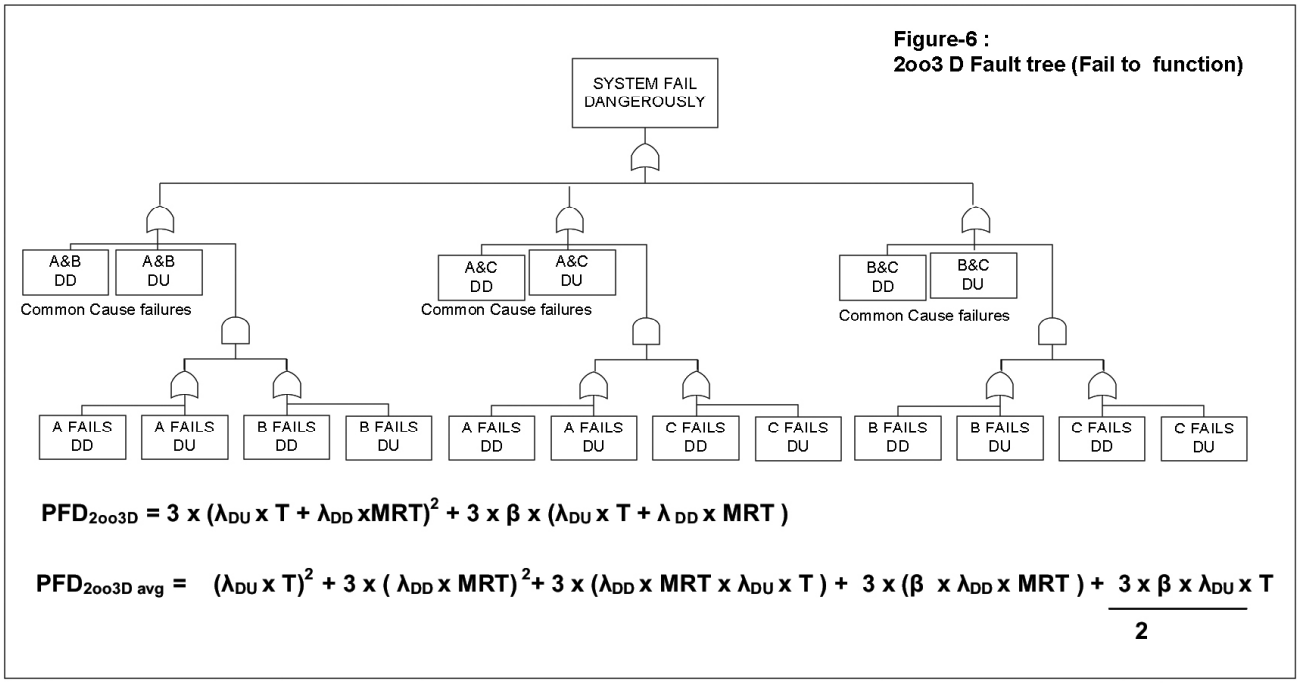


Figure-6 :
2oo3 D Fault tree (Fail to function)

$$PFD_{2oo3D} = 3 \times (\lambda_{DU} \times T + \lambda_{DD} \times MRT)^2 + 3 \times \beta \times (\lambda_{DU} \times T + \lambda_{DD} \times MRT)$$

$$PFD_{2oo3D\ avg} = (\lambda_{DU} \times T)^2 + 3 \times (\lambda_{DD} \times MRT)^2 + 3 \times (\lambda_{DD} \times MRT \times \lambda_{DU} \times T) + 3 \times (\beta \times \lambda_{DD} \times MRT) + \frac{3 \times \beta \times \lambda_{DU} \times T}{2}$$

Fault Tree diagram for safe failures and the corresponding probability of safe failures are shown in figure 7 :

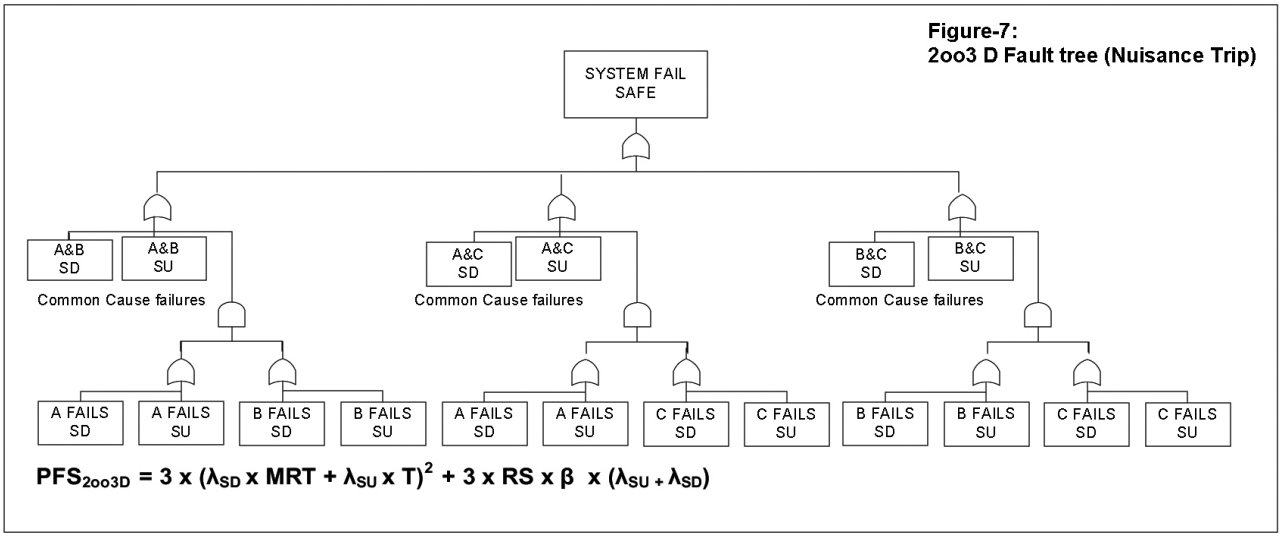
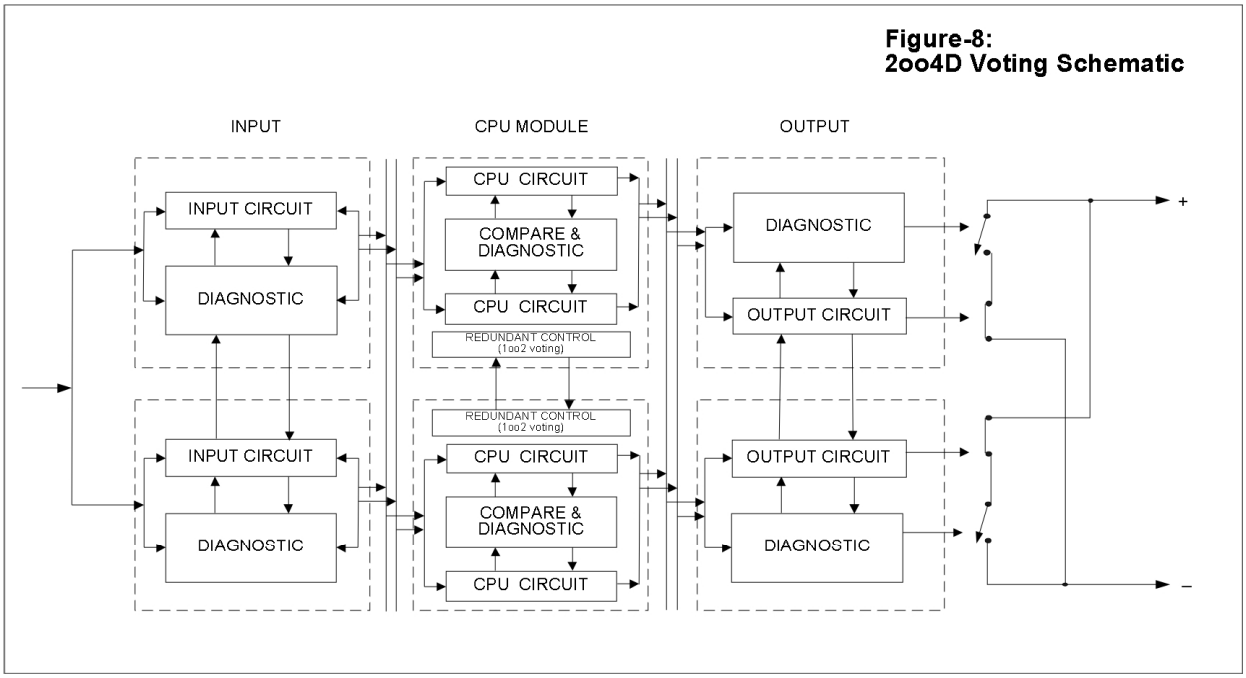


Figure-7:
2oo3 D Fault tree (Nuisance Trip)

$$PFS_{2oo3D} = 3 \times (\lambda_{SD} \times MRT + \lambda_{SU} \times T)^2 + 3 \times RS \times \beta \times (\lambda_{SU} + \lambda_{SD})$$

c) 2-out-of-4D Voting (2oo4 D, also called QMR or Quadruple modular redundant)

This architecture consists of pair of redundant channels (1oo2) connected in parallel with a high level of diagnostic. Thus it provides total four (4) channels (redundant channels per leg, both legs are connected as 1oo2D). Therefore eliminating the problem of 1oo2D architecture with regards to fail to function in case of one dangerous undetected failure of any one channel in combination with any failure in another channel. During normal operation, both (pair of) channels needs to demand the safety function before it can take place. In addition, if the diagnostic tests in either (pair of) channel detect a fault then the output voting is adapted so that the overall output state then follows that given by other (pair of) channel. If, the diagnostics test finds faults in both (pair of) channels and a discrepancy that cannot be allocated to either (pair of) channel, then the output goes to safe state.



The Voting truth table which defines the 2oo4D is shown in the Table 3 and the corresponding fault tree and the PFD equations are illustrated in Figure 9

Table-3 : 2oo4 D Truth Table

		Leg-1		Leg-2		
S. No.	Voting	Channel-1	Channel-2	Channel-3	Channel-4	System Status
1	2oo4D	DU	DU	DU	Healthy	Fail to function
2	2oo4D	Healthy	DU	DU	DU	Fail to function
3	2oo4D	DU	DU	Healthy	DU	Fail to function
4	2oo4D	DU	Healthy	DU	DU	Fail to function
5	2oo4D	DD or SD	Healthy	DU	DU	Fail to function
6	2oo4D	DD or SD	Healthy	DU	DU	Fail to function
7	2oo4D	Healthy	DD or SD	DU	DU	Fail to function
8	2oo4D	Healthy	DD or SD	DU	DU	Fail to function
9	2oo4D	DU	DU	DD or SD	Healthy	Fail to function
10	2oo4D	DU	DU	DD or SD	Healthy	Fail to function
11	2oo4D	DU	DU	Healthy	DD or SD	Fail to function
12	2oo4D	DU	DU	Healthy	DD or SD	Fail to function
13	2oo4D	SD or DD	Healthy	SD or DD	Healthy	Trip
14	2oo4D	SD or DD	Healthy	Healthy	SD or DD	Trip
15	2oo4D	Healthy	SD or DD	Healthy	SD or DD	Trip
16	2oo4D	Healthy	SD or DD	SD or DD	Healthy	Trip
17	2oo4D	SU	Healthy	SU	Healthy	Trip
18	2oo4D	SU	Healthy	Healthy	SU	Trip
19	2oo4D	Healthy	SU	Healthy	SU	Trip
20	2oo4D	Healthy	SU	SU	Healthy	Trip
21	2oo4D	SD or DD	SD or DD	Healthy	Healthy	Safe Operating
22	2oo4D	Healthy	Healthy	SD or DD	SD or DD	Safe Operating
23	2oo4D	SU	SU	Healthy	Healthy	Safe Operating
24	2oo4D	Healthy	Healthy	SU	SU	Safe Operating

Note : Diagnostic testing will report the faults and would change any output states or change the output voting.

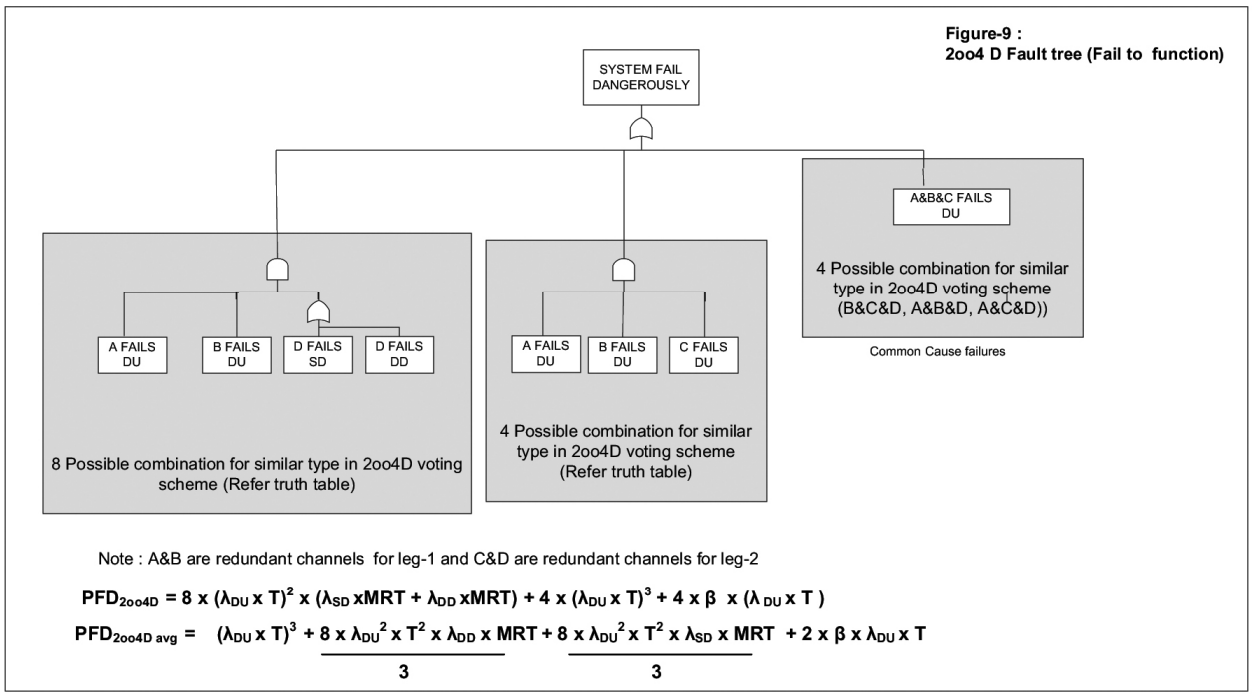


Figure-9 :
2oo4 D Fault tree (Fail to function)

Fault Tree diagram for safe failures and the corresponding probability of safe failures are shown in figure 10 :

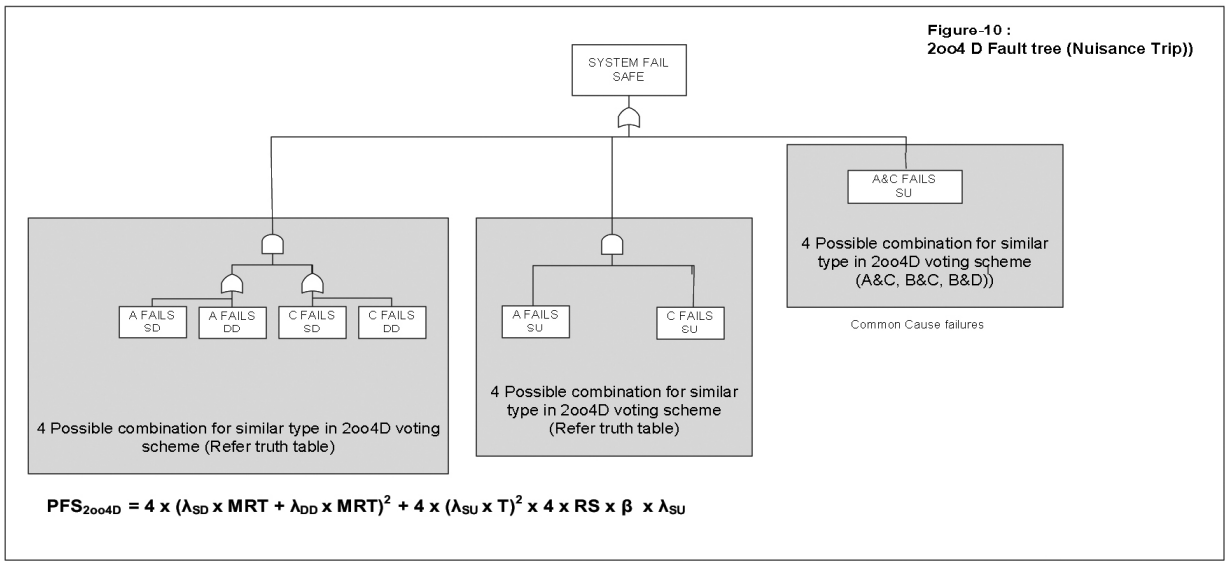


Figure-10 :
2oo4 D Fault tree (Nuisance Trip))

PREMISE FOR COMPARISON OF DIFFERENT VOTING SCHEMES:

Since safety and availability are of interest when selecting a safeguarding system the major comparison characteristics considered here are PFDavg (probability of Failure on demand) and PFS (Probability of safe failures or popularly called probability of nuisance trips) derived from the voting truth tables and fault trees. The other characteristic that is incidentally compared will be system behaviour in degradation mode (Supported by TUV reports).

CASE 1: Fail to function 1oo2D:

System will fail to function when there is one dangerous undetected failure in one channel in combination with any failure in the other channel. (System is one fault tolerant to dangerous undetected failures). This is better than 2oo2, which is zero fault tolerant for dangerous failures. (But slightly inferior for safety to 1oo2).

PFD_{avg} of our hypothetical system employing 1oo2D is 2.0487 x 10-6 .

2oo3D: System will fail to function when there are any dangerous failures in two channels. System continues to function in degraded mode of 1oo1D when there is a safe failure in one leg and dangerous failure in second leg.(One fault tolerant for dangerous failures and two fault tolerant for a combination of safe and dangerous failures).Hence overall the system is partly 2 fault tolerant.

PFD_{avg} of our hypothetical system employing 2oo3D is 6.32005 x 10-6 .

2oo4D: System will fail to function when there is one dangerous undetected in one channel of one leg in combination of SD or DD or DU in two channels of other leg. (System is two fault tolerant to dangerous failures).

PFD_{avg} of our hypothetical system employing 2oo4D is 7.7088×10^{-6} .

When the results of the calculations are examined, it becomes apparent that PFD_{avg} of 2oo3D is roughly three magnitudes higher than for 1oo2D system (three times worse) and approximately same order of magnitude as that of 2oo4D system.

CASE 2: Nuisance trips

1oo2D: System will lead to nuisance trips when there is one safe (detected or undetected) or dangerous detected failures in one channel in combination with similar failures in other channel. System is one fault tolerant to safe and dangerous detected failures for availability. This is better than 1oo2, since 1oo2 is zero fault tolerant for availability. But slightly inferior to 2oo2.

PFS (also known as spurious trip rates) of our hypothetical system employing 1oo2D voting stands computed as 1.6618 x 10-6.

2oo3D: System will lead to nuisance trip when there are safe (detected or undetected) failures in two channels. System is one fault tolerant to safe failures.

PFS_{2oo3D} stands computed as 3.95138×10^{-6}.

2oo4D: System will lead to nuisance trip when there is one safe (detected or undetected) or dangerous detected failure in one channel of one leg in combination with one safe (detected or undetected) or dangerous detected failure in another channel of other leg. System is one fault tolerant to safe and dangerous detected failures for availability.

PFS^{2oo4D} stands computed as 2.77602×10^{-6}.

Again when we analyse the calculated results, it is obvious that PFS of 1oo2D is better than both 2oo3D and 2oo4D . PFS of 2oo3D and 2oo4D are comparable as they are of approximately same order of magnitude.

Fault-free system	TUV approved Operating Modes w/Restrictions	TUV Class Approval for Safety	TUV Time Requirements for Repair	Remarks
1oo2D	2-1-0	AK5	72 Hrs	For AK6 applications, operating mode is 2-0 (immediate shutdown after the system degrades to 1oo1D)
2oo3D	3-2-1-0	AK5	72 hrs	For AK6 applications, operating mode is 3-2-0 (immediate shutdown after the system degrades to 1001D)
2oo4D	4-2-0	AK5,AK6		
2oo2		Not approved		
1oo2	2-0	AK5,AK6		

CONCLUSION:

1oo2D and 2oo4D voting schemes are based on channel comparison/switch over mechanism.

Even though 1oo2D systems quantitatively present better results for safety and availability, the real problem is that they are not deterministic and can't resolve a conflict in data. They can attempt to resolve the discrepancy by diagnostics. This places a huge responsibility on diagnostics to function very accurately and therefore the performance is based on the efficiency of the diagnostics circuit and switch over mechanism.

The essence of the above is captured in IEC-61508-6 (year 2010) which has additionally included parameter "K" for taking consideration of efficiency of inter-channel comparison/ switch mechanism in their PFDavg calculations.

Though 2oo4D is built with 1oo2D as its building block, both the safety and availability has not been comparable to 1oo2D and this is to be expected due to the fact that 2 channels of each leg lie in the same module and the degradation is 4-2-0 (degradation for a true 2oo4D would be 4-3-2-0) and also it has more components and hence more common cause failures.

2oo3D scheme is based on majority voting arrangement and therefore there is no high level of comprehensive diagnostics built in the system to perform efficiently. It surprises people to see that TMR systems have a higher nuisance trips than a dual system and greater probability to fail to function. Traditionally this system is considered as a fault tolerant system. Triplicated system is compromise between two dual systems (1oo2 and 2oo2).

It is difficult to conclusively declare which option is the best. All offers good benefits and selecting one would be a difficult task but should be based on how well any option fits in your needs. Evaluate the entire solution and take an well educated decision. Also the TUV report and restrictions to be carefully followed. Demand the failure rates from supplier and verify quantitatively the PFD figures following ISA and IEC standards.

REFERENCES

1. William M.Goble., Controls Systems Safety Evaluation and Reliabilty,3rd Edition
2. ANSI / ISA-TR84-00-02-2002-2 "Safety Instrumented Functions-Safety Instrumented Level (SIL) Evaluation Techniques Part 2, Determining SIL of a SIF via Simplified Equations.
3. IEC61508,(Part 6) 2010 Functional Safety of Electrical / Electronic / Programmable Electronic safety related systems.
4. Other Technical Publications

Wireless Technology For Oil & Gas

Hemal Desai – Endress+Hauser India Pvt. Ltd. Mumbai

Global Trends in O&G

Like many other markets, process automation is facing new challenges: provision of higher safety, use of less educated workforces, protection of the environment, need to increase effi-ciency when using energy, reduction of maintenance costs in plants. One way all these can be addressed by getting more information from the plant to gain knowledge about it and to use it more efficiently.

The question is how to extract this information from the plant in the most cost- efficient way. A wide array of wireless technologies from GPRS to Industrial Wireless Protocols is used. Industrial wireless range from mature technologies which have been used in logistics and enterprise communication for quite some time to relatively infant wireless sensor networks (WSN).

Applications of Industrial wireless can be broken down into 2 types and each has its own requirement.

1 Factory Automation

a. Fast production processes
b. Limited space
c. Short operation cycles
d. Various wireless networks to operate in small area

2 Process Automation

a. Monitoring & diagnostic of process operations
b. Relatively slower processes & longer cycle times
c. Low energy consumption for operation.

Fields of Application of Wireless Networks in Process Automation

This can be broadly classified into the following.

1. Wireless Sensor Networks which uses technologies like WirelessHART & ISA 100.11a. This is characterized by low data volume & limited distances.
2. Plant wide wireless Networks which is characterized by medium to high data volume and may use technologies including 802.11 WiFi, WiMax and others.
3. Cross-Plant Wireless Networks which is characterized by small to medium volume data and applications like monitoring, control & maintenance remotely.

Cost Benefits aspects in Application

Before applying wireless in applications a careful cost benefit calculations need be made for economic viability, specific advantage generated and the application of the right wireless technology of right wireless application.

Usage of Wireless Technology in selected Application

As mentioned above Wireless is not a replacement of wired systems. Rather it complements the multitude of other established technologies for selected application. **So how does one select the right Application and the right wireless technology for it ?**

Example - Application wise wireless is widely being used in the following

a) In plant monitoring for parameters like Level, Temperature, pH etc. usually slow variables as the current technologies restrict the network size with respect to up-date rates.

b) Near plant applications like water intake facilities, ETP, Tank farms etc which re-quire a combination wireless technologies for e.g WirelessHART and Wi-Fi without which users have reported issues.

c) Inventory monitoring, Supply and Logistics which require a completely different gamut of wireless technology & integration. Data from form traditional sensors to ERP. Example is Vendor Managed Inventory (supplier ensures client never runs out of stock) of Tanks which is completely automated using existing client ERP and reports

d) Water Treatment Plants and distribution networks. This would typically use GPRS form of Wireless transfers

e) Pipelines transfers or well head monitoring which could use combinations of GPRS, licensed wireless & satellite.

f) Using Acoustic sensors for detecting malfunctioning of steam traps. Though the application has generated lot of interest amongst the automation community, the preliminary feedback from users suggest that the application is too expensive because of the costly sensors and the large amount of steam traps in a plant e.g. Petrochemicals or Refinery could potentially have a few thousand traps. Some users have complained about the sensors themselves need maintenance. Similar sensors are used for Pressure Relief Valve operation and Safety Valve passing. WirlessHART of ISA100.11a would be typically used in this segment.

g) Vibration monitoring is another example where WirlessHART of ISA100.11a is typically used. However here too the application is limited by restrictions in the bandwidth of the data to be transmitted and the continuous receipt of data. Vi-bration monitoring software work on statistical analysis of data coming from the sensors. More the data, better the results

h) Automatic Tank Gauging systems. This application is becoming increasingly common in the Process industries. The major challenge for this application is the large distances to be covered to get data to control rooms where pure Wirles-sHART or ISA100.11a falls short of expectations. Hence a combination of the above and other technologies like the 802.11 WiFi and other secured licensed bands are being used. The example below shows the combined used of Wireles-sHART and WiHART to 802.11 gateways for tank farm application having typical distances of 2-3 Kms range.

Selecting the right Wireless technology for Application

This is the most important step to ensure that users achieve the Return on Investment or Objective when applying Wireless. Most often than not, users fall into the trap of thinking one Wireless Technology can be used in all applications. Nothing can be farther from truth.

Given below are some of the thought perspectives which help to determine the right Wireless Technology & right Applications.

Point of Receipt of Data

1) Control Room. Where is the data to be terminated? DCS? SCADA? Integration re-quirements. For example monitoring of process parameters like Level, Temperature, pH etc.

2) Multi Clients. For example all discharge effluent pH to be displayed on all Manager PC

3) Mobiles. Examples include supply alerts for storage Inventory monitoring

4) ERP integration – Supply & logistics

5) Range of Data transfer. Example Remote monitoring. Across the continents.

6) Data from multiple locations. Example multiple tank farms.

Nature of data input

1) 4-20ma
2) HART Multivariable data with diagnostics
3) Serial data like Modbus
4) On/Off
5) Digtal data. E.g Profibus networks

Requirements of Software

1) SCADA?
2) Web Server. Independent of OS platform & versions
3) Integration into client software Example OPC
4) Data Access through Web

Given below is a list of applications to be considered for Wireless in Oil & Gas Industry

Process Monitoring

- Crude oil flow measurement
- Gas plant monitoring
- Crude separator pressure monitoring
- Tank Inventory Management
- Offshore gas monitoring
- Oil production monitoring
- Oil well monitoring
- Onshore well head monitoring
- Pipe pressure monitoring
- Relief valve monitoring
- Remote vessel pressure monitoring
- Rupture disk monitoring
- Tank level monitoring
- LDAR monitoring
- Environmental surveys

Asset management

- Bearing temperature monitoring
- Pump pressure monitoring
- Vibration monitoring
- Corrosion monitoring

Safety & Mobility

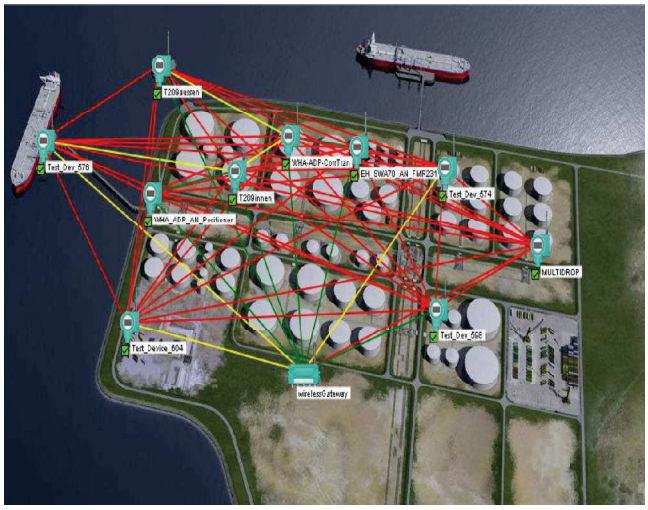
- Local monitoring
- Mustering solution
- Mobile operator & maintenance

Wireless Technology

Pepperl+Fuchs is the proven market leader for communication technology in the process automation market. Pepperl+Fuchs have always been an early adopter of new technologies. Wireless communication is the latest innovation introduced to provide communication paths between the control room and the field. Traditional 4-20 mA field instruments were using the extremely successful HART protocol to assist during commissioning and scheduled maintenance work. According to a recent study by ARC Advisory group, 32 million field devices installed worldwide by the year-end 2010 are **HART enabled field devices.**

Synopsis:

WirelessHART is an extension of the **HARTprotocol** for wireless communication, developed with the aim of preserving the same performance of the wired counterpart. The network uses IEEE 802.15.4 compatible radios operating in the 2.4GHz Industrial, Scientific, and Medical radio band. The radios employ direct-sequence spread spectrum technology and channel hopping for communication security and reliability, as well as TDMA synchronized, latency-controlled communications between devices on the network.



The WirelessHART (IEC 62591) was approved by IEC as First International Standard for Wireless Communication in Process Automation.

Each WirelessHART network includes three main elements:

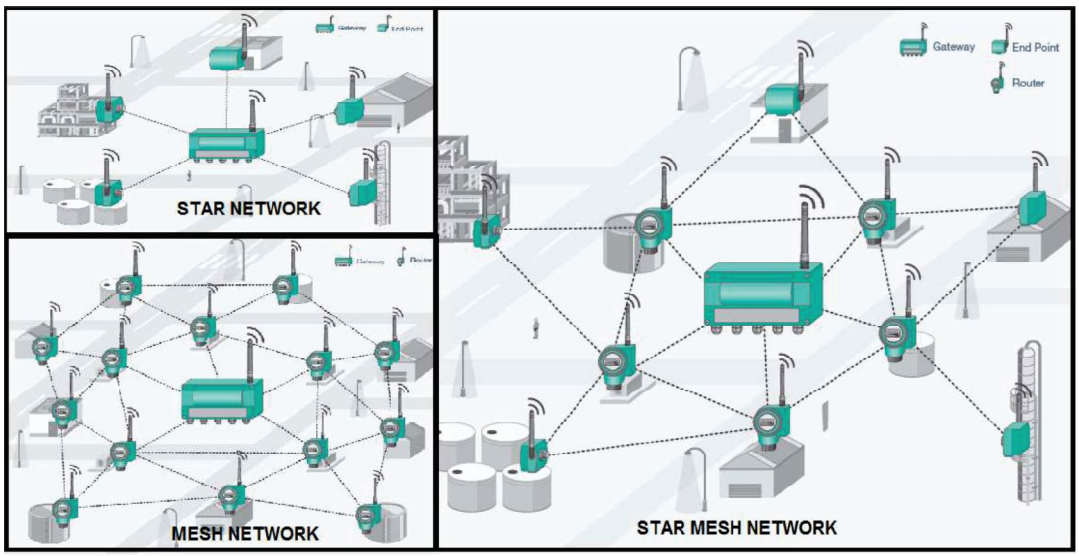
- Wireless field devices connected to process or plant equipment.
- Gateways that enable communication between these devices and host applications connected to a high-speed backbone or other existing plant communications network.
- A Network Manager responsible for configuring the network, scheduling communications between devices, managing message routes, and monitoring network health. The Network Manager can be integrated into the gateway, host application, or process automation controller.

WirelessHART includes several features to provide reliable communications in plant environments where dense infrastructures, the movement of large vehicles or equipment, changing conditions and numerous sources of radio-frequency (RF) or electromagnetic interference could cause problems which can be simulated while planning. WirelessHART uses four different communication concepts, which are interlocked to overcome the disadvantages.

- Flat Mesh Network
- Network Management
- Time Division Multiple Access (TDMA)
- Frequency Hopping

The architectures of a WirelessHART networks include star, mesh, and star-mesh hybrid topologies. Whether a network design is appropriate for the particular application depends on how much and how fast data gets transmitted, the transmission distances involved battery life, and the mobility and degree of change in the sensor nodes.

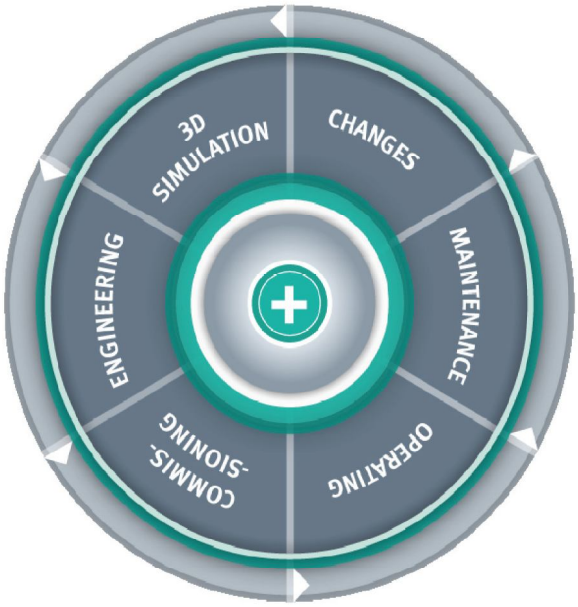
The WirelessHART technology was designed to enable secure industrial wireless sensor network



communications while ensuring ease-of-use is not compromised. Security is built in and cannot be disabled. It is implemented with end-to-end sessions utilizing AES-128 bit encryption. These sessions ensure that messages are enciphered such that only the final destination can decipher and utilize the payload created by a source device. Since WirelessHART is not built on TCP/IP as WLAN, it is also not possible to intercept network communication with WLAN standard hardware.

A wireless network offers a very scalable solution that can reduce the need for building in and paying for such spare capacity at the onset. In hazardous areas, wireless has a clear benefit that is safety. When instrument is to be installed in hazardous locations, wireless implementations can reduce the installation risks. Installing a battery-powered wireless instrument requires no wire or conduit which significantly reduces the time required to work in the classified area. Minimizing the amount of time workers spend in a classified area considerably reduces the risk of a safety incident.

OSI Layer	Security Threat	WirelessHART Defense Mechanism
Physical	Interferences	Channel hopping & Blacklisting
	Jamming	Channel hopping & Blacklisting
	Sybil	Physical Protection for WirelessHART devices
	Tampering	Protection & changing of Network Key
Data-Link	Collision	CRC & Time Diversity
	Exhaustion	Protection of Network ID & other information that is required for joining of a device
	Spoofing	Use of different path for re-sending the message
	Sybil	Regularly changing of Network Key
	Eavesdropping	Network Key protects DLPDU from Eavesdropping
Network Layer	Wormhole	Physical monitoring of Field devices and regular monitoring of network using Source Routing. Monitoring system may use Packet Leash techniques
	Selective forwarding attack	Regular network monitoring using Source Routing.
	DOS	Protection of network specific data like Network ID etc. Physical protection and inspection of network
	Sybil	Resetting of devices and changing of session keys.
	Eavesdropping	Session keys protect NPDU from Eavesdroppers.



Benefits

- Fully Flexible choice of control system manufacture , downwards compatible
- Saves time at commissioning & installation
- User Friendly Network Diagnostic
- Parallelization of planning work packages
- Bulk processing saves engineer time
- Concept of Wireless Worker / remote monitoring
- Less Downtime / increased Productivity
- Regulatory Requirements & product enhancement

WirelessHART is an enabling technology to bring wireless communication to process automation plants. It is built upon the known and proven HART protocol and combines this technology with mechanism to increase the reliability and range of wireless communication. The easy implementation of WirelessHART products and the HOST integration in the same manner as wired HART makes it easy for the customers to set up, operate, and maintain WirelessHART networks. WirelessHART will redefine the definition of asset management, preventive maintenance, and plant monitoring; therefore, it will help to plan services and maintenance tasks.

Regards,

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PROTECTING YOUR PROCESS

Industrial Wireless Technology Improves Plant Efficiency

Harish Mane/Vinayak Kore

Honeywell Process Solutions

When industrial wireless technology was introduced into the process industry a few years ago, saving money by eliminating hard wiring costs was probably the most talked about benefit. Shortly after that, the enabling of a mobile workforce became a bigger part of the conversation. Then, it evolved to include the ability to use information gathered from wireless technology to optimize operations.

Truly, as wireless technology has taken a greater hold in plants, more benefits have revealed themselves to manufacturers. The latest of these appears to be efficiency; that is, many plant managers are finding the nature of wireless technology allows them to push overall plant efficiency to newer limits and help plant operators sustain it at higher levels.

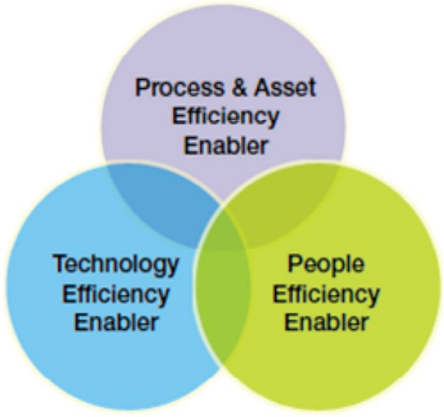
This paper attempts to explain how Industrial Wireless Technology impacts various components in a plant and makes it more efficient and globally competitive.

Drivers for Plant Efficiency

Why has efficiency become so important today? The following are key drivers, which compel operating companies to assess their efficiency level, benchmark it against industry standards and finally strive towards achieving new goals:

- Margin pressures
- Rising input costs (raw material, labor and capital)
- Global competition
- Regulatory environment
- Higher market demand

Wireless technology can significantly impact people, processes and technology to enable efficiency. Described below are such enablers, which when combined can yield noteworthy results.



Process and Asset Efficiency Enabler

Wireless Sensors

Planning numerous sensors in the design for the desired measurement coverage is cost-prohibitive; hence a compromise is often made in terms of the number of measurement points. Wireless sensors reduce the overall price point per sensor and allow designers to include any number of sensors in the design. This enables necessary secondary and tertiary measurements to monitor process and asset efficiency. Even taking a video from the process area is categorized as a sensor input and can be harnessed to generate automated triggers and alerts to monitor efficiency (e.g., material clogging, flare monitoring, etc.). These sensors may or may not participate in process control or supervisory control.

Examples:

- Additional pressure sensors to detect clogging or constriction in pipes.
- Performance and efficiency monitoring of pumps by measuring inlet and discharge pressure,

temperature, flow, vibration, motor bearing temperature, motor current, etc.

- Monitor efficiency of heat exchangers by measuring temperature, flow and pressure of hot and cold streams to detect fouling.
- Monitor efficiency of boiler or furnace.
- Monitor efficiency of reactor or mixer, and measure the effectiveness of reagents in chemical reaction.
- Monitor efficiency of effluent treatment unit key parameters of effluents (e.g., temperature, pH, volume, etc.) at the discharge point.
- Portable as well as fixed AQMS (Air Quality Management System) can be integrated via wireless networks that can signal efficiency of the process.

Technology Efficiency Enabler

Automation and Information Systems

These include ICSS (Integrated Control and Safety Systems), historians, CMMS, ERP, CRM, MES, security & access control, HSE monitoring systems, decision support systems, knowledge management systems, advanced analytics and other purpose-built information systems. These sophisticated systems usually consume large volumes of data generated by sensors as well as from manual entries. They run sophisticated algorithms to make sense of this voluminous data with some actionable information, such as KPIs, efficiency quotients, inventory alerts, HSE & security warnings, etc. More and more users prefer such systems to be hosted in a virtualized and cloud environment so they are accessible via wireless mobile devices from anywhere, anytime, but remain subject to security and privacy policies of the operating company.

People Efficiency Enabler

Mobile Digital Tools

Primarily, these are front-end applications to the above automation and information systems that use zero footprint web technologies for information access and can be deployed on a variety of devices, such as rugged industrial tablets and handhelds, smart phones or other commercial/industrial devices. These tools provide a converged applications experience to the user by simultaneously being capable of acting as a client platform such as ICSS, CMMS or ODR (Operator Driven Reliability) applications; voice over WLAN; taking pictures or recording videos and uploading them to the appropriate system; collaborating with colleagues in real time to execute tasks, generate/ process/approve work orders; calibrate an instrument and update the records in the calibration management system on the go via the wireless network; facilitate data collection, inspections, audits, or stock taking, etc.

These mobile digital tools have the capability to take plant efficiency to yet another level by enforcing discipline, digitizing workflow, and empowering people with contextual actionable information, providing them with a collaborative platform, and making training and skill-building tools accessible 24x7.

Benefits of Wireless Technology

Wireless technology enables overall operational efficiency and provides the following additional benefits:

- Flexibility and scalability – Wireless technology proves to be an ideal platform since it has built in flexibility and scalability to adapt to emerging needs. Changes can be accommodated without requiring complete re-planning and the systems can be scaled incrementally without requiring large capital.
- Faster to install – Wireless-enabled solutions are at least twice as fast to install as the equivalent wired solutions. Once efficiency has been added to the agenda by management, wireless technology allows faster deployment of solutions with less manpower.
- Standardization and interoperability – Industrial wireless standards such as ISA100, WirelessHART™, and IEEE 802.11 a/b/g/n have emerged as mature industry standards, which many vendors support and build products for them.

Honeywell's OneWireless is a broad portfolio of solutions for a number of industrial process control applications. Honeywell's industry proven wireless field instruments set the standard for safety, security and reliability; providing the highest performing devices needed for the most demanding applications. Honeywell's instrument portfolio consists of a range of wireless field instruments including wireless pressure transmitter, temperature, flow, level, and vibration sensors and wireless transmitters that fit into any industrial automation application. With a long track record of reducing risk, avoiding downtime, delivering cost savings, and providing customers with long-term support and migration paths, Honeywell OneWireless solutions are built to make a plant more efficient.

Conclusion

Wireless technology is changing every aspect of industrial automation in the same way it is changing our everyday lives. Wireless enabled applications and products have made us more productive and efficient in our personal lives from banking on the go, instant and global voice, video and mobile communications with our families and business partners, to finding the best local restaurants. All enabled by easy wireless access to information.

In this same way, industrial wireless technology will drive efficiency in our plants; provide simple access to more actionable information about our plants that enables us to make better and faster decisions, optimize processes in real time, improve working safety and security, and optimize our workforce to provide a more meaningful and challenging work environment. These gains in efficiency drive us to be more globally competitive in an ever challenging market.

Wireless Solutions for Upstream Oil and Gas Production

Abstract

A new milestone in this journey of instrumentation and automation is Wireless Technology, wherein field devices communicate with Host system without the need of wires. Wireless solutions offer unprecedented freedom and flexibility to end users, EPCs and consultants to reduce capital expenditure and accommodate last minute changes in the project execution without having impact on project schedule. It also facilitates quicker start-ups and adds measurement points in the life cycle of a plant without disturbing existing control system architecture. Based on International standards, this technology offers choice of multiple vendors, interoperability, security, reliability and immunity to common problems associated with Wireless communication such as jamming, hacking and EMI interference. Worldwide Oil & Gas producers are adopting wireless on large scale due to intrinsic advantages which come with the technology. India is no exception to the rule and depicts a very healthy adoption trend with major energy companies embracing wireless technology for upstream oil & gas production.

Protocol Evolution

Instrumentation protocol evolves to new standard typically every 10-15 years. In last few decades it has evolved from 3-15 psi to 4-20ma electronics to 4-20mA HART to Foundation Fieldbus. Each evolution of the protocol has lead to significant improvements in value to the end user. The latest change in instrumentation protocol is the introduction of wireless technology wherein field devices communicate with a host system without need of any wires. The manifestation of wireless protocol in process instrumentation in the beginning of 21st century made WirelessHart the de-facto international standard for wireless sensor networking in process applications and is now known as IEC62591.

Wireless Benefits

Smart Wireless Oil and Gas users have been able to deploy networks for costs as low as 70% of a wired installation. Cost reduction is achieved by following deliverables:

- Flexibility to change device types and locations very late in design/engineering stage without affecting delivery schedule
- Complete elimination of junction boxes/cables/ cable trays and associated accessories
- Reduced infrastructure barriers like trenching
- CAPEX savings by quicker automation of oil wells (in 1-2 days as compared to 1-2 weeks of a conventional wired implementation)

This allows companies to initiate production of oil/ gas, 12 days earlier than a conventional installation. In additional to the obvious installation savings, better and more reliable information flows from the wellhead to the control room. The process and storage facilities allow operators to improve safety, optimize

production, reduce operating costs and minimize potential environmental issues. Utilizing smart wireless devices for essential assets monitoring will also allow an operator to predict problems before they occur which will reduce maintenance costs, minimize equipment damage and significantly improve uptime and availability. Wireless is also scalable and easily expandable so adding future measurement points is easily accomplished.

Wireless Hart Technology

Wireless HART was designed specifically for process industry needs based on requirements defined by end-users back in 2004 and verified by NAMUR in a multi-vendor test in 2009.

The WirelessHart standard meets diverse user needs such as:

- Multi-vendor interoperability
- Transparent integration
- Simple commissioning
- Reliability
- Statistics and diagnostics
- Security (Achilles Level 1 Certification)
- Real-time determinism
- Long battery life
- Interchangeability
- Coexistence
- Life cycle version management, familiar tools and independent third party certification.

To date, WirelessHart devices have over one billion hours in operation at over 9600 sites worldwide.

Oil and Gas Adoption

WirelessHART Instrumentation is a key aspect of an onshore or offshore Intelligent Fields Implementation. WirelessHart provides the critical real-time process data and predictive diagnostic information which are the essential building blocks for the Intelligent Field. This real-time process and diagnostic data is used with production optimization, reservoir optimization and asset management applications which can dramatically improve performance. CERA has estimated that a full scale Intelligent Field Implementation is worth up to a 7% improvement in recovery, 6% production acceleration, 4% reduction in downtime and up to 25% improvement in operation efficiencies.

The most common cause of not meeting production goals is lack of real-time information about wellhead operation. Critical wellheads may already have automated monitoring, but due to cost barriers, most wellheads do not. WirelessHart now offers a cost-effective solution to monitor and control all production and injection wellheads. Wellheads that previously made it hard to meet production goals can now be optimized, monitored, controlled and maintained locally or remotely.

WirelessHART instrumentation is commonly used in production, lift and injection wells on Greenfield and Brownfield sites. Typical wireless wellhead measurements include monitoring casing pressure, wellhead (or Bradenhead) pressure, flow line pressure and temperature. Lift and Injection well measurements include pressure, temperature and differential pressures. With the addition of the THUM adapter from Emerson, other HART devices such as coriolis flow meters, vortex meters, mag meters, control valves and on/off valves can all be made wireless.

Studies have shown that 40% - 60% of oil and gas production and processing facility can be instrumented wireless. Some proven applications outside of the well and wellpad areas include tank pressure, temperature , level monitoring and overfill protection, pressure relief detection, and hydrocarbon leak detection. Other applications include gas compressor monitoring, hydraulic valve position monitoring, pipeline pressure and temperature monitoring, oil movements & gross oil production monitoring and enhanced oil recovery.

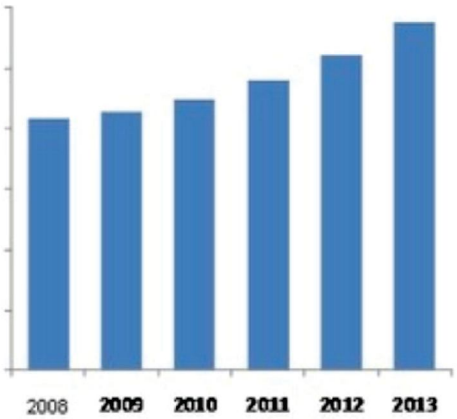
Besides tradition production measurements, WirelessHART provides the field operator with an ability to effectively monitor their essential assets. The combination of wireless field devices

and asset monitoring software makes it possible to monitor assets such as pumps, heat exchangers, compressors, fin fans and cooling towers. In addition to the operational benefits, automation and central management of assets minimizes dangerous and time-consuming trips to remote facilities.

New and innovative WirelessHart devices have been developed which allow you to monitor parameters which were difficult and costly to monitor in the past. New devices include sand monitors, erosion and corrosion detectors, vibration transmitters, level transmitters, acoustic sensors, pH and conductivity sensors, and position monitors.

Wireless Solutions for Upstream Oil and Gas Production in Asia

With no let-up in global energy demand and an increasing need to exploit newer sources of oil and gas, the upstream exploration and production sector continues to provide a well of opportunities for automation suppliers. According to ARC Advisory Group, the demand for petroleum products will increase substantially as the economies in developing regions improve and per capita energy consumption increases. And as today's production and processing capacities struggle to keep ahead of the demand curve, both upstream and midstream facilities will need to be expanded. "New sources, such as tar sands, shale oil, and coal-toliquid gas, will require new midstream and production facilities to be developed, increasing demand for automation systems and field devices," notes ARC, which also predicts Asia's share of sales for global upstream oil & gas automation to reach 25 percent by 2013.



Total Shipments of Automation Solutions to the Oil & Gas Industry
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Mr. Mike Ilgen
M/s Emerson Process

The use of surge protective devices in mitigating the effects of lightning strikes in offshore oil applications

A white paper presented by Phoenix Contact, INDIA

The frequency and magnitude of lightning strikes in the off shore installation is higher. Recognizing the same, several system specifications and practices have been written for lightning mitigation and implemented in offshore applications over the last decade. These system specifications and practices have focused on directing the primary lightning strike to ground via air terminals, down conductors, etc.

At the same time there should more focus about the induced or secondary effects that occur as a result of inductive or capacitive coupling during a lightning strike. This paper will examine the links between the primary lightning strike and induced transient secondary effects. It will also discuss the mitigation of conducted transient effects in power and monitoring circuits through the proper application of surge protective devices (SPDs).

International standard bodies and industry trade groups have written specifications that deal with the mitigation of effects of primary lightning strikes. More than 100 lightning protection codes and standards are in use by various countries and agencies around the world. Although none of these specifications deal directly with offshore oil lightning strikes1, some that have been used in the offshore oil applications are shown below:

IEC 62305 Series. The Technical Committee TC81, (Lightning Protection) of the International Electro-technical Commission (IEC) has released a series of five documents under the general heading "Protection against Lightning."

The five parts

Part 1- Protections of Structures against Lightning: General Principles;

Part 2- Risk Management;

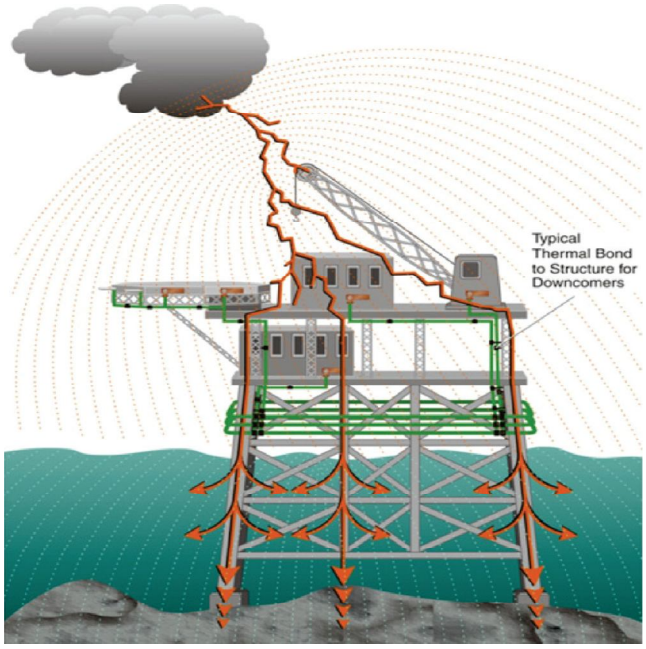
Part 3- Physical Damage and Life Hazard;

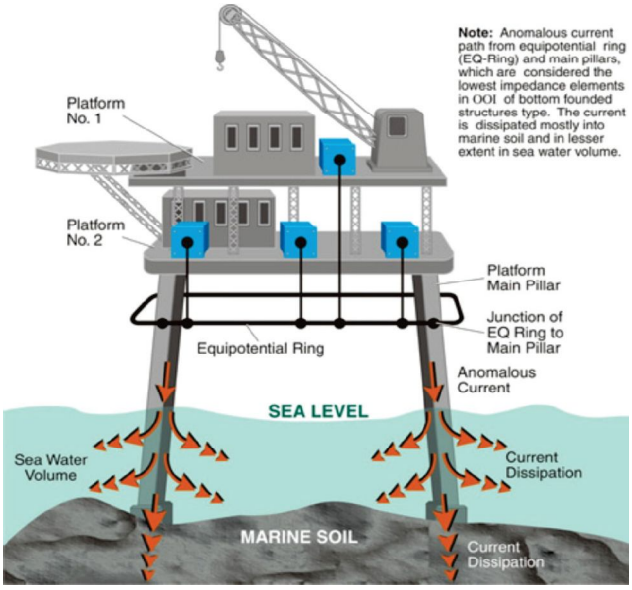
Part 4- Electrical and Electronic Systems within Structures and

Part 5- Services) provide a comprehensive standard.

All of these specifications and procedures focus on mitigating primary lightning strikes and address the problems of grounding, bonding and shielding of primary conduction paths. Figure below shows a typical example as applied to an offshore oil platform.

Note the primary conduction paths and the focus of the primary current strike to the earth ground. This figure also illustrates the critical importance of maintaining low-impedance grounding and bonding of





Induced secondary transient effects

A lightning strike on an offshore oil platform causes many secondary transient effects .Inductive and capacitive coupling mechanisms expose secondary power and control lines to radiated and conducted electromagnetic interference (EMI). Inductively coupled conducted interference is addressed by the use of surge protective devices (SPDs) and will be the main focus of this paper. Inductively and capacitively coupled secondary radiated interference is addressed by the use of shielding, where possible, of power and control lines. The shield on all shielded lines must be connected to the primary ground conduction path. All secondary and control structure frames must be bonded to the primary ground conduction path.

Inductively coupled conducted interference is a primary cause of failures for power and control circuits during a lightning strike. This conducted interference is present at all levels of circuitry on the platform.

The sensitivity of the components being used plays a key role in the amount of protection required at the system and subsystem level. The energy required to damage typical components found in an offshore oil platform is shown below.

As expected, the sensitivity, and therefore, the amount of required protection varies as a function of the power handling capability of the component.

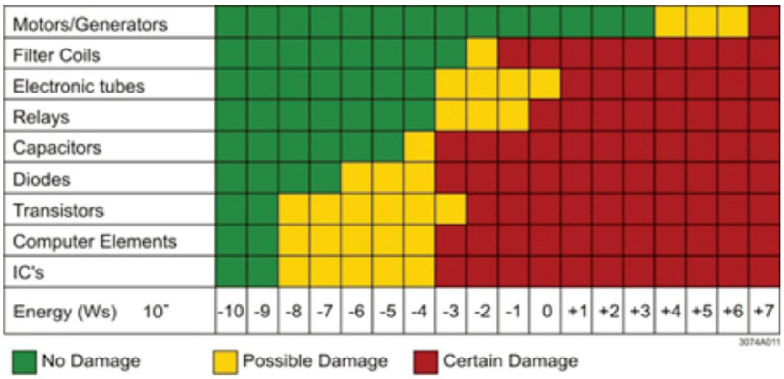
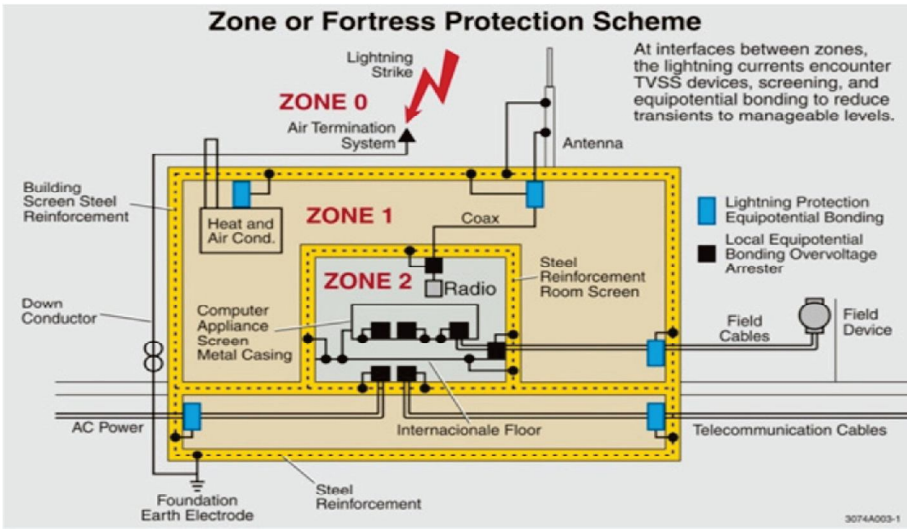


Figure below illustrates the bonding, shielding and conductive measures required as a function of location and component sensitivity relative to the lightning strike



Protection concept

The amount of protection required is defined, according to the zone protection concept, with **Zone 0** being exposed to unprotected electromagnetic field strength levels resulting from direct lightning strikes, and **zone 2** being exposed to field magnitude levels lowered by two layers of shielding. This is similar to the Lightning Protection Zone (LPZ) concept used by the IEC and defined in the IEC 62305- 4 specifications. The IEC specification definitions are as follows:

• **LPZ OA –** The zone where the threat is due to the direct lightning flash and the full lightning electromagnetic field. Internal systems may be subjected to full lightning surge current.

• **LPZ OB –** The zone where a direct hit is not possible, but the unattenuated electromagnetic field is present.

• **LPZ 1 –** A zone where a direct hit is not possible and the surge current is limited by current sharing and by SPD at the boundary.

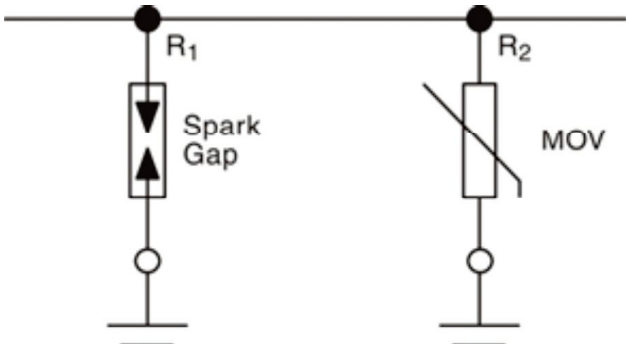
• **LPZ 2** – A zone where a direct hit is not possible and the currents in all conductive components are lower than in LPZ 1. In this zone, the electromagnetic field is attenuated through multiple screening measures.

It is worth noting that the sensitivity of equipment being protected varies greatly and ranges from motors, generators, etc., to control circuitry containing ICs and PROMs.

Surge protective devices

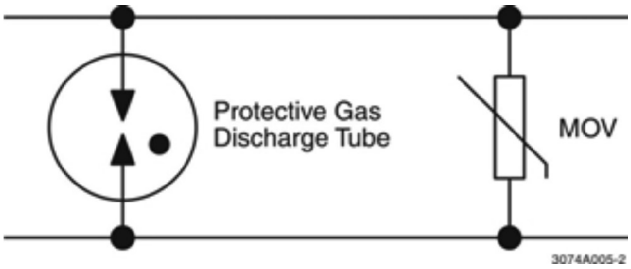
Surge protective devices (SPDs) are electronic devices used to shunt high-current magnitude pulses to ground.3 SPD manufacturers have used three different design variations to provide performance choices with regard to response time, current magnitude and cutoff voltage variables to system users.

The use of spark gaps in combination with metal oxide varistors (MOVs) (see Figure). This combination of components is associated with the highest lightning test current peak values, typically 100 kA.It has a high voltage protection level, approximately 1000 V. Open-air spark gaps have a wide variation of triggering voltage, due to the effects of differences in humidity, temperature and altitude.In an effort to mitigate the triggering voltage variations, many manufacturers now use a triggered spark-gap design, which provides a tighter band of triggering voltage values.



The use of gas discharge tubes in combination with MOVs (Figure). This combination of components is associated with lightning test current peak values in the range of 50 kA and voltage protection values of approximately 800 V. Compared to the open-air spark gap, the gas discharge tube is environmentally sealed, has a tightly controlled trigger voltage level, faster response time and a lower discharge surge current rating.

The use of parallel MOVs (see Figure below).This combination of components is associated with lightning current peak values in the range of 25-40 kA and the lowest voltage protection values, typically in the range of 400 V. When compared to the other two configurations, this combination has the fastest surge current reaction time and the lowest lightning current peak values.



SPDs are classified as T1 or T2 devices correlated to LPZ 1 or LPZ 2 ratings as shown in IEC 62305. They are positioned at the interface boundary of two LPZs. A T1-rated SPD would be inserted on lines entering an LPZ 1 zone from an LPZ 0 zone. Similarly, a T2 device

would be inserted on lines entering an LPZ 2 zone from an LPZ 1 zone.

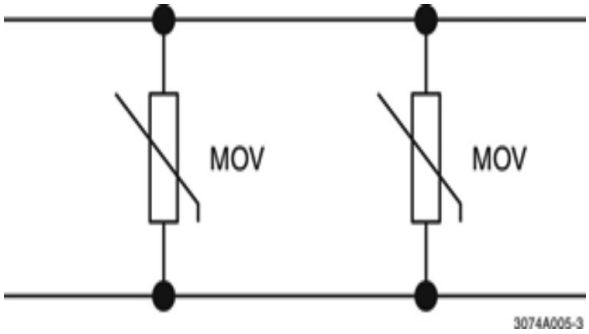


Table 1 Typical SPD specifications for SPDs used in signal line applications

Specifications	Symbol	Type 1/Class 1	Type 2/Class 2
Nominal voltage	U_N	60 V DC	60 V DC
Rated voltage	U_C	75 V DC	75 V DC
Voltage protection level, line-PG	U_p	700 V	500 V
Nominal discharge current (8/20 µS waveform)	I_N	12.5 kA	10.0 kA
Max discharge surge current			
(8/20 µS waveform)	I_{MAX}	50 kA	40 kA
Lightning test current, peak value (10/350 µS waveform)	I_{imp}	12.5 kA	4.0 kA

Table 1 shows typical SPD test parameters for SPDs used to protect signal line electronic components in an offshore environment.

Table 2 is a comparison of typical SPD test parameters for SPDs used to protect power line electronic components in offshore environments. As can be seen in Table 2, the performance characteristics of the SPDs used vary as a function of whether they are used at T1 or T2 interfaces.

Table 2 Typical SPD specifications for SPDs used in power line applications

Specifications	Symbol	Type 1/Class 1	Type 2/Class 2
Nominal voltage	U_N	240 V AC	230 V AC
Rated voltage	U_C	350 V AC	275 V AC
Voltage protection level, line-PG	U_p	<1.5 KV	<1.0 KV
Nominal discharge current (8/20 µs waveform)	I_N	25.0 kA	20.0 kA
Max discharge surge current (8/20 µs waveform)	I_{MAX}	50 kA	40 kA
Lightning test current, peak value (10/350 µs waveform)	I_{imp}	50.0 kA	25.0 kA

Lead length control

A typical installation for an SPD in a lightning-prone environment is shown in **Figure**

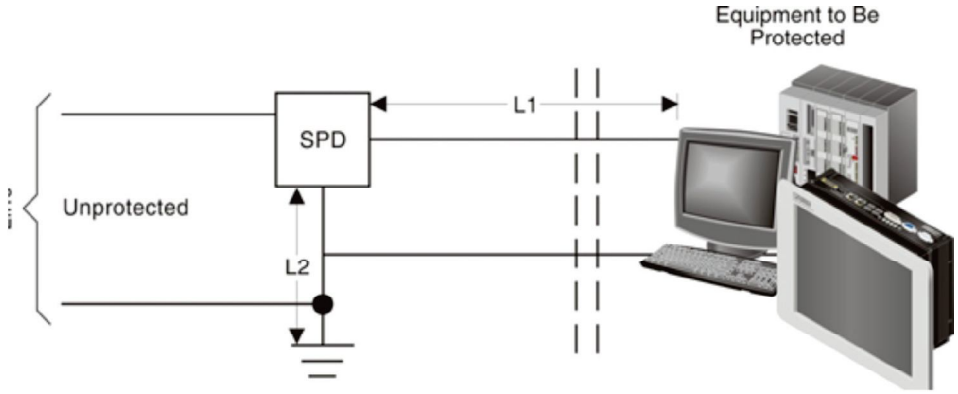
The SPD cabinet is typically mounted on the outside of the motor control center and is used to protect equipment inside the motor control center from conducted interference due to lightning strikes and current surges. **Figure 11** shows this configuration

During a current surge, the length of wire from the SPD to the input of the equipment (L1) and the length of wire from the SPD to ground Typical SPD installation

(L2) represent inductances. The magnitudes of these inductances at

surge frequencies are proportional to the length of wire used to connect

to the equipment and ground respectively.



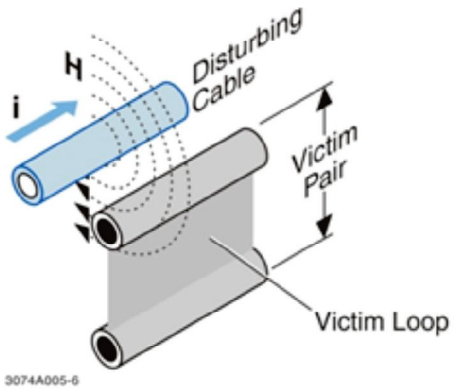
Schematic for calculation of VT

Inductive coupling

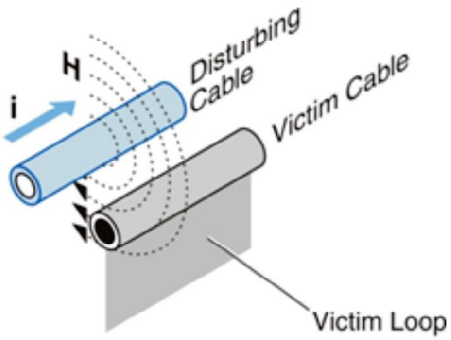
The Figure describe classic concept of both the differential and common mode inductive coupling effect. Current flow in the disturbing cable (sometimes called the aggressor) generates a magnetic field in a clockwise direction based on the direction of the current flow. The resulting magnetic field generates a current flow in the victim cable in the opposite direction. The magnitude of the current in the victim line is a function of:

• Distance between the two cables • Length of coupling between the two cables • Diameter of wire of the two cables

In general, increasing the distance between the cables, minimizing the length of coupling (distance) the cables run in parallel, and increasing the diameter of the cables will reduce the inductive coupling effect



Differential Mode



Common Mode

Lightning monitoring systems

In addition to applying the SPD information given above, it is recommended that consideration be given to the implementation of a lightning detection system at the platform level.A lightning monitoring system would facilitate the coordination of information about strikes (and potential equipment outages) for a specific production system, including platform configurations that include remote unmanned platforms. This lightning monitoring system, if equipped with remote monitoring capability via an RJ45 Ethernet interface, would significantly aid in analyzing data to promote remedial action that would prevent future equipment outages.

Conclusion

This paper reviewed steps used to mitigate primary lightning strike damage. It discussed the linkage mechanism between the primary strike current and coupled secondary inductive and capacitive effects.

The paper focused on the role of the SPD in mitigating the effects of conducted secondary coupled interference. SPD construction detail variations and typical performance characteristics have been present ed to provide a frame of reference for the application of SPDs in power and signal line circuits.

The information for SPD usage has focused on two areas of potential misapplication: the use of excess wire length in connecting the SPD and the potential for inductive coupling of interference as a result of poor routing practices

Mr. Ashish Manchanda
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SURGE PROTECTION - CASE STUDY

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Abstract

Plants these days are becoming more dependent on computer control for processes. These semiconductor circuits are most affected by stress due to surges. Lightning is the most fatal uncontrolled source of surge which has shutdown plants in recent times. This paper provides an over view of surge, its causes and consequence for industrial plants. Most common technologies available for surge protection will be discussed. Finally, a case study of actual implementation of surge protection is presented.

Keywords

Surge protection, Transient protection, Lightning, Surge protection device, Metal Oxide Varistor, Gas Discharge Tube.

Surge and Transient - Definition

Surges and Transients are sudden, brief (few microseconds) rises in voltage and/or current to a connected load. The dividing line between surge and transient is fuzzy. Surges are slow, prolonged and with very high total energy. They are caused by lightning strikes or excessive AC voltage due to faulty wiring. Transients are very fast but with low total energy. They are mainly associated with Emergency Shutdown of Electrical Equipment or Inductive Kickbacks. Generally, surge and transient are terms used interchangeably.

Sources of Surge

Surges and Transients are caused due to sudden change in electrical conditions of the circuit and release of large amounts of energy stored in the capacitive and inductive systems of the circuit. Sources can be both within the system and due to external environment. Some external sources are Lightning, Transformer switching ON/OFF, Powerline connection and disconnection, Electrostatic discharging or Switching of (ON/OFF) capacitor banks. Internal sources are Circuit breakers or fuses, VSD generators, Air conditioners or Electric motors.

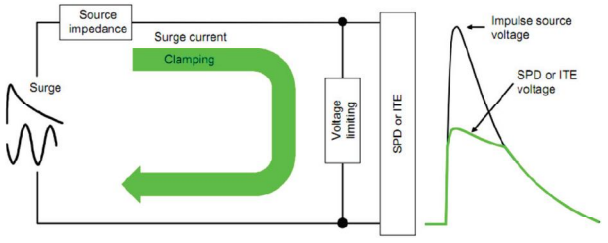
Most often the internal surge sources like VSD, welding have reliable mitigation techniques. External sources like lightning are uncontrolled which have caused plant shutdowns and hence pose a great risk.

Consequence of Surge

The oil and gas industry is a heavy user of sophisticated electric equipment for process control. Semiconductor circuits are more prone to failure due to the stress caused by a surge. Hence there is a need to use effective Surge Protection Device (SPD) to protect the process. Any absence of protective features can lead to reduce Mean Time Before Failure (MTBF), Failure, permanent degradation, increased maintenance cost, loss of revenue due to process shutdown, loss of life and property.

Technology Available For Surge Protection

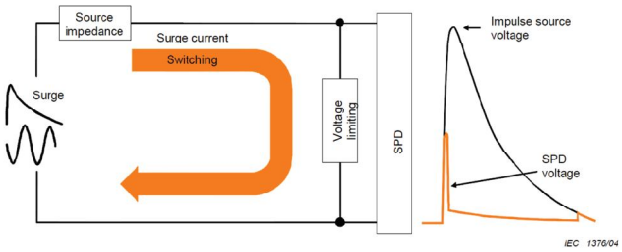
The two most common technologies used for surge protection are voltage limiting and voltage switching. Voltage limiting components are shunt connected SPD which have high impedance when no surge is present. They continuously reduce resistance with increasing surge voltage and current. They are sometimes called “clamping” type components. The common voltage limiters are Metal Oxide Varistor (MOV) and Silicon Avalanche Diodes (SAD).



Metal Oxide Varistors (MOV) can withstand high voltages. They have short response time making them suitable for limiting rapidly changing voltages. They can be used in parallel to increase voltage handling capacity. However they have high capacitance. This limits there use in high frequency applications.

Silicone Avalanche Diode (SAD) are reversed biased P-N junction. They respond rapidly to voltage surge. They clamp the transient voltage to a very small residual voltage. Though manufacturers combine several SAD to share energy, it has been found that in applications where frequent high energy transient voltages occur they are not a reliable protection measure.

Voltage Switching components are shunt connected SPD which have high impedance when no surge is present. They have a sudden change in impedance to a very low valve in response to surge voltage. They are sometimes called "Crowbar" type components. Common voltage switching component is Gas Discharge Tubes (GTD).



Circuit for voltage-switching devices

Gas Discharge Tube (GDT) are rugged, relatively inexpensive and have a low shunt capacitance. They have the maximum current carrying capacity, upto 10kA peak. They are slow to conduct. In some situations they become difficult to turn off even after transients have ended.

International SPD standards

Few important international SPD standards are:

IEEE C62.41.1-2002 - IEEE GUIDE ON SURGE ENVIRONEMENT IN LOW VOLTAGE AC POWER CIRCUITS.

IEEE C62.41.2-2002 - IEEE RECOMENDED PRACTICES ON CHARACTERIZATION OF SURGE IN LOW VOLTAGE AC POWER CIRCUIT.

IEEE C62.45-2002 - IEEE RECOMENDED PRACTICES ON SURGE TESTING FOR EQUIPMENT CONNECTED TO LOW VOLTAGE AC POWER CIRCUIT.

IEC 61643-11 - SURGE PROTECTION DEVICES CONNECTED TO LOW VOLTAGE POWER DISTRIBUTION SYSTEMS

Parameters for Selection of Surge Protector

A surge protector has various characteristics. The important parameters which should be mentioned in the product datasheet are - Voltage drop across the surge protector, load side surge withstanding capability, modes of protection and temporary overvoltage rating. Apart from this the information about number of ports, Thermal protection, mounting method should be given.

Choice of type of surge protector to be used should be based on the environment in which the protector has to be installed and the characteristics of the surge protector. The environment may be controlled which is inside a building or enclosure or uncontrolled which is out in the open. The parameters of surge protector should not affect the normal working of the system. The capacitance, series resistance and inertial loss of surge protector should be considered while selection since these parameters may influence the normal working an instrument.

When to Use Surge Protection

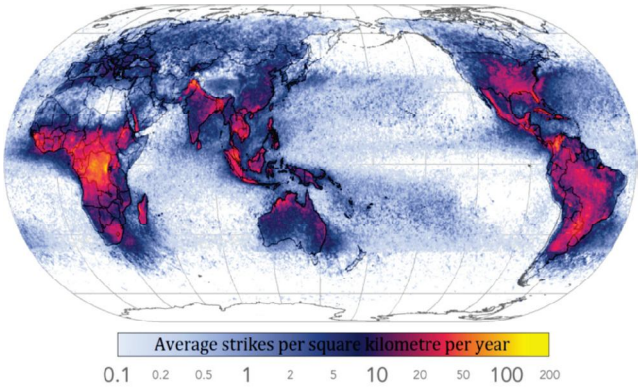
The need for surge protection should be based on Risk Assessment and Risk Identification. Risk analysis takes into account electromagnetic phenomenon of Lightning Discharge, Power Induction and Earth potential Rise. Risk identification takes into account economic aspects such as: Costs (high repair costs of inadequately protected equipment versus no repair costs of adequately protected equipment, probability of occurrence of damaging electromagnetic phenomena), intended application, protective measures in installations and continuity of the service.

Uncontrolled Surge Source – Lightning

Electrostatic charge separation processes, e.g. friction and sputtering, are responsible for charging water droplets and particles of ice in the cloud. If the space charge densities, present in a thundercloud, produce local field strengths of several 100 kV/m, Lightning takes place. Lightning flashes to earth are of two types - Downward flash (cloud-to-earth flash) and Upward flash (earth-to-cloud flash).Objects struck by lightning are subject to higher stress by downward flashes (cloud-to-earth flashes) than by upward flashes (earth-to-cloud flashes). The parameters of downward flashes are therefore taken as the basis when designing lightning protection measures.

Identification of Lightning Hazard

Keraunic number and Flash Density Maps are used to identify lightning hazard. The keraunic number is a system to describe lightning activity in an area based upon the audible detection of thunder. It is defined as the average number of days per year when thunder can be heard in a given area, and the likelihood thereby of a thunderstorm. The keraunic number has been replaced by more accurate Flash Density maps.They collect data from both ground-based and satellite lightning detectors



Case Study - ANTAPACCAY

Antapaccay is a plant located at Cusco, south east Peru at an altitude of 4200m above sea level. There were reports of damages to field instruments due to Lightening induced surges at existing Antapaccay plant. A study was conducted to establish Keraunic levels prevalent in the region which found the level is above 60. Therefore based on risk assessment, calculation done as per IEC 61643-22 and Keraunic number above 60, Surge protection was implemented at this plant as a safety measure against lightning protection. The Gas discharge tube (type SPD) surge protectors were selected based on their voltage protection level, line resistance, capacitance and maximum surge current. A total of 647 surge protectors were used in the entire plant costing $ 114,079. The detailed breakup for the types of SPDs used is given below:

Signal Type	Model Number	Connection Type
Power supply to instrument – 120Vac, 60Hz, 1 phase	DEHN 929970	Threaded
FieldBus- Loop powered	DEHN 929941	Threaded
Fieldbus- externally powered	DEHN 929970	Threaded
Profibus	DEHN 929971	Threaded
	DEHN - 920270	DIN RAIL

Conclusion

Lightning and lightning induced surges can cause major losses in plants. It is essential to determine the Keraunic number or flash density data for a plant site for lightning prone areas. Areas with Keraunic level above 60 must incorporate surge protection techniques in design for better reliability. By incorporating safety at design stage, reliability can been enhanced at fraction of overall cost of Instrumentation budget. A typical plant with 2000 field instruments can be protected from lightning with an expenditure of less than INR 20 Million.

Recommendations

Northern region of Jammu Kashmir, north eastern region specifically Assam, eastern coast of Orissa and West Bengal have high Flash density. Oil and Gas and other industries in such regions should incorporate surge protection for field instrument. The contribution of lightning surges in reduction of MTBF

of field instruments should not be ignored. In India, data is not available regarding Flash Density. More studies should be conducted to establish reliable Flash Density data. Operating companies should prepare a comprehensive lightning hazard report of plant site to assess the hazards of lightning and lightning induced surges. SPD vendors should increase awareness about the importance of surge protection.

Biographies:

Jitendra Chaudhari

Born in 1970 in Varanasi, U.P. Graduated in Electronics and Communications from IIT Madras. Working with Bechtel India Pvt.Ltd, New Delhi for the past 6 years as Engineering Group Supervisor with Total engineering experience of 18 years. Wide exposure to detailed engineering of control and instrumentation systems of Gas Processing, Alumina Refinery and Copper Concentrator Plants. Prior to joining Bechtel, worked on the Erection, Commissioning and Start up of Emerson's PROVOX and Honeywell TDC 3000 DCS systems, Analysers and Gas Chromatographs including field engineering, construction, maintenance, CPAEX of Petrochemical plants of VCM/PVC and Automated Bagging system .

Nakul Gupta

Born in 1988 in Delhi. Graduated from Netaji Subhas Institute of Technology (N.S.I.T) Delhi. Total 1.5 years of professional experience. Working as Engineer in Bechtel India Pvt.Ltd, New Delhi. So far got opportunity to work for Linear Alkyle Benzene plant and Copper Concentrator plant.

DEHN+SOHNE
Profile for
PNID-2012, New Delhi

Lightning is a natural phenomenon which takes place due to formation of heavy electric field between Earth and the Clouds. The discharge of energy when opposite Ions come enough closer to each other takes place in the form of lightning strike which carries huge amount of current to the tune of 200 KA. In electrical terms Lightning is defined as a wave shape having rise time of 10 µS and time to half as 350 µS (known as 10/350 µS wave).

Tall structures, trees, metal parts, open land and sometimes even human beings can be hit by lightning strikes.

With the lightning strike high Electromagnetic interference is created and it can damage the electronic equipment physically or by corrupting the software loaded in these electronic devices.

The damages of lightning can be as hazardous as damage of complete installation / building, fire or sometimes non availability of the very essential services.

Process plants such as refineries, oil, gas and pipelines belong to the largest and most sophisticated building structures. Reliability, quality and efficiency are most important factors for the Oil and Gas industry. Therefore Safe operations of all Electrical and Electronic systems are of vital important.

Due to the large size, location and use of measuring and control technology, the reliability of these installations are always threatened by Surges due to Lightning or switching operations.

External Lightning Protection of the complete installation / infrastructure shall be done as per IEC 62305 standards using following methods:-

- Rolling Sphere
- Mesh size
- Protection Angle

Internal Lightning & Surge Protection shall be as per IEC 61643, 60364-5-53 standards. Requirement of Surge Protective Devices (SPDs) in different lightning protection zones of plant hazardous area, to ensure optimum availability of the systems in order to meet the high requirements on safety in the hazardous area for protection against lightning strikes, switching Surges / transients.

Power and Data/Signal route shall be protected as per lightning protection zone concept.

SPDs in power, signal & data lines are used based on following technologies.

- Metal Encapsulated Spark Gap based technology for Fire Safe & Fire Proof operation.
- Heavy Duty Zinc-oxide Varistors, Gas Discharge Tube for discharging surges.

- Online Condition monitoring of Control and Data line SPDs.

- Special enclosure based Surge Protection solution for Field Devices, Isolating joints & different grounding.

Process Automation is dependent on complex electronic circuits for plant operation. One of the biggest challenges today is to ensure continuous availability / up-time of the services and dependability of this complex Automation, Instrumentation and IT systems.

Induced effect of Lightning energy & Surges into plant electronic devices and control system is major cause of failure or degradation of plant automation. Equipotential bonding and diversion of excess energy of surge to ground is achieved by the use of surge protection devices. For designing a complete lightning protection solution, a detailed risk analysis is required to be carried out, taking consideration of Lightning risk, causes of surges and flash density in that area.

For this purpose, the Lightning Protection Zones Concept described in IEC 62305 should be applied. A comprehensive study of different risk zones as per IEC 62305 is most important part.

These zones help to define the necessary devices and components for lightning and surge protection. Part of an EMC-conform lightning protection zones concept is an external lightning protection system (including air-termination, down conductor & earthing system), equipotential bonding, spatial shielding and surge protection for the power supply and control systems.

DEHN + SOHNE is a worldwide active and more than century old company , having engineering expertise in the field of complete lightning protection (External Lightning, Internal Surge, Earthing) and safety equipment.

DEHN is leader in providing lightning and surge protection for Process Automation. Past two decades; we have been setting trends in the protection solution worldwide.

DEHN is having presence in more than 80 countries including 11 subsidiaries with approx. 1500 employees.

DEHN Germany has one of the most advanced Test Lab on "Lightning Test Facility" in the world, with Lightning Impulse Current Generator up to 200 KA at 10/350 µsec and Follow Current capability up to 100 KA.

"DEHN India Pvt Ltd" is Indian subsidiary located at Plot No 346, Udyog Vihar Ph - II, Gurgaon.

DEHN offers solutions for External & Internal Lightning Surge Protection Solution for following industries:-

- Process Automation System.
- Control System protection for I/O cabinets of DCS/ PLC Power Supply System
- Lightning Surge Protection of Field Transmitters & Control system input terminals.
- Surge Protection for Foundation Fieldbus and Profibus devices
- Lightning Surge Protection for Cathodic Protection equipment's for pipelines.
- External Lightning Protection for Process Plants.
- Solution for Surveillance and communication network.
- Consultancy & End to End solution for Internal & External lightning protection.
- Safety Equipment.

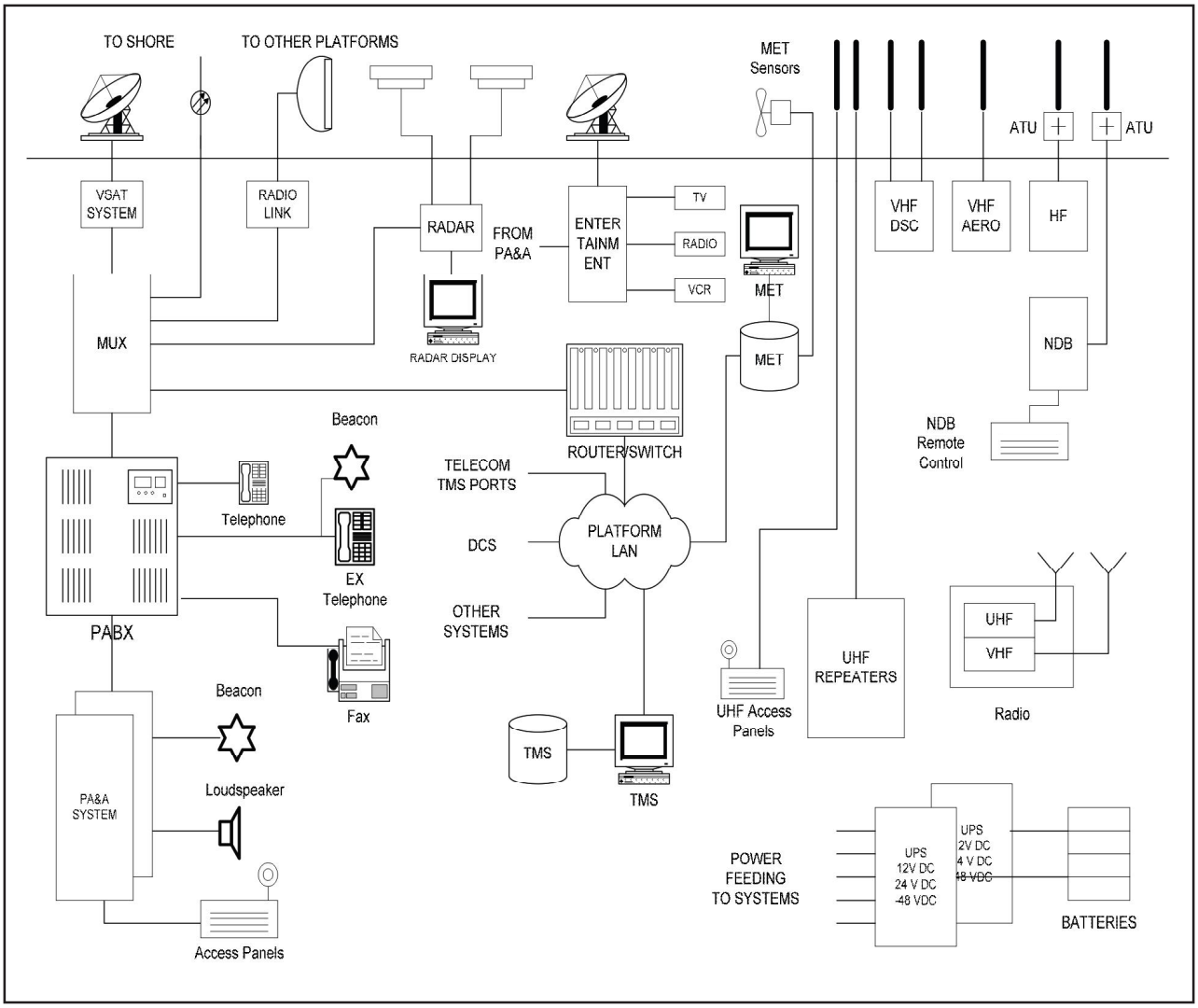
DEHN offers complete Lightning and Surge Protection solution for different field devices, SCADA, Electrical Panel, Surveillance systems, Tanks farms and Weigh bridges etc.

Wireless Technology PNID-2012, New Delhi

Synopsis of Technical Paper

Data Security & Reliability in Wireless Networks in use in Process Industry

A lot of data today flows over the wireless network in the commercial and industrial world. Some of it is critical & some is not. Industrial Wireless networks more often than not carry very critical data; which has process & operation dependability on it. While the technology moves continuously and varied methods are being adopted viz. Radio Motes. A host of communication methods present us with new & unexpected host of challenges. Not the least being availability, reliability & security of the data transmitted over the wireless networks.



The presenter will take a live case example of an Automation System Project which is implemented for taking data from the field instruments close to 150 locations across the geography in India to the Board room for decision making. This case in discussion is interesting due to the fact that it is a complex communication architecture containing both wireless and wired networks, and signal conditioning and flow of information in multiple modes.

He would explain how the complete data network was conceived and is operational for process information from field instrumentation to the board room through a Multi-Tier Architecture containing wireless & wired backbones. Concerns & Challenges of Availability, Reliability & Security are adequately addressed in the architecture.

A host of communication methods are used in the case in study:

a. Smart Instrumentation - Field Instruments connected communicating to RTU via wireless / wired communication.
b. RTU hooked up to VSAT / Radio / GSM Modem / Leased Line connectivity to Tier 1 Locations.
c. Several RTUs connected to First Tier via VSAT / Radio / GSM Modem / Leased Line connectivity and data is processed & displayed on Screen in graphics allowing operators to take corrective action.
d. Alarm Callouts to Landline / mobile via audio & data (SMS). Critical alarms to respective operators with tag threshold parameter update on auto generated message to Operators Mobile.
e. Wireless access points in datacenter & buildings.
f. Radio communication at Line of Sight locations including offshore & onshore.
g. Wireless communication of sending data from field instruments to RTU – RADAR Total flow RTU.
h. Wireless communication in the field of Data, Audio, Video.
i. Telecom CCTV System Camera installed in Fields, plants & hazardous area connected to control room via wireless communication system – Access points, Wireless tetra system etc.,

Some Advantages over conventional system are as below

a. Ease of installation
b. Total cost
c. Reliability
d. Performance
e. Security
f. Anytime, anywhere connectivity within the range of access point.
g. Ease of adding additional devices
h. Convenient
i. Easier to provide connectivity in areas where it is difficult to lay cable.
j. Moving Objects also can be hooked up to the network.
k. Mobility

Some cares need to be taken while using wireless technology

a. Signal interference (Portable / Cellular Phones, Microwaves, obstructions).
b. Speed are much slower than wired
c. QoS (Quality of Service)
d. Security Settings & Encryption
e. Initial Setup is complex to configure
f. Limited Spectrum

Wireless Technology and Standards

Wireless devices communicate through radio transmissions, without physical connections and without network or peripheral cabling. Wireless systems include local area networks, personal networks, cell phones, and devices such as wireless headphones, microphones, and other devices that do not process or store information. Other wireless devices being widely used include infrared (IR) devices such as remote controls, cordless computer keyboards, mouse devices, and wireless hi-fi stereo

headsets, all of which require a direct line of sight between the transmitter and the receiver.

Two standards for wireless technologies can be discussed. One is the IEEE 802.11 group of standards for WLANs, which were developed by a voluntary industry standards committee. The IEEE 802.11 standards provide specifications for high-speed networks that support most of today's applications. The Bluetooth standard, which was developed by a computer and communications industry consortium, specifies how mobile phones, computers, and PDAs interconnect with each other, with home and business phones, and with computers using short-range wireless connections.

As wireless technology evolves, new devices are being developed to provide more features, functions, portability and ease of use. Mobile phones can provide multiple services including voice, email, text messaging, paging, web access, and voice recognition services. Newer mobile phones incorporate PDA, wireless Internet, email, and global positioning system (GPS) capabilities.

Mr. Veeramani Kandan V,
Team Lead Telecom – IS-IT Infrastructure,
IN-PA-OGP, ABB Limited

Some Wireless Networking Standards are

a. IEEE 802.11 a b g n
b. IEEE 802.16 a
c. IEC 61508
d. EN 301 489-1 / 489-4 – Electromagnetic Interference
e. IEEE 828 Standard for software configuration management plans
f. IEEE 1042 Guide to software configuration management IEEE computer society document
g. IP Model code Area classification code for petroleum installations
h. EN 302 217-2-2 / Indian Telegraphic Act 1885 & indian Wireless Act 1933 for definition of communication & Radio Frequency.
i. IEC 61000-4-5 Lightening protection.

PNID – 2011, one day Conference and Exhibition on Petroleum and Natural Gas Industries Domain was organized by ISA-Delhi Section in Hotel "The TAJ PALACE", Sardar Patel Marg , New Delhi on 26th September 2011(Monday). The event was graced by chief guest **Shri A.K. Purwaha, C&MD, Engineers India Ltd.,** Guest of Honour **Dr. M Ravi Kanth – C&MD-Projects & Development India Ltd.,** Guest of Honour **Shri RC Kaul – Jt. Chief Controller of Explosives, Chief Patron PNID-2011 - Shri Mukesh Rohatgi, Shri B. R. Mehta- Sr. VP, Reliance Industries** and all ISA members and esteemed guests from various industries.

Esteemed dignitaries lighting the lamps.

Shri Alok Shrivastava – President – ISA-D

Shri Mukesh Rohatgi - Chief Patron, PNID

Dr. M. Ravi Kanth – C&MD, PDIL

Shri B. R. Mehta – Senior VP, Reliance Industries

Shri A. K. Purwaha, Chief Guest C&MD, EIL

Dignitaries inaugurating the Exhibition

Shri S. K. Dhawan, Convener- PNID-2011

Esteemed Audience – PNID-2011

Technical sessions started with most talked topics:

Session-1: "Safety & Security" by eminent speakers from reputed industries which consisted of:

- High Integrity Pressure Protection System (HIPPS), by Mr. I.S. Malhotra, MD, Tyco
- Considerations for Safety Instrumented Function, by Mr. Paolo Landrini of M/s GM International
- Safety Instrumented system, by Shri Amit Aglave of Honeywell
- Functional Safety perspective to Field Instruments by Shri Hemal Desai of E&H

Mr. I.S. Malhotra, MD, Tyco

Mr. Paolo Landrini of M/s GM International

Shri Amit Aglave of Honeywell

Shri Hemal Desai of E&H

Session-2: "Cutting Edge Technologies" was the technical sessions after the lunch break were discussed which consisted of following:

- Pipeline Intrusion detection using C-OTDR, by Mr. Upendra H. Manyam from Comtel Networks
- ISA100-Field Wireless solutions, by Mr. Bejoy Jose from Yokogawa India
- Advancement FF Technologies, by Mr. Sameer Shravge from Flour Daniel (India)
- Combining EFM control, by Mr. Matthew A. Diese from Thermofisher

Mr. Upendra H. Manyam from Comtel Networks

Mr. Bejoy Jose from Yokogawa India

Mr. Sameer Shravge from Flour Daniel (India)

Mr. Matthew A. Diese from Thermofisher

Session-3: "Asset Management" session, eminent specialists from industries shared their vast experiences and expertise in their own fields.

- Case study-TAS integration with ERP by Mr. Sudhanshu Shekhar and Mr. Vikrant Kumar,IOCL
- Online Analyser System, by Mr. Jochen Geiger from M/s AMETEK
- Integrated Automation Solutions to Safeguard Health of Plant Assets by Mr. Manoj Chandrasekran from GE energy

Mr. Sudhanshu Shekhar, Sr. Inst. Mgr.-IOCL

Mr. Vikrant Kumar, DMIT-IOCL

Mr. Jochen Geiger from M/s AMETEK

Mr. Manoj Chandrasekran from GE energy

Panel Discussion Session:

"Panel discussion on Statutory Requirements for installation in Hazardous Areas" among technocrats and experts in this field Mr. R.C. Kaul, Jt. Chief controller of explosives, Mr. Nand Kumar, C&MD-Chemtrols, Mr. S. K. Bardhan, DGM IOCL, Mr. Ramani Iyer, Director, Forbes Marshal, Mr. Rejith J. Thomas, Group Leader (I), Technip, turned out to be subject of interests for all the participants.

Mr. R.C. Kaul Jt. Chief controller of Explosives

Technical Experts Panel Members

Efforts of all the participants, sponsors, exhibitors, speakers were analyzed by High Power Technical Committee and best participants in each category like Best Stall and Best Paper were rewarded with token memento by ISA-D.

Mr. Bejoy Jose receiving memento

Mr. Matthew A. Diese receiving memento

Yokogawa India Team receiving memento

Phoenix Contact India team receiving memento

Participants Visiting Technical Exhibition

PNID-2011 Organiser Members

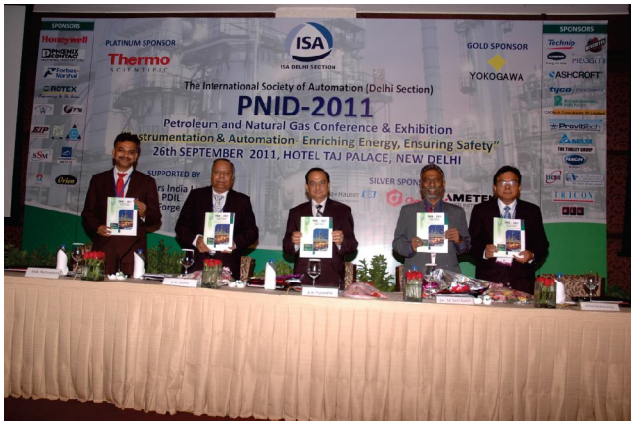
High Power Technical Committee PNID-2011

Ms. R. Priyamvada, receiving memento

Shri Rajiv Gupta receiving memento

Shri Anil Mishra presenting memento to Shri Ravi Kanth

Dignitaries unveiling PNID-2011 souvenir



Shri A. K. Purwaha visiting exhibition

Shri S. Mahesh Kumar, Technical Coordinator

Esteemed Guests from various industries

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With the experience of handling more than 1250 installations throughout the country, the Forbes Marshall expertise is now also used in the condition monitoring of plants. With effective tools available for analysis and diagnosis, Forbes Marshall engineers are well equiped to carry out a detailed vibration spectrum analysis of critical eqipment in a plant and provide a comprehensive solution for plantwide vibration monitoring and analysis.

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About ISA & ISA Delhi Section

ISA Delhi Section had been formed almost a decade back and has progressed well since then with present membership of more than 400 and growing further. ISA Delhi Section had taken many initiatives in the past including organizing two exhibitions ISA (D) EXPO' 05 & '07, PNID-2011, POWAT-2012, a large number of seminars and workshops on emerging technologies. Regular Monthly technical exchanges on diverse topics are organised for the benefit of all members of ISA(D), thereby increasing the knowledge base & technical capabilities of members.

ISA Delhi Section has taken quite a few initiatives in the recent past to better address the need for knowledge sharing among industry specific groups of Automation Engineers. Notably, within the overall ambit of ISA(D), two industry specific interest groups have already been created, one for the Petroleum and Natural Gas Industry namely Petroleum and Natural Gas Automation Group or PNID and one for the Power Industry Automation and Technology or POWAT. ISA (D) is also encouraging the formation of a systems Integrators forum, so as to share the vast scattered knowledge base resources of systems integrators community.

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ISA (D) –PNID – 2012

5th October 2012 (Friday)

Hotel Taj Palace, S P Marg, New Delhi

For more information about ISA, ISA-Delhi & PNID

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