protection
  Practical tutorial

COMMISSIONING AND PERFORMANCE MEASUREMENT
• Testing and commissioning
• Condition monitoring
• Optimising performance:
  - Inspection
  - Performance measurements
  Practical tutorial

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL MACHINERY AND AUTOMATION SAFETY FOR INDUSTRY

WHAT YOU WILL LEARN:

• How to identify hazards of machines and do risk assessments
• The essential design principles for safety-related electrical controls
• The meaning and application of "safety category" and "SIL"
• How international standards can help you develop your safety applications
• The principles of safety PLCs and safety networks
• The basics of CE marking and the EU safety regulations for machinery

WHO SHOULD ATTEND:

• Control Engineers & Technicians
• Electrical Engineers
• Instrumentation and Control Engineers & Technicians
• Compliance Engineers
• Machinery Designers & System Integrators
• Safety Professionals, Health & Safety Officers
• Production Managers
• Automation Engineers
• Process Control Engineers
• System Integrator Designers
• Systems Engineers
• Electronic Technicians

• Process Engineers
• Electronic Engineers
• Design Engineers
• Test Engineers
• Consulting Engineers
The Workshop

The technology of safety related control systems plays a major role in the provision of safe working conditions throughout industry. At the same time safety controls must not be seen as an obstacle to production performance and efficiency. It pays to have safety controls that work reliably without slowing down production or causing irritation to the operators.

Perhaps your company is wasting money on inappropriate safety interlocks that waste production time and still do not satisfy safety regulations? Perhaps your technicians and engineers could improve production at the plant through using smarter safety systems?

This workshop aims to provide you with the knowledge to tackle machinery safety control problems at a basic and practical level whilst following the best available international standards. It begins with an overview of machinery safety issues, introducing the concepts of hazard identification and risk reduction. The workshop highlights the major international standards that are used to support compliance with EU regulations and uses these as a basis for the design procedures. This approach will assist you to follow best practices for safety system applications wherever your plant is situated and is essential if you are exporting into the EU.

The workshop looks at the risk assessment processes used to identify hazards and to quantify the risks inherent in a machine. This enables engineers to define the safety functions to be provided by safety related electrical controls. The workshop then introduces the concepts of safety categories as defined by standard EN 954 and illustrates the principles of failsafe design, fault tolerance and self-testing.

With design procedures established the workshop provides an introduction to machinery protection devices such as guards, enclosures with interlocks and guard monitoring relays, locking systems, safety mats, photo electric and electro sensitive principles and the application of light curtains. Application examples such as guard door interlocking applications, two-hand controls, muting, area protection of robot installations and motion detection are then discussed.

The workshop introduces the principles of safety-certified PLCs focusing on practical useful information showing the differences between PLCs designed for safety and those for regular control duties. It also provides an outline of the principles of networking of safety devices including the integration of safety and regular control systems in complete packages.

The workshop introduces the recently established standards IEC 61508 and IEC 62061 for functional safety of programmable systems. It explains the concepts of safety integrity levels (SILs) and their relationship to safety categories and highlights key issues associated with software based safety applications.

Pre-requisites
A basic working knowledge of electrical engineering concepts is useful but not essential as there will be a brief revision at the commencement of the class.

The Program

INTRODUCTION TO MACHINERY SAFETY PRINCIPLES
- Course outline and objectives
- Definition of a machine and the scope of machinery controls
- Examples of common hazards & typical safety system solutions
- Principles of risk assessment and risk reduction
- Introduction to the safety lifecycle method of engineering

Practical 1: Exercise in calculating risk parameters

GUIDE TO REGULATIONS AND STANDARDS
- Introduction to European Directives, Regulations and Standards
- CE marking and the EU machinery directive
- Obligations of suppliers and end users
- Type A, B and C safety standards
- USA Regulations and Standards
- Concept of Control Reliability

Practical 2: Questionnaire on CE marking and compliance

RISK ASSESSMENT & RISK REDUCTION METHODS
- Risk assessment procedure based on EN1050
- How to do risk estimation and risk ranking
- Developing risk reduction by design and by safeguarding
- Practical example of a risk assessment and risk reduction exercise on a power tool

Practical 3: Hazard study and risk assessment exercise on a power tool

RISK ASSESSMENT & RISK REDUCTION METHODS
- Risk assessment procedure based on EN1050
- How to do risk estimation and risk ranking
- Developing risk reduction by design and by safeguarding
- Practical example of a risk assessment and risk reduction exercise on a power tool

Practical 4: Predict an accident rate using fault tree analysis

DESIGN PROCEDURES FOR SAFETY CONTROLS
- Introduction to safety control standards EN 954 and IEC 62061
- Procedures for the design of safety controls
- Failure modes and principles of fail safe design
- Explanation of safety categories (EN 954) and SILs (IEC 62061)
- Specification of safety requirements and selection of categories
- Circuit application examples for categories 1 to 4

Practical 5: Determine the safety categories for a production line

DEVICES: E-STOPS AND THE SAFETY RELAY
- Emergency stop functions and types.
- How does an E-stop safety relay work?
- Practical safety relays and typical applications
- Guard monitoring applications
- Programmable and electronic monitoring devices
- Bus connected monitors.

Practical 6: Design an Emergency stop system for a conveyor

DEVICES: SENSORS AND CONTROLS
- Overview of sensors and safety devices
- Choices of protection methods
- Fixed & moveable guards
- Sensing devices for guards
- Application examples: Guard interlocking systems
- Presence sensing devices including safety mats and proximity sensors
- Principles of light beams, light curtains and laser scanners.

Practical 7: Outline design of an access guarding system

SAFETY CONTROL APPLICATIONS
- How to choose the right safety control system
- Selection factors for the protection method
- Comparison of physical guarding with other safety methods
- Application of hold-to-run and two-hand controls
- Motion detection and run down safeguarding.
- Presence sensing and access guarding examples for light curtains
- Calculation of safety distances
- Application examples for muting, blanking, single- and double-break operating modes

Practical 8: Calculate safety distance for a light curtain application

PROGRAMMABLE SYSTEMS FOR SAFETY CONTROLS
- The pros and cons of using of PLCs in safety
- Why a general purpose PLC should not be used for safety duties
- Key performance features of a safety-certified PLC?
- Software characteristics of a safety PLC
- Application programming using certified function blocks
- PLC types and features
- Introduction to safety-related field bus systems.

NEW STANDARDS FOR PROGRAMMABLE SYSTEMS
- Introduction to IEC 61508 general standard for functional safety.
- Using the safety life cycle method for management of safety
- IEC 62061, a new standard for machinery controls
- How safety integrity levels are defined for machinery safety

MACHINERY SAFETY MANAGEMENT
- Maintenance and safety issues in the factory.
- Validation and proof testing of installed safety systems.
- Upgrading the safety of existing machines.

Practical 9: Checklist for safety compliance

REVISION OF KEY POINTS
PRACTICAL
MACHINERY VIBRATION ANALYSIS
AND PREDICTIVE MAINTENANCE

YOU WILL LEARN HOW TO:

- Understand the basics of vibration measurement
- Demonstrate the basics of signal analysis
- Understand measurement and the characteristics of vibration signals
- Use data acquisition equipment for vibration signals
- Apply vibration analysis for different machinery faults
- Apply specific techniques for pumps, compressors, engines, turbines and motors
- Apply vibration based fault detection and diagnostic techniques
- Diagnose machinery related problems with vibration analysis techniques
- Apply advanced signal processing techniques and tools to vibration analysis
- Detect, locate and diagnose faults in rotating and reciprocating machinery using vibration analysis techniques
- Identify conditions of resonance and be able to rectify these problems
- Apply basic allied predictive techniques such as oil analysis, thermography, ultrasonics and performance evaluation

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Control technicians
- Electrical engineers
- Electricians
- Maintenance engineers and technicians
- Process engineers
- Consulting engineers
- Automation engineers
The Workshop

This practical workshop provides a detailed examination of the detection, location and diagnosis of faults in rotating and reciprocating machinery using vibration analysis. The basics and underlying physics of vibration signals are first examined. The acquisition and processing of signals is reviewed followed by a discussion of machinery fault diagnosis using vibration analysis, and rectifying the unidentified faults. The workshop is concluded by a review of the other techniques of predictive maintenance such as oil and particle analysis, ultrasound and infrared thermography. The latest approaches and equipment used together with current research techniques in vibration analysis are also highlighted in the workshop.

Pre-requisites

This is not an advanced workshop but one aimed at the fundamentals. A basic knowledge of electrical and mechanical concepts would be useful.

Workshop Objectives

When you have completed this workshop you will be able to:

- Understand the basics of vibration measurement
- Demonstrate the basics of signal analysis
- Understand measurement and the characteristics of vibration signals
- Use data acquisition equipment for vibration signals
- Apply vibration analysis for different machinery faults
- Apply specific techniques for pumps, compressors, engines and turbines
- Apply vibration based fault detection and diagnostic techniques
- Diagnose machinery related problems with vibration analysis techniques
- Apply advanced signal processing techniques and tools to vibration analysis
- Detect, locate and diagnose faults in rotating and reciprocating machinery using vibration analysis techniques
- Identify conditions of resonance and be able to rectify these problems
- Apply basic allied predictive techniques such as oil analysis, thermography, ultrasonics and performance evaluation

The Program

INTRODUCTION
- Evolution of maintenance in process plants
- Classification of plant machinery
- Maintenance strategies as adopted to each class of machinery
- Identification of critical machinery and adoption of CBM
- Principles of predictive maintenance, its utilisation in detection and diagnosis
- Various techniques under predictive maintenance
- Vibration analysis as one of the key techniques

VIBRATION BASICS
- Spring mass system – mass, stiffness, damping
- Wave fundamentals – concepts of amplitude, frequency, fundamental frequency, harmonics, phase, waveforms (sinusoidal, complex) – concepts of peak, peak-peak, rms
- Vibration parameters – displacement, velocity, acceleration
- Choice of vibration parameters
- Using vibration theory to machinery fault detection
- Limits and standards of vibration

DATA ACQUISITION SYSTEMS AND TECHNIQUES
- Vibration transducers and their mountings
- Data acquisition equipment – hand held meters, data collectors (single, dual channel), online monitoring
- Equipment setup and data collection
- Basic steps in data acquisition, overlapping, windows

BASICS OF SIGNAL ANALYSIS
- Time waveform analysis
- Fast courier transform analysis
- Phase measurement
- Enveloping and demodulation
- Orbits
- Advanced signal analysis
  - Triggered data capture
  - Synchronous time averaging
  - Peak holding averaging
  - Coasting down analysis (bode/Nyquist)
  - Enveloped spectras – gSE, Peakvue, SEE
  - Modal shape analysis
  - Cross channel analysis – coherence, FRF, TRF
  - Cepstrum
  - Torsional vibration

VIBRATION ANALYSIS FOR DIFFERENT MACHINERY FAULTS
- Unbalanced
- Misalignment, looseness, distortion
- Bad bearings, journals
- Gears, couplings
- Critical
- Resonance
- Electrical
- Miscellaneous

MACHINERY SPECIFIC VIBRATION ANALYSIS
- Pumps
- Compressors
- Engines
- Turbines
- Motors

VIBRATION MONITORING AND ANALYSIS – TURBOMACHINERY
- Importance of shaft vibration – usage of eddy current probes
- Installation of probes on a turbomachinery train
- Brief description of the turbomachinery vibration setup
- Spectrum plot, cascade plot, waterfall plot, bode plot, polar plot, shaft centreline plot, waveform plot, orbit plot, shaft deflection plot, data trending plot, axial movement plot, full spectrum
- Typical problems associated with turbomachinery – oil whirl, structural resonance, vane blade passing, misalignment, rotor rubbing and shaft crack

RESONANCE IDENTIFICATION AND RECTIFICATION

APPLICATIONS OF VIBRATION ANALYSIS – BALANCING OTHER PREDICTIVE TECHNIQUES
- Oil particle and wear debris analysis
- Thermography
- Ultrasonics
- Performance evaluation

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL
PUMPS AND COMPRESSORS:
CONTROL, OPERATION,
MAINTENANCE AND TROUBLESHOOTING

YOU WILL LEARN HOW TO:
• Explain and understand pump/compressor terminology
• Identify the various types of pumps/compressors
• Understand pump/compressor characteristics and interpret pump/compressor curves
• Understand pump/compressor types and classification
• Understand criteria for pump/compressor selection
• Perform a number of simple pump/compressor calculations
• Confidently test and commission pump/compressor sets
• Explain how pumps/compressors are constructed
• Detail how to install, test and commission pump/compressor systems
• Explain how to start up a new pump/compressor or one after strip down for maintenance

WHO SHOULD ATTEND:
• Plant operations and maintenance personnel
• Consulting engineers
• Design engineers
• Process technicians
• Plant engineering managers and supervisors
• Process control engineers and supervisors
• Mechanical engineers
• Plant engineers
The Workshop

The pump/compressor workshop is a comprehensive course focussing on the fundamentals of centrifugal pumps and compressors. You will have an opportunity to discuss pump/compressor construction, design-applications, operations, maintenance and management issues and be provided with the most up-to-date information and best practice in dealing with the subject. Towards the end of the workshop, you will have developed the skills and ability to recognise and solve simple pump/compressor problems in a structured and confident manner.

This is not an advanced course but one focussing on the fundamentals and therefore will not be suitable for you if you are a pump or compressor “guru”!

Pre-requisites

A basic knowledge of mechanical engineering principles and some working knowledge of pumps and compressors would be useful. Please note that this course does commence with a brief overview of the fundamentals.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

INTRODUCTION
• What constitutes a good pump/compressor or compressor?
• Safety
• Reliability
• Efficiency
• Risk consideration
• Life cycle cost consideration
• Overview of statutory requirements

CENTRIFUGAL PUMP DESIGN AND CONSTRUCTION
• Casings
• Impellers
• Axial/radial forces
• Pump/compressor shafts
• Shaft seals – balanced/unbalances, seal wear patterns
• Drives and couplings
• Supports and pipe connections
• Auxiliaries

CENTRIFUGAL PUMP CHARACTERISTICS AND OPERATION
• Hydraulic properties of pumps
• QH curves
• PQ curves
• Speed changes on curves

PUMP SPECIFICATION AND SELECTION
• System analysis
• Data sheets
• Bid requests/reviews/analyses

PUMP TESTING AND INSPECTION
• Material inspection requirements
• Shop tests
• Performance test procedures
• Site locations
• Pump foundations
• Associated piping and fittings
• Pre-operational checks
• Operation of pump

PUMP MAINTENANCE
• Pump breakdown and removal
• Single stage pump dismantling and repair
• Preparation for re-assembly
• Pump assembly
• Vertical and multistage pump repairs

INTRODUCTION TO COMPRESSORS
• What is a compressor?
• Basic criteria for compressor selection
• Compressor definitions

RECIPROCATING COMPRESSORS
• Principles and mechanics
• Definitions
• Parts of a reciprocating compressor
• Maintenance and performance of reciprocating compressors
• Mechanical forces

CENTRIFUGAL COMPRESSORS
• Introduction
• Principle of operation
• Operation
• Parts of centrifugal compressors
• Casing configurations
• Types of compressors
• Performance of centrifugal compressor
• Polytropic compressor
• Characteristic curves
• Compressor controls

SUMMARY, OPEN FORUM AND CLOSING
GAS TURBINES: FUNDAMENTALS, MAINTENANCE, INSPECTION AND TROUBLESHOOTING

YOU WILL LEARN HOW TO:

- Explain the basic thermodynamic principles behind gas turbines
- Understand the basic operation of a gas turbine
- Clearly describe the operation and function of gas turbine components
- Perform simple troubleshooting and maintenance
- Do a simple review of the successful operation of a gas turbine and know what characteristics are required for materials and fuels
- Perform simple condition monitoring interpretation and maintenance

WHO SHOULD ATTEND:

Those new to gas turbines and more experienced technical personnel who want an overview of the operation and available technologies of gas turbines.
The Workshop

This workshop gives a solid review of gas turbines with a focus on:
- Fundamental thermodynamics
- Gas turbine components
- Materials of construction
- Bearing, seals and lubrication systems
- Fuels and fuel supply systems
- Combustion air filters
- Control systems and instrumentation
- Operations and maintenance

Whilst it is unfortunately not possible to use a real life turbine in the course due to cost (and perhaps space considerations!), video clips, exercises and case studies with actual hardware examples will be used to make the course as interesting and practical as possible.

3 Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

The practical exercises are:
- Components
- Thermodynamics
- Operation and maintenance

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

OVERVIEW OF GAS TURBINES
- Industrial heavy duty gas turbines
- Aircraft-derivative gas turbines
- Medium range gas turbines
- Major gas turbine components
- Heat recovery steam generators

FUNDAMENTAL THERMODYNAMICS
- Reversible cycles with ideal gases
- Actual gas turbine cycles
- Air compressor performance characteristics
- Combustion processes
- Gas turbine performance calculations
- Comparison of basic specifications

GAS TURBINE COMPONENTS
- Axial-flow compressor
- Radial-inflow turbines
- Combustors, construction and types
- Igniters
- Fuel nozzles
- Hot path components
- Axial-flow turbine
- Firing concepts and emission control

MATERIALS OF CONSTRUCTION
- General metallurgical behaviour
- Gas turbine blade materials
- Turbine wheel alloys
- Corrosion problems
- Wear problems
- Future materials
- Coating technology

BEARINGS AND SEALS
- Bearing design principles
- Bearing materials
- Non-contacting seals
- Mechanical seals

LUBRICATION SYSTEMS
- Basic components
- Oil cooling and warming
- Oil cleaning and conditioning
- Lube oil selection

FUELS AND FUEL SUPPLY SYSTEMS
- Fuel specifications
- Fuel properties
- Fuel treatment
- Heavy fuels
- Fuel measurement
- Fuel supply systems
- Cleaning of turbine components

COMBUSTION AIR FILTERS
- Combustion air quality requirements
- Function of gas turbine air filters
- Environment and type of inlet filters
- Selection principles
- Operation and maintenance

EXHAUST SYSTEMS
- Sound abatement, inspection openings and chimneys

AUXILIARY COMPONENTS AND SYSTEMS
- Starting systems, washing systems, gear boxes, and couplings

CONTROL SYSTEMS AND INSTRUMENTATION
- Pressure measurement
- Temperature measurement
- Vibration measurement
- Performance measurement
- Control systems
- Monitoring and diagnostic systems

GAS TURBINE OPERATIONS AND MAINTENANCE
- Operating philosophies
- Analytical on-line condition monitoring
- Using a borescope
- Selecting maintenance approaches
- Maintenance planning
- Spare parts and special tools
- Inspection, overhaul and repair
- Maintenance control and documentation
- Evaluating gas turbine maintenance effectiveness
- Establishing and tracking performance indices

MECHANICAL EQUIPMENT STANDARDS
- Applicable API standards
- ANSI standards
- International standards (ISO)
- Specifications

SUMMARY, OPEN FORUM AND CLOSING
**YOU WILL LEARN HOW TO:**

- Understand the principles of mechanical drawings and design
- Do basic static safety factor mechanical designs
- Identify failure modes of mechanical components
- Understand the behaviour of engineering materials and do basic selections
- Select manufacturing processes for simple designs
- Design and implement simple mechanical automation systems
- Understand the principles of fluid engineering
- Identify and select basic fluid engineering components
- Perform simple fluid engineering designs
- Select a maintenance strategy for mechanical machinery
- Recognise general mechanical problems and suggest corrective actions

**WHO SHOULD ATTEND:**

This introductory seminar is designed for those with little or no prior formal background, who function as managers, supervisors, engineers, planners, inspectors, designers, researchers, investors or procurers, and who seek a basic understanding of the practical aspects of mechanical engineering.
The Workshop

This workshop introduces the basics and fundamental concepts and applications of Mechanical Engineering. The course starts with an introduction to the basic principles of mechanical drawings such as tolerances, symbols, sections, fasteners etc. The use of computer aided design and good drawing office practices are also discussed. After this, the properties and mechanical behaviour of engineering components are presented. Phenomena such as stress and strain, fatigue, fracture, creep and corrosion are discussed. Mechanical design philosophies are discussed with the focus on the use of safety factors during the design for static strength. Delegates will have the opportunity to gain some insight in the process of mechanical design for manufacturing/production. Various manufacturing operations will be discussed, starting with the production of metal and alloys. The methods to shape metal into its final desired shape, such as casting, forging, machining, welding etc. will be discussed. Delegates will be introduced to the use of computerized methods of manufacturing (CNC, CAM) and also the use of rapid prototyping. Principles of mechanical automation as it is typically found in industry will be discussed with the focus on the application of hydraulic and pneumatic systems. There is also a discussion on electric motors, mechanical actuation systems and common control systems (e.g. PLCs).

The course will also introduce the various aspects of pipe technology, including types of pumps, flanges, gaskets, jointing methods, pipe support and standards. The basic design and analysis of pipe systems will also be presented. An introduction of underlying practical principals of thermodynamics will also be included. The course closes off with a discussion on one of the most important aspects in mechanical engineering, namely maintenance. A discussion on the various types of maintenance philosophies and their underlying principles will enable delegates to identify the correct maintenance approach for their workplace.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

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On-Site Training

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PRACTICAL
MECHANICAL DRIVES
(BELTS, CHAINS AND GEARS)
FOR ENGINEERS & TECHNICIANS

YOU WILL LEARN HOW TO:
- Install and maintain drives correctly
- Align drives correctly
- Apply correct lubrication techniques
- Select bearings correctly
- Troubleshoot and fix drives

WHO SHOULD ATTEND:
This workshop is designed for personnel with a need to understand the use, care, installation, or the economics associated with mechanical machinery. Those who will benefit the most from this workshop include the following:
- Consulting engineers
- Design engineers
- Drive sales engineers
- Drive service contractors
- Drive operators
- Mechanical engineers
- Plant engineer, managers and supervisors
- Plant operations and maintenance personnel
- Process control engineers and supervisors
- Process technicians
The Workshop

The mechanical drives workshop is a comprehensive, highly practical and interactive two-day course. You will have an opportunity to discuss drive design-applications, operations, maintenance and management issues. You will be provided with the most up-to-date information and best practice in dealing with the subject. Towards the end of the workshop, you will have developed the skills and ability to recognise and solve drive problems in a structured and confident manner.

Overview

Most engineering professionals working with drives will confirm that there are major benefits in installing and maintaining mechanical drives correctly. Typical areas which can be dramatically improved include: less wear and tear on equipment; minimal unscheduled downtime and production losses and improved operating efficiencies.

The workshop has been designed to examine most mechanical drives such as belts, chains, gears in terms of improved lubrication, proper alignment and fastening techniques. Finally, there is detailed coverage of troubleshooting techniques so that you can identify symptoms of failure well before the event and thus correct the problem.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

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The Program

MECHANICAL POWER TRANSMISSION
• Laws of motion
• Mechanical advantage
• Basic machines
• Friction

PRIME MOVERS
• Introduction and general types
• AC synchronous motors
• Induction motors
• Operating characteristics
• Selection considerations

BUSHINGS, KEYS, AND KEYWAYS
• Square, flat, tapered and woodruff keys
• Tapered, QD and split bushings
• Splines
• Sizing and fit
• Symptoms of failure

GENERAL LUBRICATION CONSIDERATIONS
• Oil vs. grease
• How much
• How often

BEARINGS
• Types and construction
• Bearing loads
• Numbering systems
• Installation and removal
• Bearing clearance and pre-loading
• Bearing failure
• Bearing life
• Bearing material
• Troubleshooting

CHAINS
• Precision roller chain
• Sprocket selection
• Silent chain
• Engineering chains
• Chain lubrication
• Installation and maintenance

BELT DRIVE SYSTEMS
• V-belt, flat belt, synchronous/timing
• Principles of operation
• Determining proper tension
• Belt selection
• Miscellaneous belts

GEAR DRIVE SYSTEMS
• Open and closed systems
• Parallel, concentric and right angle
• Load factors and selection
• Service factoring
• Installation and maintenance
• Angular errors, backlash adjustment and alignment considerations
• Lubrication
• Gear material
• Troubleshooting

COUPLINGS
• Rigid and flexible couplings
• Universal joints
• Load factors
• Chain couplings
• Installation and alignment
• Hydraulic couplings

CLUTCHES AND BRAKES
• Mechanical, friction, centrifugal and plate clutches
• Clutch selection
• Torque converters
• Mechanical, hydraulic, pneumatic and electric brakes

MECHANICAL VARIABLE SPEED DRIVES
• Open and closed
• Variable speed belt drives, gear boxes and hydrostatic drives
• Installation and adjustment
• Belt materials
• Troubleshooting
• Service factoring

SUMMARY, OPEN FORUM AND CLOSING
PRACTICAL
BALANCING, ALIGNMENT AND
CONDITION MONITORING OF
ROTATING EQUIPMENT

YOU WILL LEARN HOW TO:
• Apply practical techniques for troubleshooting rotating machinery
• Eliminate problems through proven precision maintenance methods
• Identify which machines require precision maintenance
• Reduce maintenance costs
• Prevent failures from occurring
• Manage a precision maintenance program

WHO SHOULD ATTEND:
• Plant Operations and Maintenance Personnel
• Consulting Engineers
• Design Engineers
• Process Technicians
• Plant Engineer Managers and Supervisors
• Process Control Engineers and Supervisors
• Mechanical Engineers
• Pump Sales Engineers
• Pump Service Contractors
• Pump Operators
The Workshop

This is a comprehensive, highly practical and interactive two-day course. You will have an opportunity to discuss precision maintenance for rotating machinery and associated applications, operations, maintenance and management issues. The focus will be on the most up-to-date information and best practice. Towards the end of the workshop, you will have developed the skills and ability to recognise and solve precision maintenance issues in a structured and confident manner, in working and improving the reliability and performance of your rotating machinery.

After an introduction to the application of maintenance and costs of breakdowns, the important issue of vibration and vibration measurement is detailed. The important topic of balancing is then discussed drawing on practical examples. Alignment and other machinery faults are then covered. Other often neglected areas of particle and chemical analysis, temperature monitoring and failure analysis are covered in practical detail. The workshop is concluded with a set of practical rules for a precision maintenance program including issues, such as; which machines to monitor, managing the data usefully and scheduling maintenance.

Pre-requisites

A basic understanding of mechanical processes is not essential, but would be useful.

The Program

INTRODUCTION
• The mission of maintenance
• Maintenance philosophies
• Cost of breakdowns
• The role of precision maintenance

VIBRATION BASICS
• What is vibration?
• Vibration waves
• Overall vibration
• Vibration spectrum
• Natural and forcing frequencies

VIBRATION MEASUREMENT
• Vibration sensors
• Which to choose?
• Sensor specifications
• Sensor mounting
• Spectrum analysers
• Other instrumentation

BALANCING
• Why balance?
• Identifying unbalance
• Practical aspects
• Definitions
• Single-plane balancing
• Four-run method
• Two-plane balancing
• Overhung rotor
• Balancing standards

ALIGNMENT
• Introduction
• Identifying misalignment
• Measuring misalignment
• Rough methods
• Reverse dial method
• Face-rim method
• Laser alignment
• Alignment tolerances

OTHER COMMON MACHINERY FAULTS
• Rotating machinery
• Piping, bases and supports
• Natural frequencies and resonance
• Modal and deflection shape analysis
• Troubleshooting unwanted vibration

RELATED TASKS FOR PRECISION MAINTENANCE
• Tighten, Lubricate, Clean (TLC)
• Chemical and particle analysis
• Ultrasonic inspection
• Temperature monitoring
• Performance monitoring
• Failure analysis

MANAGING YOUR PRECISION MAINTENANCE PROGRAM
• Baselines and trending
• Which machines to monitor
• Managing the data
• Scheduling maintenance
• Outsourcing
• Selling to management: A new mindset

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PIPELINE SYSTEMS - DESIGN, CONSTRUCTION, MAINTENANCE AND ASSET MANAGEMENT

WHAT YOU WILL LEARN:

- Pipeline design standards
- Design and construction considerations
- Prediction, detection and treatment of corrosion
- Environmental and legal requirements
- How to meet and exceed key safety issues
- Optimum risk and financial considerations

WHO SHOULD ATTEND:

Anyone who deals with design, construction and maintenance of pipelines including:

- Mechanical and Maintenance Engineers
- Electrical Engineers
- Pipeline Engineers and Contractors
- Utility Advisors and Planners
- Council and Regional Planners
- Operations and Maintenance Managers
- Technical and Project Managers
- Contract and Asset Managers
The Workshop

This two-day workshop covers the practical aspects of pipeline design, integrity, maintenance and repair. Applicable codes and standards will be examined, as will the issues of mechanical and hydraulic design and construction practices. The optimum routing and layout techniques will also be assessed. You will learn to recognise causes of degradation in-service, whether mechanically induced (pressure, fatigue, pressure transients and external damage) or due to corrosion for example, wall thinning, pitting and cracking.

The focus of this workshop is mainly in a land based environment and will teach you to use key performance indicators to measure the performance of your pipeline system. It concentrates on the consideration of internal, external and pipeline corrosion and assess the various inspection and repair techniques.

You will gain valuable knowledge in the implementation of integrity management programs, periodic inspections and evaluation of results, as well as evaluation of maintenance issues and asset management. Extensive use will be made of case studies and practical exercises to ensure the material is covered as thoroughly as possible.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

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The Program

PIPELINE DESIGN STANDARDS
- Standards development
- International and local codes applicable to pipelines
- Changes to the regulations
- Steps in pipeline design
- Different materials transmitted: gas, steam and water

ROUTING TECHNIQUES AND ENVIRONMENTAL CONSIDERATIONS
- Investigation of pipeline routing techniques
- Environmental issues to consider during planning

SAFETY AND RISK
- Hazard identification processes
- Consequence and probability analysis
- Risk management techniques

PIEPLINE DESIGN CONSIDERATIONS
- Compressible and non-compressible flow
- Discussion of steady state and transient analysis
- Examination of pumps and compressors
- Discussion of optimal pipe size vs. location of pump/compressor stations
- Discussion of optimal pipeline construction material

CORROSION, ASSESSMENT AND REPAIRS
- Introduction to practical corrosion
- Classification of corrosion mechanisms
- Internal corrosion
- Prediction of corrosion rates
- Chemical treatments, inhibitors and biocides
- External corrosion
- Coating applications
- Cathodic protection, design, operation and maintenance
- CP evaluation

PIPELINE CORROSION
- CO2/sweet
- Local and generalised corrosion
- Soils and microbiologically induced corrosion

CONSTRUCTION PROCESS
- Sequential spread
- Efficient construction
- Hot-tap process
- Hydrotesting

STRATEGY, RISK AND FINANCIAL CONSIDERATIONS
- Strategies for on-time delivery of cost-effective projects
- Strategic approach to pipeline construction and management
- Life cycle costing
- Financial analysis techniques

FITNESS-FOR-PURPOSE ANALYSIS
- Pipelines Damage: corrosion, mechanical, weld defects and ground movement
- Assessment techniques

MAINTENANCE PLANNING PROCESS AND ANALYSIS ISSUES
- Pipeline management and maintenance strategies
- Link between task importance and asset criticality
- Maintenance benchmarking techniques

ASSET MANAGEMENT
- Basic, intermediate and advanced asset management plans
- Staging the development of plan improvements
- Link between service delivery strategy and financial considerations

KEY PERFORMANCE INDICATORS: MONITORING AND EVALUATION
- Selection of KPIs to measure asset performance
- Selection of KPIs for your infrastructure business
- KPIs – how to use them to identify weaknesses

SUMMARY, OPEN FORUM AND CLOSING
WHAT YOU WILL LEARN:

- Plant layout fundamentals and procedures
- Fundamental principles of chemical process technology
- Terminology and symbols used in plant layout
- Equipment used in process plants
- Piping design and engineering principles
- Terminology, symbols and abbreviations in piping design
- Documents (bill of materials, equipment specifications etc) and drawings (PFDs, P&IDs etc) used in plant layout and piping design
- 3D modeling of plants and piping systems

WHO SHOULD ATTEND:

This course is designed for personnel who want to understand the design and engineering principles involved in process plant layout and piping design. Those who will benefit the most from this workshop include the following:

- Personnel from EPC (Engineering, Procurement and Construction) companies
- Chemical (process) engineers
- Mechanical engineers
- Piping designers and piping engineers
- Project engineers
- Personnel providing CAD support for plant layout and piping design
- Designers and engineers involved in instrumentation and control of process plants
- Equipment designers and engineers
- Structural designers and engineers
- Electrical designers and engineers
- Consulting engineers
- Plant maintenance personnel
The Workshop

The process plant layout and piping design course is a comprehensive, highly practical and interactive two-day course. You will have an opportunity to learn and discuss the techniques and procedures used in the design and engineering of complex process plants. You will learn the fundamentals of plant layout, the equipment used, design principles and procedures. You will also learn the fundamentals of piping system components and the specification and design of these components. Practical examples from actual projects will be used extensively to illustrate the principles and drive home the point. You will also be provided with a high quality course manual that IDC is known for. This course manual will be useful for many years after the course.

Objectives

Process plants, such as refineries and petrochemical plants, are complex facilities consisting of equipment, piping systems, instruments, electrical systems, electronics, computers, and control systems. The design, engineering and construction of process plants involve a multidisciplinary team effort. Plant layout and design of piping systems constitute a major part of the design and engineering effort. The objective is to design safe and dependable processing facilities in a cost effective manner. The fact is that there are few formal training programs with a focus on plant layout and design of piping systems. Therefore, most of the required skills are acquired while on the job, reducing productivity and efficiency.

This course will cover the fundamental principles and concepts used in process plant layout and piping design. Upon completion of this course the attendees will have a clear understanding of the design and engineering principles used in plant layout and piping design. The outcome will be a work force with the required skills and faster learning curves with minimal on the job training. This will increase productivity and shorted engineering and construction schedules. The process plants will get on stream quicker and operate with increased safety and reliability, satisfying the needs of the client.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION TO PROCESS PLANT LAYOUT AND PIPING DESIGN
- Plant layout fundamentals
- Procedures and workflow
- Physical quantities, units, trigonometry

INTRODUCTION TO CHEMICAL PROCESSING METHODS
- Unit operations and unit processes
- Process Flow Diagrams (PFDs)
- Utilities

EQUIPMENT USED IN PROCESS PLANTS
- Process equipment – reactors, towers, exchangers, vessels
- Mechanical equipment – pumps, compressors, turbines
- Equipment drawings, nozzle specifications, vendor drawings
- Equipment foundations and supports

PLANT LAYOUT AND PLOT PLANS
- Plant layout specifications
- Codes
- Safety considerations
- Plot plans
- Equipment arrangement drawings

PROCESS AND INSTRUMENTATION DIAGRAMS (P&IDs)
- Instruments and instrument symbols
- Control valve manifolds
- Meter runs

PLANT LAYOUT AND PIPING DESIGN DOCUMENTATION AND TOOLS
- Line lists
- Equipment lists
- Bill of materials
- P&IDs
- Piping isometrics
- 3D models
- Piping specifications
- Piping codes

FUNDAMENTALS OF PIPE
- Pipe dimensions
- Pipe data
- Pipe joining methods
- Pipe representation
- Common abbreviations

PIPING SYSTEM COMPONENTS
- Fittings – elbows, tees, reducers, end caps
- Fitting makeup and dimensions
- Flanges
- Valves
- Pipe racks
- Pipe supports
- Anchors and guides

PIPE ROUTING
- Piping isometrics
- Piping plans, sections, elevations
- 3D representation

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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PRACTICAL
MECHANICAL SEALING WITH
ROTARY, PNEUMATIC AND HYDRAULIC
SEAL TYPES PLUS GASKETS

YOU WILL LEARN HOW TO:

• Demonstrate a sound understanding of the fundamentals of seal selection
• Understand environmental considerations related to seals
• See how the experts repair and rebuild seals for outstanding performance
• Troubleshoot seals
• Maximise mechanical seal life
• Classify various seals, including special seal types
• Explain considerations related to the materials used in seal construction

WHO SHOULD ATTEND:

• Consulting engineers
• Design engineers
• Environmental engineers
• Facilities engineers and managers
• Lubrication technicians
• Maintenance personnel
• Mechanical engineers and technicians
• Operation, maintenance, inspection and repair managers, supervisors and engineers
• Operators
• Plant engineers, managers and supervisors
• Plant operations and maintenance personnel

Also anyone involved in maintenance who need or specifies, or uses mechanical seals

Technology Training that Works
The Workshop

Whether you consider yourself an amateur or knowledgeable, practical or theoretical, you will find this mechanical seals workshop is jam-packed with useful, easy-to-apply information. Faced with the bewildering task of selecting the correct seal type and materials of construction for a given application, it’s no wonder many end users leave the job to others. After attending this workshop, you will have the knowledge and confidence to select correct seal types, analyse failed seals, determine the cause/s of failure and propose practical, remedial action.

Learn how, with simple modifications, you can extend seal life and reduce or eliminate causes of premature seal failure. The workshop commences with a solid review of the fundamentals, basic principles and looks at seal classification and design. Special seal types are examined and the materials used to construct seals ranging from elastomeric materials to cemented carbides are examined.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

FUNDAMENTALS AND PRINCIPLES
- Definition of zero leakage
- Mechanics of sealing
- Leakage
- Purpose of sealing
- Basics regarding speed and pressure
- Temperature considerations
- Basic seal requirements
- Seal friction
- Wear and seal life
- Texture

GENERAL AND SPECIAL SEAL TYPES
- Static and dynamic seals
- Special seal types
- Bushing, labyrinth and diaphragm seals
- Gas, motion, slurry seals
- Carbon seals
- Liquid ring and liquid barrier seals
- Inflatable, ferrofluidic seals
- Positive action type
- Self-adhesive compression seals

MATERIALS OF SEAL CONSTRUCTION
- Properties of elastomers
- Elastomeric materials
- Plastic polymers
- Cemented carbides
- Miscellaneous sealing materials

SEALS FOR SPECIFIC/SPECIAL APPLICATIONS
- Hydraulic and pneumatic seals
- Seals for special applications
- Large diameter seals
- High-speed sealing applications and requirements
- Sources of excessive hydraulic pressure
- Overcoming problems associated with high pressure
- Vacuum sealing applications

SEAL SELECTION, APPLICATION AND STANDARDS
- Seal selection guides
- Static and dynamic seal applications
- Standards-ISO, British, DIN, ASME

MECHANICAL SEAL SELECTION AND STANDARDS
- Selection considerations
- Process liquid characteristics
- Inboard vs outboard mounting
- Rotating vs stationary seal ring
- Face loading
- Primary seal ring design
- Secondary sealing devices
- Seal selection rules
- Mechanical seal standards

SEAL FAILURES
- Factors influencing seal life
- Factors affecting seal performance
- Categorisation of failures
- Seal malfunction and probable causes
- Premature failure causes
- Seal face symptoms
- Friction and wear
- Adhesion, abrasion, corrosion and surface fatigue

TROUBLESHOOTING FAILED SEALS
- At the pumping site
- At the equipment teardown
- Leakage types
- Discoloration, chipping, cracking, rubbing, elastomer swelling, stickiness, hardness – what do these mean?

HOW TO MAXIMISE MECHANICAL SEAL LIFE
- Preparing the pump – mechanically, hydraulically
- Controlling temperature in the stuffing box
- Controlling pressure in the stuffing box
- What seal to choose?
- What face combination and elastomer?

SUMMARY, OPEN FORUM AND CLOSING

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BEST PRACTICE DESIGN, MAINTENANCE AND TROUBLESHOOTING OF CONVEYORS AND CHUTES

YOU WILL LEARN:

- Maintenance practice
- The fundamentals of belt conveyor design
- Troubleshooting conveyer problems
- Splicing techniques
- Safety management
- Design and installation
- Capacity, sizing and power of equipment

A practical emphasis ensures that the above concepts are put into practice.

WHO SHOULD ATTEND:

- Maintenance engineers, technicians and staff
- Plant engineers
- Operation, maintenance, inspection and repair managers, supervisors and engineers
- Mechanical engineers and technicians
- Design engineers
- Electrical engineers and technicians
- Consulting engineers
The Workshop

The workshop will cover basic conveyors, selection, safety, legal obligations, terminology and background.

This workshop is designed for engineers and technicians from a wide range of abilities and backgrounds and will provide an excellent introduction to troubleshooting and maintenance of conveyors and chutes. It is intended to cover the fundamentals of belt conveying and would be useful for those with little experience in this area.

Before commencing a detailed course on conveyors it is important to have a solid practical knowledge of the material to be conveyed. A basic knowledge is provided of the bulk materials characteristics and properties.

Numerous tips throughout the course make it practical and topical. Belt conveyors frequently provide the most satisfactory and economical method of transporting materials such as mine ores, earth, sand, crushed stone, cement and concrete. The high and continuous speed of operation of the belt makes for a high capacity of transport of materials.

Throughout the course, you will engage in problem solving and case studies to absorb the materials as quickly and effectively as possible.

Pre-requisites

Fundamental knowledge of basic mechanical plant and operation thereof.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

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The Program

INTRODUCTION
- Fundamentals of bulk materials handling
- Nature of bulk solids
- Characteristics of generally used bulk materials
- Conveyors and chutes overview
  Practical Exercise

BELT CONVEYING
- Introduction
- Layout
- Basic configuration
- Components of a standard conveyer
- Capacity of belt conveyors and selection of belt width
- Selection of other components (belt, idlers, pulleys, takeups etc...)
- Simple calculation of belt tension
- Selection of drive
- Troubleshooting tips
- Take-ups
- Operation and maintenance of belts
- Tips for cost savings
  Practical Exercise

SAFETY OF CONVEYORS
- Conveyor safety standard
- General background on AS 4024.1 (RA and hazard recognition)
- Hazard recognition
- History of accidents
- Key conveyor safety issues
- Demonstration of unsafe conveyors
- AS 1755 conveyors
- Chute doors hazards and controls
  Case Study
  Practical Exercise

MAINTENANCE AND TROUBLESHOOTING OF CONVEYORS
- Troubleshooting conveyor problems
- Types of joints
- Splice failures, inspections and repairs
- Typical problems
- Root cause process
- Systematic approach for tracking
- Site specific problems
  Case Study
  Practical Exercise

CHUTE MAINTENANCE AND TROUBLESHOOTING
- Transfer chutes theory
- Laser scanning applications
- Best practice design
- Boosting flow
- Troubleshooting chutes
- Spillage and build-up
- The awkward marriage of conveyer and chutes
  Practical Exercise

FEEDERS MAINTENANCE AND TROUBLESHOOTING
- Belt, apron, screw and other feeders
- Optimum draw down
- Troubleshooting typical problems
  Practical Exercise

STORAGE AND FLOW
- Flow properties of materials
- Funnel-flow and expanded flow
- Flow rate analysis
- Gravity reclaim
- Bin wall pressures
  Practical Exercise

SUMMARY, OPEN FORUM AND CLOSING

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PRACTICAL PROCESS COMPRESSORS

WHAT YOU WILL LEARN:

- Different types of compressors used in process industry
- Their principle, design, construction, operation and maintenance
- Theoretical basis that helps evaluate the efficiency of their operation
- Operating and Mechanical range and limits of the various types of compressors
- Practical Maintenance – Procedures and Techniques

WHO SHOULD ATTEND:

Anyone who deals with design, operation and maintenance of compressors in the course of their work, including:

- Mechanical Engineers
- Maintenance Engineers
- Reliability Engineers
- Electrical Engineers
- Professional Engineers
- Utility Advisors & Planners
- Municipal & Regional Planners
- Operations Managers
- Maintenance Managers
- Project Managers
- Contract Managers
- Asset Managers
- Technical Managers
The Workshop

This workshop guides you from the basics of thermodynamics to every practical aspect of air and gas compression as used in any process industry. It covers the principle, design, construction, operation and maintenance of the most commonly used types of compressors.

The compressors covered in this workshop include the different types of positive displacement and dynamic compressors. It discusses the special features of every compressor type, their range of operation, applications and limitations. Various aspects needed to size, select, operate, troubleshoot and maintain different types of compressors are covered in great detail.

The topics attempt to encompass the latest in compressor hardware and their manufacturing processes. It covers the various designs and materials of components and details their special features.

The interactions of components bring about the dynamics of gas compression. The correlation of thermodynamics theory to practical gas compression helps you to understand the fundamentals of compressor operation. This association has been done using many numerical examples. The behaviour of various compressor under different conditions is explained in a manner that makes it very simple to understand the how and why of their operation. The user would also be introduced to the various phenomena in gas compression that limit operation of compressor beyond certain limits.

Performance calculations are included and that enable you to evaluate the efficiency and energy requirement of compressors. This helps to benchmark their performance. These are shown as an important tool to troubleshoot compressor problems and aid in operating them in an efficient manner. The various formulae and empirical relationships required to size and select the different types of compressors are also covered.

A special focus is made on the dynamics of compressor machinery. It introduces the user to rotodynamic concepts in rotating machines and various forces and moments in reciprocating machines.

The workshop covers the practical aspects of maintenance of the different compressor types. It covers the key stages of compressor overhaul and repair.

The workshop raises the knowledge bar by many notches for someone new to compressors while at the same proving to be a very good refresher and reference material for an expert in gas compression.

The Program

COMPRESSOR BASICS
- What is a compressor?
- Compressor definitions

GAS PROPERTIES AND THERMODYNAMICS
- Gas Laws and properties
- Calculating properties
- Thermodynamics basics

RECIPROCATING COMPRESSORS
- Mechanics
- Parts of reciprocating compressor
- Troubleshooting compressor problems
- Maintenance of reciprocating compressors

CENTRIFUGAL COMPRESSORS
- Principles
- Parts
- Casing configurations
- Types of centrifugal compressors
- Performance of centrifugal compressors
- Performance coefficients
- Compressor capacity control
- Anti-surge controls
- Compressor sizing
- Rotor dynamics
- Maintenance of centrifugal compressors

SCREW COMPRESSORS
- Principles
- Construction
- Characteristic parameters
- Sizing and performance
- Rotor dynamics
- Capacity control
- Maintenance

LOBE BLOWERS
- Principles
- Construction
- Selection of lobe blowers
- Maintenance of lobe blowers

AXIAL COMPRESSORS
- Principles
- Construction
- Performance curve
- Sizing
- Rotor dynamics
- Maintenance of axial compressors

SUMMARY, OPEN FORUM & CLOSING

On-Site Training

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PERFORMANCE MONITORING OF PUMPS AND COMPRESSORS

WHAT YOU WILL LEARN:

- Optimising equipment performance
- Performance monitoring strategies
- General hydraulic concepts in relation to performance monitoring
- Centrifugal pumps - construction, operational principles, selection criteria, power requirements, efficiencies and losses, characteristic curves, performance calculations
- Gas properties - thermodynamic concepts and processes, Thermodynamic and gas laws, ideal gases, computation of gas properties, gas power cycles
- Reciprocating compressors - construction, operation, compression terms, performance calculations, evaluating efficiencies and methods to estimate them, analysis of PV diagrams
- Centrifugal and axial flow compressors - design and operational aspects, compression terms, performance calculations, evaluating adiabatic and polytropic efficiencies and methods to estimate them

WHO SHOULD ATTEND:

Anyone who deals with design, selection, sizing, operation and maintenance of pumps and compressors in the course of their work, including:

- Mechanical Engineers
- Maintenance Engineers
- Reliability Engineers
- Electrical Engineers
- Professional Engineers
- Utility Advisors and Planners
- Municipal and Regional Planners
- Operations Managers
- Maintenance Managers
- Project Managers
- Contract Managers
- Asset Managers
- Technical Managers
The Workshop

As the process plants have got bigger, the machines have become larger in terms of their power ratings and complexity. At the same time, the demand for efficient operation and higher availability of these machines has been on the rise and this in turn has led to the adoption of modern maintenance strategies and practices by the industry, so that these objectives may be achieved.

Condition Monitoring of equipment is one best practice that has proven itself over the years. It is now considered an integral part of an effective plant asset management strategy. Condition monitoring of plant equipment comprises of

- Mechanical health monitoring
- Performance monitoring

The former includes techniques such as vibration analysis, oil and wear particle analysis, thermography, ultrasonics and others.

Performance monitoring on the other hand is the thermodynamic and hydraulic evaluation of the equipment. This technique determines the efficiency with which energy conversions occur in the equipment. Performance calculations enable the computation of energy requirements of equipments. This helps in benchmarking their performance. In case gaps are noticed, this technique has the ability to trouble-shoot equipment problems. It can also indicate equipment problems that may not be normally detected by mechanical health monitoring. When used together, they help provide efficient operation of the equipment and at higher availability levels.

Another utility of the performance monitoring technique is that the same theory and concepts can be employed in the sizing, selection and re-rating of the equipment. It thus becomes a useful tool especially during the process of evaluation of technical bids.

This workshop covers in detail the technique of performance monitoring as applied to centrifugal pumps and positive displacement, centrifugal and axial flow compressors. The topics of discussion include

- Principles of operation
- Thermodynamic and hydraulic evaluation
- Important performance parameters and selection considerations
- Methods to derive the above from first principles and empirical relationships
- Handling gas and gas mixture properties
- Interpretation of results

The course includes a large number of practical examples that help to learn and clarify the concepts. These can then be readily applied to real machines in plants, to evaluate their present performance, benchmark with rated values and analyse the causes for the gaps. Additionally, examples involving sizing and selection of the equipment are also included.

The workshop will be of immense benefit to those involved in the procurement, operation and maintenance of pumps and compressors.

The Program

INTRODUCTION AND FUNDAMENTALS
- Equipment degradation and loss in efficiency
- Optimising equipment performance and establishing best maintenance practices
- Introduction to performance monitoring
- Performance monitoring strategies and techniques
- Benefits of performance monitoring

HYDRAULIC PRINCIPLES AND CONCEPTS
- General liquid characteristics and properties
- Concepts related to pressure, volume, flow, head and resistance
- Pascal’s law and momentum equation
- Hydraulic power and pump efficiency
- Specific speed
- Cavitation, recirculation and Net Positive Suction Head (NPSH)
- Impact of jet on normally fixed plates, inclined fixed plates and hinge plates
- Impact of jet on a fixed curved vane, moving curved vane and series of vanes
- Velocity triangles

CENTRIFUGAL PUMPS
- Principle of working of centrifugal pumps
- Centrifugal pump components
- Range of operation
- Selection considerations
- Multi-stage operation in centrifugal pumps
- Abnormal operation
- Power requirements, efficiencies and losses in centrifugal pumps
- Pump characteristic curves
- Improving pump reliability
- Performance calculations

SOLVED EXAMPLES AND PRACTICAL EXERCISES

WORKGROUP ASSIGNMENTS

GAS PROPERTIES AND THERMODYNAMIC CONCEPTS
- Basic thermodynamic concepts
- Working substance and thermodynamic processes
- State of a system and its transformations
- Ideal gases
- Equilibrium state
- Overview of the various gas laws
- Laws of thermodynamics
- Gas power cycles

RECIPIROCATING COMPRESSORS
- Principle of operation and construction of reciprocating compressors
- Classification of reciprocating compressors
- Mechanism of a single-stage reciprocating compressor
- Work done in a single-stage reciprocating compressor
- Multi-stage reciprocating compressors
- Work done in a multi-stage reciprocating compressor
- Volumetric efficiency and performance
- Achieving maximum efficiency in multi-stage reciprocating compressors
- P-V diagrams and their analysis

CENTRIFUGAL AND AXIAL-FLOW COMPRESSORS
- Construction and principle of working of centrifugal compressors
- Classification of centrifugal compressors
- Design and operation of axial-flow compressors
- Efficiency and performance characteristics
- Adiabatic and polytropic efficiencies
- Methods used to evaluate efficiencies

Practical session comprising quiz questions and sample performance calculations + exercises

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.
FUNDAMENTALS OF
PIPE STRESS ANALYSIS
WITH INTRODUCTION TO CAESAR II

WHAT YOU WILL LEARN:

- How stress analysis is carried out in piping systems
- The fundamental aspects related to selection of piping materials
- The objective and scope of piping codes
- The theory behind piping system stresses and failure theories
- The basis for determining the design pressure and temperature conditions
- The methods employed to determine pipe wall thickness
- Piping system loads and their characteristics along with code criterion for designing piping systems
- The design criteria for thermal stresses in piping systems
- The significance of pipe stress analysis software in general, with particular emphasis on CAESAR II and the tools and procedures used in the creation of stress models

WHO SHOULD ATTEND:

This workshop is designed for personnel who want to understand the engineering principles involved in pipe stress analysis. Those who will benefit the most from this workshop include the following:

- Chemical (process) engineers
- Consulting engineers
- Equipment designers and engineers
- Mechanical engineers
- Personnel from EPC (Engineering, Procurement and Construction) companies
- Piping designers and piping engineers
- Plant layout and piping design personnel
- Plant maintenance personnel
- Project engineers
- Structural designers and engineers
The Workshop

Piping system design constitutes a major part of the design and engineering effort in any facility. Stress analysis is a critical component of piping design through which important parameters such as piping safety, safety of related components and connected equipment and piping deflection can be addressed. The objective of pipe stress analysis is to prevent premature failure of piping and piping components and ensuring that piping stresses are kept within allowable limits. This workshop is designed for personnel from a wide range of abilities and backgrounds and will cover the fundamental principles and concepts used in pipe stress analysis. In addition to meeting the needs of design, the course is structured to provide you an in-depth understanding of the engineering principles involved in material selection, application of code criteria and the capabilities and tools incorporated in stress analysis software. The extensive use of case studies and practical exercises during the course of the discussion ensures as comprehensive coverage of the material as possible.

The pipe stress analysis workshop is a comprehensive, highly practical and interactive course. Along with learning the fundamentals of piping stress, you will also learn to appreciate the need for stress analysis in piping systems and the various design principles and procedures involved. You will have an opportunity to learn about the failure theories and codes governing piping design and stress analysis. Piping load characteristics and procedures used in designing pipe wall thickness will be outlined in sufficient detail. The importance of stress analysis software in piping system design will be emphasised through a comprehensive overview of the CAESAR II software. Practical examples from actual projects will be used extensively to illustrate the principles involved, to enable a better understanding. You will also be provided with a high quality course manual that will prove useful for many years to come.

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The Program

INTRODUCTION TO PIPE STRESS ANALYSIS
- Need for stress analysis
- Consequences of over stress
- Physical quantities and units used in pipe stress analysis

PIPING MATERIALS
- Introduction
- Material classification systems and specifications
- Common ASTM piping materials
- Material requirements of codes
- Selection criteria for materials
- Piping specifications (piping classes)
- Material testing and certificates

CODES GOVERNING PIPING DESIGN AND STRESS ANALYSIS
- ASME B31.3, ASME B31.4 and ASME B31.8
- Other codes including applicable local codes
- Role and scope of codes
- Information available from codes
- Typical organisation of code material

PRINCIPAL STRESSES AND FAILURE THEORIES
- Longitudinal, circumferential and radial stresses
- Principal axes and principal stresses
- Failure theories:
  - Maximum principal stress failure theory
  - Maximum shear stress failure theory

DESIGN PRESSURE, DESIGN TEMPERATURE AND ALLOWABLE STRESS
- Definition of design pressure and design temperature
- Basis for allowable stress
- Allowable at “hot” and “cold” conditions, that is, Sh and Sc
- Code tables for allowable stresses

DESIGN OF PIPE WALL THICKNESS FOR INTERNAL PRESSURE
- Wall thickness design equations – ASME B31.3, ASME B31.4 and ASME B31.8
- Calculation of Maximum Allowable Working Pressure (MAWP)
- Pressure – temperature class ratings for flanges
- Determining appropriate flange pressure class

LOADS ON PIPING SYSTEMS
- Primary and secondary loads
- Self-limiting and non-self-limiting characteristics of loads
- Sustained and occasional loads
- Static and dynamic loads
- Bending stresses in pipes
- Longitudinal stress and torsional stress
- Code criteria for design

THERMAL STRESSES IN PIPING SYSTEMS
- Thermal expansion/contraction of materials
- Stresses due to thermal expansion/contraction
- Thermal fatigue and cyclic stress reduction factor
- Design criteria for thermal stresses:
  - Stress Intensification Factors (SIFs)
  - Allowable stress range for thermal expansion
  - Calculation of expansion stress range

PIPE STRESS ANALYSIS SOFTWARE
- Introduction to CAESAR II stress analysis software:
  - Overview of CAESAR II software
  - Piping input and creation of model
  - Navigation and toolbars
  - Static analysis and output
  - Checking for code compliance

CAESAR II PRACTICAL EXERCISES
- Piping input – creating the model
- Running the analysis
- Output and interpretation of the results
- CAESAR II practical exercises I and II

SUMMARY, OPEN FORUM AND CLOSING

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Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.
PRACTICAL CORROSION MANAGEMENT

WHAT YOU WILL LEARN:

- Corrosion mechanism, concepts and types
- Metal defects, metallurgical factors and electrical concepts
- Oxidation principles and its effect on metals
- Corrosion forms and characteristics
- Corrosion under specific environmental conditions
- Chemical properties of materials and proper material selection for minimizing the impact of corrosion
- Corrosion protection methods, failure analysis and prevention
- Evaluation of various techniques used for testing and monitoring corrosion
- Corrosion and its impact with regard to different industries

WHO SHOULD ATTEND:

This workshop is designed for personnel who want to learn, understand and effectively implement the principles related to corrosion management, metallurgy and failure prevention. Those who will benefit the most from this workshop include the following:

- Chemical engineers
- Consulting engineers
- Equipment designers and engineers
- Material procurement personnel
- Mechanical engineers
- Metallurgical engineers
- Plant inspection and maintenance personnel
- Process control engineers
- Project and design engineers
- Quality control engineers
- Technical managers
- Weld inspectors
The Workshop

Process plants such as refineries and petrochemical plants are complex facilities consisting of a wide range of equipments and system components and their design, engineering and upkeep involves a multidisciplinary team effort. Corrosion management has a pivotal role to play in maintaining the integrity of a facility, since a large number of incidents and failures that occur in process plants are found to be related to the phenomena of corrosion and erosion. This is more so in the face of increased requirements for improved productivity and cost effectiveness, combined with an increased emphasis on environmental and safety related issues. By effectively managing the critical parameters and activities related to corrosion and material degradation, sufficient cost savings and safety in operation can be ensured. By paying adequate attention to corrosion in aspects related to material selection, construction, operation and maintenance of infrastructural facilities, it is possible to achieve savings to the tune of billions of dollars in repair, maintenance, and replacement costs.

INTRODUCTION TO CORROSION
• Definition of corrosion
• Types of corrosion
• Cost of corrosion

CORROSION FUNDAMENTALS
• Thermodynamic aspects of aqueous corrosion
• Aqueous corrosion kinetics
• Effect of concentration
• Electrode potentials, anodic and cathodic reactions
• Utilities Potential measurement with reference electrode, standard redox potential
• EMF series
• Exchange current density
• Mixed potential theory
• E-log (i) Evans diagram
• Corrosion cells
• Tafel equation and Tafel plot for corrosion rate determination
• Linear polarization and Stern-Geary equation
• Types of polarization and rate controlling step
• Passivity and passivation behavior of iron in nitric acid
• Effect of temperature and pressure on rate of corrosion
• Effect of velocity on rate of corrosion
• Definition and effect of pH
• Dissolved gases and importance of dissolved oxygen

BASIC METALLURGY AND ELECTRICAL CONCEPTS
• Introduction to metallurgy
• Principles of Metallurgy
• Defects in metals
• Metallurgical factors affecting corrosion
• Iron-carbon phase diagrams
• Common ferrous and non-ferrous metals/ alloys
• Microstructure of common metals/alloys
• Weldment metallurgy
• Basic electrical concepts

OXIDATION
• Oxidation of metal and alloys
• Oxidation resistance of low alloy steel
• Environments
• High temperature corrosion

CORROSION FORMS
• Uniform corrosion
• Aqueous corrosion
• Atmospheric corrosion
• Galvanic corrosion
• De-alloying and graphitisation
• Stray current corrosion
• Pitting corrosion
• Crevice corrosion
• Filiform corrosion
• Effects of metallurgical variables on aqueous corrosion
• Effects of metallurgical variables on the corrosion of stainless steels, aluminum alloys and de-alloying corrosion
• Erosion corrosion, impingement attack and cavitation damage
• Stress corrosion cracking, stress corrosion
• Inter-granular stress corrosion cracking, weld decay and knife-line attack
• Hydrogen damage, hydrogen embrittlement
• Selective leaching
• Liquid metal induced embrittlement
• Solid metal induced embrittlement
• Sulfide stress cracking
• Exfoliation
• Caustic embrittlement
• Corrosion fatigue
• Fretting
• Microbiologically influenced corrosion in metals

CORROSION UNDER SPECIFIC ENVIRONMENTAL CONDITIONS
• Corrosion in atmospheres
• Corrosion in portable water, natural waters and sea water systems
• Corrosion in soils
• Corrosion of reinforcement and concrete

DESIGN AND MATERIAL SELECTION FOR CORROSION PREVENTION
• Introduction to methods of corrosion protection
• Corrosion resistance properties of stainless steels
• Corrosion resistance properties of cast iron
• Corrosion resistance properties of carbon steel and low alloy steels

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

The Program

To gain full value from this workshop, please bring your laptop/notebook computer.

INTRODUCTION TO CORROSION
• Definition of corrosion
• Types of corrosion
• Cost of corrosion

CORROSION FUNDAMENTALS
• Thermodynamic aspects of aqueous corrosion
• Aqueous corrosion kinetics
• Effect of concentration
• Electrode potentials, anodic and cathodic reactions
• Utilities Potential measurement with reference electrode, standard redox potential
• EMF series
• Exchange current density
• Mixed potential theory
• E-log (i) Evans diagram
• Corrosion cells
• Tafel equation and Tafel plot for corrosion rate determination
• Linear polarization and Stern-Geary equation
• Types of polarization and rate controlling step
• Passivity and passivation behavior of iron in nitric acid
• Effect of temperature and pressure on rate of corrosion
• Effect of velocity on rate of corrosion
• Definition and effect of pH
• Dissolved gases and importance of dissolved oxygen

BASIC METALLURGY AND ELECTRICAL CONCEPTS
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• Metallurgical factors affecting corrosion
• Iron-carbon phase diagrams
• Common ferrous and non-ferrous metals/ alloys
• Microstructure of common metals/alloys
• Weldment metallurgy
• Basic electrical concepts

OXIDATION
• Oxidation of metal and alloys
• Oxidation resistance of low alloy steel
• Environments
• High temperature corrosion

CORROSION FORMS
• Uniform corrosion
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• Stray current corrosion
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• Crevice corrosion
• Filiform corrosion
• Effects of metallurgical variables on aqueous corrosion
• Effects of metallurgical variables on the corrosion of stainless steels, aluminum alloys and de-alloying corrosion
• Erosion corrosion, impingement attack and cavitation damage
• Stress corrosion cracking, stress corrosion
• Inter-granular stress corrosion cracking, weld decay and knife-line attack
• Hydrogen damage, hydrogen embrittlement
• Selective leaching
• Liquid metal induced embrittlement
• Solid metal induced embrittlement
• Sulfide stress cracking
• Exfoliation
• Caustic embrittlement
• Corrosion fatigue
• Fretting
• Microbiologically influenced corrosion in metals

CORROSION UNDER SPECIFIC ENVIRONMENTAL CONDITIONS
• Corrosion in atmospheres
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• Introduction to methods of corrosion protection
• Corrosion resistance properties of stainless steels
• Corrosion resistance properties of cast iron
• Corrosion resistance properties of carbon steel and low alloy steels

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.
RELIABILITY CENTRED MAINTENANCE (RCM)

WHAT YOU WILL LEARN:

- Understand the history of RCM, i.e. classical, RCM 2 and streamlined RCM
- Paradigm changes in industry due to the implementation of RCM
- Benefits of RCM to your organisation
- Planning the RCM process
- RCM working groups
- Integration of maintenance management with overall business objectives
- Building the RCM principles into new designs
- Development of a maintenance strategy blueprint
- Key Performance Indicators (KPIs) for RCM

WHO SHOULD ATTEND:

This workshop is intended for all maintenance managers, reliability engineers and technicians directly involved in maintaining and preserving the function of assets. Since the RCM process makes use of cross – functional groups as well as the fact that a lasting maintenance program can only be developed by maintainers and users of the assets, it is also recommended that operation/production personnel attend this workshop to ensure an effective RCM program. These should comprise:

- Consulting engineers
- Key leaders from each maintenance craft
- Maintenance managers/supervisors
- Operation specialists
- Planners
- Plant managers
- Reliability engineers/technicians
The Workshop

The primary objective of the maintenance function is no longer only to focus on optimising plant availability at minimum cost. In modern day, maintenance affects all aspects of business effectiveness and risk, i.e. safety, environmental integrity, energy efficiency, product quality, customer service, plant availability and cost. Further to this maintenance is about preserving the functions of assets, as well as avoiding, reducing or eliminating the consequence of failure.

Reliability Centred Maintenance (RCM) is a systematic and structured process used to decide what must be done to ensure that any physical asset, system or process continues to do whatever its users want it to do. It is taking into consideration the primary performance parameters of the asset, possible failure mode and consequence and lastly a suitable failure management policy.

This workshop is designed to familiarise you with the principles and the process of implementing a RCM program. It will help you to apply the rules of RCM through cross-functional review groups in order to produce robust and cost effective asset management programs, by applying the four maintenance strategies, i.e. corrective, preventive, predictive and pro-active.

Pre-requisites

All the principles of RCM will be covered, including the type of strategies, as well as the tools that are used to facilitate the process. A basic knowledge of maintenance management as well as the practical operations and maintenance of assets would be an advantage. This practical experience will enable the workshop to be placed in context.

No special knowledge or skills are required – only a technical background so that there is a better understanding of issues related to RCM and the application thereof.
RIGID AND FLEXIBLE HOSE CONNECTIONS

YOU WILL LEARN HOW TO:

- Obtain a greater understanding of the basic aspects related to hose design and construction.
- Recognize the various hose types from the design as well as application point of view.
- Size and select the right type of hose for a particular application.
- Know about the different materials of construction and the use of reinforced material.
- Obtain a detailed perspective on other hose selection criteria based on parameters such as pressure and temperature and also get to understand better concepts such as shelf life and useful life of hoses in general.
- Identify the common hose fittings, adaptors, couplings and clamps and also other miscellaneous fittings.
- Understand the various hose standards and testing procedures.
- Demonstrate a sound understanding of standard installation practices and hose routing.
- Be well versed in maintenance and safety practices related to hoses.
- Understand the various aspects related to hose failures in general and learn about the common troubleshooting techniques.

WHO SHOULD ATTEND:

- Mechanical engineers and technicians
- Plant engineers and supervisors
- System and design engineers
- Hose manufacturers and suppliers
- Project managers and Consultants
- Plant layout and safety specialists
- Maintenance engineers and technicians
The Workshop

Hose design and construction is a very technical and precise science. Proper selection and sizing of hoses and allied fittings is critical to ensuring the efficiency of a hydraulic system. Good installation and routing practices not only enhance system performance and efficiency but also provide sufficient safeguards under conditions of extreme pressure and temperature. Proper material selection is vital to ensuring long service life of the hose and also goes a long way in minimizing the possibility of premature hose failures.

It is also important to strictly adhere to safety considerations, while deciding on the type of hose to be used in a particular application. Hose condition in general can be effectively monitored through the implementation of timely maintenance practices. In the event that any failure symptoms are identified, remedial measures must be undertaken well in time, if catastrophic failures are to be prevented.

Pre-requisites
No specialist knowledge or skills are required – only a technical background so that there is a basic understanding of various components comprising a hydraulic system and for such factors as the difference between pressure and force.

In fact this course is a good introduction to someone who has had no dealings with hoses in the past as well as an important refresher course for hydraulic system specialists who benefit from the back-to-basics approach.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

On-Site Training

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The Program

INTRODUCTION
- What constitutes a good hose?
- Hose design principles
- Common hose types
- Rigid and flexible applications

CLASSIFICATION AND TYPE
- Classification based on the medium used – Hydraulic, Air, Fuel
- Classification based on the nature of application – Compressor line, Fuel line, Brake line, lubrication line, work equipment control
- Classification based on the equipment type - Plant machinery, Automobile, Marine, Aircraft
- Low, Medium and High-pressure hoses

HOSE DESIGN AND CONSTRUCTION
- Hose requirements
- Hose selection and sizing
- Pressure surges and drops
- Pressure and temperature ratings
- Design considerations of common air, hydraulic and fuel hoses

HOSE FITTINGS AND ASSEMBLY
- Common fittings, connectors, adapters, couplings and clamps used in hydraulic, pneumatic and fuel hose lines
- Design and type
- Assembly and fitting
- Commonly used thread types
- Miscellaneous hose fittings

MATERIALS OF CONSTRUCTION
- Common hose materials
- Material compatibility
- Reinforcement material
- Metallic, non-metallic materials used in the construction of common connectors, fittings and couplings

HOSE STANDARDIZATION AND TESTING
- Purpose of standardization
- Hose standards – SAE, DIN, BS
- Testing requirements
- Test procedures
- Prototype and production testing
- Bursting and Impulse testing
- Service simulation

INSTALLATION AND MAINTENANCE
- Generally recommended installation practices
- Installation procedure on fixed and flexing applications
- Hose routing
- General upkeep and maintenance of hoses

HOSE FAILURES AND TROUBLESHOOTING
- Shelf life and useful life of hoses
- Common hose failures
- Ways to prevent premature hose failures
- General troubleshooting techniques
- Safety considerations

SUMMARY, OPEN FORUM AND CLOSING

“
Instructor has a great depth of knowledge to share and made the topic interesting, useful and practical.

Doug Forsythe

“
SAFETY RELIEF VALVES
INSPECTION, OPERATION AND TROUBLESHOOTING

WHAT YOU WILL LEARN:

- To increase your awareness and understanding that the mechanical integrity of relief valves depends jointly on the proper design, operation, condition assessment, and maintenance of the equipment.
- To provide you with a clear understanding of the degradation mechanisms that relief valves could be subjected to over their operating life, how to identify them, predict and determine their impact, and what appropriate measures can be taken to prevent and control the resultant damage.
- To provide you with the knowledge and failure analysis skills they need to conduct damage and failure analysis so as to prevent similar failures from happening.

WHO SHOULD ATTEND:

Maintenance, production and other plant engineers and technicians responsible for pressure relieving devices.
The Workshop

This three day workshop is structured so that the inspection and maintenance personnel will benefit most from the first two days and the third day will also benefit pressure vessel engineers and system designers. A safety or safety relief valve can be considered the most important single safety device on a boiler, piping, pipeline or pressure vessel. If it fails to function in the manner for which it was intended and an over pressure condition develops, the result could be catastrophic.

Like all mechanical devices, pressure relief valves require periodic maintenance and repair. To properly carry out repairs, it is essential that the work be done by trained personnel under controlled conditions, using proper parts and procedures.

Competencies Emphasised

- Working knowledge in design, operation and maintenance of pressure relieving devices
- Understanding, prediction and identification of degradation and damage mechanisms that affect relief valves fitness for continued service and could result in significant potential failures
- NDT methods and their effective application
- Your company will be able to enhance its ability to use applicable inspection and maintenance resulting in lower life cycle costs while complying with codes and standards, and other regulatory requirements.

Organisational Impact

Your company will be able to achieve measurable improvement in mechanical integrity through effective interaction between engineering, operation and maintenance functions. Your company will be able to enhance its loss prevention and safety performance.

Personal Impact

You will gain sound and practical understanding of the major degradation mechanisms affecting relief valves in oil and gas plants and refinery process units, how to predict them, how to assess their impact on relief valves over their operating life, and how to prevent and control these degradation and damage mechanisms using best industry practices including API and ASME codes.

- Enhance knowledge about inspection and testing strategies and methods and their effective application to achieve the highest probability of detection of damage and defects
- You will achieve a better understanding of the regulations and industry practices pertaining to repairs and alterations to safeguard against related failure and to avoid excessive repair costs
- Enhance competence and productivity thereby enhancing your competence and performance level and making additional value added contributions to your organizations

The Program

**PRINCIPLE OF PRESSURE RELIEF VALVES**
- Operation
- Development and application
- Dimensional characteristics of pressure relief valves

**SAFETY AND RELIEF VALVE TYPES**
- Conventional safety relief valve
- Balanced safety relief valve
- Pilot-operated pressure relief valve
- Pressure and/or vacuum vent valve
- Rupture disk device

**RELIEF VALVE STRATEGY**
- Selection
- Materials
- Sizing overview

**OPERATIONAL CHARACTERISTICS**
- System pressures
- Device pressures

**CAUSES OF IMPROPER PERFORMANCE**
- Mechanical design (springs, materials etc)
- Process (corrosion, fouling, damaged seating surfaces)
- Maintenance

**INSPECTION AND TESTING**
- Reasons for inspection
- Shop inspection/overhaul
- Visual on-stream inspection
- Inspection frequency
- Time of inspection

**TESTING FACILITIES**
- Pressure relief device certifications
- Pressure relief valve repair
- Nameplate data interpretation and stamping

**OVERHAUL**
- Pressure relief valve disassembly
- Lapping and grinding
- Assembly
- Setting, testing and sealing

**SIZING RELIEF VALVES**
- Gas and vapour sizing
- Liquid sizing
- Multiple valve sizing

**CODES AND STANDARDS**
- API RP 576 and API RP 520
- ASME Code Sections I and VIII
- National Board Inspection Code

**QUALITY CONTROL SYSTEMS**
- Records and reports
- The need to keep records
- Responsibilities

**SUMMARY, OPEN FORUM AND CLOSING**

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

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MECHANICAL DESIGN CONCEPTS
FOR NON-MECHANICAL ENGINEERS

WHAT YOU WILL LEARN:

- Basic mechanical engineering concepts such as force, work, power, moments and torques
- The importance of common engineering material properties in relation to component life and failure
- Basic design for static strength
- How to select appropriate gears and bearings
- How to perform simple design and selection of piping systems and related components
- How to monitor, control and analyse vibrations
- How to set up an effective but simple inspection and maintenance program (including lubrication)

WHO SHOULD ATTEND:

This workshop is designed for personnel with a need to understand the use, care, installation, or the economics associated with mechanical machinery. Those who will benefit the most from this workshop include the following:

- Consultants
- Consulting engineers
- Electrical and chemical engineers and technicians
- Industrial and commercial plant and facilities engineers
- Military personnel
- New graduates
- Operators
- Plant engineer/managers and supervisors
- Plant operations and maintenance personnel
- Process control engineers, technicians and supervisors
- Process technicians
- Professionals who want to upgrade their knowledge in mechanical engineering
- Project and design engineers
- Property managers
- Sales engineers
- Service contractors
### The Workshop

Mechanical engineering in simple terms deals with any equipment that moves; this is what makes it perhaps the most broad and diverse of engineering disciplines. The mechanical discipline essentially derives its breadth from the need to design and manufacture everything from small, even nano, individual devices, such as measuring instruments, to large systems such as machine tools, power plants. Easy installation and serviceability are critical to the success of a mechanical system as is operational and design flexibility.

Understanding parameters governing the selection and design of mechanical systems is essential for identifying suitable systems for a particular application. In order to place all these issues in context, a good working knowledge of mechanical principles combined with a solid understanding of key concepts such as force, energy and heat is important.

Mechanical power transmission is discussed from the point of view of gears, couplings and bearings. Proper selection and sizing of these critical mechanical components is vital to ensuring optimum performance and improved efficiency of a mechanical system. Recently, fluid engineering has undergone significant change and therefore a detailed overview of the underlying principles of fluid power and its applications is vital. The theory behind heat transfer, the various heat transfer mechanisms and the design of heat-exchangers is also examined.

Any study of mechanical systems would be incomplete without including a review of mechanical vibrations. This will help you in monitoring, controlling and analysing vibrations and in conducting fault diagnoses in mechanical systems.

The field of maintenance has evolved into a separate and highly specialised function. An effective maintenance regime helps identify failure symptoms and enables initiation of corrective measures, for preventing unscheduled and sometimes catastrophic failures. Lastly, a discussion on the numerous standards, codes and regulations governing mechanical systems, helps put the whole workshop into perspective.

### Practical Demonstrations, Videos and Exercises

We at IDC know that no matter how good the instructor is (and ours are very good!) no one learns from listening to a lecture. Hence we have a busy schedule of activities to help you really learn.

- 23 short, punchy videos on mechanical design, materials, drives, vibrations, fluid, heat transfer and maintenance
- 30 short, practical design exercises on each topic focusing on design, gears, drives, fluid engineering, heat transfer, vibrations and engineering codes and standards
- 4 case studies on mechanical design, gears, fluid engineering and maintenance where you will work in groups to solve real mechanical engineering problems

*Please bring a calculator to get maximum benefit. To gain full value from this workshop, please bring your laptop/notebook computer.*

### The Program

#### MECHANICAL ENGINEERING BASICS
- Introduction and basic concepts
- Units for engineering quantities
- Interpretation of mechanical drawings
- Friction - importance in mechanical systems, types, static and dynamic friction coefficients

#### ENGINEERING MATERIALS
- Stress - strain relationship
- Properties of engineering materials: strength, hardness, ductility and toughness
- Thermal processing of metals and how it affects their properties
- Ferrous and non-ferrous alloys
- Common failure of modes of materials: fracture, fatigue, creep and corrosion

#### MECHANICAL DESIGN
- Basic principles
- Factor of safety
- Static equilibrium
- Design for static strength
- Threaded fasteners
- Keys and keyways
- Riveted joints
- Design for fatigue strength

#### GEAR AND BEARINGS
- Gears: terminologies, types, ratios and gear trains
- Gear selection and gearboxes
- Troubleshooting gear problems
- Bearings: loads, types, selection and troubleshooting
- Installation guidelines

#### MECHANICAL DRIVES
- Belt and chain drives
- Mechanical couplings
- Hydrostatic drives
- Hydrodynamic drives
- Torque converters and fluid couplings
- Clutches: types, performance and selection
- Brakes: types, performance and selection

#### PRIME MOVERS
- What is a prime mover?
- Internal combustion engines
- Electric motors
- Hydraulic and air motors
- Gas turbines
- Mechanical variable speed drives
- Hydraulic and pneumatic cylinders
- Comparative merits/demerits of different prime movers
- Primer mover selection criteria, applications

#### FLUID ENGINEERING
- Concepts: viscous flow and Reynolds number
- Piping, selection and sizing
- Pumps and valves: types and applications
- Fluid engineering symbols and diagrams
- Analysis of piping systems
- Seals, fittings, flanges gaskets and O-rings
- Mechanical seals: types, selection and maintenance

#### THEORY OF HEAT TRANSFER
- Laws of thermodynamics
- Thermal cycles
- Heat exchangers: types, maintenance and troubleshooting
- Heat pumps
- Air conditioning
- Heat: conduction, convection and radiation

#### MECHANICAL VIBRATIONS
- Single degree of freedom system
- Terminologies: amplitude, phase and frequency
- Natural frequency of vibration
- Multiple degree of freedom system
- Vibration measurement: sensors, analysers and interpretation
- Use of vibration as a condition monitoring tool
- Troubleshooting and correcting unwanted vibrations

#### MANUFACTURING AND PRODUCTION SYSTEMS
- Metal production - foundry process
- Cast making and metal melting
- Die and precision casting
- Heat treatment (hardening and softening)
- Hot and cold working of metal
- Presses
- Numerical control
- Machining and metal cutting
- Broaching, shaping and sawing
- Basics of welding and types of welded joints
- Brazing
- CAD/CAM
- Rapid prototyping

#### MAINTENANCE
- Objectives, reliability and availability
- Breakdown, preventive and predictive maintenance
- Standard practices and tools
- Lubrication
- Factors influencing equipment downtime
- Hazardous failures
- Condition monitoring methods
- Non-destructive testing and inspections
- Planning and inspection schedules

#### MECHANICAL ENGINEERING CODES AND STANDARDS
- Need for standardisation
- Mechanical engineering standards
- Overview of standards
- Benefits of standardisation
- ISO 9000/1
- Six-sigma

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PRACTICAL HYDRAULIC AND PNEUMATIC SYSTEMS: OPERATIONS AND TROUBLESHOOTING

YOU WILL LEARN HOW TO:

- Work with basic hydraulic and pneumatic components
- Understand essential hydraulic and pneumatic terms and understand their key applications
- Describe the characteristics of fluid used in hydraulic systems and air used in pneumatic systems
- Understand how the basic hydraulic components function in a hydraulic circuit and how the basic pneumatic components function in a pneumatic circuit
- Read hydraulic and pneumatic schematics
- Perform simple circuit design using standard symbology and functions such as automatic return, logic control, speed control, pressure sequencing, reduced actuator forces and timing
- Discuss the correct operation, control sequences and procedures for the safe operation of various simple hydraulic and pneumatic systems
- Troubleshoot simple hydraulic and pneumatic system problems
- Make simple repairs to hydraulic and pneumatic systems
- Minimise forced outages and prevent serious damage to hydraulic and pneumatic equipment
- Outline the latest technologies available for electro hydraulic and pneumatic systems

This is not an advanced workshop but one focusing on the fundamentals. You are however expected to have some knowledge of the topic of hydraulics and pneumatics. Pre-course reading will be provided for you if you have no knowledge whatsoever.

WHO SHOULD ATTEND:

- All those who plan to make career in hydraulics and pneumatics
- All those working with hydraulics and pneumatics systems
- Consulting engineers
- Design engineers
- Mechanical engineers
- Mechanical technicians
- Operation, maintenance, inspection and repair managers, supervisors and engineers
- Plant engineers
- Plant operations and maintenance personnel
- Process technicians
This information packed practical course on hydraulics and pneumatics would enhance your knowledge of the fundamentals, improve your maintenance programs and help you become excellent troubleshooter of the problems in this area. No matter what hydraulics or pneumatics applications you are working on, and what the level of your knowledge, the workshop will be highly beneficial to you.

The practical hydraulics and pneumatics workshop is a comprehensive, highly practical and interactive two-day course. You will have an opportunity to discuss construction of hydraulic and pneumatic systems, design-applications, and learn operations, maintenance and management issues. You will be provided with the most up-to-date information and best practice in dealing with the subject.

During the course sessions cutaways of all major components are brought to visually demonstrate the components’ construction and operation. Developing an understanding of “how” it works leads to an understanding of how and why it fails. Multimedia views of the equipment are given to you as realistic a view of hydraulic and pneumatic systems as possible. Towards the end of the workshop, you will have developed the skills and ability to recognise and solve hydraulic and pneumatic problems in a simple, structured and confident manner.

Pre-requisites
A fundamental knowledge of basic mechanical plant and operation thereof and some exposure to hydraulic and pneumatic systems would be helpful but is not essential.

The Program

**HYDRAULIC SYSTEMS**

**INTRODUCTION TO HYDRAULICS**
- Origin of hydraulics and classification

**FUNDAMENTALS**
- Force, work, power, energy, mass, weight, torque, density, specific gravity, specific weight, basic hydraulic principles, properties of fluids, viscosity

**PRESSURE, LAWS AND FLOW**
- Hydrostatic principles
- Pascal's Law and applications
- Pressure-force relationship
- Fluid flow and flow rate
- Bernoulli’s equation

**HYDRAULIC PUMPS**
- Principle of pump operation
- Classification (positive and non-positive displacement)
- Standard parameters for pump selection
- Gear, vane, piston motors
- Piston: radial piston, axial piston, fixed displacement and variable volume, bent axis pumps
- Pressure, flow and efficiencies of pumps

**HYDRAULIC MOTORS**
- Principle of motor operation
- Performance characteristics
- Classification of hydraulic motors
- Gear, vane, piston motors
- Difference between hydraulic motors and hydraulic pumps
- Specifications of hydraulic motors
- Efficiency of hydraulic motors and their sizing

**HYDRAULIC CYLINDERS**
- Classification (single and double acting)
- Construction of cylinders
- Sealing systems used in cylinders
- Design of cylinders
- Common cylinder problems

**DIRECTION CONTROL VALVES**
- Functions of direction control valves and their classification
- Valve symbols
- Valve elements: reciprocating spools, rotary spools, poppet type
- Spool valve element: characteristics and position changeover
- Centre conditions
- Non-Return Valves (NRV)
- Check valve

**PRESSURE CONTROL VALVES**
- Classification of pressure control valves
- Pressure relief valves (pressure regulating and emergency relief)
- Pressure reducing valves

**FLOW CONTROL VALVES**
- Functions of flow control valve
- Classification of flow control valves (non-pressure compensated and pressure compensated)
- Location of flow control valve (metre-in, metre-out and bleed-off circuits)

**ELECTRO-HYDRAULIC SYSTEMS**
- Proportional solenoid valves: technology and operation
- Types of proportional valves (direct, control, flow control and pressure control valves)
- Servo valves: first and second stage use of transducers in hydraulic systems
- Comparison of proportional and servo valves

**HYDRAULIC ACCESSORIES**
- Hydraulic oil reservoirs types (pressure and non-pressure types)
- Hydraulic filters
- Hydraulic tubes and fittings
- Hydraulic hoses and fittings
- Hydraulic accumulators

**HYDRAULIC FLUIDS**
- Types of hydraulic oils
- Oil additives
- Common problems with hydraulic oils (cavitation, aeration, foaming)
- Oil sampling and oil cleanliness
- Monitoring oil and removing contamination

**SEAL DESIGN IN HYDRAULIC SYSTEMS**
- Classification and types
- O-rings and their applications
- Common seal materials
- Reasons for seal failures

**HYDRAULIC CIRCUITS**
- Types of hydraulic circuits
- Symbols used in hydraulic circuits
- Pump unloading circuit
- Pressure control circuit
- Counterbalance circuit
- Regenerative circuit
- Pre-fill and compression relief circuit

**MAINTENANCE AND TROUBLESHOOTING**
- Commissioning
- Maintenance
- Troubleshooting

**PNEUMATIC SYSTEMS**
- Air preparation, generation and distribution
  - Characteristics of air
  - Air generation, preparation and distribution
  - Characteristics of pneumatic systems

**SYMBOLS AND STANDARDS**
- Standards for pneumatic systems

**PNEUMATIC ELEMENTS**
- Basic structure of pneumatic control system
- Components of pneumatic systems
- Compressors
- Directional control valves
- Flow control valves
- Other control valve types
- Actuators and output devices
- Cylinders (single and double acting)

**BASIC CIRCUIT DESIGN**
- Operation of single and double-acting cylinders
- Timing system for cylinder extend and retract cycle
- Speed and safety control systems

**TROUBLESHOOTING AND FAULT FINDING PNEUMATIC SYSTEMS**
- Maintenance requirements
- Guidelines for maintenance of system components
- Troubleshooting problems

**SUMMARY AND OPEN FORUM**
PRACTICAL
CONVEYOR, CHUTE AND
FEEDER DESIGN

YOU WILL LEARN BEST PRACTICE IN:

• Maintenance of conveyors
• Troubleshooting conveyor problems
• Splicing techniques
• Safety management
• Design and installation
• Capacity, sizing and power of equipment
• The fundamentals of belt conveyor, chute and feeder design

WHO SHOULD ATTEND:

• Consulting engineers
• Design engineers
• Electrical engineers and technicians
• Maintenance engineers, technicians and staff
• Mechanical engineers and technicians
• Operation, maintenance, inspection and repair managers, supervisors and engineers
• Plant engineers
The Program

INTRODUCTION AND OVERVIEW

PRACTICAL CONVEYER DESIGN
- Review of bulk material characteristics
- Layout
- Component selection
- Lump size limitation
- Capacity
- Minimum pulley diameters
- Burden cross sectional area calculations
- Volumetric capacity
- Velocity calculations
- Idler spacing and load rating
- Belt tension calculations
- Drive arrangements
- Power demand capacity
- Starting and stopping
- Start up current calculations
- Vertical curves
- Gearbox and drive selection
- Safety factors
- Bearing types and selection

Conveyor design calculations exercises

CHUTE DESIGN
- Liner selection
- Use of solidworks
- DEM and application to transfer design
- Stress analysis using cosmos

Chute calculation exercise

FEEDER DESIGN
- Calculation of loads/drive torques and power
- Feeder selection

Feeder design exercise

APPLICATIONS AND FUTURE TRENDS
- Case studies
- Future trends in conveyors and hoppers/bins and chutes

SUMMARY, OPEN FORUM AND CLOSING

The Instructor put points across excellently - due to his personal experience.

Marius Joubert
PROJECT AND FINANCIAL MANAGEMENT

TRAINING WORKSHOPS

Practical Financial Fundamentals and Project Investment Decision Making .......................................................... 8.1
How to Manage Consultants ........................................................................................................................................... 8.3
Practical Marketing for Technical Professionals ........................................................................................................... 8.5
Practical Project Management for Engineers and Technicians .................................................................................... 8.7
Practical Specification and Technical Writing for Technical People ............................................................................. 8.9
Train the Trainer - Presentation & Instructing Skills for Engineers and Technical Professionals .......................... 8.11
Leading your Engineering Team to Top Performance ................................................................................................. 8.13
The Practical Business Engineer .................................................................................................................................. 8.15
People Management Skills for Technical Professionals ............................................................................................... 8.17
Engineering Leadership - Making the Transition from Engineer to Leader ................................................................. 8.19
Practical Shutdown and Turnaround Management for Engineers and Managers .................................................... 6.21
PRACTICAL FINANCIAL FUNDAMENTALS AND PROJECT INVESTMENT DECISION MAKING

YOU WILL LEARN HOW TO:

• Understand economic evaluation techniques in engineering project proposals
• Calculate the financial viability of expenditure proposals
• Optimise the use of capital on your projects
• Understand the essentials of discounting cash flows for a project and calculate NPV as well as IRR
• Manage your company assets more effectively and know when to replace equipment
• Execute sensitivity studies taking into account risk and uncertainty
• Rank alternative investment proposals using discounted cash flow techniques
• Understand different economic evaluation methods
• Prepare project expenditure proposals that can win management approval
• Make effective decisions when short of capital
• Read and explain financial statements
• Communicate with your financial manager and peers
• Manage your personal wealth and finances far more effectively than before

WHO SHOULD ATTEND:

• Instrumentation Engineers
• Mechanical and Electrical Engineers and Technicians
• Technical Professionals
• Production Workers
• Management Accountants
• Sales Engineers
• Plant Engineers, Operators and Supervisors
• Technical Specialists
• Metallurgists and Scientists
• Consulting Engineers
The Workshop
Finance courses are among the most frequently requested by engineers and technical professionals. One reason is rapidly advancing technology, increasing project complexity and competitive pressures place enormous demands on you to do the best possible cost estimation and economic evaluation of your engineering projects, products and services. Secondly, people wish to communicate effectively with finance personnel and in the board room, but don’t understand the language.

Finance is, in fact, uncomplicated. The main problem is that accountants (as with other specialists in their fields) communicate using a language that has much topic-specific jargon. In today’s world financial decisions are coming under increasing scrutiny. It is essential therefore that you have enough information to make effective choices and to drive your engineering projects forward with sound justifications.

This course commences with the basics of finance pertinent to engineers and technical professionals. Basic accounting and finance terms are explained in simple English with an emphasis on the engineering and technology world. Cash flow concepts are discussed and the issue of making appropriate investment decisions is examined, using such techniques as NPV and IRR. Finally, capital budgeting and risk are discussed in an easy-to-understand manner.

This is certainly not an advanced course, but one aimed at providing you with the fundamentals of Financial Management from a practical engineering and technology perspective.

Pre-requisites
A basic knowledge of projects and accounting concepts would be useful, but is not essential.

Practical Sessions
Seven useful practical exercises which you engage in to demonstrate the application of the concepts to your next engineering project or industry in general.

The Program
FINANCIAL STATEMENTS
- Recording of financial information
- Assets, equity and liabilities
- The Balance Sheet
- The Profit and Loss Statement
- The Cash Flow Statement
- Ratio analysis
  - Liquidity ratios
  - Leverage ratios
  - Activity ratios
  - Profitability ratios
  - Investment ratios
- Cash flow versus profit
- Du Pont analysis
Practical Exercise

COST ESTIMATION
- Direct and indirect costs
- Fixed and variable costs
- Breakeven analysis
Practical Exercise

CASH FLOW CONCEPTS
- Cash flow models for manufacturing
- Depreciation methods
  - Straight line
  - Declining balance
  - Years digits
- Cash flow forecasts
Practical Exercise

TIME VALUE OF MONEY
- Compounding vs discounting
- Discount Rate, Hurdle Rate and Cost of Capital
- Present and future values of money
- Effect of compounding period
- Effective and nominal interest rates
- Compounding and discounting multiple cash flows
- Net Present Value vs Internal Rate of Return
- Annuities
- Compounding and discounting tables
- The use of spreadsheets
Practical Exercise

RANKING OF INVESTMENT PROPOSALS
- Undiscounted and discounted payback method
- NPV method
- NFV method
- IRR method
- Benefit/cost ratio and NPV ratio methods
- Incremental NPV method
- Incremental ROI method
Practical Exercise

CAPITAL MANAGEMENT
- Capital rationing
Practical Exercise

EFFECTS OF INFLATION
- Inflation and NPV
Practical Exercise

RISK AND UNCERTAINTY
- Sensitivity analysis
- Monte Carlo analysis
Practical Exercise

TYING IT ALL TOGETHER
- Revision of the key concepts
- How to apply this to corporate financial decision making
- How to apply this to personal wealth creation

OPEN DISCUSSION AND CLOSING

On-Site Training
✓ SAVE over 50% by having an IDC workshop presented at your premises.
✓ Customise the training to YOUR workplace.
✓ Have the training delivered when and where you need it.

Contact us for a FREE proposal.

Well structured and very informative.
Bruce McLennan
HOW TO MANAGE CONSULTANTS

YOU WILL LEARN HOW TO:
- Recognise the myths and realities about using consultants
- Properly define your consulting projects
- Select the right consultant for the project
- Get what you want from consultants
- Communicate your needs more effectively
- Manage using effective and flexible methods
- Minimise disputes, delays and other problems
- Get your projects done on time and within budget
- Get the best value for your money

WHO SHOULD ATTEND:
- Engineers, Accountants, Supervisors
- Project and Maintenance Managers
- Human Resources Professionals
- Financial and Marketing Managers
- Purchasing and Procurement Officers
- Occupational Health and Safety Professionals
- Contract Administrators
- Quality Assurance Co-ordinators
- All users of Consulting Services
The Program

CONSULTANTS - WHO THEY ARE AND HOW THEY WORK
- Advantages and disadvantages of using consultants
- Internal consultants - when to use them and how
- 10 reasons why you may consider outsourcing services
- Avoiding outsourcing pitfalls - the warning signs
- The right and wrong reasons for hiring outside consultants
- How to recognise qualities of top consultants
- Ten wrong reasons for hiring consultants

MODELS OF CONSULTATION
- 3 types of client-consultant relationship - which one should you use and how?
- Various roles consultants should and should not play
- Why role-confusions occur

SELECTING CONSULTANTS
- How to justify the use of consultants on your project
- Developing the process and criteria for evaluating and selecting consultants
- Establishing your needs and requirements
- Problems with under- and over-requirements
- The 7 most common project proposal flaws and how to spot them
- 4 things to look for when comparing and evaluating proposals
- Recognising the 7 types of bias in hiring consultants and minimising its impact
- Interviewing and evaluating consultants

Exercise: Assessing the consultant

MANAGING CONSULTING CONTRACTS
- 3 ways to create a consulting contract
- Types of consulting contracts and charging methods - which one to choose and when
- How to negotiate favourable consulting contract terms
- 6 tactics you can use to reduce consultants fees
- An overview of contract law
- 14 items you should always include in your consulting contract

Case Study: Withdrawal of tenders

MANAGING CONSULTING PROJECTS
- What is project management?
- 5 aspects of each consulting project
- Goals of an engineering system or project - technical, economic, operational health, safety and environmental
- Estimating and budgeting issues
- Balancing risk versus cost

Exercise: Budgeting dilemma

CONSULTING PROJECT TEAMS
- Team issues
- Team roles and personalities
- 3 ways of managing a consulting team
- 7 most common team problems and how to overcome them

Teammwork and negotiation exercise: The road building project

HOW CONSULTANTS SOLVE PROBLEMS
- Dealing with problems. The ice-block theory.
- Fallacies (Faulty reasoning)
- 2 ways towards finding a solution to client’s problems
- Changing your frame of mind - paradigm shifting in consulting

Problem solving exercise: The case of pokey elevators

MONITORING AND CONTROLLING CONSULTANTS
- 10 most common client complaints
- 5 basic clients’ management styles
- Methods for effective control of consultants
- Comparing proposals with final reports
- Evaluating the evaluation process

Case Study: From negotiation to litigation in the construction industry

COMMUNICATING WITH CONSULTANTS
- Levels of communication
- The impact of your communication
- 4 types of consultants and how to communicate with them
- Barriers to effective communication - how to identify and remove them
- 7 rules of communicating with consultants
- Progress reports and meetings - practical communication issues

Exercise: Broken squares

CRISIS MANAGEMENT
- SWOT analysis
- Dispute avoidance and minimisation
- Signs of trouble
- The psychology of a crisis
- How to use flexibility and contingency plans instead of fire-fighting
- Strategies for conflict resolution

FOCUSING ON CLIENTS
- Analysing yourself and your organisation
- Various types of clients and where they go wrong - discover which type is you!
- Case Study: The Sydney Opera House
- Client’s fears about consultants and how to overcome them
- Evaluation: your consulting ethics
- Productive and counter-productive client’s attitudes and strategies
- Common mistakes clients make and how to avoid them

WHY CONSULTING PROJECTS FAIL
- Individual factors
- Organisational factors
- Corporate constraints and resistance to change
- The games consultants play

REVIEW OF THE COURSE, QUESTIONS AND CLOSE
- Questions and answers
- Overview of literature and further reading

Exercise: Action steps to be taken from the workshop to the workplace

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Neil Petersen

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PRACTICAL MARKETING FOR TECHNICAL PROFESSIONALS

WHAT YOU WILL LEARN:
- Find, keep and grow profitable clients
- The nuts and bolts of industrial marketing
- Identify your product's unique selling points
- Create an effective marketing message
- Segment your market
- Design a professional industrial marketing campaign
- Develop and retain long term client relationships
- Select and use promotional media to your advantage: print ads, direct selling, web, email, direct mail, technical articles, press releases and brochures
- Use industrial guerilla marketing to minimise your costs
- Harness Public Relations (PR) in your campaigns
- Develop and nurture long term client relationships

WHO SHOULD ATTEND:
- Engineers
- Technicians
- Sales Engineers & Technicians
- Managing Directors & Managers
- All marketing people
- Technical people who need an introduction into the commercial world
- Those who need a refresher course
- All personnel who are marketing a technical product to technical people
The Workshop

Engineers, technicians and other technical professionals are notoriously cautious about industrial marketing. Often taught from an early age that this is a pursuit to be avoided at all costs. However the most successful industrial companies have a strong underlying focus on marketing and sales. Marketing can be considered nothing more than astute communicating of your message about your products - whether they be services or widgets. This workshop will distil the instructor’s 30 years worth of experience in industrial marketing into one short day in applying an integrated marketing approach to your business. We will show you how to combine your technical expertise with world class marketing skills to improve your company’s sales and indeed profits and make you an indispensable member of your team. You will leave with an increased level of skills in improving your marketing for your industrial products. This workshop will equip you with the competitive advantage to prosper in the 21st century to outsmart, outmarket and outsell your competitors and indeed grow the overall market in which you operate.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed during the workshop.

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The Program

FROM IDEA TO MARKET
• How marketing can make the difference between success and failure

UNDERSTANDING THE PROCESS
• Marketing vs Sales
• Why is engineering marketing different?

Practical Exercise
• What are the essential factors in engineering marketing?
• How can I make these factors work for me?

Practical Exercise

WHAT IS MARKETING?
• Various definitions
• Changing your customers’ perspective

Practical Exercise

THE MARKETING MIX: THE 4 (OR MORE) P’S
• What message do you want to send? (product)
• What value will your customer be getting? (price)
• What is your target market? (place)
• Which promotional media will you use? (promotion)

Practical Exercise

THE RETURN CHANNEL

• Sales staff
• Distributors
• Service/installation staff
• Receptionists
• Accounts department (debt collection)

Practical Exercise

BARRIERS TO RECEIVING
• Non-marketing staff and their role in marketing
• Insufficient technical staff
• Difficult order-taking process
• Poor reception facilities and staff
• Barrier secretaries and your prompt replies
• Recognition of problems and their solutions

Practical Exercise

PROBLEMS IN THE LOOP
• Identifying problems in the marketing process and how to solve them

Practical Exercise

ANALYSING ORGANISATIONAL PROBLEMS
• SWOT: How to get the system functioning properly

Practical Exercise

BRANDING
• Creating and promoting brand awareness with potential customers

Practical Exercise

LEARNING ORGANISATIONS
• Personal improvement
• Shared vision within the company
• Team learning
• Scenario planning
• Systems thinking with feedbacks and dead-time

A “learning organisation” will recognise that they consistently need to build on their strengths and work on their weaknesses to become unassailable.

Practical Exercise

TIME AS A DIMENSION
• The ongoing nature of marketing, and the need for consistent messages over long time periods
• Advantages of customer retention
• Costs of new customers vs retaining existing customers

Practical Exercise

CONCLUSION
• Understanding and preparing for economic and business cycles
• Making the cycles work for and with you
• Sharpening the axe by using the cycles to your advantage

Practical Exercise
PRACTICAL
PROJECT MANAGEMENT
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Plan to meet deadlines and complete projects within budget and on time
- Manage resources effectively
- Develop the personal skills critical to effective project management
- Organise and improve performance to create a productive and competent team
- Evaluate and make use of project management software packages
- Create quality project plans
- Generate effective work breakdown structures
- Create computerised PERT and Gantt charts for your projects, add and level resources, and monitor/report on your project effectively
- Define appropriate cost reporting mechanisms for your projects
- Define, analyse and manage the risks associated with your projects
- Introduce appropriate quality management procedures
- Keep your projects on track using the ‘Earned Value Analysis’ method
- Exercise an appropriate leadership style and keep team members creative and motivated
- Avoid the pitfalls caused by a lack of understanding of the legal issues pertaining to projects
- Use appropriate software to leverage your time and expertise
- Deal with projects that have a large degree of inherent uncertainty and/or a strong emphasis on timely completion
The Workshop

More and more engineering and technical professionals are making career transitions from product design into project management. This, however, requires formal training and a willingness to learn new skills. All the technical know-how in the world will not deliver a project successfully, without proper project management skills. Unfortunately very few engineering professionals have any degree of formal project management training, which results in a great deal of personal stress as well as cost blowouts and other woes.

To address this problem, the workshop will focus on the critical project related activities such as work breakdown, scheduling, cost control and risk management, and show how these can be performed with software to lighten the project manager’s workload. The ‘soft’ (but equally important) aspects such as team leadership and contract law are also covered in detail. All topics will be supplemented with practical exercises focussing primarily on the areas of electrical/electronic (including instrumentation) and mechanical engineering. If delegates wish to do so, they can choose small projects from their work environment as a basis for the practical exercises.

Pre-requisites

A basic appreciation for the concepts involved is desired but not essential.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

Who Should Attend

- Engineering professionals
- Technical personnel
- Information technologists
- Maintenance/ supervisory managers
- Project team members in
  - Manufacturing
  - Process industries
  - Research & development
  - Utilities
  - Local authorities

The Program

INTRODUCTION TO PROJECT MANAGEMENT

FUNDAMENTALS OF PROJECT MANAGEMENT
- Overview of the project environment
- Project life cycle and phases
- Project organisations
- Project success
- Project definition
- Project planning

Case study - An exercise in developing a work breakdown structure

TIME MANAGEMENT
- The Precedence Method of schedule analysis
- Presentation of the schedules
- Resource analysis
- Monitoring and reporting achieved progress
- Selection of software

Case study - Application of the Precedence Method analysis technique

COST MANAGEMENT
- Cost estimating
- Budget presentation
- Financial control
- Change control
- Cost reporting
- Value management

Case study - Preparation of a project cost report with variance analysis

INTEGRATED TIME AND COST MANAGEMENT
- The Performance Measurement System (PMS) defined
- Determining cost and schedule variance
- Computer software PMS tools

Case study - An exercise in integrated time/ cost analysis

CONSTRUCTION CONTRACTS
- Procurement strategies
- Responsibilities of the parties
- Tender and contract documentation
- Conditions of contract
- Contract disputes

MANAGEMENT OF THE PROJECT TEAM
- Management and leadership
- Organisation and project team cultures
- Motivation and employment
- Authority and power of the project manager
- Required attributes and essential functions

QUALITY MANAGEMENT
- Defining quality and quality management
- Quality systems
- ISO 9000
- Project quality assurance
- Preparation of ITFs

Case study - Preparation of inspection and test plans

RISK MANAGEMENT
- Risk management defined
- Risk identification
- Risk analysis
- Risk management responses

AN INTRODUCTION TO CONTRACT LAW
- The legal system
- Essential elements of contracts
- Factors destroying the legal force of contracts
- Termination of contracts
- Breach of contracts
- Time extensions and liquidated damages

Case study - Analysis of contractual situations

PROJECT PLANNING SESSION

Working in teams you will develop an outline project quality plan for a defined engineering scenario.

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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YOU WILL LEARN HOW TO:

- Systematically design and write accurate and comprehensive technical specifications
- Write realistic specifications, thereby improving project management and performance
- Write clear and concise formal reports, equipment manuals and other technical documentation
- Develop effective communication with technical as well as non-technical staff at all levels (from top management within the organisation to the end user in the home environment)
- Brainstorm and identify technical problems and solutions
- Collect, organise, analyse and evaluate information
- Transfer technical information into powerful graphs, flowcharts and tables
- Translate technical documents into captivating oral presentations

WHO SHOULD ATTEND:

- Engineering professionals (e.g. project and design engineers)
- Maintenance planning staff
- Maintenance/supervisory managers
- Technical personnel
- Project team members in: manufacturing, process industries, tendering, contracting, marketing, procurement, feasibility study, research and development, utilities and local authorities
The Workshop

Researching and preparing technical documents, especially technical specifications, calls for much effort and time. This workshop is designed to give you step by step guidance to writing these documents in a professional manner, working within a cost and time framework.

The course will demonstrate techniques to establishing more effective communication between technical and non-technical staff and foster skills relating to problem identification and solutions, plus enhancing skills in information seeking, research and organising collected data in a non-conflicting, unambiguous manner.

Pre-requisites

A fundamental knowledge of basic technical writing of reports is expected and some understanding of what you want to achieve with specification writing.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION TO TECHNICAL WRITING
• Fundamentals of technical writing

FORMATS OF TECHNICAL WRITING
• Formal report, technical memo reports, technical proposals, equipment/maintenance manuals, journal articles

TYPES OF TECHNICAL REPORTS
• Periodic, progress, research, recommendation, field, feasibility

COMPILING THE REPORT
• Establish a framework
• Terms of reference: subject matter, purpose for writing it, reader of the report

STRUCTURE OF A TECHNICAL REPORT
• Main sections, elements of technical writing, other sections
Case Study: Developing awareness of fact and opinion and substantiating opinions with facts
Practical Session: Determining terms of reference and writing an introduction

DEVELOPMENT PROCESS
• Preparing to write, identify readers, perform necessary research, organising the report, methods of development, overview of conclusion
Practical Session: Applying the four stage reading process, group discussion on conclusion and recommendations

REPORT OUTLINE
• Mind mapping, outline formats, rough draft, revising the report, activate the writing, simplify the writing
Practical Session: Investigating faulty construction methods. Participants to research design faults and problem areas. Make observations/findings, mind map and write a rough draft

FINALISING THE REPORT
• Report appearance: white space, headings/sub-headings, colour, illustrations, graphic material
Practical Session: Interpreting graphic material, graphic presentation

VERBAL PRESENTATION OF YOUR REPORT
• Preparing your presentation, formulating the central message, arranging the ideas, mind mapping technique, make a positive impact, using visual aids effectively, maximising delivery
Practical Session: Delivery of a two minute presentation (each delegate delivers a presentation on a particular aspect of the technical report)

SPECIFICATION WRITING
• Fundamentals of specification writing, preparing the specification, specification database

Practical Session: Brainstorming exercise, creating a specification data input sheet

STRUCTURE OF TECHNICAL SPECIFICATIONS
• Master format (correct numbering and titling)
• Section format: administration, product information, execution of the specification

Practical Session: Format outline

SPECIFICATIONS AND CONTRACTS
• Securing a contractor, contract, user manual, review checklist

SPECIFICATIONS AND THE PRODUCT
• Detailed descriptions, standards, performance, property rights

SPECIFICATIONS AND STATEMENTS OF WORK
• Services, products
Practical Session: Writing specification clauses

CHECKING THE SPECIFICATION
• Functional language correctness, theory, prototypes, realistic specifications, compliance test, evaluation criteria

Practical Session: Editing the specification

TYPES OF SPECIFICATIONS
• Government and industry standards, specifications for complex goods and services, performance, design and cancelled specifications

Practical Session: Creating a specification template

WRITING THE SPECIFICATION
• Time and cost framework, collaboration with other purchasers, etc
Practical Session: Writing the specification

QUALITY DEPLOYMENT FUNCTION
• Historical background, management and planning tools, etc
Practical Session: Using the QFD template as a specification design tool

DO’S AND DON’TS OF SPECIFICATION WRITING

SPECIFICATION CHECKLIST

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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TRAIN THE TRAINER -
PRESENTATION AND
INSTRUCTING SKILLS
FOR ENGINEERS & TECHNICAL PROFESSIONALS

YOU WILL LEARN HOW TO:

• Deliver outstanding technical training
• Make powerful and convincing presentations
• Understand technical training principles and levels of involvement
• Overcoming learning barriers in the technical classroom
• Evaluate, assess and address audience needs and requirements
• Develop effective communication skills
• Use appropriate body language and voice projection to reach your training objectives
• Design effective and easy to use technical course material
• Systematically design and develop effective and powerful technical instructional presentations
• Integrate text, graphics, audio and video elements into your presentation
• Satisfactorily answer questions and offer solutions to common problems
• Handling difficult situations

WHO SHOULD ATTEND:

• Engineering, technical and business professionals
• Computer specialists and analysts
• Managers and supervisors
• Educators and facilitators
• Researchers
• Course designers
• Non-technical managers and decision-makers
• In-house trainers who want to organise and present training workshops
• Trainers who need a refresher course on presentation skills
• Anybody who wants to improve their public speaking, presentation or training skills or who needs to train groups of people effectively and efficiently
"What I hear, I forget. What I see, I remember. What I do, I understand." (Confucius) This course is designed to equip you with the skills required to become an effective and consistent technical instructor. Ever-changing and complex technology requires a constant need of technical training, which can be quite intimidating.

An effective technical instructor needs a combination of technical skills and presentation abilities to help delegates overcome technical barriers. During this course, you will be guided on how to overcome the fear of speaking in public and addressing technically skilled delegates, how to deliver spellbinding presentations and employ practical, memorable and clear instruction methods. Learning must be challenging, encouraging, reflective and entertaining. It requires both the instructor and the participant to listen, to understand, to agree and to do.

This is a highly interactive two-day workshop that provides delegates with hands-on opportunities to prepare, organise and deliver effective and powerful technical presentations. Delegates will be shown techniques to arouse and maintain participants’ attention, effectively convey information, actively involving the audience, demonstrating concepts and creating powerful visual presentations.

We will show you what to do before a technical training session, how to start a technical training session and what to do during, at the end and after the training session.

Pre-requisites
A technical background with practical skills is required to convey the know-how and provide training in a technical environment.

The Program

SECTION A
TRAINING
• Introduction to technical training
ELEMENTS OF TRAINING
• Communication
• Listening
• Learning techniques

SECTION B
THE TRAINEES
• Audience analysis
• Cultural diversity
• Training environment

SECTION C
THE INSTRUCTOR
• Handling anxiety and calming nerves
• Voice
• Language

THE SECRETS OF SUCCESSFUL INSTRUCTORS
• Attributes and characteristics
• Physical appearance
• Non-verbal language

SECTION D
THE PRESENTATION
• Preparation
• Successful training with impact
• The introduction
• Conclusion

INSTRUCTOR/DELEGATE RELATIONSHIP
• Time management
• Supporting material
• After the workshop
• Participatory exercises
• Questions and answers
• Myths

SECTION E
VISUALS AND ELECTRONIC EQUIPMENT
• Integrating text, graphics, visuals and audio to structure powerful presentations
• Using PowerPoint to maximise impact

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"Written material was about the best I’ve seen for this type of course; the instructor was able to set an excellent pace and was very responsive to the class."

John Myhill

Practical Sessions & Discussions
This workshop contains 7 practical sessions and discussions:
• Handling cultural differences in your working environment
• Use tone and pitch to change emphasis, inflection, interpretation and emotion
• What signals do you send out with your body language
• Identify your presentation weaknesses and strengths
• Impromptu technical presentations
• Rephrasing questions and supplying answers
• Creating PowerPoint slides

Contact us for a FREE proposal.
LEADING YOUR ENGINEERING TEAM TO TOP PERFORMANCE

YOU WILL LEARN HOW TO:

- Develop a high performance engineering team
- Improve team communications
- Grow superb problem solving abilities
- Make quicker and better decisions as a team
- Resolve team conflicts
- Manage and keep a high performance team
- Identify team weaknesses and strengths
- Improve team productivity and time management

WHO SHOULD ATTEND:

This program is intended for those who want to build up their engineering team and operate at peak performance. You will learn how to develop and lead teams and avoid the pitfalls of unsuccessful teamwork. Individuals will learn how to be effective team players.

This workshop is aimed at:

- Engineering Professionals
- Technical Personnel
- Maintenance/Supervisory Managers
- Project Team Members in:
  - Manufacturing
  - Mining
  - Process industries
  - Research and development utilities
  - Local authorities
The Workshop

One of the great truths of life is our interdependence. Everything we accomplish within a company is through the efforts of people working together. No matter how technologically advanced we are, especially in the engineering world, we have to work together effectively as a team, and effective teams are made up of effective members. Engineers and technical professionals are notoriously bad at working together in teams and this workshop is a great opportunity to learn and then apply the skills of working in a high performance engineering team.

The workshop consists of eight modules containing instruction on the key principles, skill assessments, participative discussions and many, many exercises and case studies to make the training come alive and ensure that you can apply your skills to your job immediately. The program is designed to be fun and dynamic as well as strongly beneficial to you working with your engineering team.

On this workshop you will learn the basic and critical team skills which will enable you to make a much greater contribution to the success of your engineering team.

Practical Sessions

Eight practical and group exercises will be completed. All exercises focus on engineering team building and cater to the unique demands placed on engineering professionals today.

- Race for Truth
- Illusions
- Group Survival Exercise
- Gum Art
- Mine Field
- Totem Truths
- Bafa Bafa
- Meyers-Briggs

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION TO ENGINEERING TEAM BUILDING

WHAT MAKES AN ENGINEERING TEAM DIFFERENT

RADIANT THINKING FOR ENGINEERS
- Introduction to radiant thinking
  Case Study
- Group discussion - how to use and apply lateral thinking
- Group exercise - mind mapping
  Practical Session: Race for Truth

EFFECTIVE COMMUNICATION
- Communication styles
- Barriers to communication
  Case Studies
- Understanding the skill of listening
- Nonverbal behaviours of communication
- Speaking effectively and providing successful feedback
- Improved questioning techniques
- Team communication
  Practical Session: Illusions Meyers-Briggs

MEYERS-BRIGGS TYPE INDICATOR
- Personality types
- Benefits for engineers
- Group discussion

TEAM MANAGEMENT PROFILE
- Identifying your role in the organisation
  Case Study
- Group dynamics in actions
- Personal improvement plan within the group process
- Strengths and weaknesses
- Team management wheel
  Practical Session: Group Survival Exercise

EMOTIONAL INTELLIGENCE
- Four domains of emotional intelligence
- Assessing and measuring emotional intelligence
- EI in the engineering context
  Case Study
  Practical Session: Gum Art

CONFLICT RESOLUTION
- Root cause analysis
- Assessing conflict styles
- Attribution theory
- Handling engineering team conflict
- Principles and processes of conflict resolution
- Skills for team-based problem-solving
  Case Study
  Practical Session: Mine Field

GOALS AND OBJECTIVES
- How to create win-win negotiation skills
  Case Study
- Learning about your negotiation style
- Guidelines and challenges to effective negotiation
  Practical Session: Bafa Bafa

NEGOTIATION FOR ENGINEERS

I've gained a lot from the workshop and the instructor was excellent - this was an eye opener for me.

Monica Mgbobozi

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THE PRACTICAL BUSINESS ENGINEER

YOU WILL LEARN HOW TO:

- Deal effectively with the key commercial and business issues impacting you as an engineer
- Communicate with financial managers and business people
- Develop and grow your business
- Build strong commercial relationships with your clients and partners
- Interpret and draft simple key legal contracts
- Prepare expenditure proposals to win management approval
- Apply tried and tested tips and tricks in dealing with legal challenges
- Market yourself and your business more effectively
- Understand the key issues with financial statements and see the warning signs

WHO SHOULD ATTEND:

If you are a technical person who wants to gain commercial ‘savvy’ then this is the workshop for you. Typical participants include:

- Engineers and other technical professionals working in industry
- Technicians
- Engineering Officers
- Project Managers
- Maintenance Professionals
- IT Managers
- Architects
- Administrators
- Technical Specialists
- Geologists
- Metallurgists
- Production Managers
- Process and Operational Personnel
- Electrical, Mechanical and Civil Engineers
- Consulting Engineers
- Operations Managers
- Plant Managers
The Workshop

It is a truism that engineers tend to focus on technical issues to the detriment of the commercial realities that impact on their businesses on a daily basis. Engineers and other technical professionals put enormous effort into achieving technical excellence in their jobs and believe that their technical skills are extremely important. Unfortunately the reality is considerably different. What enables you to run a successful business and to get to the top are possessing excellent commercial and management skills. Once they have received the necessary training in the critical issues, engineers and technical managers are generally bright, capable, hard working and highly trained individuals who can effectively deal with commercial issues they have to confront on a daily basis.

The workshop presents the secrets of many experienced engineers who have worked in business and commerce and been involved in managing cash flow, marketing, drawing up and negotiating contracts, setting up joint ventures and a myriad of other testing commercial challenges. We have distilled all the key commercial and business issues into one hard hitting course to enable you to solve real commercial problems which you will encounter and enable your business to grow.

One of the key ingredients for success in any business and project is understanding that “cash is king” and your firm should be able to generate it effectively and consistently. Rapidly advancing technology, increased project and product complexity and competitive pressures place enormous demands on you to do the best costing and economic evaluation of your products and projects. You must be able to justify your costing decisions using a solid framework that your financial decisions come under scrutiny.

This workshop is designed to help you build up strong competencies in business communications and promotion and marketing of your business and indeed of yourself. This workshop will save you years of learning from experience. Learning from your own experience whilst very important and a key part of your development can be frustrating, risky and expensive and this workshop will help to expedite your learning process in the commercial area.

Whilst you will not be an expert in two days of the course; this workshop will transform your knowledge and ability to deal effectively with commercial issues and set your business and your personal skills firmly on a sustainable growth path with minimal risk.

You will emerge from this workshop confident in your new found commercial skills and be able to apply your know-how immediately to your job.

The Program

BASIC COMMERCIAL AND BUSINESS CONCEPTS
• Overview of the course
• Business communication skills
• Questioning skills
• Giving and receiving feedback
• Presenting winning business presentations
• Four typical team structures
• Dealing with team problems
• In pursuit of excellence
• Effective habits of success in business

MAXIMISING YOUR PROFIT CONSISTENTLY - BASIC FINANCIAL CONCEPTS
• Profit and loss
  • Balance sheets
  • Cash flow versus profit
  • Quick ratios and indicators
  • Cash is King
  • Creative accounting
  • Trends and patterns
  • Pricing of products and projects
  • Fixed price versus hourly rate
  • Business triangulation techniques
  • Maximising your company’s profits and income
  • Tracking costs and revenues

ESTIMATION AND COSTING
• Capital costs
• Working capital and operating costs
• Factors affecting profitability
• How to get the estimate right first time
• Decision making under capital rationing
• What to do if there is not enough money
• Costing and estimating

APPLYING BUSINESS LAW TO ENGINEERING
• Commercial law and engineers
• Essentials of contract law
• Key elements of a contract
• Breach of contract and remedies - practically speaking
• Duty of care
• Professional liability
• Avoiding conflict

NEGOTIATING SKILLS FOR A WIN-WIN
• Managing the 7 Ps of negotiation: people, positions, perceptions, problems, power, preparation and process
• Negotiating issues in business
• Developing your negotiating qualities
• The importance of a win-win

GAIN MORE BUSINESS - INDUSTRIAL MARKETING AND SELLING
• Key elements
• Advertising - direct mail, web and email and telemarketing
• Contact databases that work
• Building relationships
• Presenting proposals
• Quoting, negotiating and closing deals
• Researching and finding new business and clients
• Practical elements of marketing
• Lateral thinking

MANAGING COMMERCIAL RISK
• Risk and uncertainty
• Quantifying project risk
• What is risk management
• Tools of risk management
• Risk and contingency amounts

BUSINESS STRATEGY
• Adjusting your sails to maximise the wind
• Business plans and action steps
• Sailing close to the wind
• Business ethics

TYING IT ALL TOGETHER

Practical Sessions

We have tried to make this workshop as practical as possible and have minimised on the standard lecturing. It includes 8 case studies, practical exercises, simulations and role playing comprising over 65% of the course content to ensure maximum absorption by the participants.

To gain full value from this workshop, please bring your laptop/notebook computer.

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WHAT YOU WILL LEARN:

- Gain a clear understanding of the goals and tools of effective management
- Learn the characteristics of the four behavioral styles so you can understand the needs of your employees and know how to work with and bring out the best in each one
- Learn how to practice effective communication skills when training, managing and coaching employees
- Develop strategies for motivating employees to be more engaged and productive
- Learn proven delegation strategies that will open up more blocks of time for you, improve the efficiency of your team and enhance the skills of the entire work group
- Receive and practice skills in planning and goal setting to enhance employee performance
- Learn a proven set of skills to address conflict in the workplace and implement effective solutions
- Understand how the principles of emotional intelligence work within a team environment
- Manage poor performance
- Improve personal productivity and manage time effectively

WHO SHOULD ATTEND:
Anyone who wants to hone their leadership and management skills
The Workshop

As a skilled professional in today’s ever-changing business world, you face many challenges. You must continually evolve your skills to face the demands of your profession.

This is dynamic and practical programme aimed at energising managers into radically improving their skills and the performance of their teams. This workshop uses highly interactive exercises, and case studies in a way that challenges professional managers to explore new strategies and develop new skills to solve typical management problems.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

REGISTRATION

STRATEGIC GOALS AND OBJECTIVES
• Group goal objectives
• Managing group goals
• Goal setting guidelines
• Monitoring and improving objectives
• Performance measurement

THE FOUR BEHAVIOURAL STYLES
• Dimensions of behaviour
• Style profiles
• Enhancing team relationships

EFFECTIVE COMMUNICATION
• The communication process
• Barriers to communication
• Non-verbal communication
• Assertiveness
• Keys to active listening
• Planning for constructive feedback
• Effective feedback
• A short case example of effective communication

TEAM MOTIVATION
• Motivation and your team
• Motivating factors
• How to improve motivation
• Manager’s role in motivating

DELEGATION AND EMPOWERMENT
• Delegation excuses
• How to delegate effectively
• Lessons in empowerment
• Effective control

TAMING CONFLICT
• Understanding conflict
• Developing trust
• Recognising behaviour patterns
• Effective probing
• Conflict modes
• Psyche management
• Fighting perceptions to win

EMOTIONAL INTELLIGENCE
• What is EQ and why does it matter?
• The emotional competencies model
• The domains of EQ
• The value of EQ
• Learning how to apply EQ in the workplace
• EQ and leadership

PERFORMANCE MANAGEMENT
• Principles of poor performance
• Guidelines for managers
• Recommendations of application
• Employment essentials

PROACTIVE TIME PLANNING
• Establishing priorities
• Decision making
• Avoiding time wasters
• Eliminating procrastination
• Time planning

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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ENGINEERING LEADERSHIP -
MAKING THE TRANSITION
FROM ENGINEER TO LEADER

YOU WILL LEARN HOW TO:

- Shift from a technical to a people expert
- Lead engineers and technical professionals
- Gain a valuable toolbox of skills and tools to:
  - Assess and identify emerging leaders
  - Implement work life balance for yourself and your staff
  - Assess the personality types of your people
  - Use your knowledge of personality types to communicate to difficult people
  - Use knowledge of personality types align the values of your team with others
  - Use 10 different coaching tools to assess, develop and motivate everyone on your team
- Use 6 straight forward time management steps that can double your team’s productivity
- Make conflict work for you and not against you
- Apply the 5 steps of a professional coaching framework to coach the emerging leaders in your organisation

WHO SHOULD ATTEND:

This workshop is designed for mid level managers and technical professionals who want to update their leadership skills and position themselves to adopt a leadership role in their organisation. Those who will benefit the most from this workshop include the following:

- First-line supervisors
- Middle level executives and managers
- Operations, marketing, human resources and customer service executives
- Project managers
- Team leaders and technical professionals
The Workshop

The engineering leadership workshop is a comprehensive, highly practical and interactive two-day course. The program begins with an introduction to the fundamentals of leadership and helps one distinguish the leadership for engineers from other forms. The changing paradigms from engineer to leader are also discussed in depth. The discussion underlines the importance of personal leadership and the subsequent transfer to being leader of people. Related tasks such as setting of goals, time management and life balance are covered in detail and their significance in regard to personal leadership adequately emphasised. A discussion on the personality traits and leadership influence of exceptional leaders is included so that participants may understand how leadership skills can be put to actual practice.

In order to deliver on the key areas of leadership, a leader needs to understand the dominant behavioral styles in people. This helps in understanding one’s strengths and weaknesses and to identify and align them in accordance with the relevant roles and in building a team. Communication skills convey one’s ability to communicate a message effectively and this includes both questioning and listening skills. During the workshop of the discussion one will not only get to know and understand the basic communication tools and strategies, but also know how the power of rapport and constructive feedback could be utilised for effective communication.

Another key area associated with engineering leadership is conflict management. This refers to the ability to reduce and resolve conflict, by applying the appropriate conflict management style as demanded by the situation. The workshop provides a detailed account of the conflict causes and the various conflict management styles that can be applied in a particular situation.

A good leader must possess ample creativity and problem solving skills, in order to arrive at or facilitate creative solutions to resolve conflict or to overcome obstacles. This discussion covers the various aspects of problem solving and facilitation skills and how best to employ them in leadership management."
PRACTICAL
SAFETY INSTRUMENTED SYSTEMS
AND EMERGENCY SHUTDOWN SYSTEMS
FOR PROCESS INDUSTRIES

WHAT YOU WILL LEARN:

• What your company should be doing to manage safety control projects in accordance with the international standards IEC 61508 and IEC 61511
• The meaning and tasks of "The Safety Life Cycle"
• How HAZOPS are done and how they are used to define safety functions
• To understand Safety Integrity Levels (SILs) and to set target values using the methods described in IEC 61511
• How to identify what kind of instruments and PLCs must be used in safety controls
• How networks can be safely used for protection systems
• How to design safety systems to meet SIL targets and avoid spurious trips
• How to calculate SIS failure rates and verify SIL performance
• To identify where your safety instrumentation practices may need upgrading

WHO SHOULD ATTEND:

• Automation/machinery design engineers
• Control systems engineers
• Chemical or energy process engineers
• Instrument/electrical engineers and technicians
• Instrument suppliers technical staff
• Maintenance supervisors
• Project engineers and project managers
The Workshop

For project managers and engineers involved with hazardous processes, this workshop focuses on the management, planning and execution of automatic safety systems in accordance with IEC 61511, the newly released international standard for process industry safety controls. (See over for background to IEC 61511).

IEC 61511 has been recognised by European safety authorities and by USA based process companies as representing the best practices available for the provision of automatic safety systems. The new standard captures many of the well established project and design techniques that have been described since 1996 in ANSI/ISA standard 884 whilst introducing many newer principles based on the master standard IEC 615108. The newly released standard IEC 61511 (published in 3 parts) combines the principles of IEC 61508 and 884 into a practical and easily understood code of practice specifically for end users in the process industries.

This new IDC workshop is structured into two major parts to ensure that both managers and engineering staff are trained in the fundamentals of safety system practice. The first part of the workshop, approx the first third, provides an overview of the critical issues involved in managing and implementing safety systems.

Section 1
A wide-ranging overview of the subject
- Risk management principles applied to protection systems.
- The legal framework such as major accident hazard regulations and control of substances hazardous to health.
- An overview of standards IEC 61508 and 61511
- An introduction to the safety life cycle as defined in IEC 61511.
- Process hazard analysis and its link to protection systems.
- The meaning of SILs and their cost implications.
- The problems and rewards of SIL determination
- Basics of safety instrumentation.
- Why programmable systems need special treatment
- Economics and cost of ownership
- Competency requirements and conformity assessment programmes.
- Conclusion: What should management be doing towards compliance?

Section 2
Selected detail topics
- The role of HAZOP studies and hazard analysis in deciding what safety measures are needed. The training includes an outline of basic HAZOP methods and trains participants in fault tree analysis methods used to predict accident rates.
- Understanding safety integrity levels (SILs) and their impact on capital and operating costs.
- Methods for the determination of SIL requirements. This subject is known to cause difficulties and confusion in the early stages of process development projects and the subject has now been covered in depth by IEC 61511. This workshop examines the various SIL determination methods presented in IEC 61511 and provides practical exercises to ensure participants are able to carry out their own SIL determinations with confidence.
- Why safety PLC’s are special and need to be certified for safety.
- Safety system architectures such as 1oo2 and 2oo3 and which versions to use to meet performance needs of reliability and availability.
- What IEC 61511 requires from instruments, sensors and valves to qualify them for safety applications. Are smart transmitters acceptable for safety? How can a smart positioner improve safety performance?
- How to perform reliability analysis to predict and verify safety system reliability and spurious trip rates.
- Guidelines on documentation and validation of completed installations.
- Essentials of maintenance and proof testing. The benefits of diagnostic systems in reducing test frequencies.

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The Program

MODULE 1
- Overview of safety instrumented systems for managers

MODULE 2
- Introduction to IEC 61511 and the safety lifecycle

MODULE 3
- HAZOP methods and hazard analysis for defining risk reduction requirements

MODULE 4
- Principles of risk reduction and safety allocation

MODULE 5
- Practical SIL determination methods based on IEC 61511

MODULE 6
- Practical SIS configurations for both safety and availability targets

MODULE 7
- Practical selection of sensors and actuators for safety duties

MODULE 8
- Practical reliability analysis methods and programs to IEC 61511

MODULE 9
- Practical selection of safety controllers

MODULE 10
- Practical system integration and application software for safety controllers

MODULE 11
- Practical documentation and validation of SIS systems

MODULE 12
- Practical diagnostics and proof testing of safety instrumentation

SUMMARY, OPEN FORUM AND CLOSING

To gain full value from this workshop, please bring your laptop/notebook computer.
## CIVIL ENGINEERING

### TRAINING WORKSHOPS

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HAZARDOUS WASTE MANAGEMENT AND POLLUTION PREVENTION

AFTER THIS WORKSHOP YOU WILL:

- Be able to identify potential sources of pollution in and around your plant
- Be acquainted with the latest technologies and techniques for preventing contamination/pollution
- Be acquainted with the latest technologies and techniques for handling hazardous waste materials
- Be able to detect and measure the incidence of contamination
- Have the skills for managing hazardous waste materials
- Know how to plan for and deal with emergencies

WHO SHOULD ATTEND:

Anyone involved in the handling of hazardous materials, this includes, but is not limited to:

- Project Leaders
- Production Managers, Supervisors, Engineers and Technicians
- Maintenance Managers, Supervisors, Engineers and Technicians
- Consulting Engineers
- Chemical Engineers and Technicians
- Plant Engineers
- Operation, Inspection and Repair Managers, Supervisors, Engineers and Technicians
- Mechanical Engineers and Technicians
- Electrical Engineers and Technicians
The Workshop

This workshop is designed for engineers and technicians from a wide range of abilities and backgrounds and will provide an excellent introduction to mastering the management of hazardous waste materials as well as preventing contamination of the environment. This knowledge makes participants aware of the legal and regulatory aspects of pollution and the handling of hazardous waste materials within their plants. It will also allow them to reduce the amount of hazardous waste produced and save money through preventing personal injury and preventing or limiting the effects of accidental pollution.

Pre-requisites

A basic knowledge of electrical, mechanical and chemical plant environments.

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The Program

DAY ONE

INTRODUCTION
• Course objectives
• Definitions

BASIC CONCEPTS
• Pollution monitoring technologies
• Environmental effects of pollution/hazardous waste
• Toxicology
• Radioactivity

REGULATORY CONSTRAINTS
• Environmental laws
• Regulations governing storage and transportation of hazardous materials (national, provincial, regional, municipal)

WATER SUPPLIES
• Water treatment processes
• Ground water management
• Drinking water management

AIR
• Pollution prevention
• Pollution monitoring
• Air cleaning

PERSONAL SAFETY
• Handling flammable materials
• Handling corrosive materials
• Handling poisonous substances
• Handling radioactive materials

POLLUTION/CONTAMINATION

PREVENTION PROCEDURES
• Material balance systems
• Building/plant design/layout
• Safety codes
• Management systems

DAY TWO

CONTINGENCY PLANNING
• Planning for emergencies
• Training of response teams
• Protective equipment and clothing
• Dealing with spillage
• Dealing with release of hazardous substances into the atmosphere

MEASURING TECHNIQUES
• Measurement techniques
• Statistical sampling theory

COSTS AND BENEFITS
• Cost-benefit trade-offs
• Opportunity costs
• Costs of implementing (or not implementing) safety measures
• Ethical issues

PRACTICAL EXERCISES DURING THE WORKSHOP
• Delegates will work on a recommendation addressing a particular safety concern (related to the handling of hazardous materials) in their own plant.

SUMMARY, OPEN FORUM AND CLOSING

The course addresses a very big need in the industry.
A D Swanepoel

Well presented, excellent material.
Stephen Baron

Excellent knowledge of subject and ability to communicate it.
Mark Moore
STRUCTURAL DESIGN
FOR NON-STRUCTURAL ENGINEERS

YOU WILL LEARN HOW TO:

• Fully understand the role of a structural engineer
• Predict the behaviour of structural members under loading
• Understand the concept of stress functions such as tension, compression, shear and bending
• Perform a basic analysis of statically determinate as well as statically indeterminate structures
• Analyse the deformation of structural members under loading
• Understand the significance of material properties in design
• Undertake the basic design of Reinforced Cement Concrete (RCC) structures
• Undertake the basic design of steel structures
• Undertake the basic design of masonry and timber structural members

WHO SHOULD ATTEND:

Anyone associated with the construction industry would be benefited from the course. In view of the vastness of the sector, following personnel would typically be able to gain immediate benefit out of the course.

• Architects
• Building inspectors
• Building maintenance personnel
• Concrete technologists
• Construction supervisors
• Insurance surveyors
• Municipal officials
• Project managers
• Quantity surveyors
• Reinforcement detailers
• Structural fabricators
• Structural rehabilitation staff
The Workshop

Construction is the largest industry in the world and all structures need to be designed first. Structural engineering deals with the analysis and design aspects required to ensure a safe, functional and economical structure.

During the design process the designer constantly interacts with specialists such as architects and operational managers. Once the design is has been finalised, the implementation requires additional people to handle aspects such as statutory approvals, planning, quality assurance and material procurement. The entire exercise can be undertaken in highly-coordinated way only if all participants fully understand the ‘project language’. However, in order to understand this language, it is necessary to first have a thorough grasp of the principles of structural analysis and design.

Participants in the workshop will gain a basic knowledge of structural engineering that includes principles of analysis of structures and their application, behaviour of materials under loading, selection of construction materials, and design fundamentals for RCC as well as steel structures. The emphasis has been kept on the determination of the nature and the magnitude of the developed under loads, and the way structures offer resistance to it. Being the most widely used construction materials, RCC and steel has been covered in detail though masonry and timber are also discussed.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

“Excellent workshop, very informative and interesting and very well presented.
Simon Fleming

Great workshop - well balanced presentation and course content.
Richard Turnhout

Instructor had good background knowledge that was used to support course material.
J Clarke

The Program

DAY ONE

INTRODUCTION TO STRUCTURAL ENGINEERING
• Elements of structural design
• Course objectives
• Course outcomes

ANALYSIS OF STATICALLY DETERMINE STRUCTURES
• Classification of structures
• Types of loads
• Stress in structural members
• Types of supports in structures
• Equilibrium of bodies
• Bending moment and shear force
• Effect of moving loads
• Analysis of pin-jointed frames
• Influence lines

PRINCIPLES OF STRENGTH OF MATERIALS
• Mechanical properties of materials
• Development of internal stresses
• Flexural stresses in beams
• Relationship between horizontal and vertical shear
• Determination of bending shear stress
• Deformation of beams
• Combined stresses
• Analysis of columns

ANALYSIS OF STATICALLY INDETERMINE STRUCTURES
• Structural classification based on degree of indeterminacy
• Principle of superposition
• Analysis of statistically indeterminate beams
• Multi-span or continuous beams
• Slope deflection method
• Moment distribution method
• Influence line diagram for statically indeterminate structures

DESIGN THEORIES AND LOADS
• Stress-strain relationship for different materials
• Design philosophies
• Combination of loads
• Theories of failure

DAY TWO

DESIGN OF STEEL STRUCTURES
• Properties of structural steel
• Steel structural sections
• Design of steel structures
• Joints and fasteners for steel structures
• Design of tension members
• Design of compression members
• Design of beams
• Design of truss and allied structures

DESIGN OF RCC STRUCTURES
• Properties of concrete
• Principle of reinforced concrete design
• Design norms for reinforced concrete beams
• Design of reinforced concrete slabs
• Design of reinforced concrete foundations
• Design of axially loaded columns
• Prestressed concrete
• Multi-storied buildings

DESIGN OF MASONRY AND TIMBER STRUCTURES
• Masonry structures
• Design of masonry structures
• Strength of timber
• Design of timber structures

LIMIT STATE AND PLASTIC DESIGN
• Limit state theory
• RCC design by limit state
• Steel structural design by limit theory

SUMMARY, OPEN FORUM AND CLOSING

On-Site Training

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BEST PRACTICE IN
SEWAGE AND EFFLUENT TREATMENT TECHNOLOGIES

YOU WILL LEARN HOW TO:

• Maintain and troubleshoot waste water treatment systems
• Understand the different waste water treatment systems available
• Understand national and local legislation
• Apply knowledge of the latest technologies and best practice

WHO SHOULD ATTEND:

• Municipal planners
• Sewage operators
• Municipal engineers
• Consulting engineers
• Anyone responsible for managing and operating sewage treatment facilities
• Maintenance engineers, technicians and staff
• Plant engineers
• Operation, maintenance, inspection and repair managers, supervisors and engineers
• Mechanical engineers and technicians
• Design engineers
The Workshop

The quality of groundwater used cannot be compromised any longer and the servicing requirements of on-site sewage disposal systems cannot be ignored. With limited funds available to you – the private owner or regulatory agency who have responsibility for inspection, the task of on-site sewage treatment and disposal is becoming very difficult.

With limited funds available to the owners we believe this workshop will help you to install an effective system. You will learn numerous tips and tricks throughout the workshop to make it very practical and relevant to your applications.

Pre-requisites

Fundamental knowledge of basic waste water treatment requirements. Pre-course preparation material is available on request.

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

“Very good, instructor!
Customised the workshop content to ongoing requirements of the attendees.

David Wood, Air Products

This course gave me a good foundation to build upon in the workforce.

Lui Di Bcca, GPA Engineering

Good technical information & interchange of information between attendees.

Neil Miller

The Program

DAY ONE

PLANNING CONSIDERATIONS – PROVINCIAL AND NATIONAL GOVERNMENT
- Economic, social and environmental goals of planning
- Environmental assessment
- Need for Health and Safety
- Factors in preparing municipal plans
- Protection for stepped up demand

WASTE WATER FUNDAMENTALS
- Basic terminology
- Contaminant considerations
- Biological, phosphorous, ammonia
- Pathogens
- Effluent objectives
- Alternate discharge options
- Receiving water capacity-provincial water quality objectives
- Surface discharge
- Subsurface discharge

DESIGN CONSIDERATIONS
- Collection of sewage
- Aerobic and anaerobic treatments
- Critical design parameters for communal sewage treatment systems

TREATMENT TECHNOLOGIES
- Suspended solids removal
- BOD Removal
- Nitrification and denitrification
- Phosphorous reduction

TREATMENT SYSTEMS
- Conventional septic tank
  - As the treatment system
  - Enhanced septic tanks
- As a primary for other bioreactors
- Bioreactors
  - Fixed film
  - Rotating
  - Suspended
  - Batch
- Filters-sand, peat, stone, synthetics
- New technologies targeting specific contaminants

RECIRCULATING SAND FILTERS
YEAR ROUND TREATMENT
- History experimental design
- Construction
- Operation

DAY TWO

SUBSURFACE DISCHARGE
- Filter bed
- Shallow trench
- Leaching bed
- “Constructed wetland”
- Recycle, reuse

DIRECT DISCHARGE
- Stream assimilative capacity
- Mixing zone
- Disinfection

BIOSOLIDS DISPOSAL
- Hauled waste
- Compost
- Lime stabilisation

MANAGEMENT OF COMMUNAL WASTE WATER SYSTEMS
- Regular monitoring
- Long term satisfactory performance

FINANCIAL AND LEGAL ISSUES
- Funding sources
- Approval process
- Regulatory compliance
- Municipal and owner liability

DESIGN AND INSTALLATION OF YOUR OWN SYSTEM
- Simple design rules
- Implementation of your system
- Tips and tricks
- The Thirteen Golden Rules of working with waste water systems

CASE STUDIES
- Municipality
- Private roudavel in a pristine inaccessible area
- In the middle of suburbia

SUMMARY, OPEN FORUM & CLOSING

On-Site Training

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DESIGNING, SPECIFYING AND CONSTRUCTING WITH MODERN CONCRETE

YOU WILL LEARN HOW TO:

• Understand concrete, what it is and why it is used for construction
• Study the ingredients of concrete and their importance in the quality control of concrete
• Learn the chemistry of concrete
• Be able to do simple concrete mix designs
• Learn about concrete manufacturing
• Learn about testing, inspection and the quality control of concrete
• Understand the defects which can occur in concrete at different stages and their remedies
• Study the modern concepts - ready mix concrete, pre-cast concrete and pre-stressed concrete
• Learn the methods of protection and maintenance of concrete
• Understand the safety precautions to be taken while working with concrete
• Understand admixtures which can affect the properties of concrete

WHO SHOULD ATTEND:

• Architects
• Civil engineers
• Construction site engineers and technicians
• Construction planners
• Construction supervisors
• Consulting engineers
• Maintenance engineers and technicians
• Maintenance planners
• Project engineers
• Structural designers
Concrete is everywhere! In pavements, building structures, foundations, motorways/roads, overpasses, parking structures, brick/block walls and bases for gates, fences poles and many more. Concrete is used more than any other man-made material on the planet. It has been said that instead of naming our era “the nuclear age” it should be named “the concrete age” as almost all of our modern lifestyle and constructions depend on this material.

Our new course deals with concrete, it’s manufacturing, designing and maintaining. It includes the details about ingredients, its quality, quantity and effect on the final product of concrete. Concrete designing, its specifications, standards, codes are the parts of this course and the concrete mix design is discussed in detail. On field manufacturing of concrete, various procedures, precautions are also covered. The defects, investigations and the remedial measures, repairs are covered in detail. The modern concepts like ready mix concrete, precast and prestressed concrete and their applications are covered in this course. The admixtures used to get a specific quality concrete, special purpose concrete etc is also discussed in detail.

Pre-requisites
No specialist knowledge or skills are required – only a technical background so that there is an understanding for simple terminologies like reinforcement. In fact this course is a good introduction to someone who has had no dealings with concrete or any kind of construction in the past as well as an important refresher course for concrete specialists who benefit from the back-to-basics approach.

Practical Sessions
This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

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TRANSPORTATION PLANNING AND MANAGEMENT

YOU WILL LEARN HOW TO:

- Anticipate future traffic problems of a transportation network.
- Understand the use and limitations of various modes of transportation and learn a technique to design an efficient transportation system by combination of these.
- Understand the concept of Level of Service of the transport system and techniques to maintain those within acceptable limits.
- Obtain guidance in the traffic control systems and their use during special events as well as during construction.
- Develop an intelligent transportation system as well as efficient parking system
- Be aware of and be able to evaluate the effects of any new development on the adjacent traffic network.
- Understanding the concepts of traffic calming, forecasts, traffic management systems etc
- Acquire a basic knowledge of standards of transportation safety.
- Obtain sufficient knowledge to manage traffic in your small neighborhood/ complex/construction site.

WHO SHOULD ATTEND:

- Engineers and Technicians in charge of a construction site
- Builders and Developers
- Architects
- Traffic controllers
- Traffic control authorities of big events
- Town Planners
- Civil Engineers
- Development Control Officers
- Construction Project engineers
Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

Practical Sessions

The Program

INTRODUCTION
• Understanding the need of transportation, and its demand in urban and rural areas.
• Various modes of transportation, their uses and limitations
• Overview of a Transportation system
• Introduction transport planning and various stages of transport planning.

TRANSPORTATION PLANNING
• We begin transportation surveys and analysis of their results
• Study the Transportation Impact Analysis
• Study the traffic forecasts, methods of forecasting
• Traffic models, their use and limitations, model splits
• Trip generation and distributions
• Traffic assignments and evaluations

Practical Session

TRAFFIC CONTROLS
• Traffic Control using physical barriers, highway geometrics and other controls
• Street furniture
• Road markings
• Intersection Controls – roundabouts, STOP-controls, signals
• Grade separated interections-interchanges
• Traffic regulations

Practical Session

TRAFFIC SAFETY
• Accidents and their analysis
• Identification of cause
• Cost of an accident
• Prevention measures
• Street lighting

TRAFFIC MANAGEMENT
• Scope of management
• Restriction of turning movements
• Access controls
• One way streets
• Tidal Flow operations
• Exclusive Traffic lanes
• High occupancy lanes
• Traffic calming
• Other management measures

Practical Session

PARKING
• Parking requirements
• On street parking
• Off street parking
• Design standards for parking facilities
• Loading and unloading facilities
• Sheared Parking

Practical Session

TRANSPORTATION MANAGEMENT UNDER SPECIAL CIRCUMSTANCES
• Importance of traffic management under special situations
• Transportation management under natural disasters
• Transportation management during construction
• Transportation management for special events
• Management of constriction site
• Management of special event area

Practical Session

TRANSPORTATION ECONOMICS
• Economic evaluation any transportation or improvement plan
• Vehicle operating cost
• Value of travel-time saving
• Accident cost
• Road Pricing

OTHER MODES OF TRANSPORTATION
• Railway Transport
• Transportation management at Railway stations
• Maritime Transport
• Transportation management at Docks and harbors
• Air Transport
• Transportation management at airports

Practical Session

MASS TRANSPORTATION SYSTEMS
• Need and importance of Mass transportation System
• Responsibilities of a Mass transportation System
• Common Mass transportation Systems
• Paratransit
• Comparison of different transit systems

INTELLIGENT TRANSPORTATION SYSTEM
• Use of computer in Transport management
• Use of satellite in Transport management
• Use of other modern technologies in Transport management

Practical Session

SUMMARY, OPEN FORUM AND CLOSING

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Pre-requisites

Basic Knowledge of Transportation and traffic Engineering Principles and Concepts will be an advantage.