ISA

International Society of Automation
Delhi Section

PETROLEUM & POWER AUTOMATION MEET 2024

"COLLABORATIVE AUTOMATION for ENERGY TRANSFORMATION"

26th and 27th April 2024
(FRIDAY & SATURDAY)

Venue: Hotel Eros, Nehru Place, New Delhi

e - Souvenir

International Society of Automation
Delhi Section

Message

It is my immense pleasure to be part of ISA-D flagship Annual Mega Event "PETROLEUM AND POWER AUTOMATION MEET- 2024" with the theme "COLLABORATIVE AUTOMATION for ENERGY TRANSFORMATION" and the Souvenir being brought out to commemorate this occasion.

Since its inception in year 2000, ISA-D had been promoting latest Technologies in Process Automation through regularly conducting monthly Technical Meets, PPA Meets and imparting Technical Training. ISA-D has emerged as a forum of choice for End users, Consultants, EPC's, System Integrators, Suppliers, Contractors and Students. ISA Delhi always believes that Decarbonization, Decentralization and Digitization are three pillars for making tomorrow better than today. At the same time Automation shall greatly contribute to the greening of our globe.

ISA-D is now venturing beyond the boundary of Automation into the areas important for Energy Transformation in keeping with the key role automation professionals are playing in the industry.

I solicit your co-operation to enable ISA-D to keep on contributing more effectively to enriching the life of all professionals who are part of it.

I express my sincere gratitude and heartfelt thanks to all the industry leaders for bestowing their blessings, guidance, and continuous support to ISA DELHI.

(M. K Srivastava) Hony.
President ISA Delhi
Section

International Society of Automation
Delhi Section

Shanmugha Sundaram Kothandapani
Director (Projects)
NTPC Limited

It gives me immense pleasure to be a part of International Society of Automation (ISA) - Delhi section's flagship annual event "Petroleum and Power Automation Meet – 2024" being held on 26th and 27th April 2024. International Society of Automation (ISA) is a non-profit Organization dedicated to building a better world through transformative trends in automation ensuring safety, security, availability & reliability.

The noble theme '*COLLABORATIVE AUTOMATION for ENERGY TRANSFORMATION*' of ISA's Delhi Chapter will address key challenges of energy transition. Latest advancements in Automation Technology that are shaping up the world of Instrumentation and Controls, Operations and Safety, Artificial Intelligence & Cyber Security, Energy Efficiency, and the overall management of Electrical and Control System design stands as cornerstones to increasing productivity without compromising on safety, reliability and security meeting regulatory requirements.

Transition to clean energy is no longer an option and with India on a growth path with cleaner, greener & sustainable energy mix supporting net zero, this forum is an apt platform.

I am glad that the two-day symposium has the right mix of technology providers and end users and hence look forward to an extensive deliberation in addressing the key challenges of energy sector.

My best wishes to the participants and for a grand success of PPAM-2024.

K S Sundaram

International Society of Automation
Delhi Section

MESSAGE

Shri Rajiv Agarwal

Director (Technical)

I am pleased to know that ISA Delhi Section is once again organizing Petroleum & Power Automation Meet 2024 in Delhi on 26th and 27th April 2024 with a theme of "Collaborative Automation for Energy Transformation".

The Energy resources in the country have been under severe pressure due to the imbalance created in the demand and supply with majority of raw materials being imported. It is an area of concern for the country with regards to sustainability in the future, however India has taken big steps in various alternative sources of energy like Solar Power, Green hydrogen, Wind Energy etc.

Automation Technology and Instrumentation & Control Systems are the key enabler for efficiency, safety, innovations and above all sustainability of these industry domain that may help reducing this gap as well as become a major factor in meeting the sustainability needs of the Petroleum and Power sector in India.

A focused dedicated Automation Technology campaign organized by ISA Delhi section, in the critical sectors of Petroleum and Power, is very much needed to accelerate the transformation of the infrastructure sector in India.

As our country has moved forward for "Make in India", this is an excellent opportunity for the Control and Instrumentation professionals from various domain of industries to attend this conference and enhance their technical expertise through various modes of knowledge sharing like live demo, technical presentations, case study discussions and networking.

It is also note-worthy that through such seminars, ISA Delhi Section is striving to facilitate through integrated automation, the realization of world class plants in India with green, clean and lean visualization. We are proud of our established global benchmarks in using latest technology using Artificial Intelligence, Collaborative Automation in both Power and Petroleum industries enhancing reliability and cost competitiveness.

I wish ISA Delhi Section members and all the participants in this event, a very best of time ahead.

(Rajiv Agarwal)

International Society of Automation
Delhi Section

Message

I am happy to know that International Society of Automation (ISA) Delhi Section is organizing the Petroleum & Power Automation Meet-2024 on April 26-27, 2024 with a special focus on "Collaborative Automation for Energy Transformation."

As India is targeting a quantum jump in GDP in the next decade, the economy's energy requirement is likely to grow beyond our expectations. For the administration of energy's Demand Side Management (DSM), automation will play a significant role in the near future.
With the development in the areas of IIOT, there is a growing connection between production networks and office networks as part of IT/OT integration, and the utilization of Internet of Things (IOT) has many benefits for industrial companies. However, this also poses a risk due to the increase in the risk of cyber threats. Cybersecurity for Industry ensures that both know-how and plants are protected at all times.

I am confident that PPAM is a good opportunity for Energy sector professionals to enhance their know-how in the field of energy automation.

I extend my best wishes for the event's great "Success."

With Best Wishes,
Tajinder Gupta
Director (Power) - BHEL

Message

Dear Members, Sponsors, and Esteemed Guests,

It gives me immense pleasure to welcome you all to a pivotal event presented by the ISA Delhi Section, focusing on the impactful sphere of "Collaborative Automation for Energy Transformation in Industry". The necessity for sustainable operational practices has never been more critical as we venture into an era of augmented technological integration compelling every industry to reconsider and reshape their energy consumption and management strategies.

Today, we gather in the capital city, illustrious in its vigor and adaptability, to embark on discussions that we hope will pioneer novel pathways and foster technological collaborations aimed at nurturing an energy-efficient industrial environment. This initiative is in direct response to our collective commitment to supporting the United Nations' Sustainable Development Goals, particularly those targeting responsible consumption and production patterns.

Our carefully curated sessions and workshops have been designed to equip each of you with understanding, tools, and strategies needed to implement and excel at automation technologies that not only optimize energy use but also enhance production efficiency. We have invited experts and visionaries from various sectors who will share their insights and real-world examples of successful integration of automation in energy systems.

As the convenor, I anticipate constructive interactions that I trust will inspire all stakeholders — from engineers to business leaders, and policymakers to academic researchers — to tackle the challenges presented by energy needs and environmental constraints with innovative and scalable solutions.

Let us leverage this gathering to forge strong partnerships, stimulate intellectual exchange, and outline actionable strategies that will guide our industries towards a more sustainable and energy-efficient future. Your active participation is crucial in turning these discussions into tangible outcomes.

I extend my heartfelt gratitude to our sponsors, without whose generous support this meeting would not be possible. And to our participants, your engagement is vital in driving forward the agenda of energy transformation through collaborative automation.

Looking forward to two days of engaging discussions, insightful debates, and actionable outcomes. Let's make this a milestone event for ISA Delhi and for the broader objectives we all strive to achieve in the automation landscape.

Warm regards,

Sanjeev Sharma

Sanjeev Sharma
Convenor, ISA Delhi Section

International Society of Automation
Delhi Section

Message

On behalf of Emerson India, I extend a hearty welcome to all attendees of the Petroleum and Power Meet 2024 organized by ISA Delhi. This gathering epitomizes the spirit of collaboration and innovation that defines our industry.

In today's dynamic energy landscape, where challenges and opportunities intersect, it is through events like these that we forge new partnerships, share best practices, and chart the course for a sustainable future. The discussions, insights, and connections made here are crucial in propelling our collective efforts towards greater efficiency, reliability, and environmental stewardship.

Emerson is committed to being a catalyst for progress, offering cutting-edge solutions that empower organizations to optimize operations, enhance safety, and achieve their sustainability goals.

I extend my gratitude to ISA Delhi for their exceptional efforts in organizing this impactful event. Together, let's continue to drive innovation, foster partnerships, and shape the future of the petroleum and power industries.

Regards,
Anil Bhatia
Vice President & Managing Director, Emerson India

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International Society of Automation
Delhi Section

Message

As we gather for the Petroleum & Power Automation Meet 2024, it's evident that the landscape of the energy sector continues to evolve rapidly. With a pressing need for sustainable and environmentally friendly solutions, coupled with the relentless advancement of technologies, we find ourselves at the forefront of a transformative era.

Under the theme of "COLLABORATIVE AUTOMATION for ENERGY TRANSFORMATION," this year's event promises to be a beacon of innovation and collaboration. It's a testament to our collective commitment to harnessing Automation as a catalyst for ushering in a new era of energy transformation.

The Petroleum & Power Automation Meet serves as a platform for knowledge exchange and skill enhancement, empowering professionals in the Automation field associated with the Oil & Gas and Power sectors.

I commend the tireless efforts of the ISA-D team for their dedication in orchestrating this impactful event. Through their diligence, we have the opportunity to explore groundbreaking advancements, foster industry collaborations, and drive meaningful change.

The collaboration between ISA and industry stakeholders underscores our shared vision of achieving world-class production facilities and advancing core expertise in automation. Together, we are poised to elevate standards, enhance productivity, and ensure the safety and reliability of our energy infrastructure.

I extend a warm welcome to all Automation professionals to participate in this event, seize the opportunity to expand your knowledge, and contribute to our collective journey towards energy transformation. Let us unite in purpose, leverage the power of collaboration, and make the Petroleum & Power Automation Meet 2024 a resounding success.

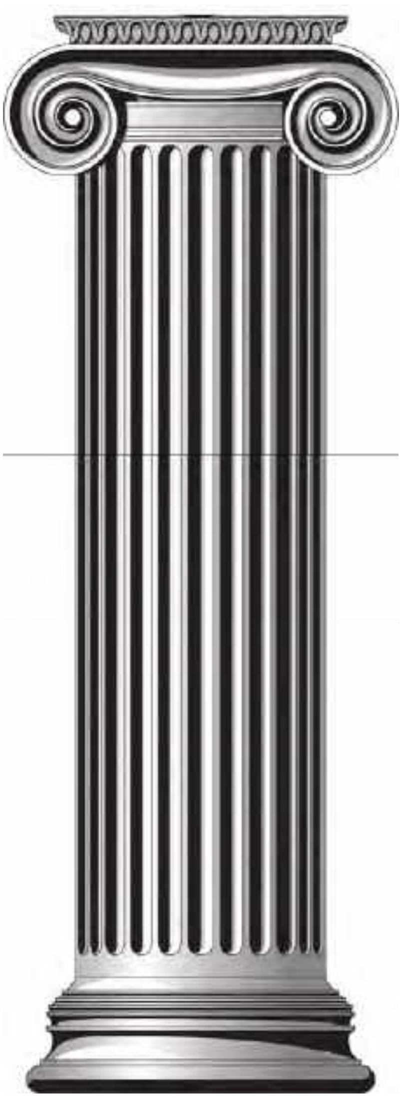
With best regards

Sachin K Agrawal
Hon. Secretary, ISA - Delhi

The International Society of Automation (ISA)

Founded in 1945, the International Society of Automation (ISA) is a leading, global, non-profit organization that is setting the standard for automation by helping over 30,000 worldwide members and other professionals to meet, interact and share their knowledge. Based in Research Triangle Park, North Carolina, ISA is organised into 14 districts and hundreds of sections across the world. The Southeast Asia region is designated as District-14 and within this district, the Delhi Section is an active organization drawing members from the entire spectrum of automation industry across Power, Oil & Gas, Metallurgy, Chemicals & Fertilizers including the Engineering fraternity from Consultants, EPC Contractors, Automation Component Suppliers & Equipment Manufacturers, System Integrators, and many other industries.

ISA has been involved in promoting emerging technologies across the globe by a variety of ways such as:



- Developing and updating standards for existing & evolving technologies in automation related fields.
- Publication of Textbooks, handbooks, journals, proceedings etc. on a wide array of automation related subjects from primary field sensors to integrated automation and management systems for various kinds of plants & processes.
- Facilitating Interface & interaction with other agencies like IEC, IEEE, EPRI, ASME and others to develop and maintain automation related standards with regular updating, keeping pace with the march of technology in various fields.
- Organising Training, Seminars/Workshops, Webinars and Exhibitions.
- Carrying out certification programs for technicians, engineers, and senior professionals.
- Recognizing the talented and the dedicated professionals in the field of Automation through various honours and awards
- Enabling Interaction with Student members, formation of student section and annual scholarships, competitions etc. are many interesting student programs of the ISA.

The ISA Delhi Section - ISA(D)

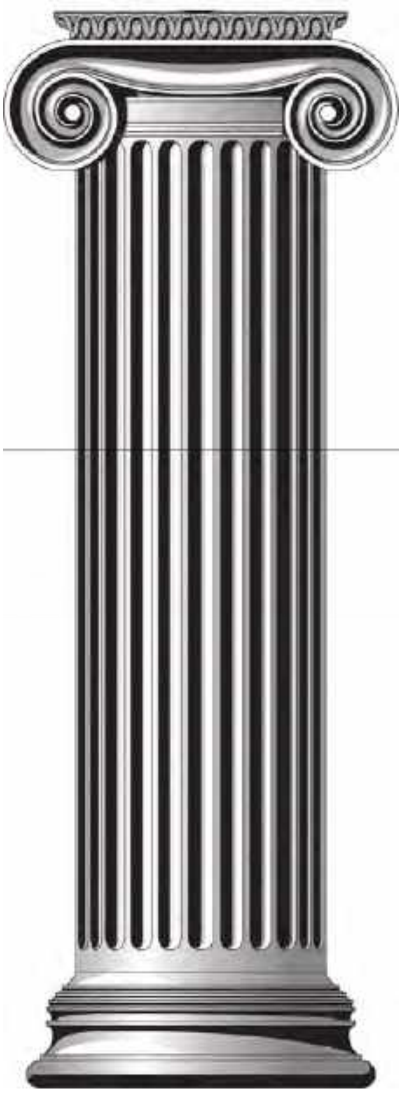
ISA Delhi Section has now completed its more than two decades of successful presence in the country. With the core aim of providing highest levels of technical engagements for its members who are from all over the automation industry domains of Plant and Process Automation. Regular Monthly technical exchanges on diverse topics were also organised for the benefit of all members of ISA (D), thereby increasing the knowledge base & technical capabilities of members.

Currently, ISA Delhi Section holds one of the largest Membership Strength in the Asia Pacific District that covers a diverse number of professionals from Engineering Companies, EPC Entities, End Users, System Integrators, Instrumentation and Automation Component Manufactures, Licensors and Consulting Companies, Traders and Equipment Suppliers, Academia, and Students from Engineering Colleges. Such a gathering of Domain Experts, Designers and Users being the core strength of the Section has provided a value-add platform among the industry.

Our Executive Board members also carry forward the spirit of leading by example to conduct the activities and programs of the Section thereby providing the much-needed synergy of all the stakeholders. We are also proud to be the one of the most active Sections that gives opportunity for new leaders to emerge and showcase their passion for technology.

ISA Standards

Practical Solutions from Industry Experts



ISA Standards help automation professionals streamline processes and improve industry safety, efficiency, and profitability. Over 150 standards reflect the expertise from over 4,000 industry experts around the world. Since 1949, ISA has been recognized as the expert source for automation and control systems consensus industry standards.

Key Features, Advantages, and Benefits of Standards

Realize a direct return on investment by

- Lowering installation and start-up costs.
- Reducing need to maintain large inventories.
- Enabling interchangeability of components
- Improving design with less "custom" effort.
- Increasing safety.

Use of standards in industry

- Improves communication.
- Provides practical application of expert knowledge.
- Represents years of experience and avoids necessity of starting each project from ground up.

Standards help you achieve operational excellence by

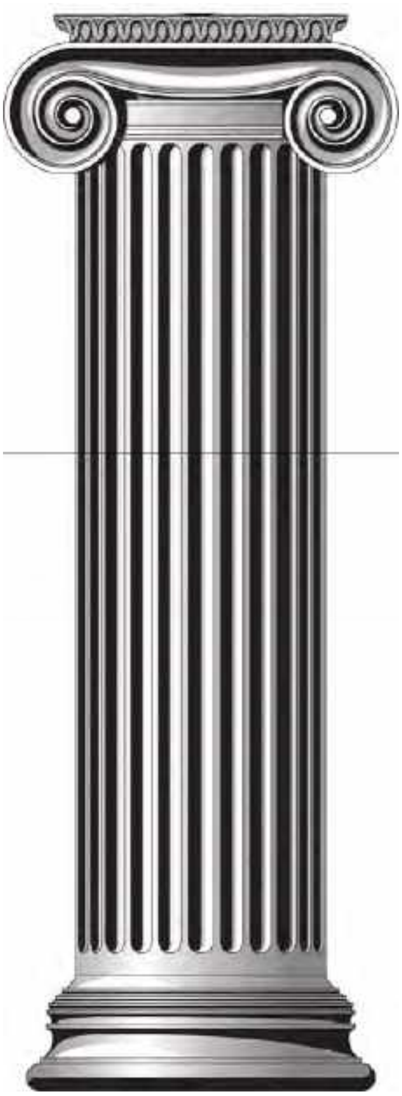
- Improving performance.
- Lowering maintenance costs.
- Reducing downtime.
- Enhancing operability.
- Saving money

ISA's Role in Developing Standards

More than 4,000 individuals cooperating with more than 140 committees, subcommittees, working groups and task forces are involved in ISA standards. They're developing standards in areas as diverse as ensuring the safety of electrical equipment used in hazardous locations to cost-savings for interfaces between industrial process control computers and subsystems.

How a Standard Saves Money

ISA's batch control standard illustrates how using a standard cuts cost. Food, pharmaceutical and specialty chemical companies build factories with increasingly sophisticated computer-driven automation. The batch standard ISA developed- ANSI/ISA-88.00.01 - shaves as much as 30 percent off the cost of designing the system and software used in these plants. ANSI/ISA-88.00.01 sets out a blueprint that engineers can use to make portions of the code interchangeable, which is less expensive than designing each piece from the ground up.



The savings extend beyond the facility's design, though. By using the batch standard, companies save as much as 10 to 15 percent off the typical cost of meeting Food and Drug Administration criteria for the reliability of automation equipment.

How a Standard Saves Lives

Other ISA standards focus on safety. ISA has developed standards for the performance requirements of toxic gas detectors, standards to keep electrical equipment from igniting flammable material and standards to ensure safety at nuclear power plants.

And some ISA standards can help an entire industry combine cost savings and safety. The most popular ISA standard is ANSI/ISA-5.1, Instrumentation Symbols and Identification. Developed in 1949 and most recently revised in 2009, these symbols are used in blueprints for everything from power plants to factories. If every contractor on a project knows the standard symbols, there are fewer communication problems that could lead to costly delays or safety problems.

Using Standards to Help Your Business Expand Globally

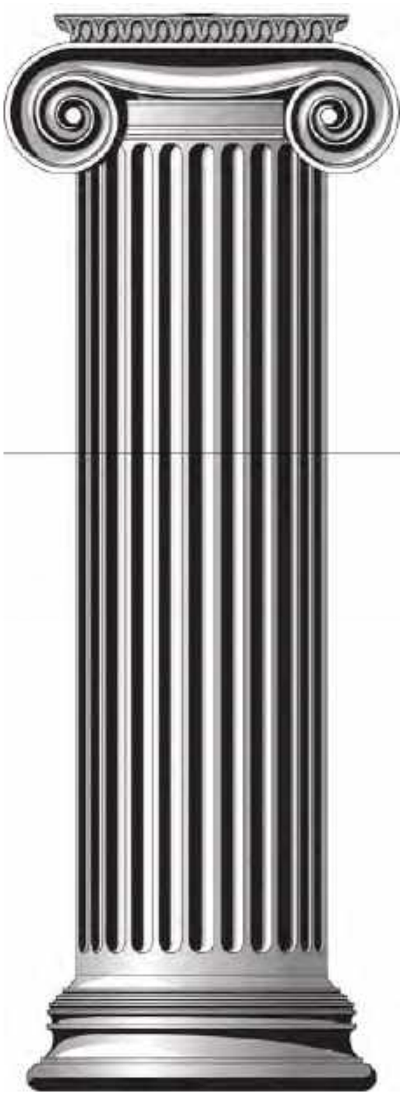
Your company has a product that's taken the United States by storm; now you want to expand globally. But there is a hitch or, as the engineers might tell you, a "technical barrier to trade.'' Your company's product, or the process by which it's made, doesn't meet international standards.

Many ISA standards are also international standards, and our committees strive to stay current with evolving global standards. ISA administers three committees for the International Electro technical Commission (IEC), which is one of the two most widely recognized international standards groups, along with International Organization for Standardization (ISO).

How Your Company Can Take Advantage of ISA's Standards

- Buy ISA standards and train your employees to follow it.
- Help set a standard. ISA's committees are eager for help.

Both voting and non-voting memberships are available. Voting members must have their employers' approval, in part because attending at least one meeting a year is expected. But we're cutting down on the time demands of committee membership by encouraging members to do a great deal of their work via e-mail. Non-voting members supply input but are not required to attend meetings. Apply online to volunteer.



Students

Students can come to automation from a variety of backgrounds and academic programs. It is sometimes difficult for you to find programs that concentrate on automation as a career or specialty. This potential variety can create challenges for students like you that are not seen in many areas of studies.

The essence of automation is that it is a multidisciplinary art, not a single discipline. You are required to know a lot about many things to function as an automation professional. Automation studies are rarely centred in one department. Automation students and faculty on a campus could come from any number of engineering areas. That means that published findings could appear in several journals and presented at a myriad of scientific conventions. This diversification makes it extremely difficult for students to stay current on the newest findings. It also means that you need to have a very open outlook on what will make you a good automation professional.

The ISA web site helps students more easily stay current on research without attending numerous expensive conventions or wading through non-automation related literature for the useful gems. Also, students can find the conferences they should attend to both gain information and networking possibilities, which can lead to job possibilities.

The ISA web site contains the Automation Body of Knowledge, from the very basics of sensors and controls to the most detailed industrial networking, enterprise integration, cyber security, and safety information. When you have digested that Body of Knowledge, you will be ready to be a Certified Automation Professional, and you can find the tutorials and test materials here to help you.

The ISA Mentor Program for Young Professionals and Students

ISA's Mentor Program enables young professional ISA Members and Student Members to access the wisdom and expertise of seasoned ISA Members, while it offers veteran ISA professionals the chance to share their wisdom and make a difference in someone's career. A mentor can give a young professional guidance in his or her career or help a student determine if automation and control is the right path to follow.

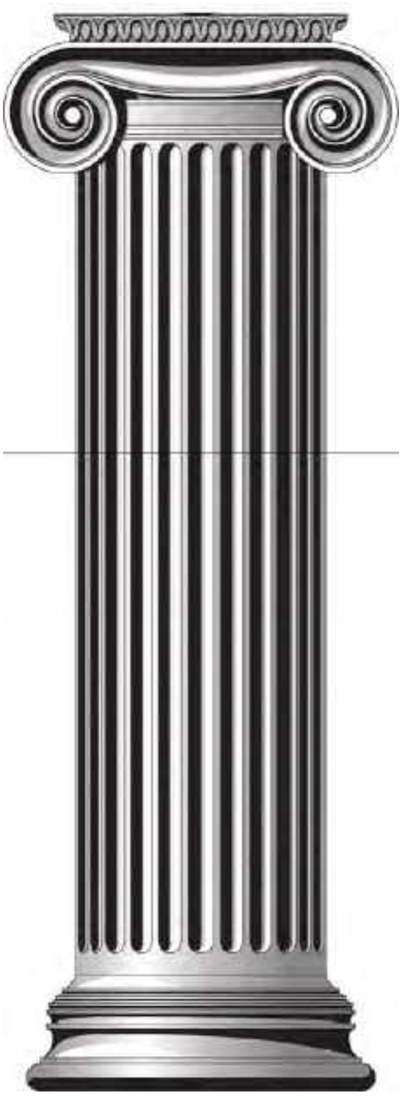
ISA's Mentor Program is an online program, so there are no meetings to attend and there is no travel. ISA Members from all over the world can participate, and the relationship can develop and progress at the convenience of the mentor and protégé.

ISA Members are encouraged to register and participate in the program as mentors. Find out more about becoming a mentor.

ISA's younger Members and Student Members are urged to use this valuable Member benefit. Find out more about getting an ISA Mentor and how to select a mentor.

Membership Benefits

Join ISA to engage with peers and subject matter experts around the world, share and develop best practices to advance the profession, build your resume and reputation, and use this opportunity to inspire the next generation of professionals. Together, we create the future of automation, and we need your skills, perspective, and insight to make it happen.



Learn

- Access over 150 standards that reflect the expertise of industry leaders in the automation industry.
- Read the latest in industry information through our online news source, Automation.com and flagship publication, InTech magazine ebook.
- Take advantage of training programs designed to increase knowledge and build essential skills of automation professionals.
- Earn professional credentials that document your skills and set you apart.
- Improve your management and financial skillset with ISA Business Academy, a 10-week virtual certificate program based on an MBA curriculum.
- Access a wealth of valuable technical content like Intech archives, ISA standards, technical reports, and more with ISA Pub Hub.

Connect

- Engage in technical discussions on ISA Connect.
- Network with automation professionals through geographic sections.
- Build connections through conferences, webinars, and online discussions.

Grow

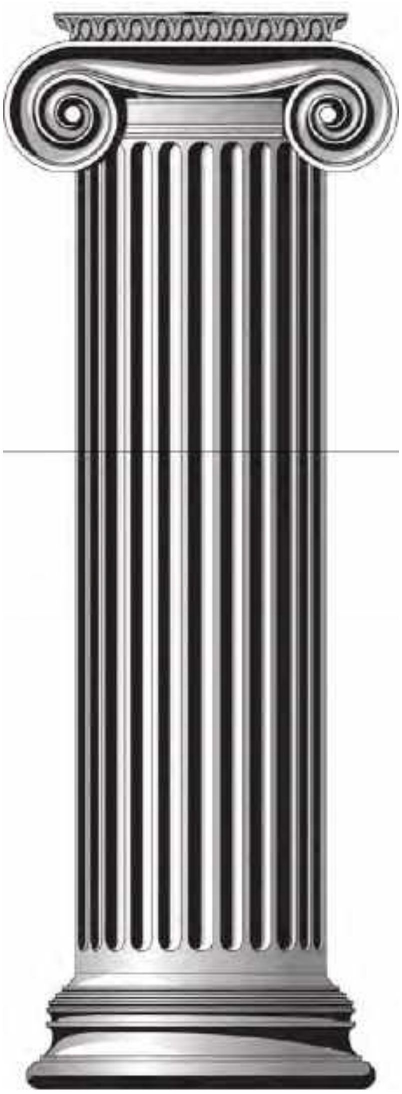
- Explore career opportunities and build your resume with the ISA Career Center.

- Post job openings and access over 50,000 automation professionals seeking new opportunities.

- Serve on a standards committee and help influence the future of automation.

- Connect with and inspire others through ISA Mentor, a professional development opportunity that connects those early in their career with seasoned professionals.

As an ISA member, you will be surrounded by a network of professionals with whom you can share experiences and challenges, gain technical knowledge, and develop lasting friendships. Join today and start taking advantage of all the amazing benefits ISA has to offer.



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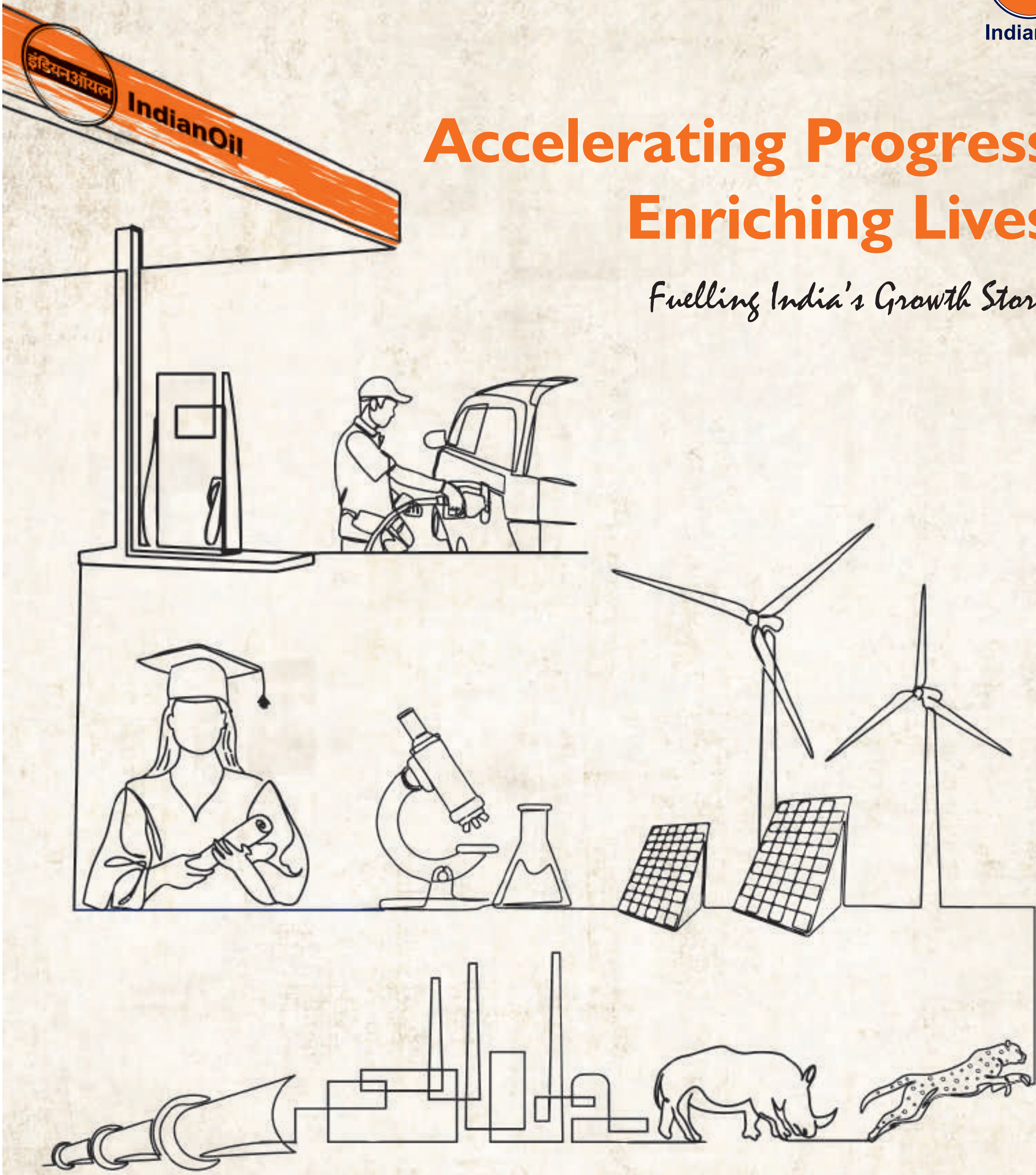

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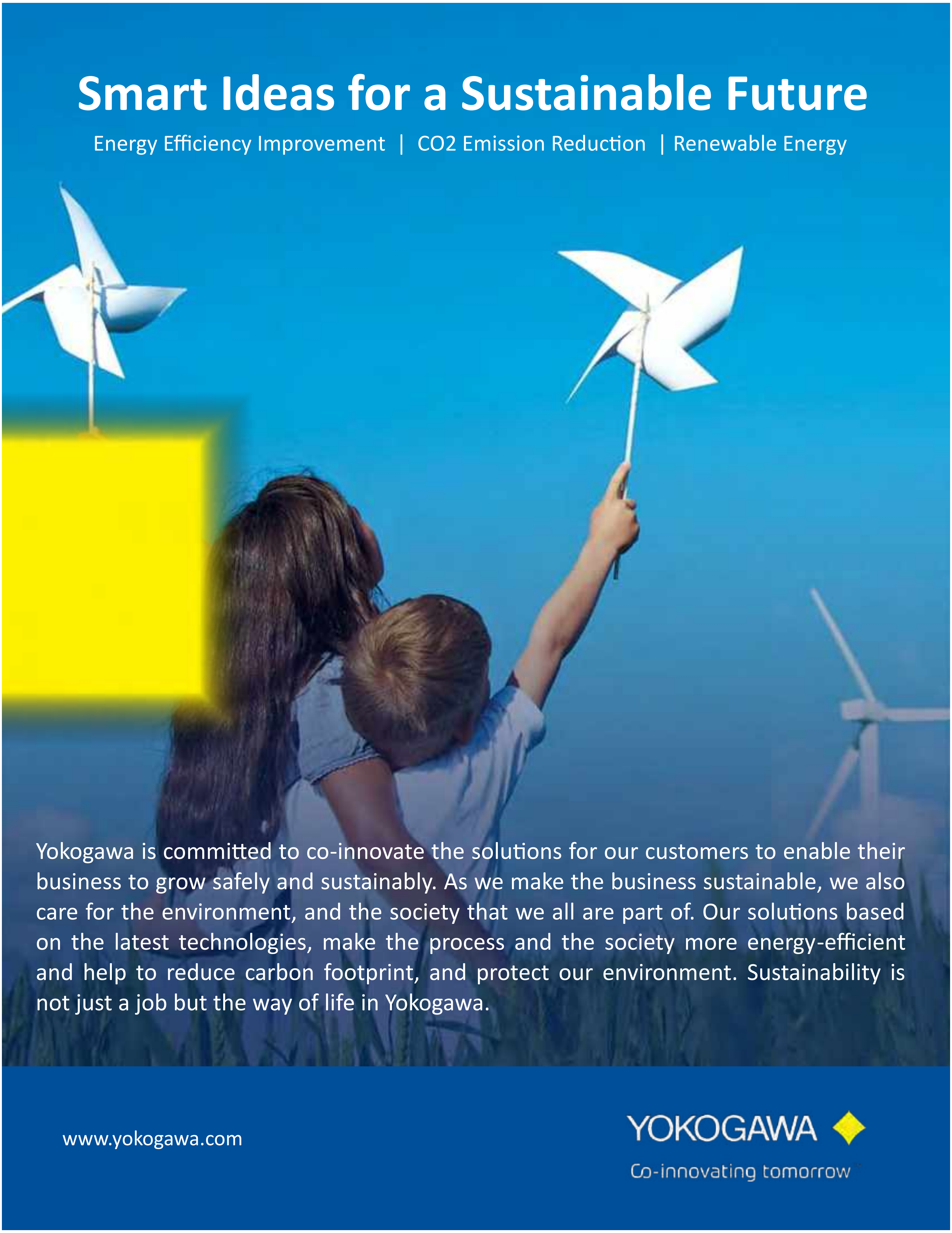
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info@axisindia.in | www.axisindia.in

Petroleum & Power Automation Meet

PROGRAM DETAILS

DAY-1 26th April'2024

	PROGRAM DETAILS				
	Date-26th and 27th April'2024				
	Petroleum & Power Automation Meet				
	DAY-1	26-Apr-24			
	Inaugural Session			Time	
				FROM	TO
1	Introduction of Chief Guest and Guests of Honour			09:30 AM	9:40 AM
2	Lamp Lighting Ceremony			9:40 AM	9:45 AM
3	Welcome Address by ISA-D President			9:45 AM	9:55 AM
4	Address By Chief Guest and Guests of Honour	IOCL / NTPC / EIL / EMERSON		10:00 AM	11:00 AM
5	Note of Gratitude - Convenor PPAM-2024			11:00 AM	11:10 AM
6	Release of e-Souvenir and Inauguration of Exhibition			11:10 AM	
	TEA BREAK AND STALL VISIT			11:15 AM	11:30 AM
	LEADERS CONCLAVE:			11:30 AM	12:30 PM
	FUTURE LANDSCAPE OF COLLABORATIVE INDUSTRIAL AUTOMATION EXCELLENCE	NTPC / EIL / EMERSON / E&H / FLUKE / ROCKWELL			
	Session - 1 :	Organization	Participant	12:30PM	1:30 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	AUTONOMOUS CONTROL AI THAT ACHIEVES BOTH ENERGY SAVING OPERATION AND HIGH QUALITY PRODUCTION	Yokogawa India Pvt. Ltd.	Mr. Keiichiro Kobuchi Mr. Srinath S		
2	IMPORTANCE OF MEASUREMENT OF COMBUSTIBLES ALONG WITH O2 IN HEATERS & BOILERS – IN TERMS OF EFFICIENCY AND SAFETY	AMETEK	Mr. Anantha Kukkuvada		
3	ENSURING PROCESS SAFETY & PRODUCT QUALITY USING H2 , O2 & DEW POINT MEASUREMENT IN WATER ELECTROLYSIS IN H2 PRODUCTION	AXIS Solutions	Mr. Saeed Mulla		
	SMART QUIZ SESSION				
	NETWORKING LUNCH BREAK AND STALL VISIT			1:30 PM	2:30 PM
	Session - 2 :			2:30 PM	03:45 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	WORKSHOP ON A. MASS FLOW METER CALIBRATION SOLUTIONS B. AUTOMATIC PRESSURE CONTROLLER CALIBRATION	FLUKE	Mr. Satyajit Nath		
2	VIBRATIONS ANALYSIS AND DIAGNOSIS WITH AI & ML TO ENHANCE PRODUCTIVITY	FORBES MARSHALL	Mr Hiro Ogasawara, Mr. Nitin Joshi		
3	SECURING TOMORROW'S ENERGY GRID	EMERSON	Ms. Nidhi Chaudhury		
4	Hazardous Area Communication and Signalling, The New Frontiers	EATON MTL	Mr Tarun Nigam		
	SMART QUIZ SESSION				
	TEA BREAK AND STALL VISIT			03:45 PM	04:15 PM
	Session - 3 :			4:15 PM	5:30 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	COMPONENT CONSIDERATIONS FOR HIGH-PERFORMING HYDROGEN FLUID SYSTEMS	SWAGELOK	Mr. Parv Sud		
2	SULFUR AND NITROGEN ANALYSIS IN AN EVOLVING LANDSCAPE	ADAGE AUTOMATION	Mr. Karl Kuklenz		
3	SMART MANUFACTURING, TESTING AND CERTIFICATION OF VALVES FOR CARBON EMISSION REDUCTION IN HYDROCARBON PLANTS	ADVANCE VALVES	Mr. Bobby Poulose		
4	HUMAN FACTORS FOR ENGINEERING CONTROL CENTRE DESIGN	PYROTECH	Mr. Kuldeep Singh Rathore		
	SMART QUIZ SESSION				
	STALL VISIT			5:30 PM	6:30 PM
	NETWORKING DINNER			6:30 PM	9:00 PM

Petroleum & Power Automation Meet

PROGRAM DETAILS

DAY-2 27th April'2024

	Day-2	27-Apr-24			
	Session - 4 :			09:30 AM	11:00 AM
	OPENING ADDRESS BY SESSION CHAIR				
1	FTIR - FOR PROCESS AND STACK EMISSION MEASUREMENT	THERMOFISHER	Mr. Bhavya Shrivastava		
2	COAL MILL OPERATIONS – CHALLENGES ARRIVING FROM BIOMASS ADDITION & LAND'S SOLUTION	AMETEK	Mr. Nitin Gupta		
3	TECHNOLOGICAL MARVELS: A DEEP DIVE INTO PETROCHEMICAL ADVANCEMENTS THROUGH INSTRUMENTATION, CONTROL, AUTOMATION AND IT INTEGRATION	HMEL	Mr. Subir Mondal Ms. Tanu Arora		
4	HOW IOT-RTLS - HELPING TO IMPROVE INDUSTRIAL SAFETY IN OIL & GAS	BLACK BOX	Mr. Amit Chatterjee Mr. Girish Surshe		
	SMART QUIZ SESSION				
	TEA BREAK AND STALL VISIT			11:00 AM	11:30 AM
	Session - 5 :			11:30 AM	1:00 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	REDUCE YOUR PLANTS BREAKDOWNS BY UPTO 37% - A CASE STUDY	ROTEX	Mr. NR Shah		
2	DESIGNING COLLABORATIVE AUTOMATION FOR NEW GREEN THERMAL GENERATING UNITS OF DEVELOPED INDIA	NTPC	Mr. Sumit Haldar		
3	COLLABORATIVE AUTOMATION FOR ENERGY TRANSFORMATION	RITTAL	Mr. Venkatesh Babu		
4	CRITICAL ASPECTS OF SAFETY VALVES / LUBRICATED PLUG VALVES	BLISS ANAND	Mr. Sandeep Nagpal		
	SMART QUIZ SESSION				
	NETWORKING LUNCH BREAK AND STALL VISIT			01:00 PM	02:00 PM
	Session - 6 :			2:00PM	3:30 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	HIPPS SYSTEMS	DELVAL	Mr. Ravindra Patil		
2	ETHERNET APL AND HART IP- NEXT-GEN PROCESS AUTOMATION COMMUNICATION TECHNOLOGIES	FIELDCOM	Mr. Harish Wadhwa		
3	ALARM INFORMATION MANAGEMENT SYSTEM	SSM INFOTECH	Mr. Rajeev Shukla		
	SMART QUIZ SESSION				
	TEA BREAK AND STALL VISIT			03:30 PM	04:00 PM
	Session - 7 :			04:00 PM	04:30 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	PANEL DISCUSSION: MAKE IN INDIA: OPPORTUNITIES, EXPECTATIONS AND CHALLENGES FOR INSTRUMENTS, VALVES AND SYSTEMS MANUFACTURING INDUSTRY	ISA-DELHI/ IIT-DELHI/ NTPC/EIL	Mr. Rajiv Gupta		
	TEA BREAK AND STALL VISIT			04:30 PM	4:45 PM
	Session - 8 :				
1	FELICITATION TO EXHIBITORS FOLLOWED BY LUCKY DIP DRAW			4:45 PM	5:15 PM
2	VOTE OF THANKS BY SECRETARY - ISA-DELHI	EIL	Mr. Sachin Agarwal	05:15 PM	
	****************************** EVENT NEXT ******************************				

TECHNICAL PAPERS

AUTONOMOUS CONTROL AI THAT ACHIEVES BOTH ENERGY-SAVING OPERATION AND HIGH-QUALITY PRODUCTION

Keiichiro Kobuchi
Yokogawa Digital Corporation

ABSTRACT

Until now, no one has applied AI control using reinforcement learning to oil or chemical plants. The reason for this is that it is extremely difficult to apply it safely and in a short period of time. This paper describes the development history of reinforcement learning AI that can be applied to petroleum and chemical plants. Furthermore, I explain a case study in which this AI control achieved an operation that achieves both quality and energy savings.

KEYWORDS

AI Control, reinforcement learning, energy-saving operation, high-quality production, oil and chemical plants

INTRODUCTION

In recent years, AI technology has achieved great results in various areas of our lives. Today, we are surrounded by products and services that use AI technology. New ways to use it are being introduced all the time. Recently, the emergence of generative AI has shown how to use AI technology in a way that has never been seen before. Generative AI is having a major impact on our lives. It is thought that this trend will continue, that AI technology will continue to penetrate the world, and that AI technology itself will continue to evolve.

By the way, because safety is the first priority, it is extremely difficult to apply unfamiliar technology to petroleum and petrochemical plants (hereinafter referred to as "plants"). AI technology tends to be a black box, so its application to plants has not progressed well. It is particularly difficult to apply to control, which is the key to autonomous operation.

However, recently, several cases of application of control systems based on AI technology to plants have been reported. There are several possible reasons why AI technology is so painstakingly applied to plant control. For example, we would like to automate areas that could not be automated and were controlled by the initiative. Or, customer may want to completely automate operations by changing the target values according to the situation based on a veteran's sense of automation.

Here, we will describe in detail the history of the development of autonomous control AI (Factorial Kernel Dynamic Policy Programming, hereinafter referred to as FKDPP), which was developed by Yokogawa in collaboration with Nara Institute of Science and Technology, including the impetus for the development and the contents of the experiments. After that, we learned how FKDPP could be used to automate operations at chemical plants that had previously been carried out manually to achieve both energy savings and high quality while ensuring safety. I will explain the details of the field test.

HISTORY OF AUTONOMOUS AI ALGORITHM DEVELOPMENT

Although the automation of factories and plants has progressed considerably, human labor is required in various situations, and the current situation is that it is rare for plants to operate completely without hands. For example, even if something is said to be "automated," in reality, "people are adjusting the settings to suit things like the temperature each morning." Of course, there are cases where the target system itself or the surrounding environment is complex and cannot be automated using existing control technology. The control field is a core area of Yokogawa's business, and we have begun developing technology to automate such cases using AI technology, expand the scope of automation, and ultimately aim for

complete autonomy.
When entrusting control to a machine, one of the expectations is that it will be able to respond to unexpected situations as much as possible. In order to meet this expectation, it is necessary to reduce the number of "unexpected events" as much as possible. From this perspective, we considered reinforcement learning to be effective for AI that realizes autonomous control. Most of the past data collected at the plant is normal data, and supervised learning using this data has fewer abnormal areas in the learning range, making learning weaker in unexpected ranges. In contrast, with reinforcement learning, the AI itself learns, and in the process learns abnormal conditions, which can reduce unexpected situations.
In 2017, we started joint development with Nara Institute of Science and Technology Graduate University (hereinafter referred to as NAIST), incorporated YOKOGWA's knowledge based on NAIST's Kernel Dynamic Policy Programming, and in 2018 we developed Factorial Kernel Dynamic Policy Programming (hereinafter referred to as FKDPP). completed). In this development, the performance of the algorithm was confirmed using a plant simulator. In this case, through just 30 trials and errors, they determined how to operate the four valves using nine sensor values and maximizing production while meeting quality and safety standards. The greatest feature of FKDPP is that it derives stable solutions with a small number of trials and errors, and it has great potential to apply reinforcement learning to the real world.
At the time of FKDPP development in 2018, the performance of FKDPP was confirmed using a plant simulator and was not tested in the real world. Therefore, we confirmed in 2019 that it could actually be controlled using a process control experimental device called a three-tier water tank shown in Figure 1.
In this experiment, FKDPP succeeded in deriving a control method that almost eliminates overshoot through valve operation, which is completely different from conventional PID control, after about four hours of learning (trial and error).

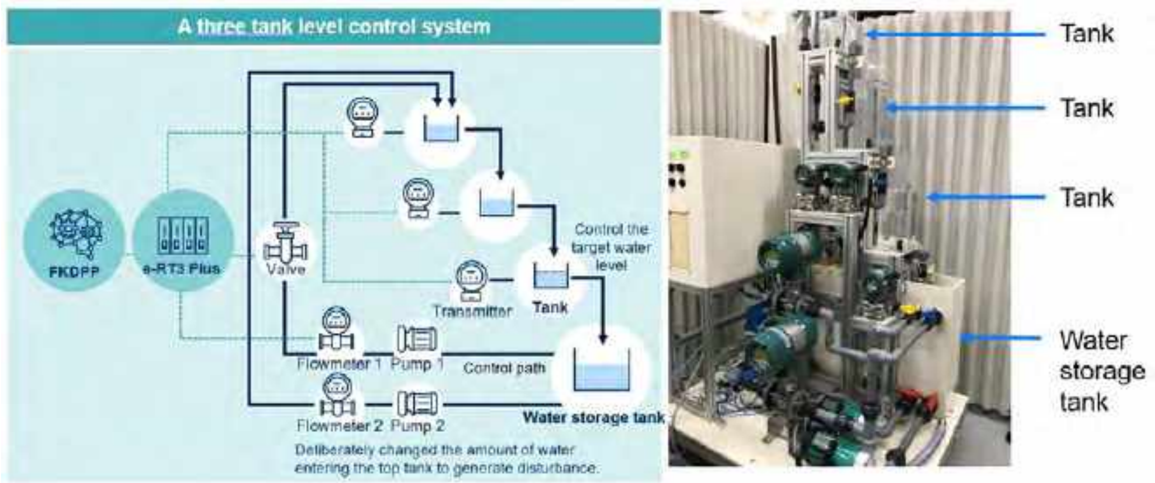

Figure-1

DEMONSTRATION AT CHEMICAL PLANT

In August 2020, we began a demonstration with ENEOS Materials Co., Ltd. to apply autonomous control using FKDPP to an actual plant. There were two main purposes for this demonstration.

1) Show that FKDPP, which is reinforcement learning that requires trial and error, can be safely applied to a chemical plant where safety is paramount.

2) It shows that FKDPP can control parts that cannot be controlled with existing control technology and can contribute to expanding the scope of automation.

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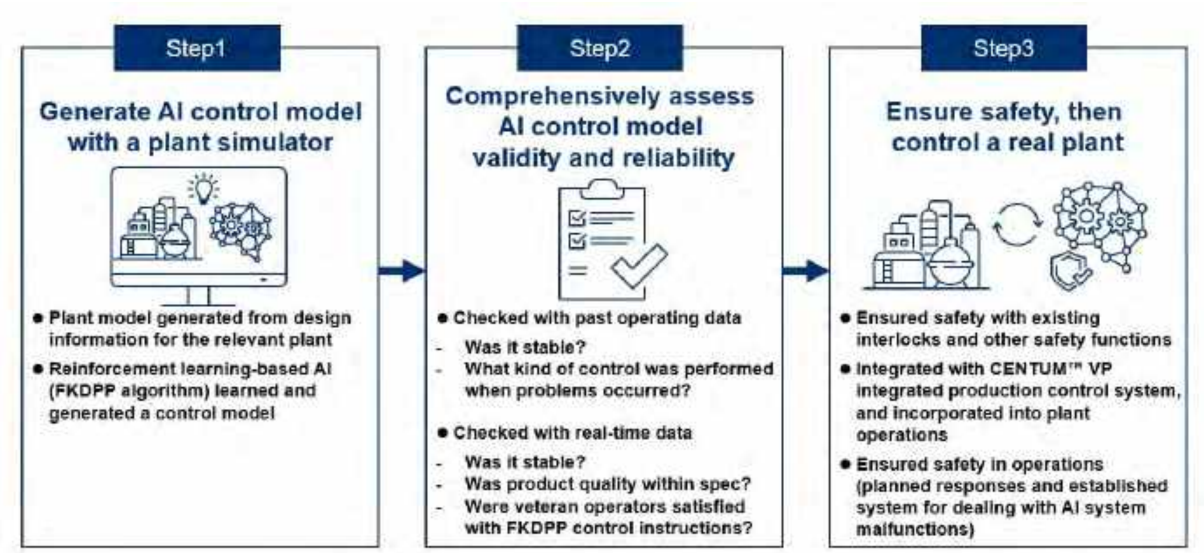

Figure-2

The first goal was achieved through the three steps shown in Figure-2, and in phase 1, continuous control was achieved for 35 days. The three steps are shown below.

1) Use a plant simulator as a learning environment for FKDPP.

2) Check the safety and stability of the AI control model output by FKDPP by involving field operators from various angles.

3) Incorporate safety functions unique to AI control systems while utilizing the safety functions of existing systems, and define operational methods.

The Phase 1 demonstration took one and a half years, but each step took eight months, six months, and two months. In particular, we took time to confirm the safety and stability of the second step, and we believe that we were able to dispel any concerns about AI control by carefully checking the performance of the AI control model with on-site operators.
The second purpose relates to where AI autonomous control is applied. The areas where AI autonomous control was applied could not be controlled using conventional control technology (PID control, altitude control), and the on-site operator had no choice but to check various parameters several times an hour to determine the opening degree of the valve. . In other words, it was controlled manually.
Conventional control technology could not be applied to this area because there was a complex trade-off (Figure 3) between using unstable waste heat to produce stable quality, and unsteady disturbances. That which occurs is considered to be a genin. FKDPP succeeded in solving this problem and performing optimal control. In other words, we succeeded in automatically performing energy-saving operations that had previously been done manually.

After the repairs were completed, the AI control system was restarted in early May, and Phase 2 began. Figure 4 summarizes the results. As a result, the following four things became clear.

1) Through continuous control throughout the year, we were able to produce at the specified quality even when the outside temperature changed by up to 40°C.

2) New steam consumption could be reduced by 40% compared to manual control. (Of course, CO2 emissions were also reduced)

3) Since the manual has been changed to a child's manual, the burden on the operator has been reduced, and stability and safety have been improved.

4) Even if the conditions of the heat exchanger etc. changed during regular maintenance, the control could be maintained at the same level, confirming high robustness.

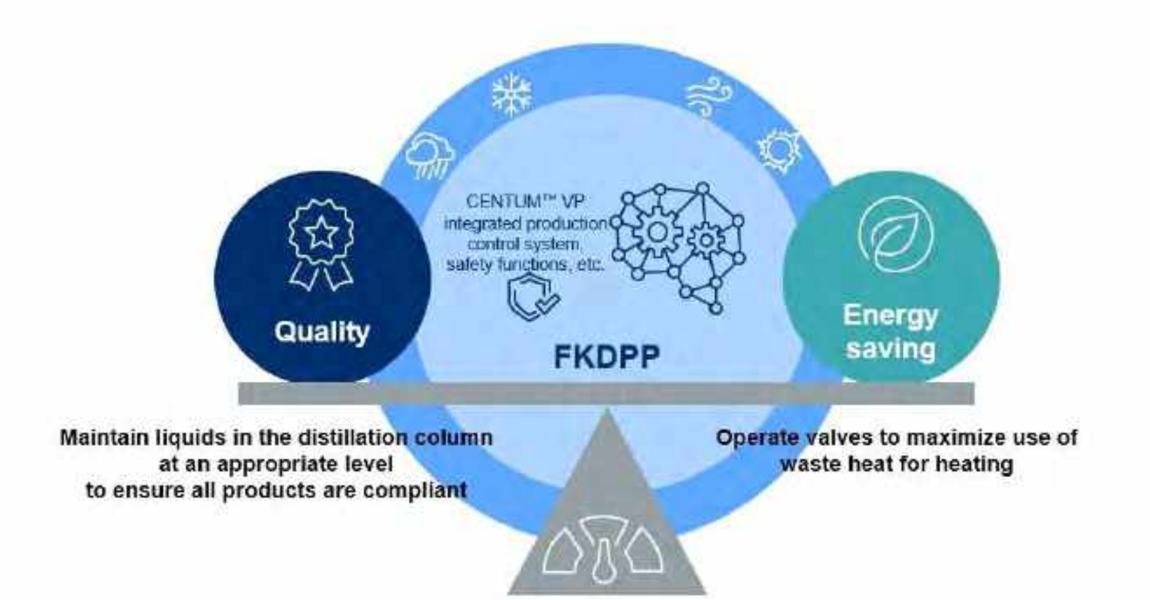

Figure-3

Figure-4

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CONCLUSION

AI autonomous control cannot be applied everywhere and be effective. If the existing control technology (PID control, altitude control) is working well, there is no need to replace it. AI autonomous control is a technology that expands the scope of automation and is one of the key technologies to realize autonomous operation.
On the other hand, AI control is an example of an action that involves AI, and is a highly advanced field of application of AI technology. There are relatively few examples of AI actions. Generative AI, which has been attracting attention recently, is also an example of AI-based actions.
In the future, the application of action-based AI technology is expected to progress, and various examples are sure to emerge. We believe that by combining these, factories and plants will become more autonomous. As a result, I believe that issues such as a shortage of personnel, a lack of skills, and the transfer of technology will be resolved.

REFERENCES

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L. Zhu, Y. Cui, et al., "Scalable reinforcement learning for plantwide control of vinyl acetate monomer process," Control Engineering Practice 97, 2020

BIOGRAPHIES

Keiichiro Kobuchi was born in Kobe, Japan. Earned a master's degree in engineering (coastal engineering) and joined Yokogawa Electric Corporation in 1987. I engaged in development of digital oscilloscopes and industrial recorders, development of software for data acquisition devices and configuration software for field devices, and international standardization activities such as field communication. Since around 2013, I have led YOKOGAWA own AI development department and have challenged AI data analysis and AI control. From 2022 Assumed current position with the establishment of Yokogawa Digital.

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ISA Delhi Petroleum & Power Automation Meet.

26th & 27th April 2024.

Euro Hotel New Delhi.

Title

Importance of measurement of Combustibles along with O2 in heaters & boilers – in terms of efficiency and safety

by

AMETEK Process Instruments

Anantha Kukkuvada Regional Sales Manager, India & Africa

Most of the Refinery furnace /power plants boilers are using gas as a fuel for combustion, type of fuel changes based on the location, availability & commercial aspects. Many refineries uses recycled gas/Naphtha/NG as fuel, power plants uses Naphtha /NG as fuel. Sometimes fuel availability keeps changing & based on availability burners gets different type of fuel, therefore more flexibility from refiners is required in terms of taking the available gases In the refinery as fuel, at the same time the environmental impact has to be monitored, emissions need to be reduced & they have to ensure their operating methods are safe & they are ensuring safety of process Equipments. This ensures no accidents happens. Stoichiometric Combustion is important, achieving stochiometric combustion all the time is a challenge as we may have the situation where excess fuel or excess air is going to burner, customer should know the affects of both the cases & ensure this situation does not continue for long time. Customer should know how the efficiency of the combustion system can be increased by measuring combustibles along with O2 & how methane measurement helps in refineries along with O2 & combustibles. Operators should know different types of combustion control systems & advantages of each type.

We will try to understand the process industry risks, how we can identify the risks & how we can eliminate such risks by doing additional measurements in the existing analyzers.

This paper will discuss about the common causes of furnace explosions, what measurements are critical for combustion control, what are the general industry practice of analytical measurements in combustion controls, is it good a good practice or it can be done in different way & what are the advantages of the same.

Briefly discuss about *Why Safety Integrity Level , different type of SIL capabilities & how it is related to the analyzer availability in the field.*

We would like to avoid the situations given in the below pictures, so we discuss about the safety precautions & how the diagnostic information's from the analyzer help the operators to do the predictive maintenance of the combustion control system & avoid the accidents.

We will briefly discuss about the Ametek model WDG-V /C/M , how it helps the operators with the information from Analyzer, what is the importance of measurement of combustible over only CO.

We will discuss about one case study , ExxonMobil Refinery , what made them to do such detailed sturdy & how they found measurement of Combustibles is important than only CO, with this study what changes they have made in the refinery to ensure safe operations.

At last we will discuss about the combustible measurement importance in power plants , where we need to for Methane measurement also along with O2 & Combustibles.

Summery:

- Introduction to combustion & how changes in fuel availability gives the challenges to operators.
- What are the risks for heaters in refinery & power plants & how we can mitigate them.
- Common causes of furnace/boiler explosions & how we can avoid those.
- Introduction to *Safety Instrumented Systems* (SIS) & *Safety Integrity Level* (SIL).
- Introduction to Ametek WDG VCM model.
- Case study: Why measurement of Combustibles is important over only CO.

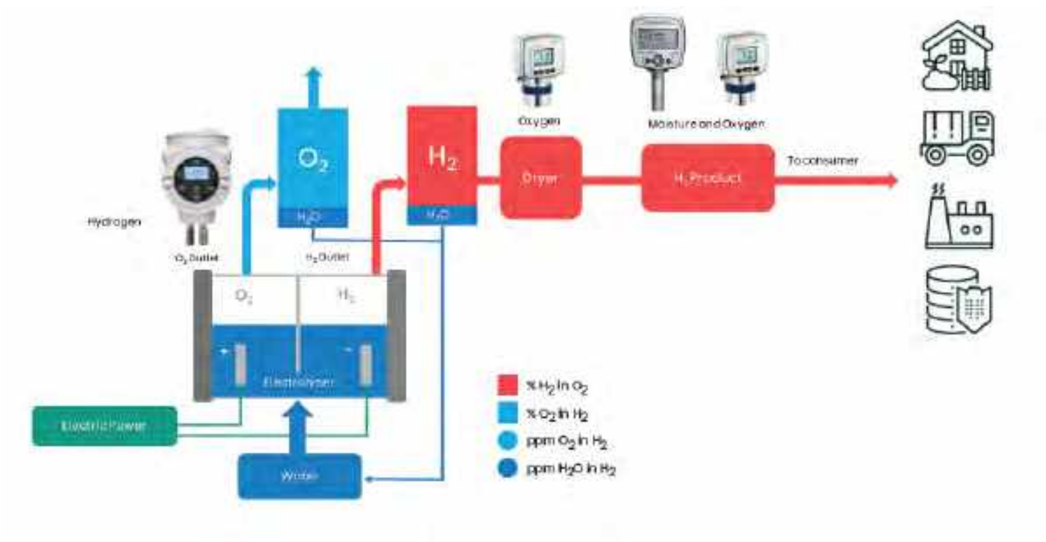
Abstract for ISA Presentation:

Ensuring Process safety & Product Quality using H_2, O_2 & Dew point measurement in Water Electrolysis in H_2 production.

Analyzers that monitor process safety, efficiency, and product quality - Water electrolysis uses electricity to split water into hydrogen and oxygen. Electrolyzers convert electrical energy into chemical energy. Hydrogen is the energy carrier. The continuous measurement of the oxygen and hydrogen levels on either side of the membrane ensures process safety, as the mixture of hydrogen and oxygen at high enough concentrations can lead to an explosive mixture.

Application Specific Technologies Make the Difference for Process Safety - Thermal conductivity binary gas analyzers measure hydrogen in generated oxygen and oxygen in generated hydrogen to detect and alarm any crossover on either side of the membrane.

Final product quality - Trace moisture and trace oxygen analyzers are used to monitor the final product quality for storage, transportation, or use.



Setting the Standard for Automation™

Enhancing Process Safety and Product Quality in Water Electrolysis Hydrogen Production by Gas Measurements

Panametrics Process Analyzers

Saeed Mulla
E: Saeed.Mulla@bakerhughes.com
T: +971 56 422 622 1

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

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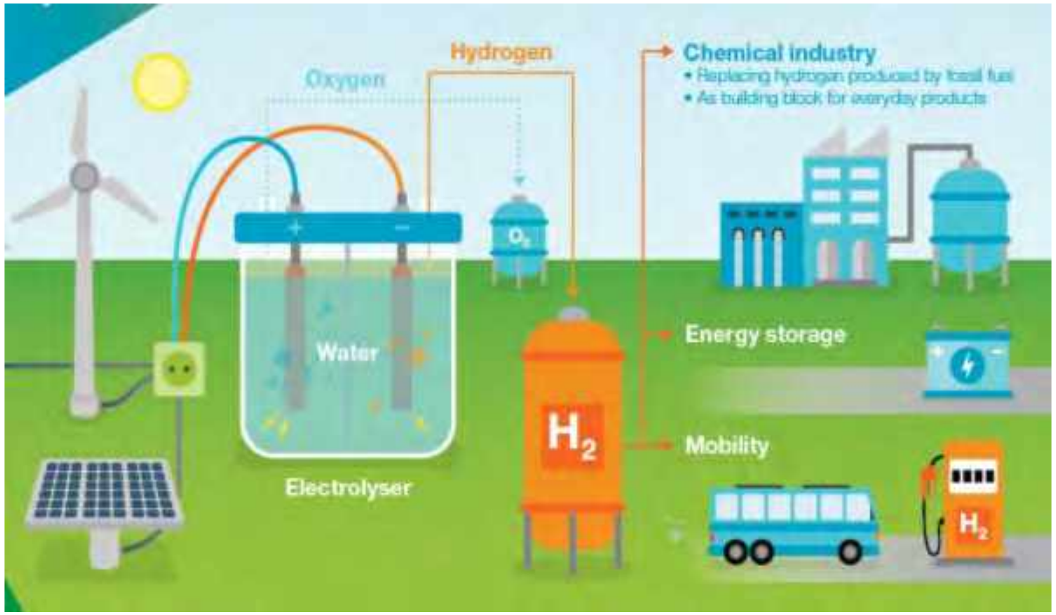
Agenda

- Overview of Hydrogen Production Process
- Electrolysis Mechanism and Critical Process Parameters
- Roles of Measurements Process Safety and Product Quality
- Measurement Technologies Overview
- Hydrogen Measurement and Technology
- Oxygen Measurement and Technology
- Dew Point Measurement and Technology
- Measurement Systems Implementation Strategies
- Q&A

Overview of Hydrogen Production Process

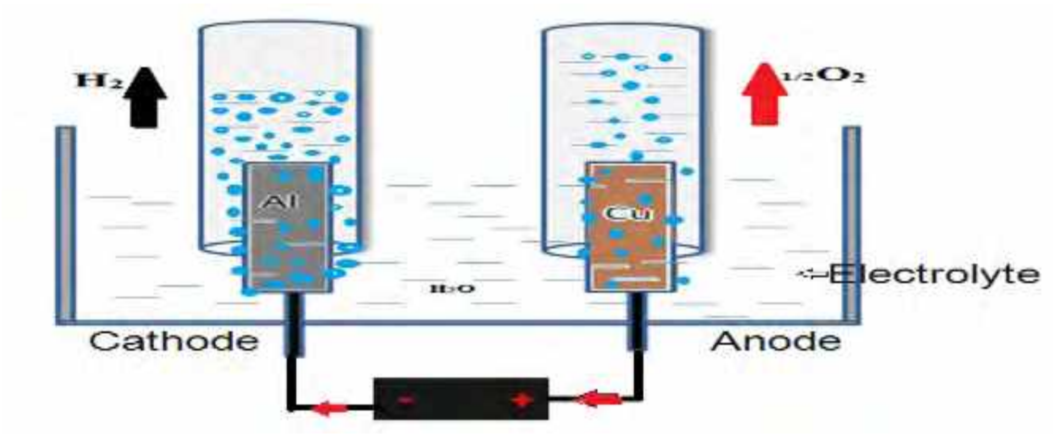
As the world transitions from hydrocarbons to alternative energy sources, hydrogen will play an increasingly vital role.

- ~ 95% H_2 produced by steam methane reforming today
- ~ 5% H_2 produced by electrolysis (15% CAGR)
- Water Electrolysis: Primary method for Hydrogen production which splits water molecules into hydrogen and oxygen gases
- Different types of water electrolysis, including Alkaline electrolysis, Proton exchange membrane (PEM) electrolysis, solid oxide electrolysis etc.
- Cost and scalability
- Transition to sustainable energy economy



Electrolysis Mechanism and Critical Process Parameters

- The decomposition of the water into hydrogen and oxygen gases through the application of the current
- Cathode Reaction:
- 2H2O (l) + 2e- --→ H2 (g) + 2OH-
- Anode Reation:
- 2H2O (l) ---→ O2 (g) + 4H+(aq) + 4e-
- Overall reaction equation of water electrolysis:
- 2H2O (l) --→ H2 (g) + 1/2 O2 (g)
- Critical Process Parameters: Electric current, electrolyte composition, pressure, temperature, purity of input water etc.

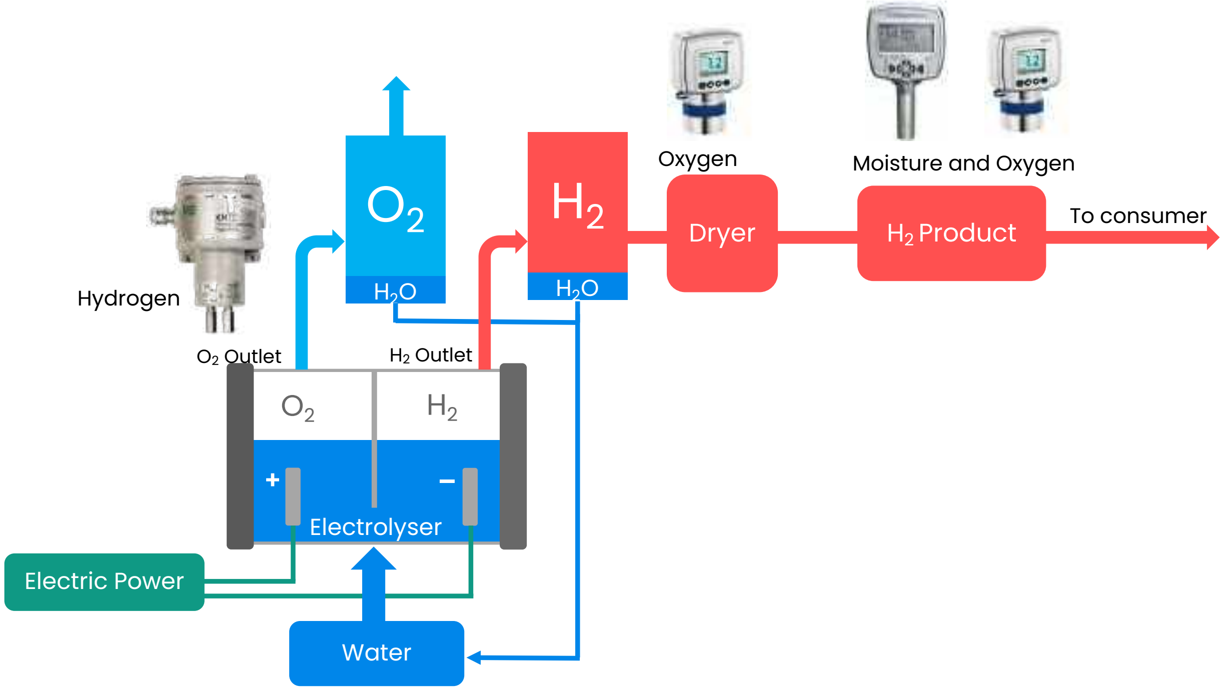


Role of Measurements in Process Safety and Product Quality

- Importance of accurate measurement in preventing accidents
- Real-time monitoring for maintaining safe operations

Key Measurements:

- Oxygen measurement in hydrogen
- Hydrogen measurement in oxygen
- Moisture measurement in hydrogen and oxygen



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Measurement Technologies Overview

Hydrogen, oxygen and dew point measurement technologies

Safety & efficiency measurements

- Oxygen in Hydrogen (0 - 2%)
- Hydrogen in Oxygen (0 - 2%)

Quality measurements

- Oxygen in end-use hydrogen: < 5 ppm
- Moisture in dried hydrogen and/or oxygen: < 10 ppm

Typical selection technology

- H_2 & O_2 safety — Thermal Conductivity (TCD)
- Trace O_2 in H_2 — Galvanic (fuel cell)
- Trace H_2O — Aluminum Oxide (AlOx)

Hydrogen Measurement: Thermal conductivity

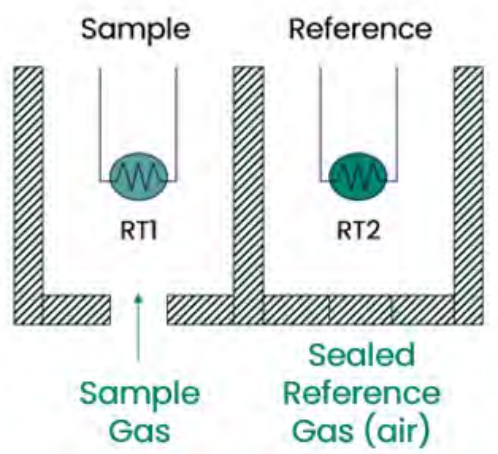
Technology

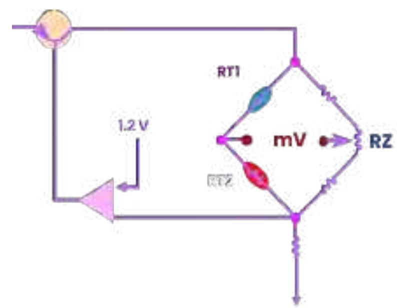
Sample and reference gases contact the constant current thermistors. Heat is transferred from 150 °C thermistors to 55 °C cell wall at a rate proportional to the thermal conductivity of the sample gas and reference gas. Thermistors are two legs of a Wheatstone bridge circuit. There is a linear relationship between bridge voltage and gas composition.

Zero and span gases define the 4 to 20 mA output.

Decision Making Factors

- % level Oxygen in Hydrogen
- % level Hydrogen in Oxygen
- General purpose to ATEX/IECEX Zone 1 and Class 1, Division 1
- Auto-calibration when used with XDP display
- Ultra-stable calibration and no moving parts result in infrequent maintenance



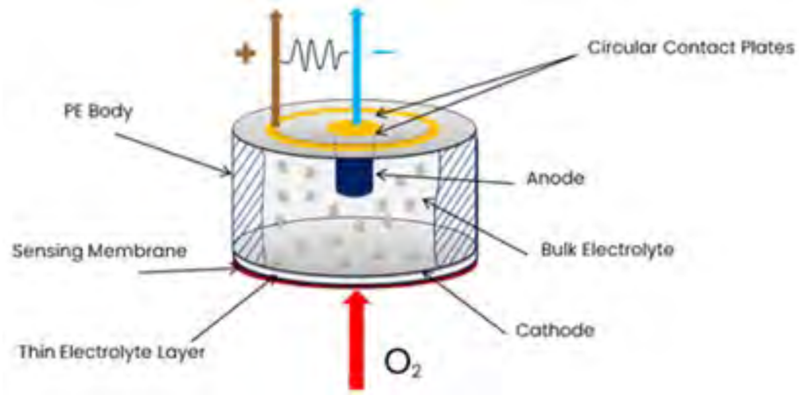


Oxygen Measurement: Galvanic Fuel Cell

Technology

Cathode and anode immersed in KOH solution with Teflon diffusion membrane on one end and polyethylene membrane on the other. The electrons released at the surface of the anode flow to the cathode surface via an external circuit.

The current is measured to determine the O_2.



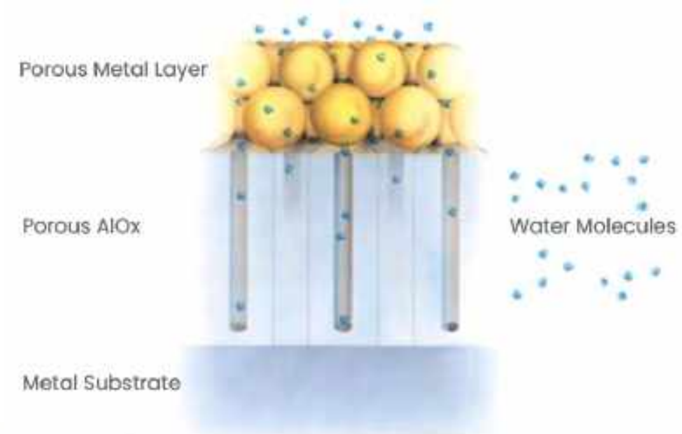
Decision Making Factors

- PPM and percent level oxygen in inert and hydrocarbon gases
- General purpose to ATEX/IECEX Zone 0 and Class 1, Division 1 (intrinsically safe)
- Non-incendive for Class 1 Division 2 without barriers
- Immune to changes in background gas
- Most compact design with a display

Dew Point Measurement: Aluminum Oxide

Technology

The sensor is a vapor pressure sensor calibrated for dew/frost point. With pressure and/or temperature, moisture can be shown in ppmV, ppmW, and many other measurement units.



Decision Making Factors

- Ambient moisture down to parts per billion
- General purpose to ATEX/IECEX Zone 0 and Class 1, Division 1
- Background gas/liquid agnostic
- Sensor can be installed at process pressures in liquids and gases
- Displays pressure dew point

Measurement Systems Implementation Strategies

- Sample system designs to knock out water for your hydrogen measurements
- Assessment of measurement requirements
- Selection of sampling technologies
- Application Design and Engineering
- Safety and Quality Assurance

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MASS FLOW METER CALIBRATION SOLUTIONS

Overview

Thermal mass flow controllers (MFC) are essential devices in the operation of a Pilot Refinery. MFCs provide critical data, which are used to assess the pilot plant results.

The process gas handled by the MFCs is Air, N2, H2, CO2, CO, CH4, hydrogen, air, and a mixture of gas. They are installed in different pressure lines (100 bar to 1 bar). Lastly, Manufacturers and Industries use different reference temperatures (0°C, 21.1°C & 23°C)

All the above conditions significantly influence the gas flow measurement results. Our objective was to create an optimized calibration solution. There are multiple process variables, so it needs a close study of the workload and gas flow measurement principle and technique. We have initiated Calibration Solution for a Pilot refinery. The first step is to compile the workload and process requirements. After a close study and interaction with the user, we created an optimized calibration solution. Fluke's solution meets the NABL TUR guideline (4:1), is fully automatic, and is Cost-effective solution.

Setting the Standard for Automation™

Vibration Analysis & Diagnosis by Using AIL & ML

Improve Uptime of Rotating Machines & Reduce Operating & Maintenance Costs

By : Nitin Joshi & Nagahiro Ogaswara

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

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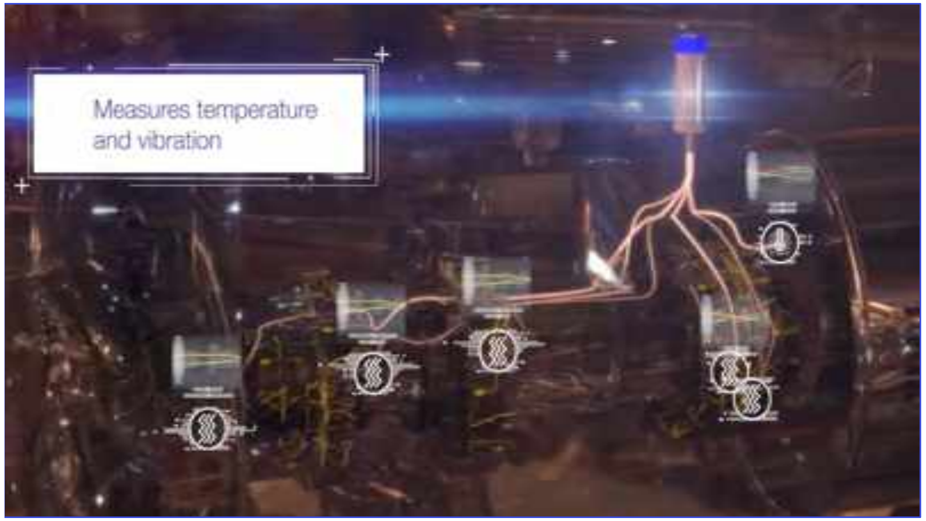
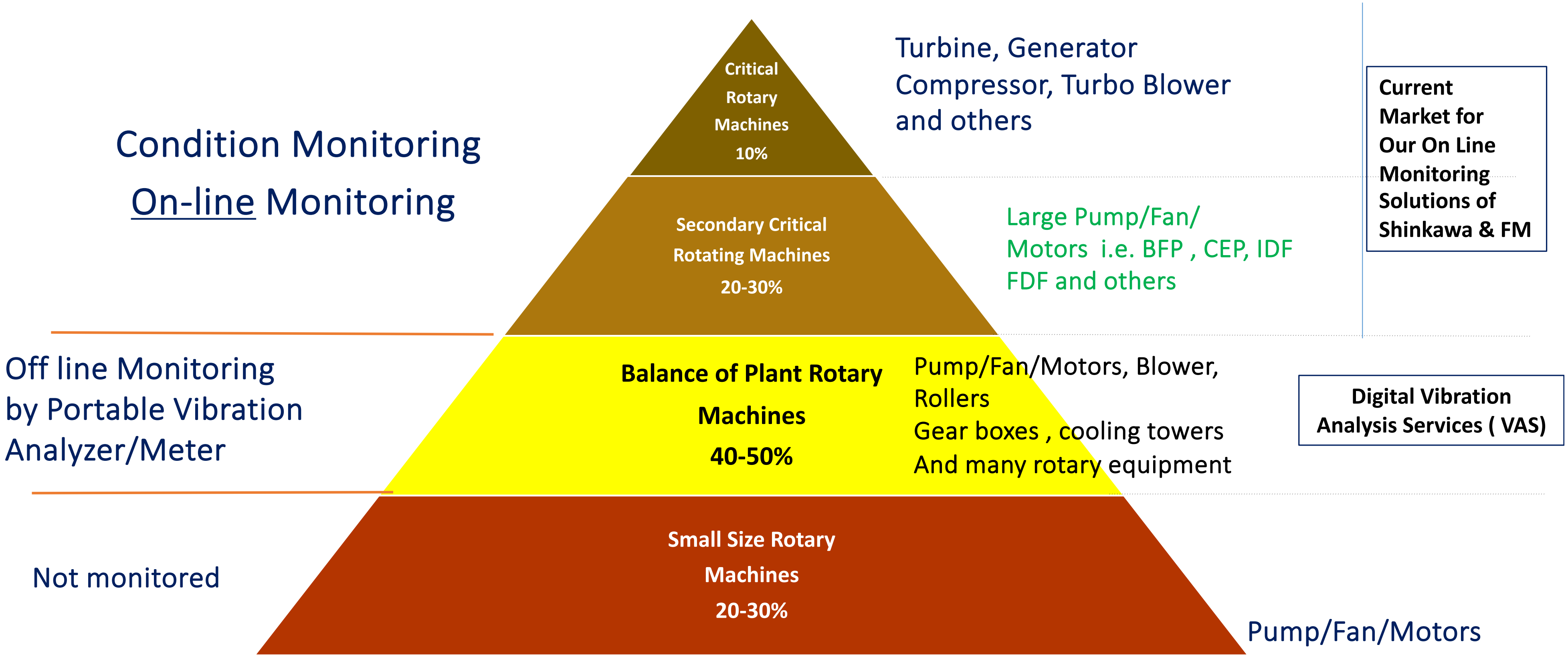
Digital Vibration Analysis

Improve Uptime of Rotating Machines & Reduce Operating & Maintenance Costs



Rotating Assets & machine health monitoring in the Plant



FM Digital Vibration Analysis Services Benefits

Current Method:

- Manual Vibration Data Collection (Offline monitoring)
- No real time monitoring & accuracy of data collection
- Missing live alarms & activity starts only after data collection
- Limited experts & OEM Dependency
- Unplanned shutdown still exists

Digital Solution (IOT Platform):

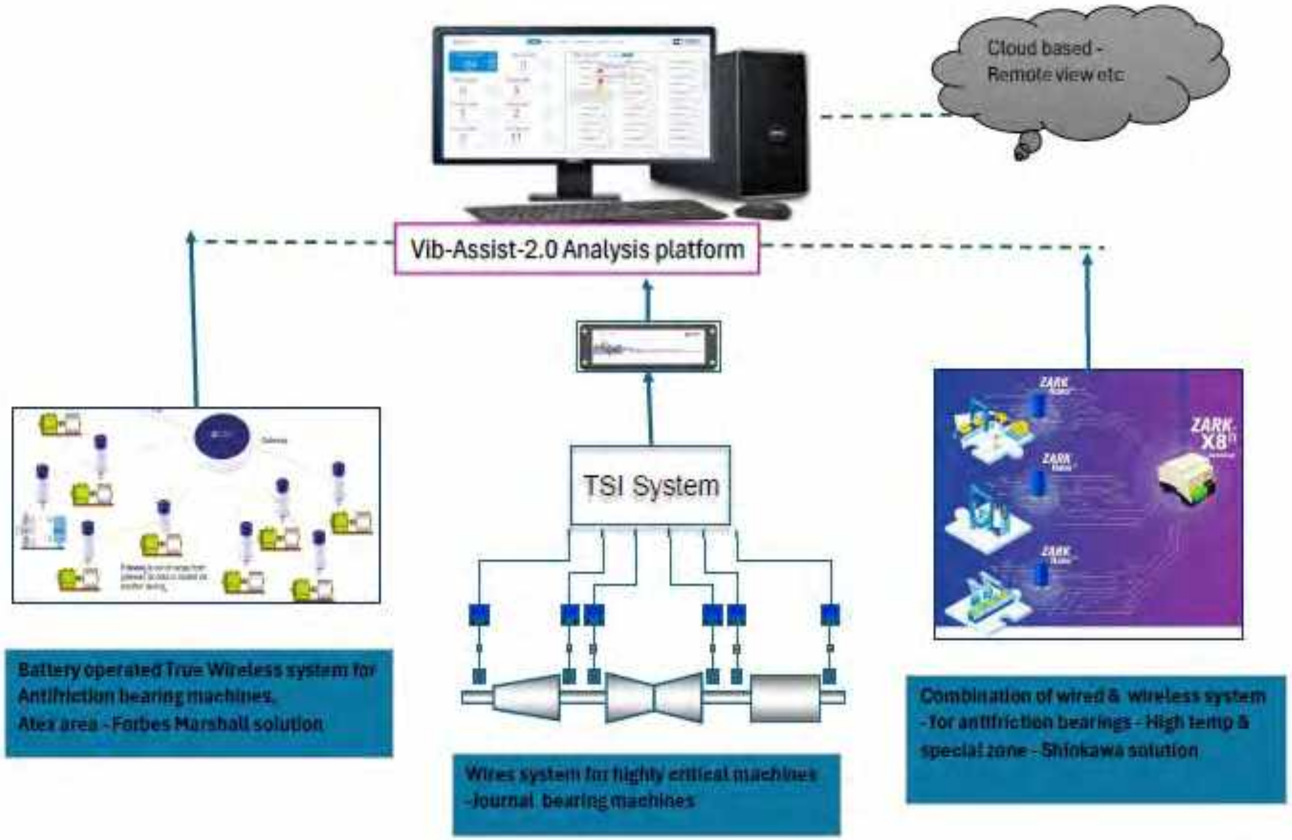
- Smart Vibration Sensor & Expert Vibration Analysis & Diagnostic Services : Daily / Weekly / Monthly update on health of Rotating Machine by Forbes Marshall & Shinkawa Experts

User Benefits :

- **Extending usable life of equipment & Reduce Unplanned shut down to productivity & profitability**
- *ARC Advisory / KPMG Report : 35% Maintenance cost in the plant is due to unplanned rotating machine shutdown due to Vibration problems*

Plant Wide Digital Vibration Analysis Solutions
Vib-Assist 2.0 Platform

FORBES MARSHALL



Vib-Assist 2.0

- One stop solution
- All type of bearings
- All kind of machines
- Any Industry
- Normal as well hazardous area
- Machine health Monitoring
- Analysis graphs
- Alarm management system
- Diagnostic report
- Machine remaining life prediction
- Accurate fault diagnosis

Forbes Marshall Solution (Wireless)

FORBES MARSHALL

FM-ACCL-100-W

- True Wireless system
- Powerful battery 4 years approx. life
- Triaxial Acceleration & velocity
- Bearing casing temperature
- Wirepass based communication
- Mesh network feature
- Data buffering
- Alarm wakeup function
- Machine Fault analysis
- Useable machine life prediction
- Alarm management
- Asset health indication
- Safe & Hazardous area

Machine Monitored 24X7 : Alarm Actuated Report

Hello User,

An alarm of type Vibration has been generated on:

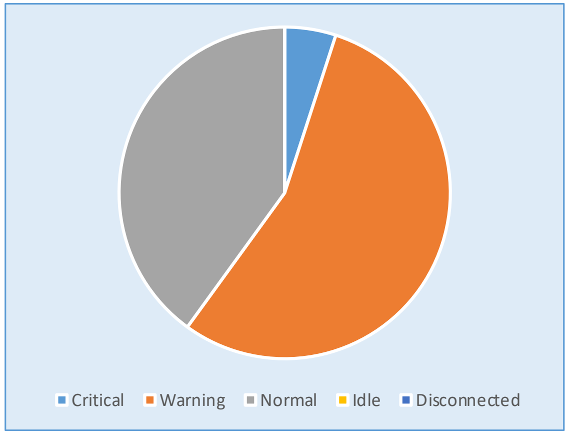
Device Location	Alarm Start Time	Alarm End Time	Alarm Occurences
FD FAN1 MOTOR | Motor NDE (73feee5e)	Wednesday, March 20, 2024 at 2:52:08 PM India Standard Time	Monday, April 15, 2024 at 8:27:36 AM India Standard Time	12

Parameter Name	Value	Warning Limit	Critical Limit
Axial axis RMS acceleration	11.18 m/sec^2	9.81 m/sec^2	19.6 m/sec^2

Case Study : Health Report

Plant name	XYZ
Machine shop name	XYZ
Report date and time	2024/04/13 00:00:00 AM To 2024/04/13 23:59:59 PM (IST)
Total Number of Assets	10
Total Number of Devices	20
Total Number of Devices in critical state	1
Total Number of Devices in warning state	11
Total Number of Devices in Normal state	8
Total Number of Devices in idle state	0
Total Number of Devices disconnected	0

Critical
Warning
Normal
Idle
Disconnected



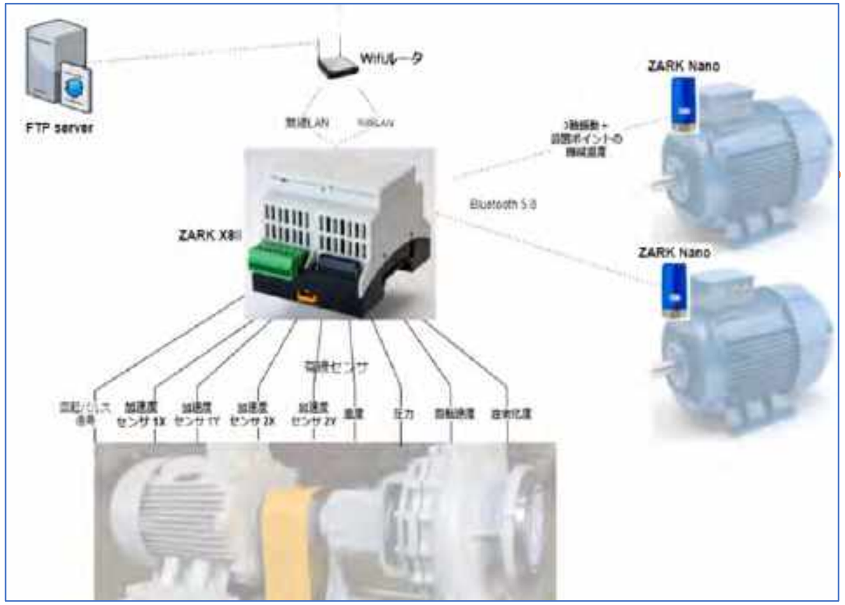
Equipment needing user attention listed below

Asset Name	Health Score	Severity	Diagnostic details Fault name	Diagnostic	Recommendation
MUKUND CPP\CTF area\CTF2 GB	66	Medium Risk	Structural Looseness	Motor Drive end Structural Looseness Risk Level:Medium Pattern of structural looseness fault observed at lower side amplitude. The synchronous energy at 1x of running speed slightly increased in horizontal direction. Most likely the structural looseness fault is diagnosed.	Motor Drive end Structural Looseness Closely monitor the overall vibration trend for any significant increase. Reinforce the mounting and improve stiffness. Check the looseness of mounting bolts, failed grout or cracks in concrete bases, cracks or other forms weakness in machinery mount, base plates and hold down bolts etc. in upcoming maintenance cycle. Also, check the tightness of foundation bolts, in upcoming maintenance cycle.
MUKUND CPP\CTF area\CTF3 MOTOR	57	Medium Risk	Soft Foot,Electrical issue	Motor Non-Drive end Soft Foot Risk Level:Medium Pattern of soft foot fault observed at lower side amplitude. The synchronous energy at 1x of running speed and Non-synchronous energy at 2*Line frequency slightly increased. Most likely the soft foot fault is diagnosed. Motor Non-Drive end Electrical issue Risk Level:Medium Pattern of motor electrical issue observed at lower side amplitude. The Non-synchronous energy at 2*line frequency slightly increased in radial direction. Most likely the motor electrical issue is diagnosed.	Motor Non-Drive end Soft Foot Closely monitor the fault vibration trend for any significant increase and Check all the feet of the motor are on flat base, in upcoming maintenance cycle. Also, check the tightness of foundation bolts, in upcoming maintenance cycle. Motor Non-Drive end Electrical issue Closely monitor the fault vibration trend for any significant increase and Check the motor for the stator eccentricity, loose rotor bar, shorted laminations or loose connections in upcoming maintenance cycle.

ZARK X8II Features

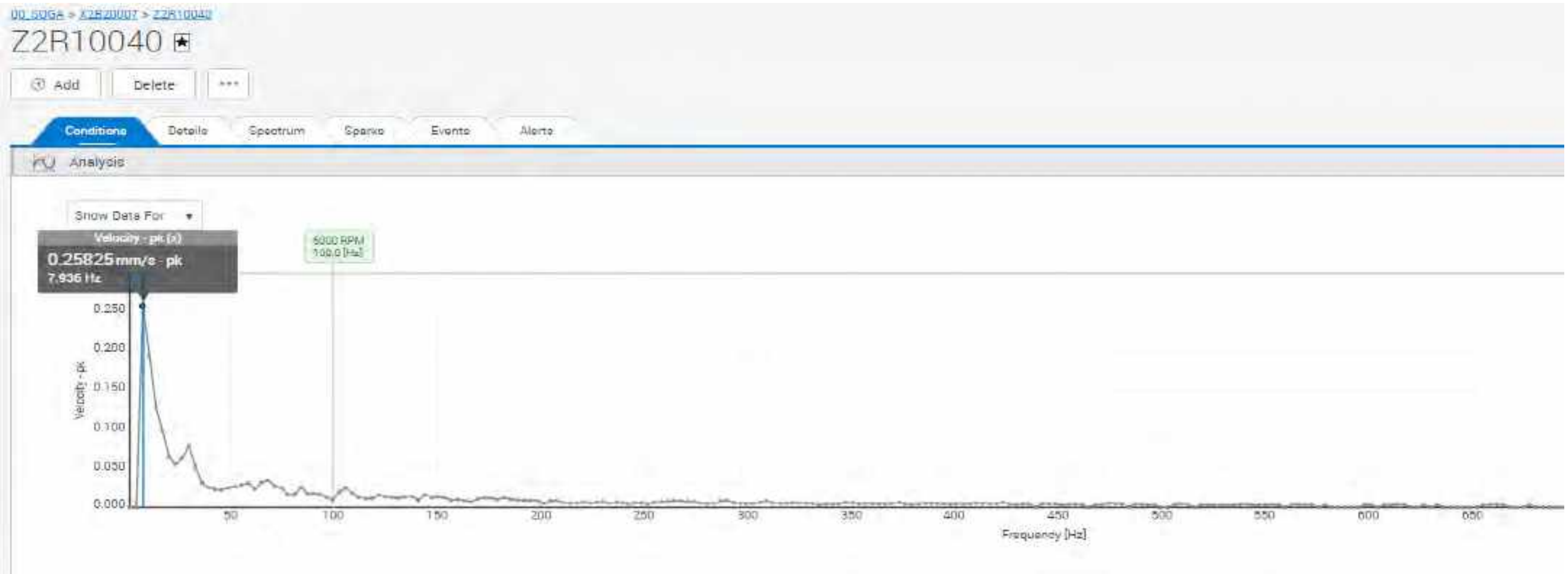
- AWS based
- Data measurement device ZARK X8II
- Wireless vibration sensor ZARK Nano

System architecture

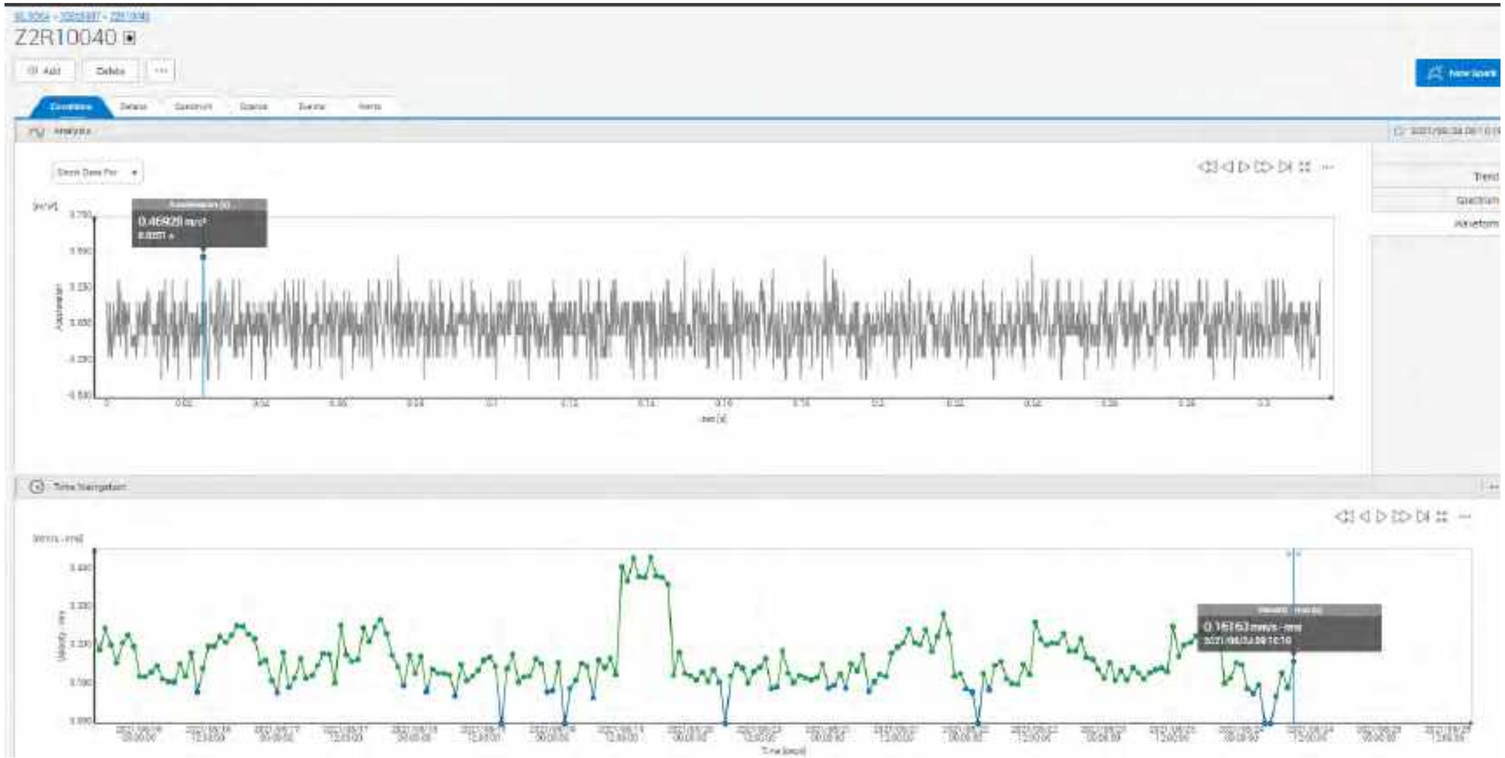


- IoT Tool for junction box (switchbox)
- Up to 8CH wired sensors measurement
  - IEPE Integrated Electronics Piezo-Electric power supply
  - 1-5 V analog signal
- Up to 16 ZARK Nano data transfer hub
  - =16 - Number of used wired sensor

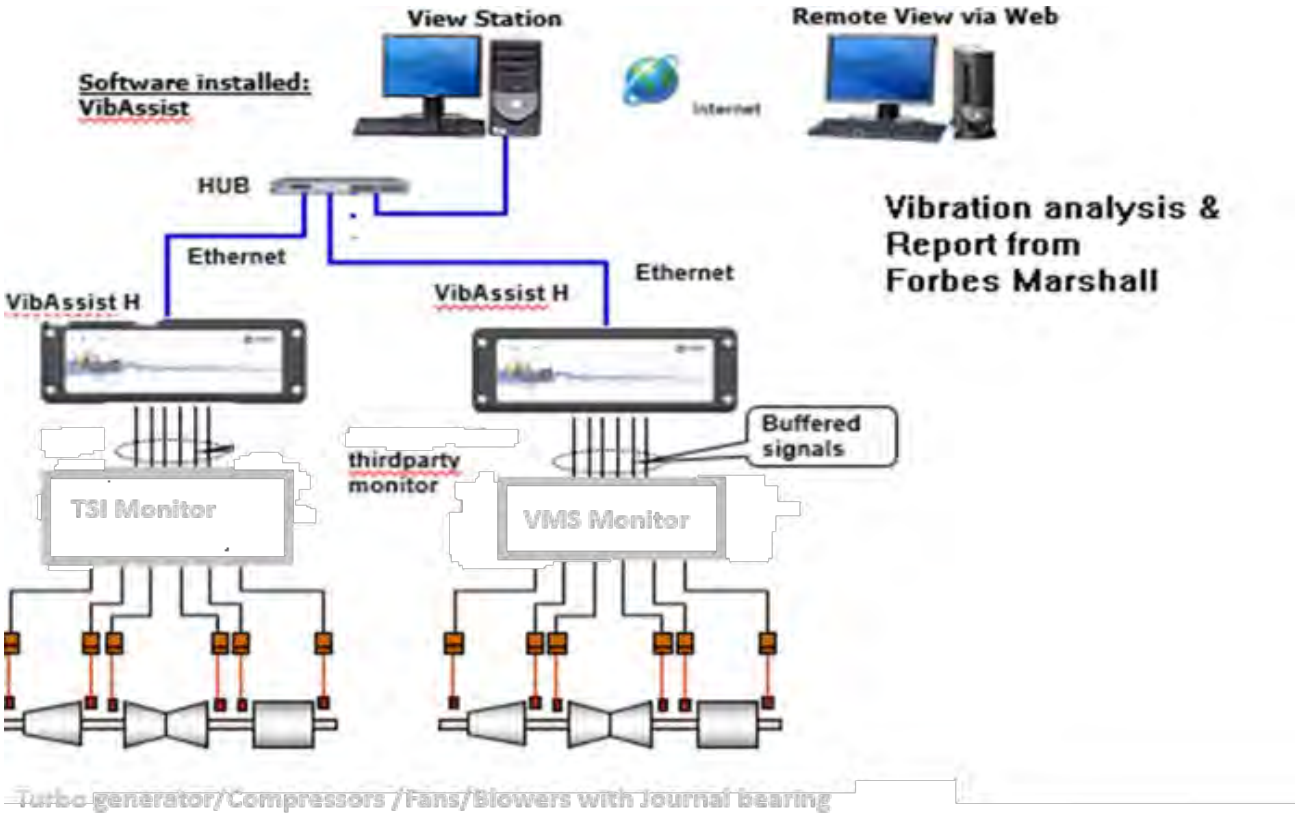
Measurement Point: Spectrum



Measurement Point: Waveform

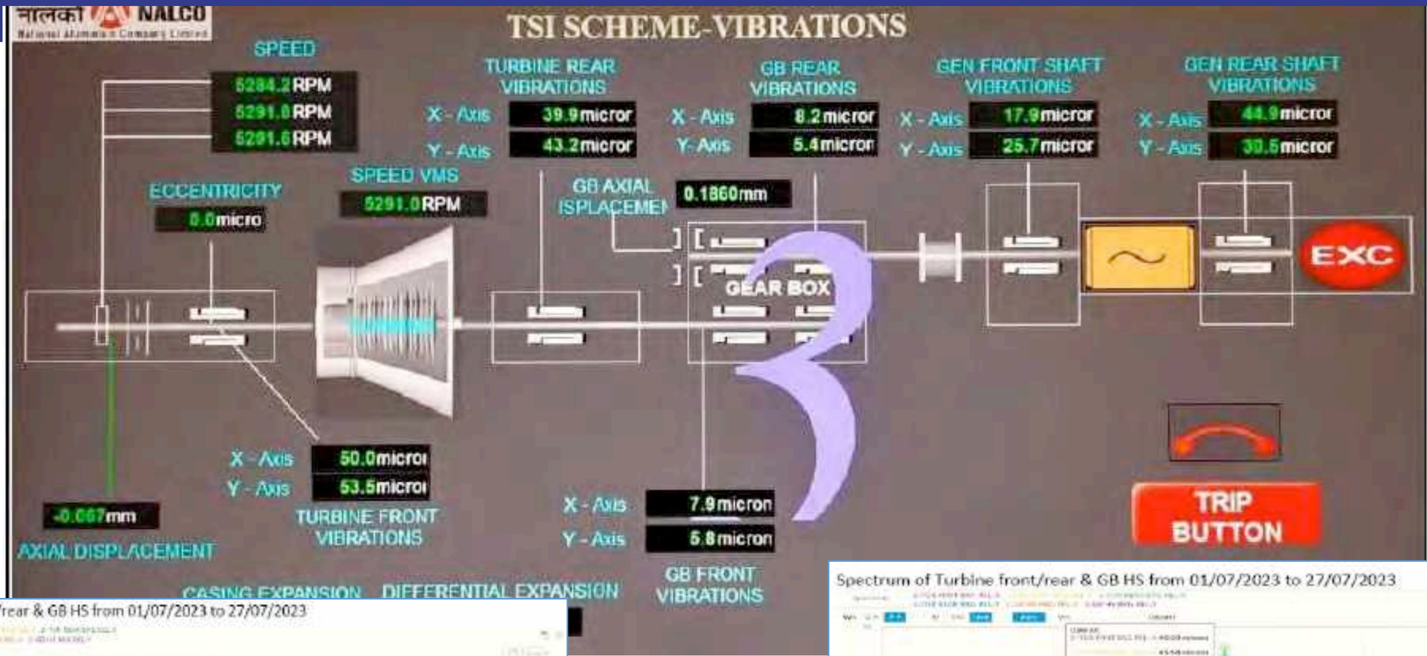


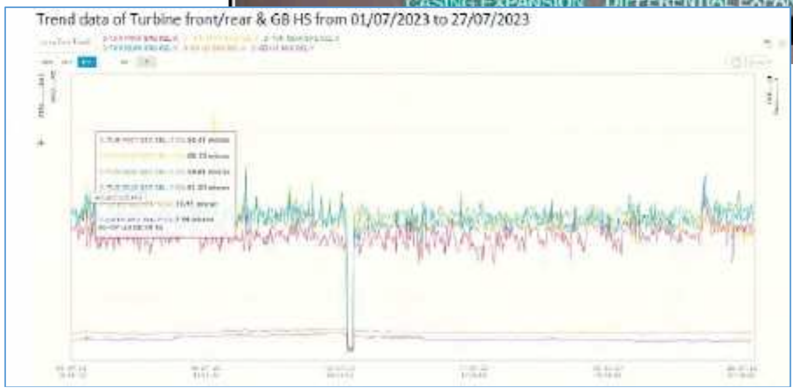
Small Turbo generators /Compressors/Fans/Blowers

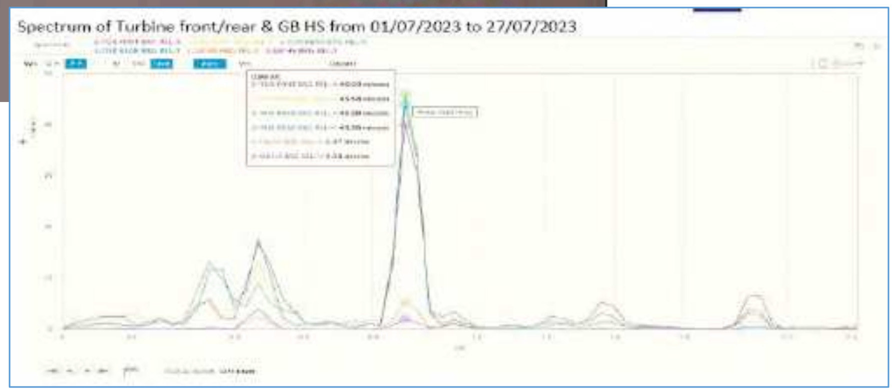


- Browser based GUI with web connectivity
- Wide range of analysis and real time display Functions
- Machine Trains, Analysis graphs
- High Resolution Spectrum Analysis
- Customized analysis & diagnostic
- E-mail configuration for alarms / reports
- Bearing frequency monitoring
- Transient data analysis
- Machines with Journal Bearings

Sample Report 18.5 MW Turbogenerator analysis







FORBES MARSHALL

Sample Report 18.5 MW Turbogenerator analysis

FORBES MARSHALL

Conclusion -

Alarming Channel Waveform—Abnormal waveform, alarm occurrence based on current data.

Alarming channel Spectrum —Sub- synchronous 0.4x ,0.5x spectrum peak occurrence based on current data.

In case of event occurrence—No alarm occurrence based on current data.

Suggestions by analyst-Overall, vibrations are normal, but vibration is dramatically raised.

-FFT spectrum indicates unbalance, rub and misalignment on turbine, G/B and generator bearing .
-Check the gearbox internal for any inaccuracies.

-Machine is allowed to run till next observation.

-Closely monitor the vibration trend.

Practical Fault ratification during Maintenance
- In-situ generator rotor balancing and correcting the misalignment between the LP rotor and generator rotor.

Thank You

Securing Tomorrow's Energy grid

As utilities drive to Net Zero goals, operational complexity is growing dramatically. Investors, activists, and economics are driving towards increased renewable energy penetration into the power market. However thermal and renewable will have to coexist to meet demand.

Solar PV's Wind turbines, Energy storage, Hydrogen and hydroelectric power all use a wide variety of automation software and technologies. As renewable portfolios grow, the number of applied technologies will multiply, increasing learning curves and adding complexity to operations as solutions from different vendors require additional integration. At the same time the future of power requires integrated hybrid energy systems where renewable and traditional generation, are combined to increase the resiliency and reliability of the grid while helping for dynamic supply of clean electricity.

Modern automation systems are more than just control. Today's providers are looking for holistic software and technology that form a comprehensive portfolio of sustainable grid solutions, implemented on a common platform for an entire power or water network to provide asset and grid management, data analytics, digital twin simulation, cybersecurity, visualization, and more.

Now with the two-way flow of electricity—basically behind-the-meter generation—managing the grid is much more complicated. That is what's driving the need for not only new physical grid infrastructure, but the need for software.

Fig 1: Two-way Power flow

India's energy transition will benefit from the synergy between Virtual Power plants and microgrids, addressing both technical and economic challenges while ensuring a sustainable and resilient power grid. Advanced energy management systems like smart grids can leverage a range of technologies to help consumers and utility companies track energy usage: Technologies like advanced metering infrastructure (AMI), Demand response management (DRM), Phasor measurement units (PMUs) are key to smooth Energy transition.

Smart grid technology has countless benefits, including increased grid efficiency and reliability and easy integration with renewable energy sources. However, to really maximize the benefits of a smart grid, power companies must implement effective optimization strategies as well. To get the most of your smart grid system, following should be done:

- Power network advanced analytics.
- Monitor grid data in real-time and implement predictive maintenance.
- Integrate distributed energy resources (DERs)
- Implement cybersecurity and data privacy measures.
- Maximize grid resilience with microgrids.
- Utilize energy storage systems for increased grid flexibility.
- Install grid automation and control systems.

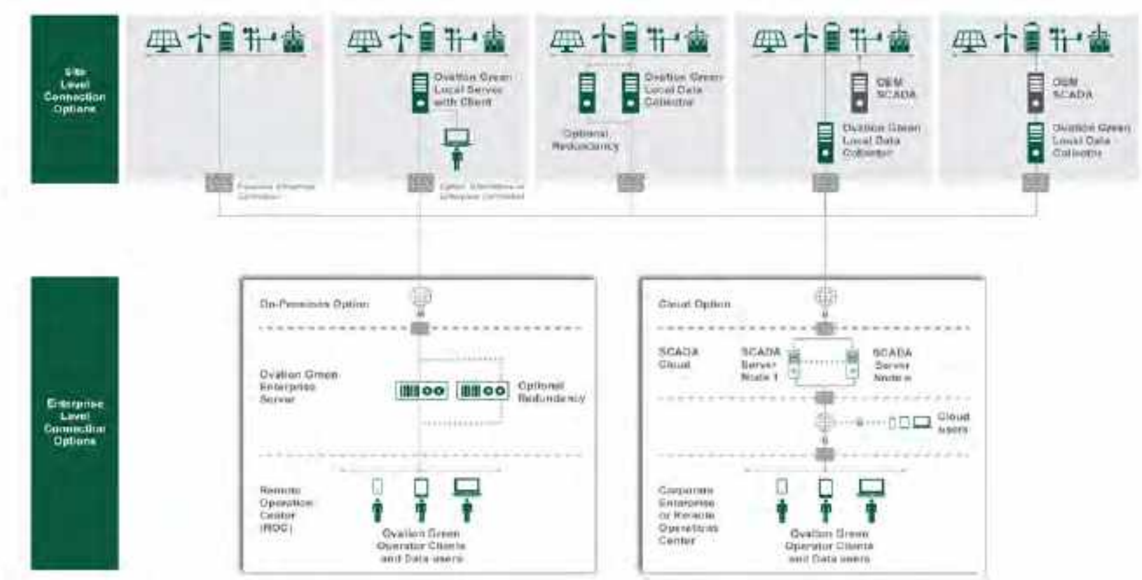


Fig 2: Technology stack for renewables

At the bottom layer, we don't make wind turbines, PV panels, or battery storage containers, but we do provide all the controls and data acquisition for them at the Local Site Ops layer. This includes PPC, Park Management, turbine control and Battery SCADA.

At the next level, we provide fleet operating systems through our unified SCADA and historical data. Coupled this with APM systems provided by AspenTech products, a whole slew of predictive maintenance and responses can be performed.

And at the very top layer, when Grid planning and scheduling is performed by OSI T&D software solutions which have EMS, DERMS and other grid level solutions.

Emerson's hybrid and microgrid software/control solutions optimize operations and supports a reliable power system through energy management, load-levelling, reserves and black start or backup power control. Our software gathers, contextualizes and securely delivers real-time and historical data to key stakeholders providing accurate, actionable intelligence that enables better decision-making and higher revenues. Our flexible solutions are scaled to meet the needs of standalone renewable assets or hybrid applications that includes Wind, solar, and hydro, providing full operational visibility across all assets to increase performance, improve efficiency and reduce costs.

Nidhi Chaudhary

Business Director
Sustainability Decarbonisation
Emerson Automation Solutions, India

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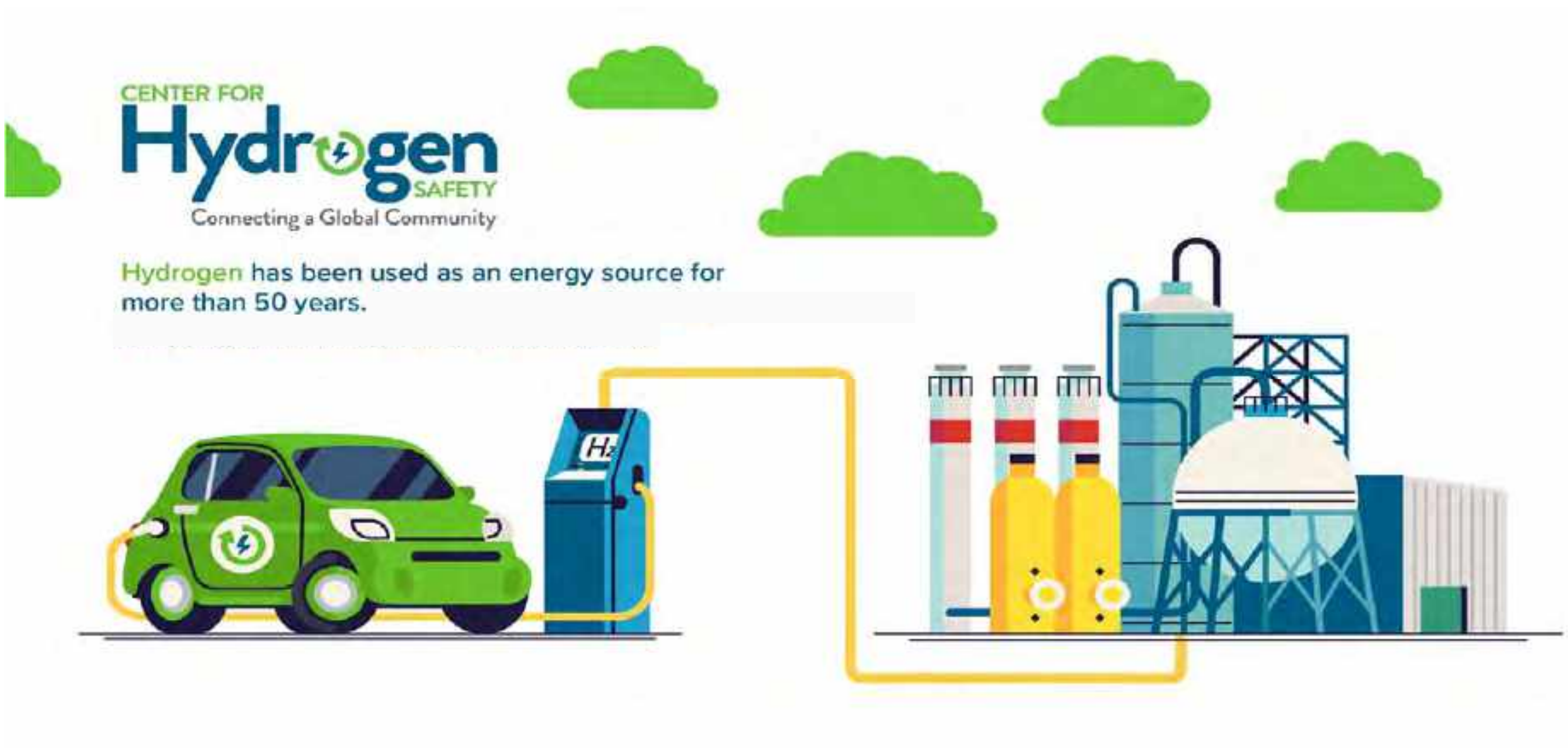
Component Consideration for Safe & High-Performing Hydrogen Fluid Systems

Parv Sud

Swagelok Bangalore

Safety: *h2tools.org*



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Why Fluid System Components Matter?

Why Fluid System Components Matter?

Gas Seal

Pressure

Temperature

Safety

Vibration

Maintenance

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Challenges Containing Hydrogen

- Small molecule gas
- Negative Joule-Thompson effect
- Hydrogen embrittlement causes permeation

Material & **Design** are Critical for **Leak-Tight Performance**!

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Permeation & Leakage

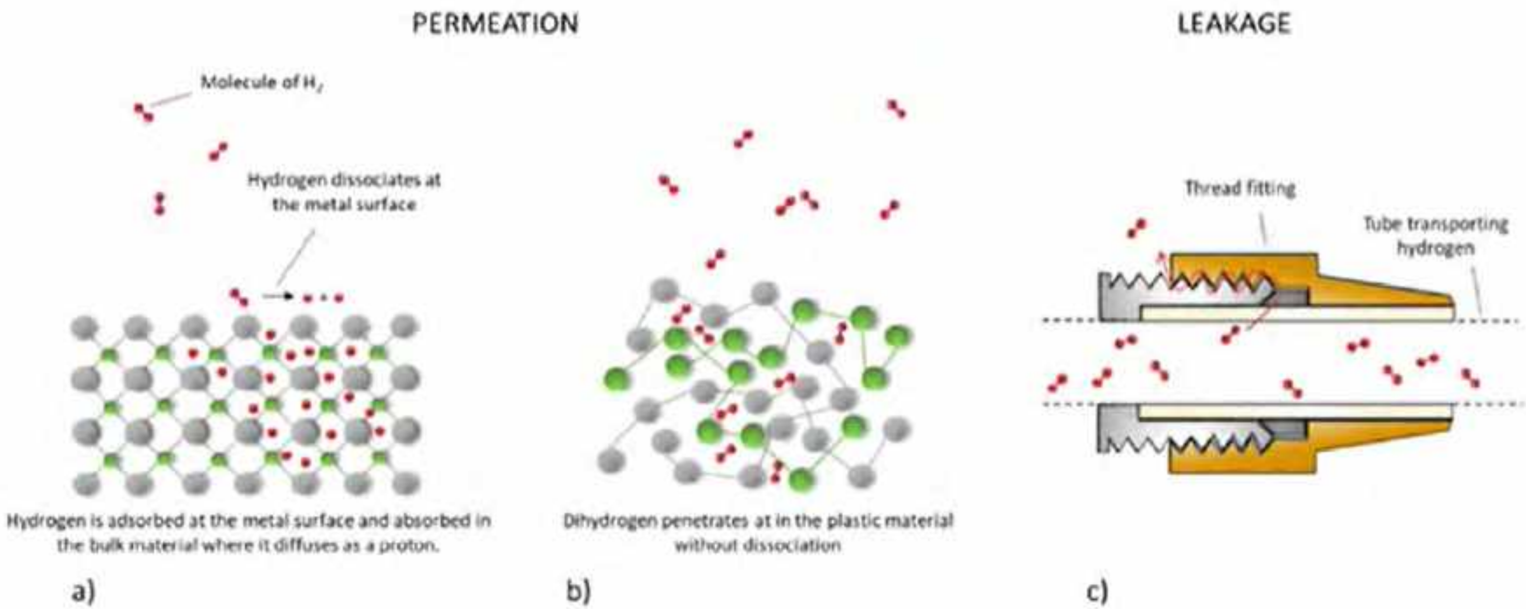
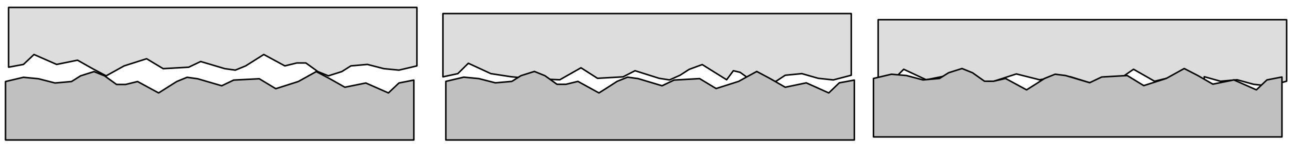


Figure 21 : Schematic representation of permeation in a) a metallic and b) a polymer material and c) leakage through a fitting in hydrogen gas environment.

Creating a Seal

Objective: Eliminate continuous pore structure between mating surfaces:

- All machined surface have a degree of roughness
- Peaks and valleys can link to make leak paths
- Metal-Fittings: Employ plastic deformation of metal surfaces to create the seal



Two-dimensional representation of rough surfaces coming together to form a seal

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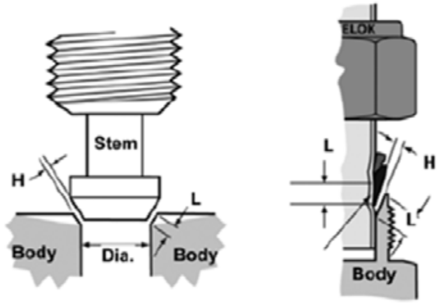
Leak Paths



Assuming that the parameters are known, the flow rate in a system can be estimated using the following formula (*Swagelok Tube Fitters Manual*, n.d.):

$$Q = \frac{\Delta P \times H^3 \times W}{\mu \times L}$$ *Equation 3*

Q is the flow rate of the leak [$m^3.s^{-1}$]

ΔP is the pressure drop H the height of the gap W is the circumference

μ the absolute, or dynamic viscosity [$kg.m^{-1}s^{-1}$] L the length of the leakage path

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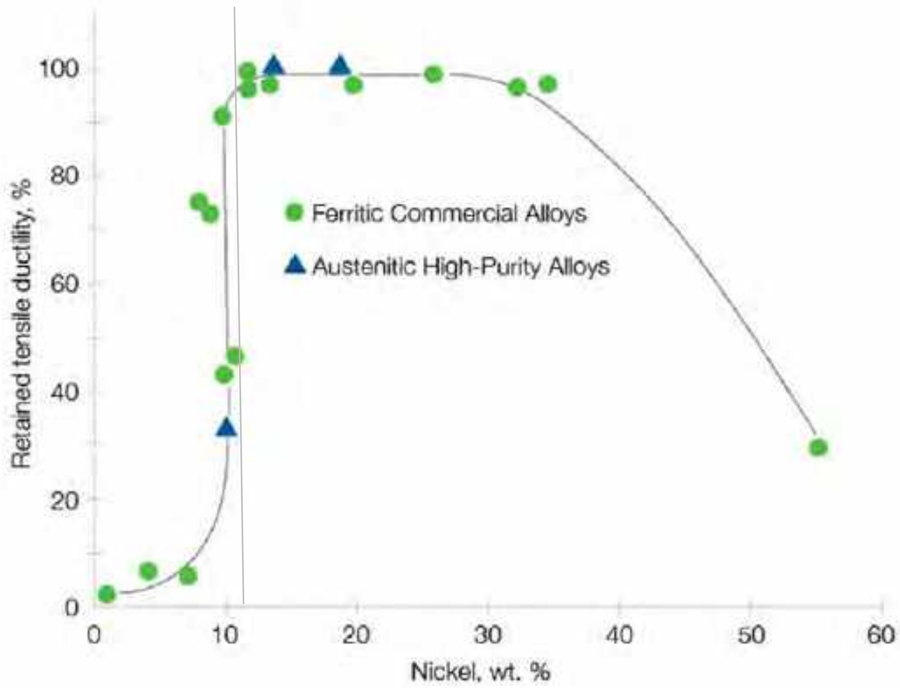
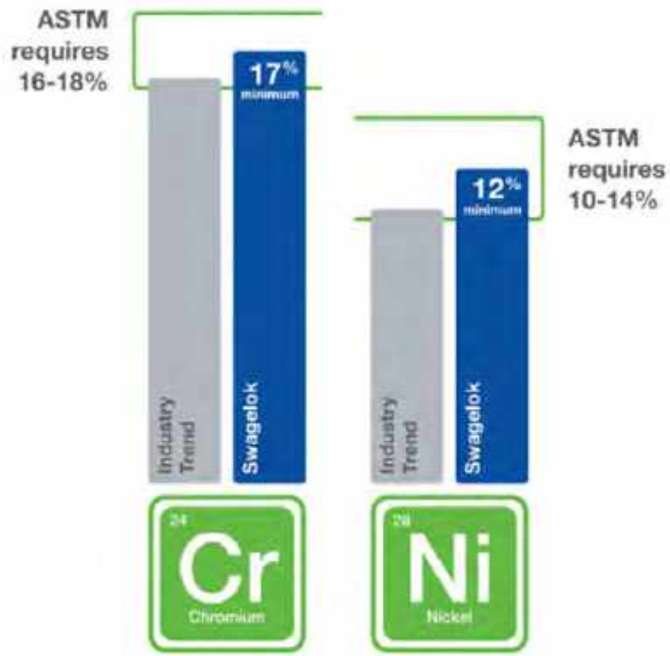
Swagelok SS 316/316L

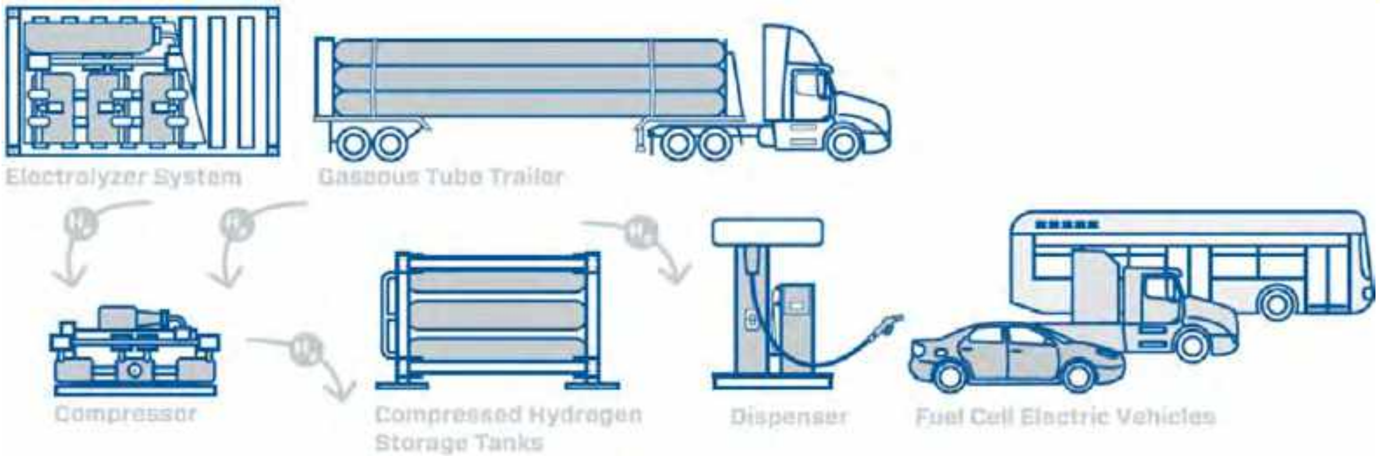


Source: G.R. Caskey, Hydrogen Compatibility Handbook for Stainless Steels (1983)



Swagelok 316 stainless steel tube fittings and instrumentation valves exceed minimum ASTM specifications.

Component Considerations



Why Fluid System Components Matter?

- Gas Seal
- Pressure
- Temperature
- Safety
- Vibration
- Maintenance

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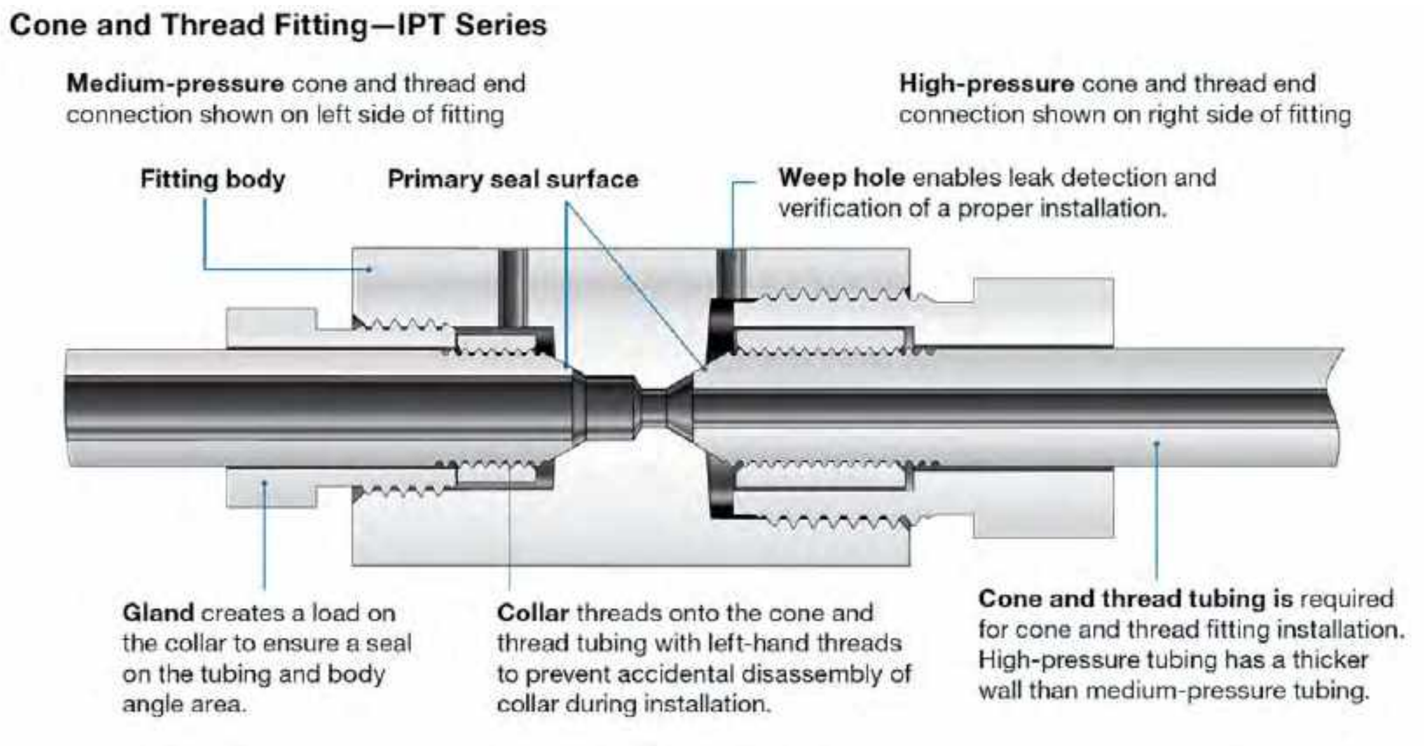
Cone & Thread Fitting



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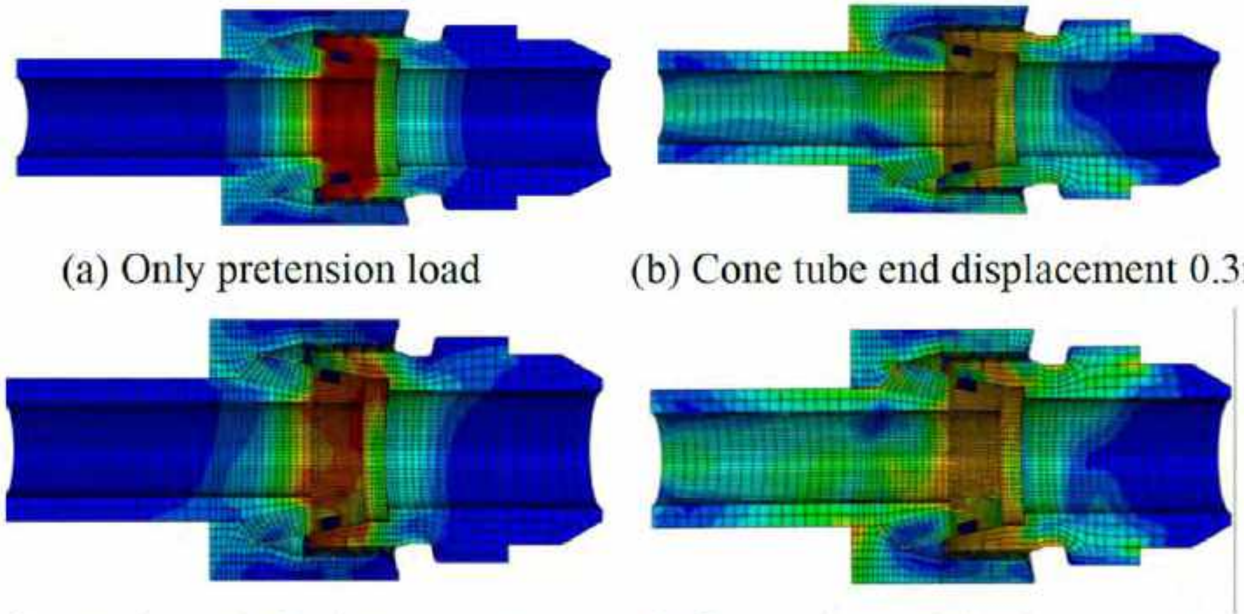
Learnings on Coned Seal Technology



(a) Only pretension load (b) Cone tube end displacement 0.3mm

(c) Cone tube end displacement 0mm (d) Cone tube end displacement -0.3mm

Fig.2. Mises stress distribution of cone sealing structure

Summary of Cone & Thread

- No International Standard (57° to 62°)
- Coning is Performed Manually
- Consistency of Cone Based on Skill
- Susceptible to Vibrational Failure
- Requires Grease to Seal

Cone & Thread for Hydrogen

- ✗ Gas Seal
- ✓ Pressure
- ✓ Temperature
- ✗ Safety
- ✗ Vibration
- ✗ Maintenance

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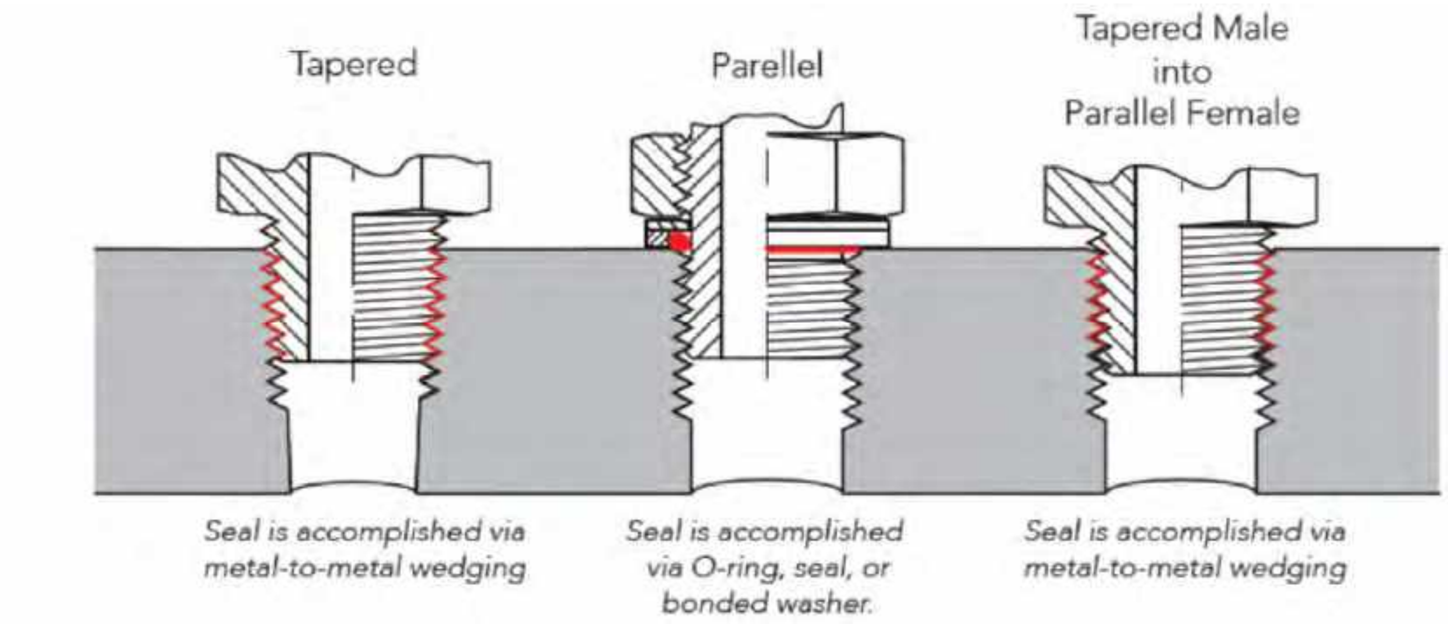
Threaded Joints



Spiral Leak Path

Commodity Seals

Bad Idea

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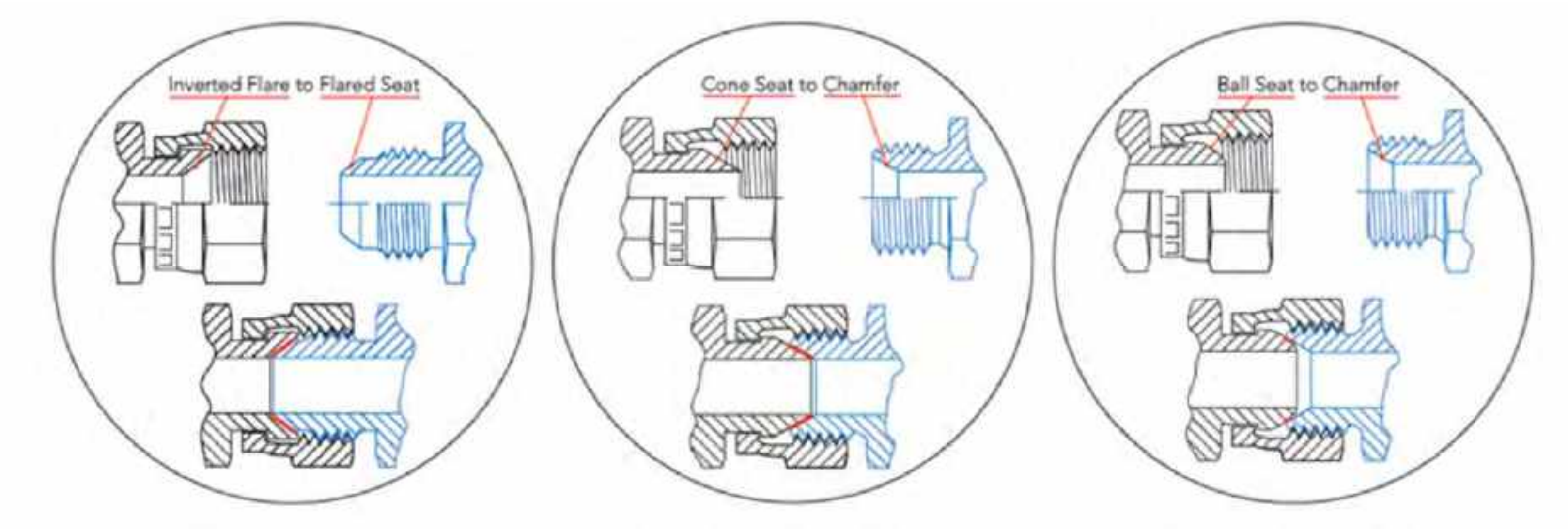
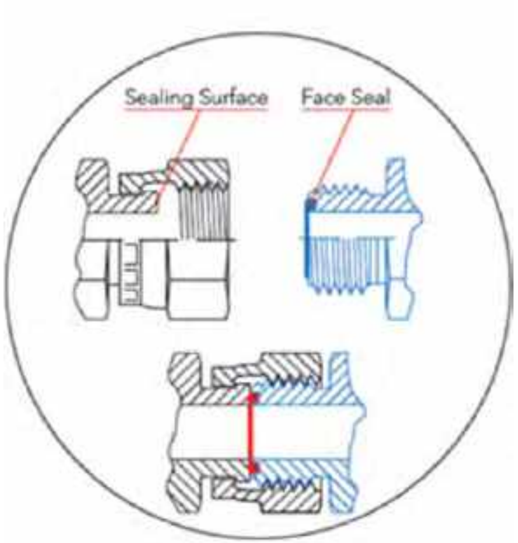
Flare Style Fittings



Angle on Angle Seals Cannot Ensure Long Seal

Ball on Chamfer Creates Single Line of Contact

O-Ring Sealing Fittings



ORFS Seals Rely on Internal System Pressure; Seal Moves on Every Pressure Cycle

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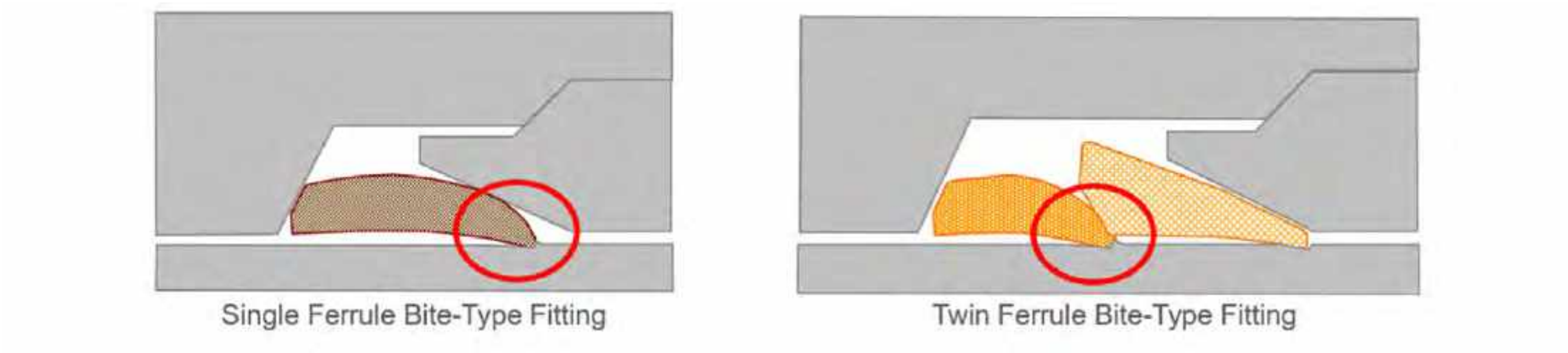
Single Ferrule Bite Style



Single Ferrule Fittings: Either Bite and Introduce a Stress Riser or Single Line of Contact of Limited L and No Elasticity

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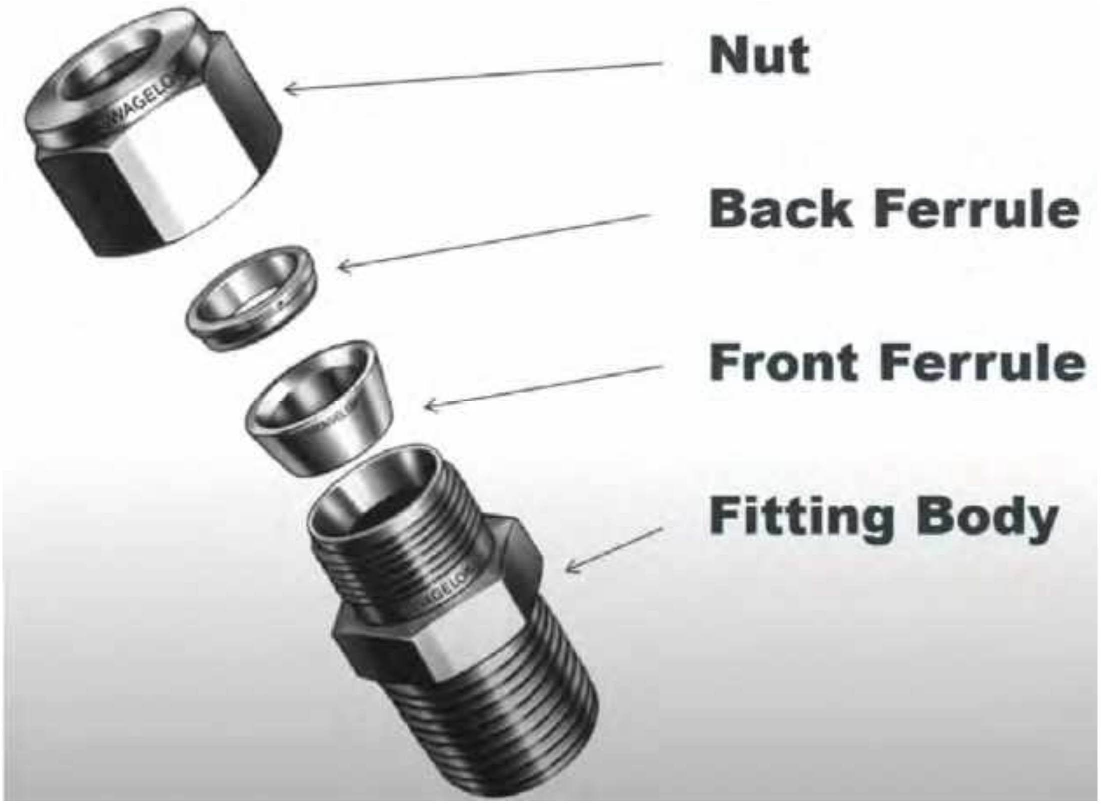
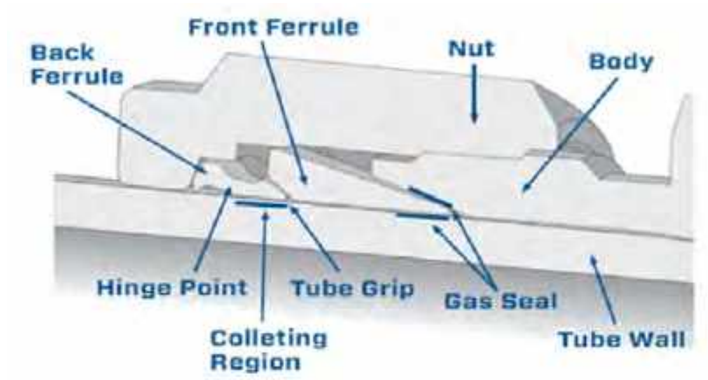
Swagelok Tube Fitting

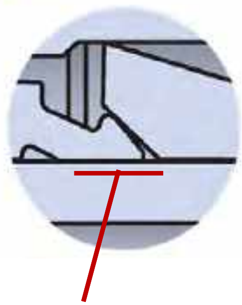
Double Ferrule Fitting



Swagelok Tube Fitting Advantage

- High Quality Product
- All-Metal Construction
- No Loose Parts





Swagelok Advanced Geometry &
Hardening Process = Superior Tube Grip

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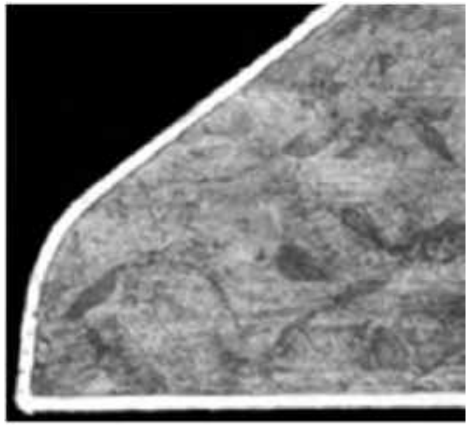
SAT 12 Surface Carburization Technology

- Patented Swagelok Surface Hardening Process
- Low-Temperature Carburization of Rear Ferrule
- Tool Steel-Like Hardness
- Enhanced Corrosion Resistance
- Improved Wear Resistance & Retained Ductility



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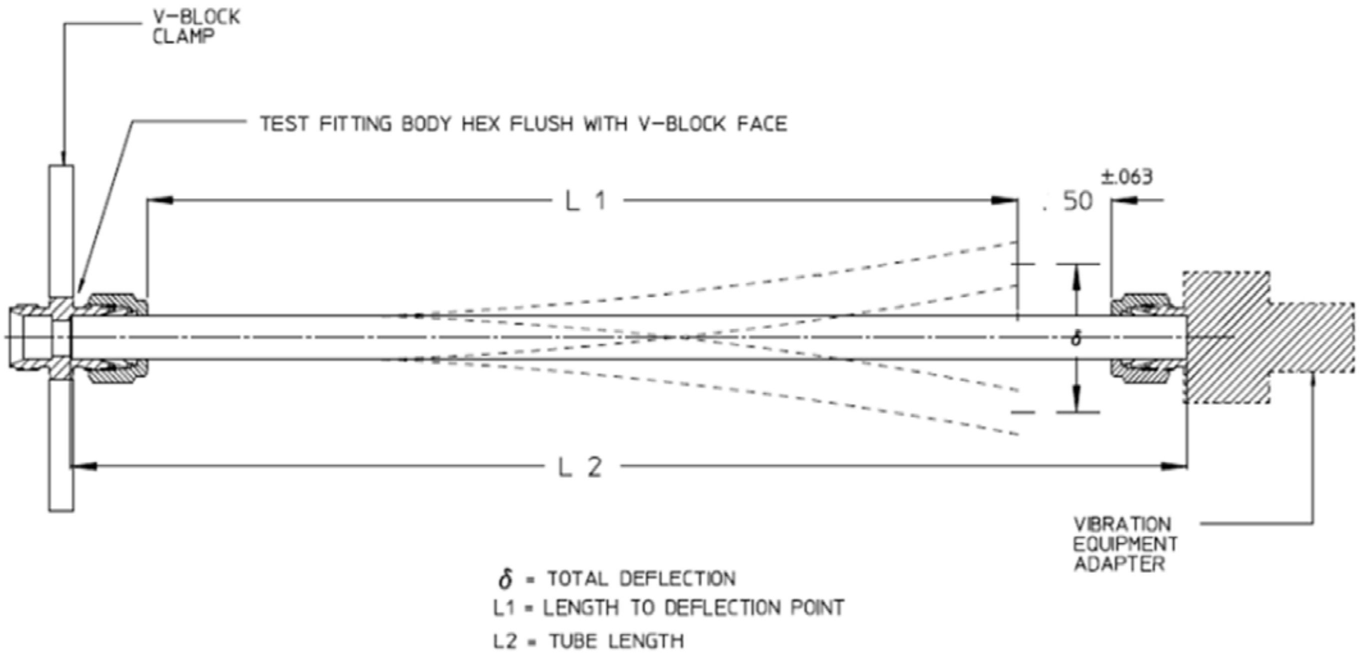
Rotary Flexure Test



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Product Test Report

Swagelok

Product Test Report

Swagelok Company
29500 Solon Road
Solon, Ohio 44139 USA

PTR-3222
Ver 03
November 2022

TITLE
Rotary Flexure Test of 316 Stainless Steel Swagelok® Tube Fittings with Stainless Steel Tubing

PRODUCT TESTED
The following stainless steel Swagelok tube fittings were tested with stainless steel tubing. Each tubing size was represented with a minimum of 4 samples.

The following data sets include product tested 2013 through 2015.

Ordering Number	Form	Tubing Size	Tubing Hardness HRB
Fractional, in.			
SS-400-1-4	Bar stock	1/4 × 0.028	86
SS-600-1-4	Bar stock	3/8 × 0.035	84
SS-810-1-4	Bar stock	1/2 × 0.035	81
SS-1010-1-8	Bar stock	5/8 × 0.049	84
SS-1210-1-8	Bar stock	3/4 × 0.049	79
SS-1410-1-8	Bar stock	7/8 × 0.049	78
SS-1610-1-8	Bar stock	1 × 0.065	78
Metric, mm			
SS-6M0-1-4	Bar stock	6 × 0.8	80
SS-10M0-1-4	Bar stock	10 × 1.0	83
SS-12M0-1-4	Bar stock	12 × 1.0	86
SS-14M0-1-8	Bar stock	14 × 1.0	78
SS-15M0-1-8	Bar stock	15 × 1.0	78
SS-16M0-1-8	Bar stock	16 × 1.2	82
SS-18M0-1-8	Bar stock	18 × 1.2	79
SS-20M0-1-8	Bar stock	20 × 1.2	80
SS-22M0-1-8	Bar stock	22 × 1.2	78
SS-25M0-1-8	Bar stock	25 × 1.8	79

PURPOSE
The assemblies were tested to observe the fatigue endurance of 316 stainless steel Swagelok tube fittings with advanced geometry back ferrules under laboratory conditions at various levels of applied alternating bending stress of the tube.

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Swagelok Tube Fitting for Hydrogen (350 bar)

- ✓ Gas Seal
- ✓ Pressure
- ✓ Temperature
- ✓ Safety
- ✓ Vibration
- ✓ Maintenance

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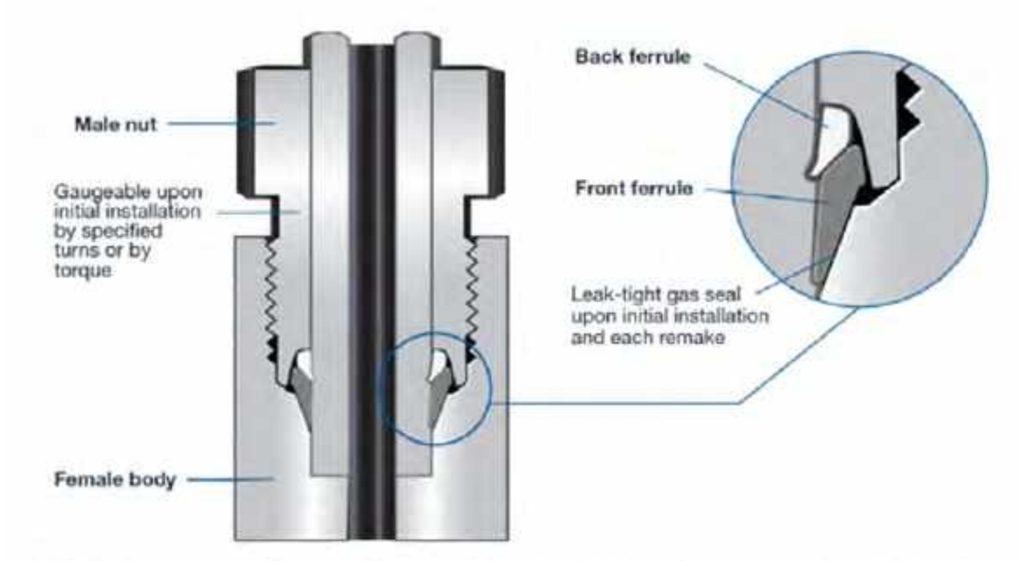
1378 Bar: FK Series Fitting

- Reliable Leak-Tight Installation & Reassembly
- Quick & Easy Installation
- Variety of Tubing Options



This cutaway image shows how optimized seal contact can be achieved with two-ferrule fitting technology.

Swagelok FK Fitting for Hydrogen (700 bar)

- ✓ Gas Seal
- ✓ Pressure
- ✓ Temperature
- ✓ Safety
- ✓ Vibration
- ✓ Maintenance

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Conclusion

- Not all Products Created Equal (SS316)
- Understanding Leak Modes Help Designers
- Strong Foundation of Appropriate Components Leads to Success

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SULPHUR AND NITROGEN ANALYSIS IN AN EVOLVING LANDSCAPE

Karl Kuklenz
Petroleum Analyzer Company L.P., Houston-USA

KEYWORDS

Sulphur, Nitrogen, Fluorescence, Chemiluminescence, Elemental Analysis, Refinery, Petrochemical, Hydroprocessing, Octane Destruction, Gasoline Blending, Catalyst Poisoning

INTRODUCTION

Elemental analysis is a broad class of chemical analysis that refers to techniques that are used to determine the elemental composition of a substance or material. It involves identifying and quantifying the different chemical elements present within a sample, typically through various analytical methods such as spectroscopy, chromatography, or mass spectrometry. By breaking down a substance into its constituent elements, elemental analysis provides crucial insights into its chemical composition, purity, and potential applications across a wide range of fields. In the oil, gas, and petrochemical realm, some elements have a critical impact on the operations of the process and/or the quality of the end product(s), and as a result an impact on the profitability of the plant. Nowhere is this more evident than in the modern petroleum refinery.

The first and most obvious example of this is the sulphur in the finished transport fuels we use every day, all over the globe. Petrol, diesel, jet fuel, and marine fuel oil all must meet a sulphur specification of some magnitude, in addition to their many combustion performance specifications, in an effort to curb toxic air emissions. In 2020, the International Maritime Organization (IMO) imposed new limits on the sulphur content of marine fuel oil used in open waters to 0.5% (down from 3.5%). This added to its rules in designated emission control areas where the limit was already 0.1%, greatly reducing the emissions burden of the entire journey. As demonstrated in figure 1, over the next several years on the way to 2030, many countries in south America, Africa, and southeast Asia have committed to lowering their sulphur specifications in their petrol and diesel by orders of magnitude. Many of them have even committed to sulphur levels on par with the leading nations which mandate specifications of 15 ppm or less. This will lead to a market shift as the last outlets for higher-sulphur petrol and diesel dry up and the worlds refiners complete the transition to a low-sulphur fuel economy, in addition to cleaner air for everyone.

Projected Sulfur Specs – out to 2030 (ppm)

Diesel in...	Current	Projected	by Year
Argentina	800	10	2028
Bolivia	5000	500	2028
Brazil	500	10	2025
Dominican Rep.	500	15	2025
Ecuador	500	15	2025
Mexico	500	15	2025
Burkina Faso	10000	50	2025
Cote d'Ivoire	3500	50	2026
Guinea	2000	50	2026
Guinea-Bassau	5000	50	2026
Liberia	3000	50	2026
Mali	10000	50	2026
Nigeria	3000	10	2024
Senegal	5000	50	2026
The Gambia	5000	50	2026
Togo	10000	50	2026
Indonesia	500	50	2025
The Phillipines	50	10	2026
Vietnam	50	10	2025

Gasoline in...	Current	Projected	by Year
Australia	150	10	2027
Azerbaijan	500	10	2024
Bolivia	500	50	2028
Liberia	2000	50	2026
Mali	500	50	2026
Togo	5000	50	2026

Source: S&P Global: Global Fuels Specification Outlook, 11 May, 2023.

Figure 1

The impacts of sulphur are not limited to the fuels arena. The burgeoning petrochemical industry has specifications of sulphur which in many cases are lower than transport fuels. Olefins like ethylene and propylene are in the range of 0-5 ppm, often maximum 2 ppm. Aromatics like benzene, toluene, and xylene some grades specify maximum 1 ppm sulphur. Given the chemical reactions yet required to make useful consumer products from these petrochemicals, it's not hard to understand the need for such purity. Curiously, the depth of purity is not often the issue. Rather it is the scale that is exciting. Of the roughly 10 million barrels per day of oil demand that is expected to grow by 2030, a full 30% of that growth is forecasted to be destined for petrochemicals. And by 2050, a full 6 million barrels per day of crude oil are expected to be refined direct to chemicals.

Cleaner fuels, increased petrochemicals, and other aspects of the acclaimed energy transition are increasingly reliant upon established catalytic conversion technology. Many of which are presented with deactivation when subjected to even small concentrations of sulphur and/or nitrogen. Steam-methane reforming for the production of syngas is heavily reliant upon a desulphurization step to protect the downstream catalytic reaction. And in fact, employs a system of guard beds of ZnO as a last line of defense against the poisoning. Fluidized catalytic-crackers (FCC) which have in recent years been converted to maximize petrol or propylene depending on the dynamics are more sensitive to nitrogen poisoning than have been in the past. That is owed to the increased use of ZSM5 catalyst at higher temperatures and pressures which are responsible for the higher olefins production. The poisoning of which puts a constraint upon the regenerator and impacts the quality and quantity of propylene which can be made.

Another classic example of catalyst nitrogen poisoning is in the hydrocracking and reforming catalysts where the nitrogen reacts to form ammonia and neutralizes the acid active sites through an acid base reaction.

With these transitions will come increased focus on process and control of these critical elements, and as such, the need for real time monitoring of the same. This can only be achieved through the use of a reliable, responsive, and precise analysis technique. The choice in many cases is a combustion-fluorescence analyser.

COMBUSTION-FLUORESCENCE ANALYSIS

Combustion-fluorescence analysis encompasses a method for detecting and quantifying fluorescent analytes after a high-efficiency combustion reaction. This implies the sample of interest must be combustible, of a sort. There are cases where water-continuous matrices with some combustible material in them have been analyzed successfully using this technique. However, the vast majority of applications are to majority hydrocarbon matrices of either liquid or gaseous phases. The combustion reaction is critical in a couple of areas.

1. The combustion simplifies the matrix considerably for the detector assembly.
2. The removal of water vapor from the analyte, which would otherwise quench the fluorescence, is best accomplished at a high temperature.
3. It allows for minimal impact to waste handling. All that remains from the initial combustion after moisture removal and post analysis scrubbing is CO_2.

The combustion is carried out at approximately 1100 °C inside a furnace in the presence of an oxidizing atmosphere. Depending on the analytical sensitivity required of the application, that atmosphere can be anything from instrument air to special helium-oxygen blends, to pure oxygen. Generally speaking, lower specifications require purer oxygen.

Once combusted, what remains is a simple mixture of CO_2, H_2O, SO_2, and NO. This is pressed forward by an inert carrier gas, often nitrogen but can alternatively be argon. The first step post-combustion is to remove any moisture. This is often accomplished by exposure to a sulfonated-PTFE membrane which selectively permeates water vapor but not gases. On the opposite side of the membrane is the same dehumidified gas stream after analysis just prior to exhausting, or possibly another suitable dry gas to accept the moisture.

With the analyte combusted and dehumidified, it is ready for analysis. For sulphur analysis, the fluorescent technique is a direct excitation of the SO_2 with shortwave ultraviolet light. A photomultiplier tube (PMT) with a maximum sensitivity in the range of about 400 nm then captures the photons and magnifies their signal. For nitrogen analysis, a slightly different technique is employed.

The combusted analyte travels to a chamber where it is mixed with ozone gas from a suitable generator. The reaction with NO converts it to NO_2 but in a quantum excited state. This excited state is unstable and releases a photon to regain stability and this photon is captured similarly with a PMT sensitive around 600 nm.

After analysis, the analyte is exhausted from the instrument after passing through a catalytic scrubber to remove any unreacted ozone and contacting the opposite side of the moisture barrier if necessary and appropriate.

The method sounds standardized and indeed these measurements are based on ASTM standard laboratory methods for total sulphur and nitrogen measurement. However, there are some idiosyncrasies that differentiate the process sulphur analysers. One is the furnace itself. If the analyte as received from the process is already a combustion product such as from a flue gas, or if the gas composition is guaranteed to have no combustible material such as that from a gas purification plant then it is possible to omit the furnace and proceed to feed the dried gas straight to the PMTs. The signal processing for this configuration is markedly different from the discrete injection fed configuration. In the case of most analysers, and all liquids analysers that the author is aware of, discrete injections of a few microliters of sample are fed to the furnace from an actuated valve. This has the effect of inducing a chromatograph-like response in the detector and the signal is processed in a similar way by integration. This technique is sensitive to all the same types of data perturbations as gas chromatography (skew, injection speed, tailing, broadening, double peaks, misshapen peaks). However, in general these are not an obstacle to precise measurement. In the case of continuous feed gas analysers, the output is merely read from the constantly responding PMT and ratioed against the baseline, greatly simplifying the signal processing task.

One design choice which has considerable bearing on the analytical performance of the analyser is that of the introduction method to the furnace. There are some designs which employ a heated expansion chamber ahead of the furnace to lower the combustion load. This has the effect of reducing the possibilities of coking or plugging the injection line at the furnace but also greatly delays the instrument's response to a new process change. If this type of analyser is multi-stream processing, then it may not get to more than 90% of the true process value in the time allotted due to this effect. The alternative, "direct-injection" analysers, feed the analyte directly to the furnace. This greatly increases the responsiveness to a process change as the instrument is always injecting exactly what came from the process. Another benefit of this method is that it allows the introduction of heavier feeds such as lube oils that might not be possible in "expansion-chamber" designs due to their low volatility. Direct-injection analysers do need to be carefully set-up to ensure the injection mechanics are free of problems and as a result are more reliant upon a working sample conditioning system to remove material that might foul the injection tube.

There are many more differentiators that all fall into the category of reliability or serviceability.

- PLC vs embedded control architecture: PLCs are expensive but reliable. Forms of embedded control like PCBs are sometimes hard to ruggedize to the process environment but can be cheaper if done right.

- Rotameter vs mass flow control (MFC) gas regulation: All things being equal, a MFC should be a superior solution for gas regulation. However in practice, gas streams, especially instrument air, prove too variable around the world and so the tried and true rotameter persists.
- Pyrotube (the glass chamber inside the furnace where the gasses are isolated from the furnace element) design and construction: The optimum design is one that minimizes or eliminates the need to replace it while maximizing the combustion efficiency in the time/space allowed.
- UV lamp technology: More intense lamps can increase sensitivity. Pulsed lamps are capable of higher power but for shorter time, and repeatability can suffer. Specialized lamps like noble gas discharge lamps have a high spectral efficiency as they emit nearly monochromatic light. The industry seems to have found these distinctions in lamp technology to be without a meaningful difference. The maintenance cycle of other preventative actions like the injection valve and the pyrotube tends to ensure that the lamps are replaced at a regular frequency regardless of their technology.

APPLICATIONS

TOTAL SULPHUR AND OCTANE DESTRUCTION

One of the toughest challenges for a refinery is to select the best combination of components to produce cost-effective, on-spec gasoline products. The goal of gasoline blending is to blend, as economically as possible, the many components while still meeting the required specifications. Presently, there are great pressures in many countries to reduce sulphur emissions as low as possible. However, beyond a certain point, that sulphur reduction comes at the expense of octane. A concept that is referred to as “octane destruction”. This destruction comes about as the process units are pushed in their severity, especially the hydroprocessing units, to produce sulphur lower than 10 ppm. At this severity, hydrogen saturation and thus octane destruction begins to outweigh the sulphur destruction. Accurate, online measurement of total sulphur provides crucial information to prevent product giveaway and reprocessing, and helps optimize the gasoline blending process.

If the octane destruction resulting from a reduction from 15 to 10 ppm sulphur is about 1 octane number (ON) and the value of octane is $2.75/ON/Bbl, then a refinery making 100,000 Bbl/day of gasoline destroys $275,000 dollars per day or about $55,000 dollars per day per ppm of sulphur. This means that the cost of consistently reporting 10.1 ppm when the true value is already 10 ppm is nearly $2M/yr. Or said another way, if your sulphur analyser takes 10 minutes to respond to a 1 ppm process change then that wastes about 400 dollars at each change. Conservatively, if that happens 4 times a day then that amounts to half of a million dollars in unnecessary octane destruction.

PAC has experience in this area with its NSure sulphur analyser. It is a direct-injection type and responds very quickly to process changes, often within two injections (about 3 minutes total time).

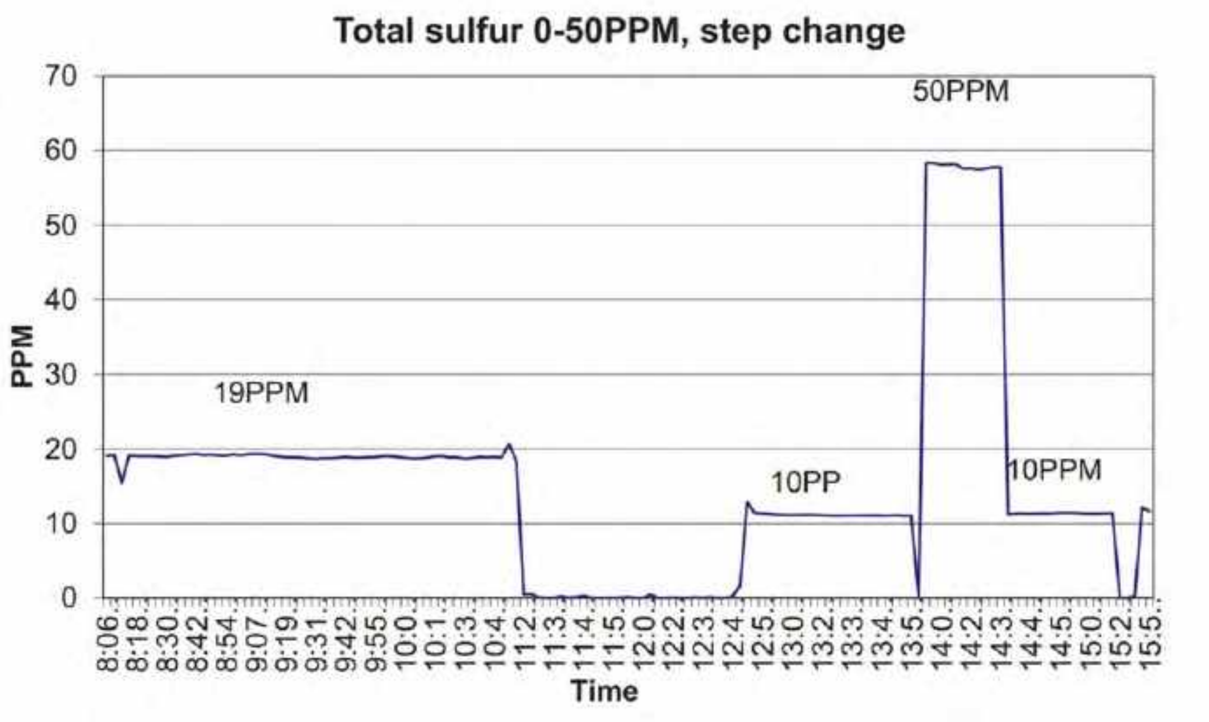

Figure 2

TOTAL NITROGEN IN FCC ON-PURPOSE PROPYLENE

One of the most exciting avenues of propylene production that is often discussed is on-purpose propylene by fluidized catalytic cracking technology (FCC-OPP). This process involves modifying the operation and catalyst of an existing fluidized catalytic cracker (FCC) to optimize the process for propylene production from naphtha instead of the typical production of fuels from gas oil. The advantage of this approach is the ability to repurpose existing assets for a new purpose, requiring only a moderate investment while retaining a certain degree of flexibility.

Nevertheless, FCC-OPP does present a new set of challenges. The catalyst poisoning by nitrogen-containing molecules, an issue typically of minor concern in a fuels-based operation, becomes significantly more problematic in an OPP operation. Numerous factors contribute to this, beginning with the feedstock itself. Instead of the gas oils conventionally fed to an FCC, naphtha is used for propylene production. And because naphtha is a blendstock for gasoline, the highest quality naphthas are reserved, leaving lower quality naphthas like coker and visbreaker naphtha for FCC-OPP. However, these naphthas carry a higher nitrogen load on average, and which can vary significantly, sometimes reaching levels as high as 2000 ppm. Additional factors such as the catalyst's reduced pore size and increased temperatures and pressures work against the regenerator which must keep pace with the catalyst poisoning.

If the conversion loss due to the temporary nitrogen catalyst deactivation leads to an estimated 2% loss of conversion in an average 120,000 Bbl/day FCC that is making 10% propylene at $1000/MT loses about $25k/year. Some of the higher propylene yields reach around 20% where the loss is even greater.

In the case of permanent catalyst deactivation, even a marginal 1% increase in the daily consumption rate of 10-20MT amounts to a substantial annual expenditure of $55k to $110k.

Preventing these types of losses has been accomplished with an online total nitrogen analyser program and has justified its use for source monitoring and control.

CONCLUSION

These applications are just a taste of the many ways in which a well-placed elemental analyser program can benefit a fuels or petrochemical manufacturer. There are other applications around the hydroprocessing units, reformer and isomerization units, sats gas plant, natural gas, and finished product specifications of all manner of petrochemicals. Choosing the right analyser is most often a question of reliability and responsiveness. One thing which was not discussed in detail which often factors into decisions is the limitation of bias management between the laboratory and process analysers. That is, as much as possible, mirroring the same techniques employed in both environments to limit questions of correlation (or lack thereof). It is important to measure these elements of nitrogen in sulphur and their importance appears to grow with each passing year.

ACRONYMNS

IMO	International Maritime Organization
FCC	Fluidized Catalytic Cracker
PTFE	Poly-tetrafluoroethylene
ASTM	American Society for Testing and Materials
PMT	Photomultiplier Tube

MFC	Mass Flow Controller
PLC	Programmable Logic Controller
UV	Ultraviolet
ON	Octane Number
OPP	On-Purpose Propylene

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BIOGRAPHIES

Karl is the current Product Manager for Process Analytics at PAC in Houston, Texas. He's worked in the refining industry for 15 years, previously in the field of process chemical treatment. Karl has held roles in research and product management for companies like General Electric and SUEZ where his area of expertise was oil-and-water separations, and predictive chemical analytics. Karl holds a Master's degree in chemistry from Sam Houston State University, and has authored publications for renowned organizations such as National Association for Corrosion Engineers (NACE), Instituto Argentino del Petróleo y del Gas (IAPG), and the American Chemical Society (ACS). Karl also holds three US patents.

Setting the Standard for Automation™

Smart Manufacturing, Testing and Certification of Valves for Carbon Emission Reduction in Hydrocarbon Plants

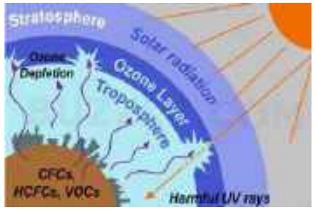
Bobby Poulose
VP- Mktg, Advance Valves

What is Fugitive Emission

- In simple terms, **Fugitive Emissions (FE) refers to involuntary release of harmful substances (vapors or gases) into the environment that adversely affects the nature and neighborhood.**

- This can be due to an unanticipated leak from pressurized equipment such as Valves & Pumps in an industrial site typically a Refinery.

Impact of Fugitive Emission on Environment



- Ozone layer depletion
- Rise of Sea Level
- Climate Change / Global Warming
- Rise in the number of diseases due to pollution

Major Source of Emissions

- Refineries, Chemical & Petrochemical plants, Terminal & Storage Plants are considered as major source of Emissions. Emissions from Refineries and Chemical Plants can be broadly classified as volatile organic compounds (VOCs) and hazardous air pollutants (HAPs). These gases enter our atmosphere, contributing to the formation of ozone, smog, and other organic aerosols.

- Emissions are regulated by a number of environmental laws related to air, land, water. Increasingly stringent government regulations, aggressive code enforcement, and **ESG initiatives** have put a strong focus on eliminating these types of unintended releases.

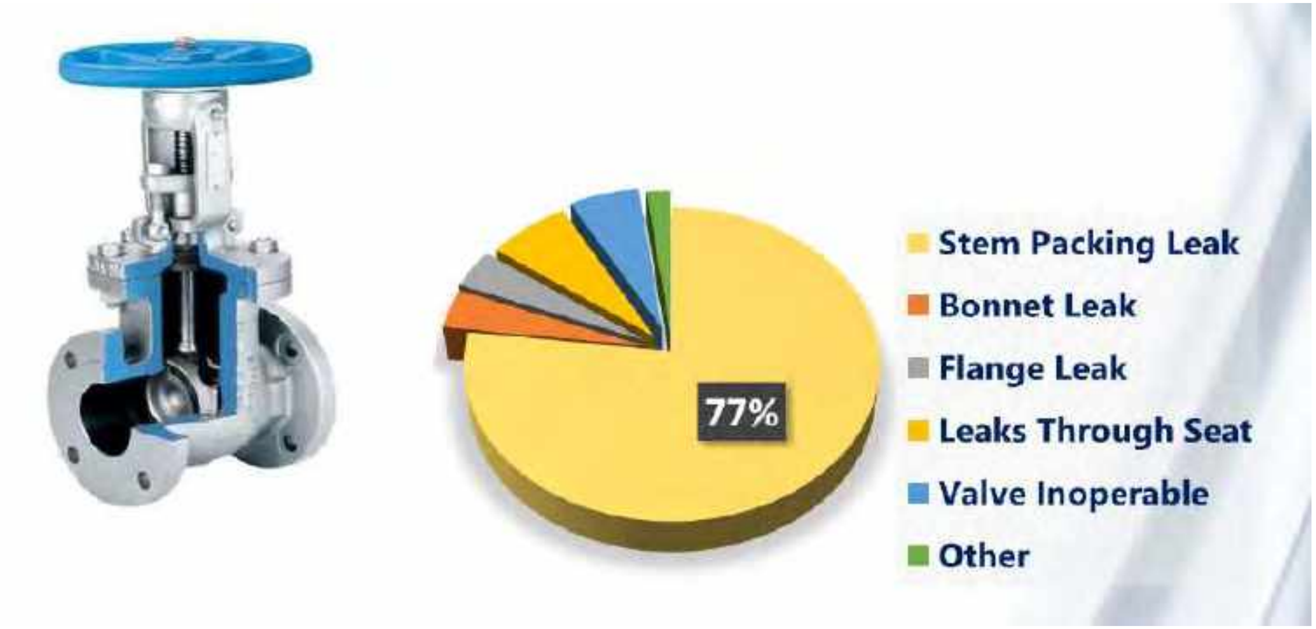
- Globally, drivers for compliance are laws. For instance, the U.S. Clean Air Act Amendments by the Environmental Protection Agency (EPA) has dropped the allowable leakage rate limits and are enforcing it with multi-million $ fines.

Valves - Primary Contributor to Emissions

Approx 10,000 to 15000 valves per refinery

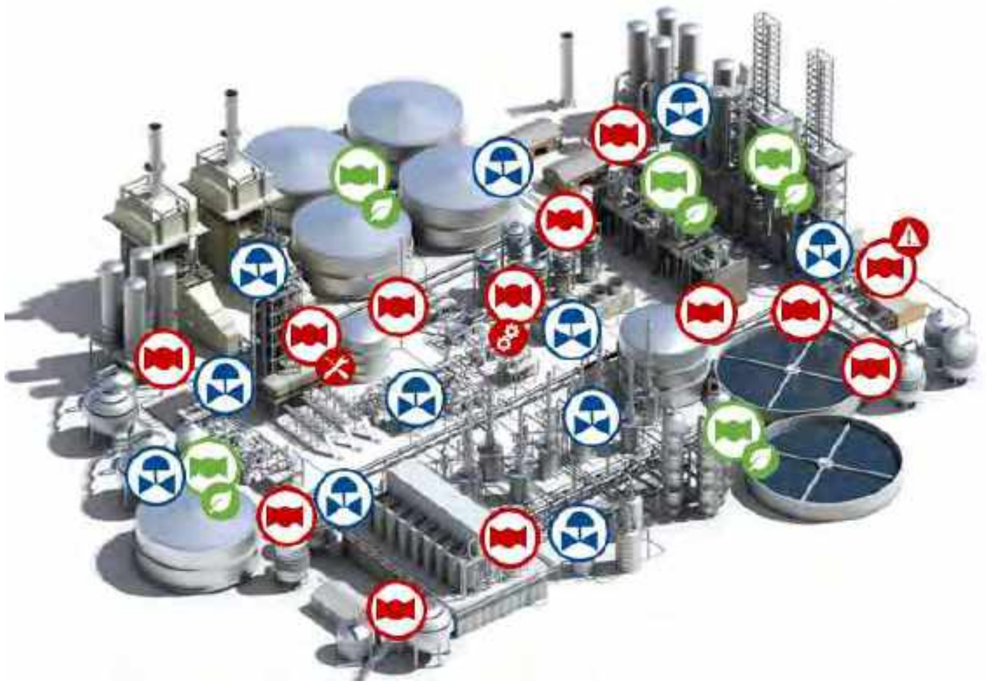
Source: Fugitive Emission Journal

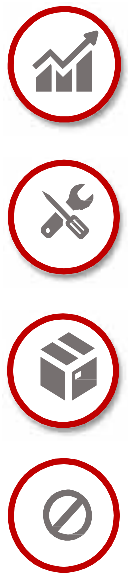
Valve Emission



Source: Fugitive Emission Journal

Main Reasons of Valve Fugitive Emissions





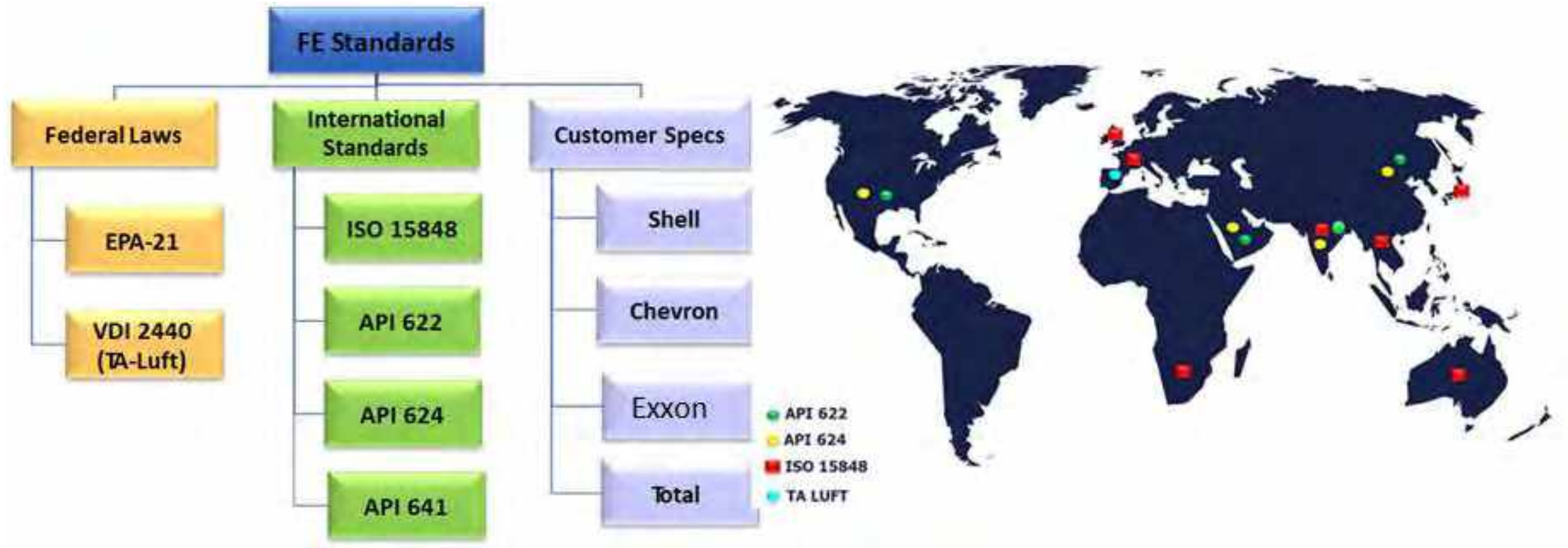
Hundreds of devices on your plant

Aging assets going through many cycles

No commoditized **product ownership**

Incorrect technology choice & **sizing** of the valves

Fugitive Emissions (FE) standards in the Industry



Comparison among Fugitive Emissions Standards

PARAMETERS	**ISO 15848-1** Second Edition 2015 +A1 2017	**ISO 15848-2** Second Edition 2015	**API 622** Third Edition 2018	**API 624** First Edition 2023	**API 641** First Edition 2016	**Shell Mesc 77/300** 2022	**Shell Mesc 77/312** 2022
Method	Vacuum / Sniffing	Sniffing	Sniffing	Sniffing	Sniffing	Sniffing	Sniffing
Medium	Helium / Methane	Helium	Methane	Methane	Methane	Helium	Helium
Pressure	Rated pressure	6 bar	41.4 bar max	41.4 bar max	41.4 bar max	Rated Pressure	Rated Pressure
Units	Atm.cc/sec / PPM	ppm	ppm	ppm	ppm	Atm.cc/sec	Atm.cc/sec
Leakage	Class A/B/C	Class A-50/ B-100/C-200	<100	<100	<100	Class AHS/B	Class A /B
Mechanical	205 to 2500	5	1510	310	610	200	5
Thermal	2 to 4	0	5	3	3	2	0
Max temp	User defined	Ambient	260	260	260	User defined	Ambient
Max SSA	1 to 3	0	0	0	0	1	0

Leakage Correlation for a 4” Class 300 Valve

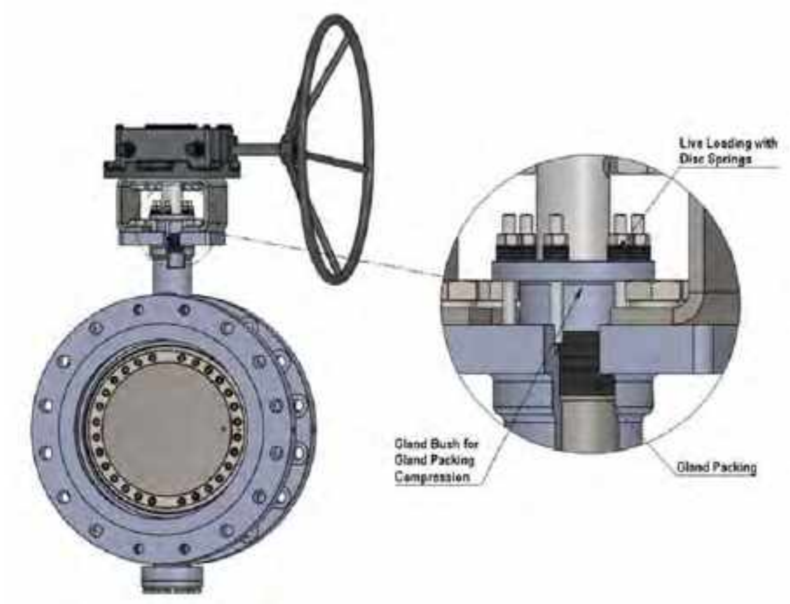
Leakage Class (1” Stem dia)	Correlation	Remarks
ISO 15848 Class A / Shell MESC SPEC 77/300 – Class A (4.4 x 10-6 atm.cc/sec)		*~ Leak volume that will fill a Tennis ball in a year*
ISO 15848 Class B / Shell MESC SPEC 77/300 – Class B (4.4 x 10^{-5} atm.cc/sec)		*~ Leak volume that will fill a Soccer ball in 4 years or 10 tennis balls in a year*
ISO 15848 Class C (4.4 x 10^{-3} atm.cc/sec)		*~ Leak volume that will fill 25 Soccer balls in a year or 1000 tennis balls in a year*

Approach for Fugitive Emission Compliance

DESIGN	MANUFACTURING	TESTING	QUALIFICATION
Designing of Valves for Low Leakage	Stem surface finish of 0.4-0.8 Ra	Development of Vacuum chambers for test	Qualification with a Third-party agency
Calculation of Clearances, Tolerances, Cylindricity	Stem straightness and Cylindricity within limits	Gas Testing up to Class 2500 (426 bar)	Qualifying the entire range of Valves
Surface roughness for Stem and Stuffing box	Controlling key design parameters in Large size valves	Use of Helium Mass spectrometers	Qualifying other Valve types

Fugitive Emission – Certifying Agencies

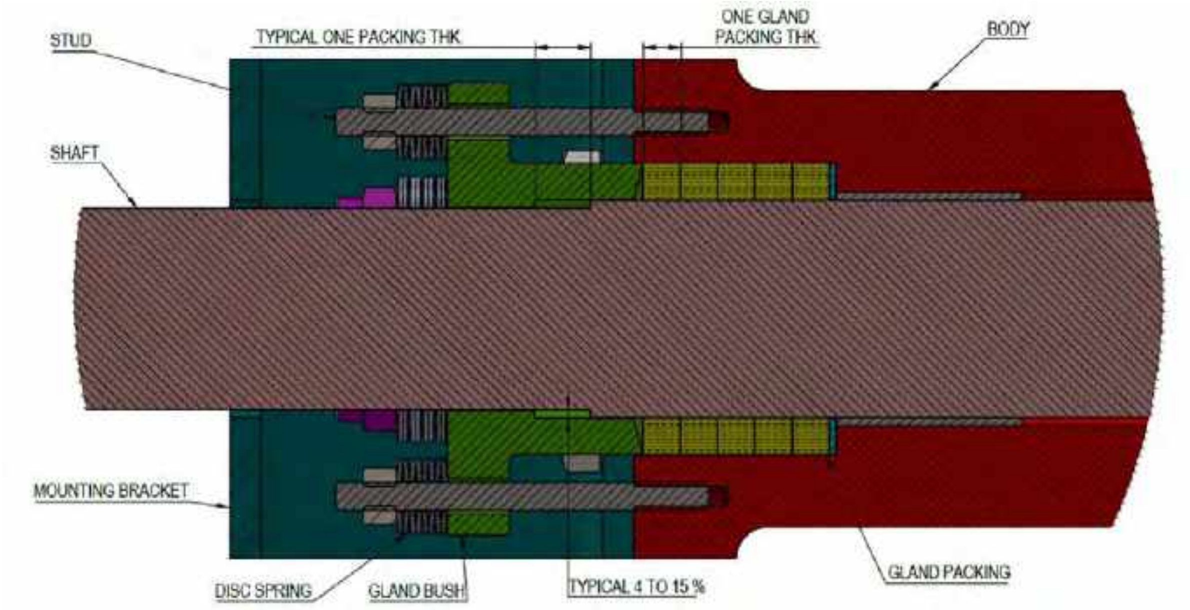
Modern Sealing Technologies



Modern Packings

Special premium expanded pure graphite (carbon content 99.5 to 99.9%) fiber yarn braided packing, each yarn of which is reinforced with Multiple Inconel wire, thoroughly incorporated with INORGANIC PASSIVE CORROSION INHIBITOR and special lubricating agents. This Passive Corrosion Inhibitor safeguards parent equipment from Galvanic Corrosion and reduction of LOSS ON IGNITION. Each yarn is jacketed with Inconel wire mesh. The reinforcement and jacketing with Inconel wire mesh in each yarn enables the packing to withstand extreme mechanical stress and cyclic loads.

ISO 15848-1 Class A Valves



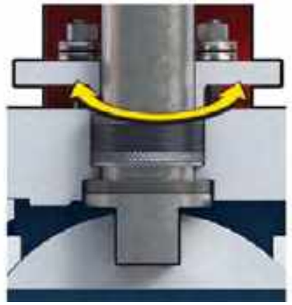
Transition in Valve Type - helps in reducing Emissions

Linear / Multi- Turn Valves (Gate / Globe etc)

- Vertical Stem travel
- Stem moves parallel to the leak path
- Hence chance of higher emissions in the long run
- Less demanding standards- API 624 calls for 310 mechanical cycles

Quarter Turn Valves (Ball / Butterfly Valve)

- 90-degree Stem travel
- Stem rotates perpendicular to the leak path
- Packing wear minimized
- Hence lesser chance for emissions in the long run
- Stringent standards - API 641 calls for 610 mechanical cycles.
  ISO 15848-1 CO3 Endurance Class specifies 2500 mechanical cycles.



CASE Study: Switching Valves in Molecular Sieves

A process application with multiple fugitive emission risk factors are the switching valves used in molecular sieve service.

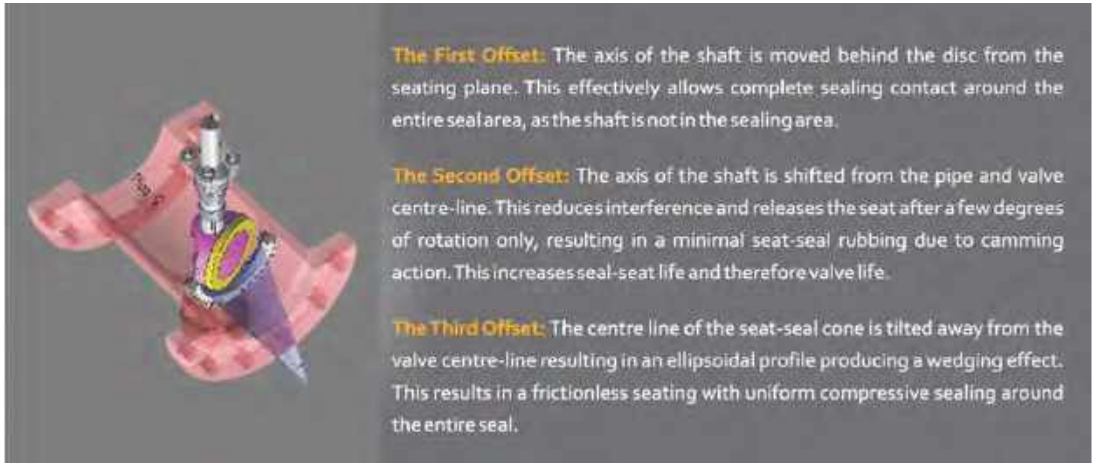
The process requires tight sealing between the adsorption and regeneration streams, runs years between turnarounds, and cycles two to three times a day.

These service demands are difficult to meet, made more difficult by the constant thermal cycling and the presence of abrasive adsorbents in the process. Despite these conditions, the valves must continuously meet very strict fugitive emission requirements.

Rotary valves (Triple offset butterfly valves) are cost effective solutions **with reduced emissions** for these applications in comparison to Linear valves like Rising stem ball valves.

Zero seat leak valves - for Emission Reduction

High performance Triple Offset Butterfly Valves are metal to metal seated valves suitable for Bi-directional flow control, Zero leakage, Low fugitive emissions at temperatures ranging from -196 to 550 deg C



Zero Seat Leak	Reduced Energy Consumption	Carbon Emission Reduction
With zero seat leak, less hydrocarbons or other harmful substances escape to atmosphere through the flare	Valve leakage significantly increases energy consumption of pumps , compressors and other allied equipment's.	Reduction in Energy Consumption results in indirect Carbon Emission Reduction.

Triple Offset Butterfly Valves-Zero leak valves with reduced Emissions

- Excellent flow and control characteristics
- Tight sealing capabilities
- Dependability across critical and severe applications
- Generally Bi-directional – zero leak valves
- Extended life cycle because of lesser wear and tear
- Compact and lesser weight
- Can replace Multi turn / Linear valves like Gate valves and Rising Stem Ball Valves in the industry and can reduce emissions

Minimize Emissions in Your Operations

Thank you!

HUMAN FACTOR ENGINEERING
CONTROL CENTRE DESIGN

Latest Innovations and trends in Control Room Display Technology

ABSTRACT

In last one decade the use of Video Wall in Process Control Room has become an emerging trend. The Control Room Video Wall technology is upgrading very fast from Digital Light Processing (DLP Lamp Based) rear projection to Fine Pitch Direct View LED video wall technology. In this paper, change in technology from DLP to LCD and from LCD to Fine Pitch Direct view LED Video Wall is being discussed.

KEYWORDS

Fine Pitch, Pixel Pitch, Video Wall, DLP, LED wall, LCD, Nits

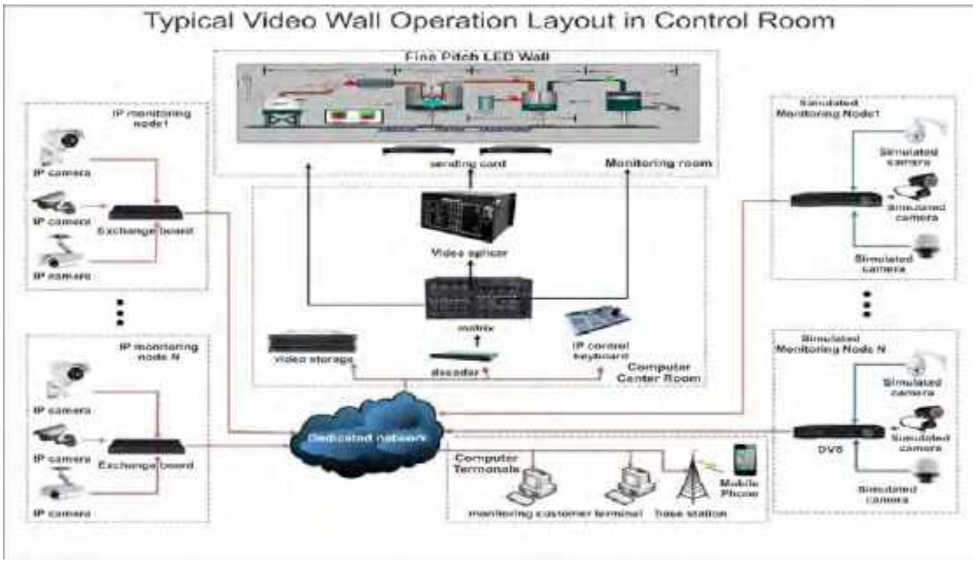


Figure No-1

VIDEO WALL INTRODUCTION

(Ref. Figure No. 1)

For the sake of this definition, Video Wall, Data Wall, and Media Wall will all be referred to as a Video Wall. The scope of this paper is to introduce the concept and technology for fine pitch direct view LED video walls.

A video wall is a large electronic display of an image or images being displayed in a presentable format. Typically multiple display devices (Cubes/panels/cabinets) are tiled together as close as possible in a matrix to create a single logical screen (The Video Wall).

With special Video Processor devices, an image is scaled across the logical screen; multiple images are spread over the logical screen or a combination of both in the case of picture in picture. This is all done without the limitations of individual display devices.

The individual display devices can be anything from the smallest (4" diagonal) direct view LCD screens to very large (120" diagonal) front or rear projection devices depending on the ultimate size of video wall being created by the matrix. LED walls use individual discrete light emitting diodes of 0.5mm or less to create each pixel.

The adoption of fine pitch LED Wall has risen rapidly in the last five years as prices drop. The industry is seeing high number of installations in process industries and infrastructure control rooms.

We will likely see fine pitch or direct view LED video wall displays taking the place of Rear Projection Cubes and Narrow Bezel LCD panels in control room in near future.

WHY YOU NEED A VIDEO WALL FOR YOUR CONTROL ROOM

Staff and operators in control rooms, command centers, Network operation centers,(NOCs) and Disaster Management Centre are in charge of overseeing infrastructure, security, operations, communications, safety and more. They rely heavily on accurate and timely (mostly real time) data from video walls that helps them to make informed & strategic decisions about their operations.

Similarly critical set of data inputs is needed for control room operations in every sector like Space, Defense, Nuclear & Thermal power, oil & gas, Transportation, Banking, City Surveillance & security.

In industry, control room operation teams make decisions, monitor vital information and support core business functionalities which need data to visualize and work on it together to make collaborative decisions.

DLP REAR PROJECTION DISPLAY TECHNOLOGY (CUBE)

(Ref. Figure No. 2)

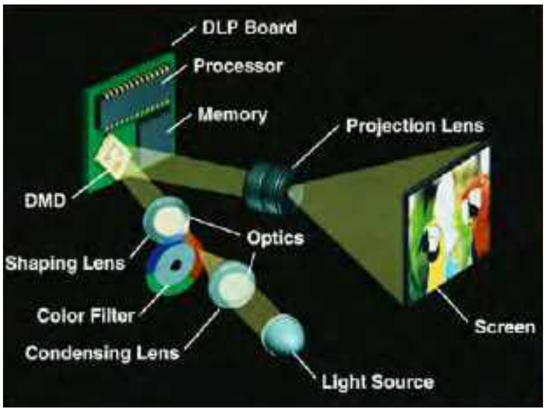


Figure No: 2

DLP Digital Light Processing

Meaning processing of light with the help of DMD chip, in which multiple optical components are used to complete this phenomena components like UHP lamp (Ultra high pressure lamp), condensing lens, color wheel shaping lenses, DMD processor Board, projection lenses, all these component are enclosed in a housing called DLP projector.

Further this projector is enclosed in an huge enclosure called cube (*Figure No 2)* which consists of signal input box, unique front polish Milo mirror, and a frame made of multilayer acrylic sheets of different diagonal sizes named screen (50”,67” 70” 80”).

The phenomena works in the similar way what shown in Figure No2 and further networking of cubes is done in matrix to achieve video wall.

LIMITATIONS OF DLP REAR PROJECTION VIDEO WALL

Long back, Rear Projection Digital Light Processing (DLP Lamp Based Rear Projection cubes) was used. It was an expensive solution for the End user because of high cost of inventory involved in maintaining consumables like UHP Lamp and color wheel *(Figure No: 2).* In 2010 LED Lit Rear Projection engine got introduced where LED cluster was used as an illumination source but having upper hand over Lamp based, as there were no consumables like UHP lamp and color wheel. But both above options had one big limitation of occupying huge space i.e. minimum 800mm depth. Also achieving color uniformity across the video wall was a great challenge.

ADVANTAGE OF DLP REAR PROJECTION VIDEO WALL
(Ref Figure No:3)

Advantages of Rear Projection cube was, that they were modular and available in fixed diagonal screen sizes of 50”, 67”, 70” & 80” having respective resolution of XGA, SXGA+ & Full HD. They were ideal for displaying static data or SCADA images for 24x7 applications. The wall created by matrix (Rows x Columns) were having image to image gap between adjacent cubes of < 0.5mm. leading to fine grid lines across the video wall.

Figure No: 3

LED LIT LCD WITH NARROW BEZEL *(Ref Figure No: 4)*

Over the time technology came with one more economical video wall solution, specifically for video or Dynamic content displays available in fixed resolution of FHD 1920 x 1080 of size 46” and 55” and could be arranged in desired matrix of rows and columns. It was ideally meant for retail showroom, CCTV surveillance, and advertisement purpose.

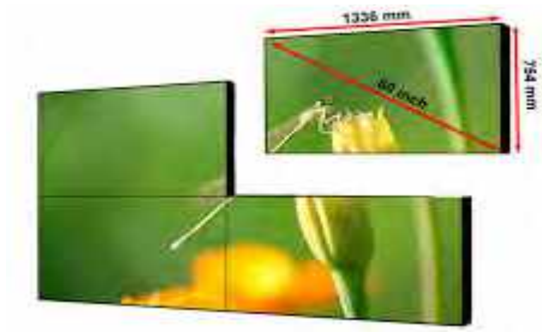


Figure No: 4

LIMITATIONS OF LED LIT LCD

It has got bezel which leads to 0.8mm to 3.5mm bezel to bezel gap, which was very high as compare to DLP cubes. LED lit LCD panels have limitation of burning effect or ghost image which occurs due to continuous display of long time still image or static image which gets fixed at one location over the display area. Product was not ideally meant for Control room Video wall & for 24 x 7 applications. These were the only reasons it could not get popular especially in control room segment, where SCADA images required to be displayed for long duration. Also LED lit LCD panels have got shorter life span of 5-6 years if they are used in for 24x7 applications.

ADVANTAGES OF LED LIT LCD

It has got very low price impact as compared to DLP Cubes, also occupies less space and can be mounted on brick wall & floor mount. Touch screen feature can be enabled optionally to make it interactive and at the top it has got very high brightness, color gamut and high resolution.

ABOUT LED (Light Emitting Diode)

(Ref Figure No: 5)

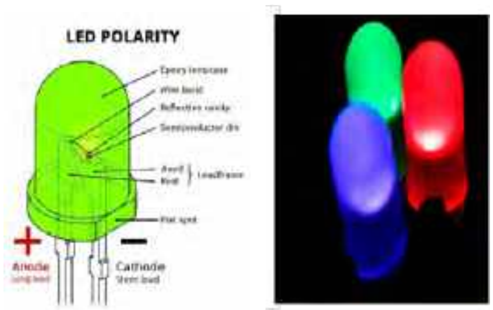


Figure No: 5

Light emitting diodes were first developed in the 1950's by using semiconductor technology; LED's proved an efficient way to convert electrical energy into photons over the years.

COMPARISION BETWEEN LED & LCD TECHNOLOGIES

(Ref Figure No: 6)

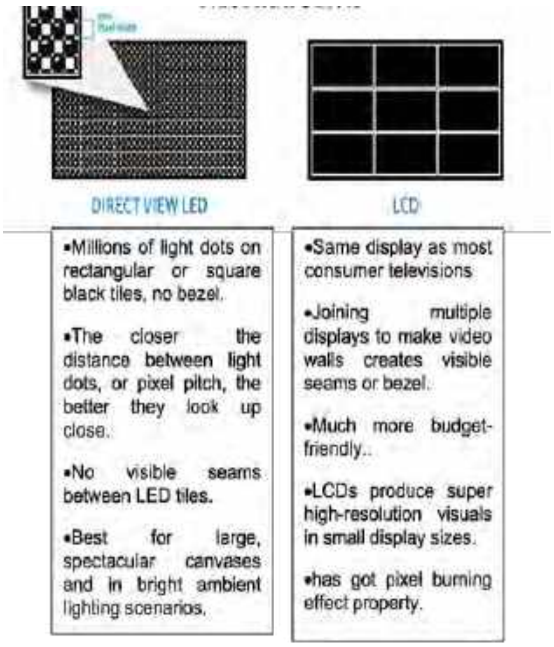
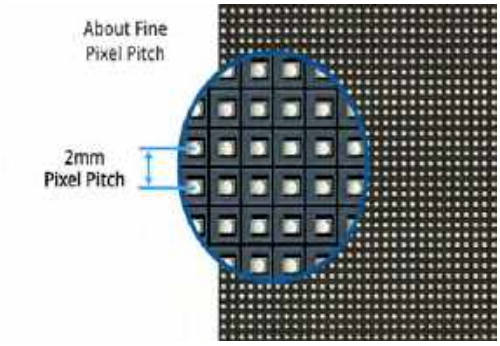


Figure No.: 6

Basics of LED Display PIXEL PITCH

(Ref Figure No: 7)



The distance from the center of one LED to the center of adjacent LED is called pixel pitch and the distance is measured in millimeters, so its denoted as P4, P2.5, P1.5,P0.9

The colored light you see on an LED display comes from three Light Emitting Diode (LED) chips Red Green Blue

The chips used for displays are the same or similar to one used in things like commercial and automotive lighting. The older, generally lower resolution version of LED displays tends to use Through-Hole Diodes (THDs) that look like tiny light tubes with wire legs on the end mainly used in outdoor LED video wall.

The majority of the LED displays now being used for indoor video walls – called fine pixel pitch displays or Narrow Pixel Pitch (NPP) <2.5mm use Surface Mounted Diodes (SMDs).

The LED chips – Red, Green and Blue – are packaged by high-speed robotics machines into a housing that has a reflector cup to amplify the light. The packages are wired to pass electricity, and then encapsulated with an epoxy, creating a lens for the lights.

LED SURFACE MOUNT DEVICE

(Ref Figure No:8)

This configuration is called a Surface Mount Device – or SMD. The three diodes are affixed to a mount, gold conductive leads are attached and a plastic frame and epoxy seal are added. Refer to Fig 7 This example of an SMD pixel is 1.6mm square, so would be ideal for a display with a 2 mm pixel pitch.

Figure No: 7

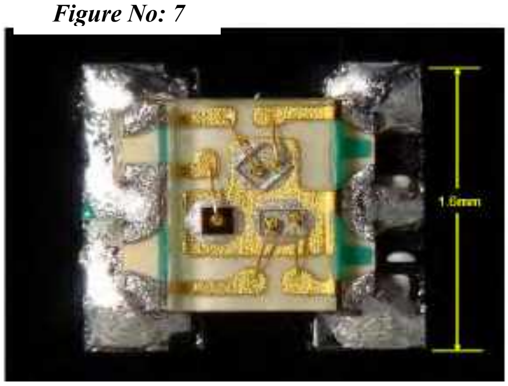


Figure No: 8

Each LED is Driven independently by specialize chips called LED drivers. There are numerous companies – the majority in Japan, Taiwan and China– that are fully or partially in the business of developing and manufacturing LED chips. Different LED makers have different reputations for the light and color output, lifespan and overall quality of their LED chips, also known as die. The LED chips are grown as silicon wafers and then diced into individual, tiny light sources. The major cost of LED displays owes to the precise manufacturing process of growing layers of semiconductor crystals from a chemical vapor.

LED MODULE AND CABINETS

(Ref Figure No: 9)

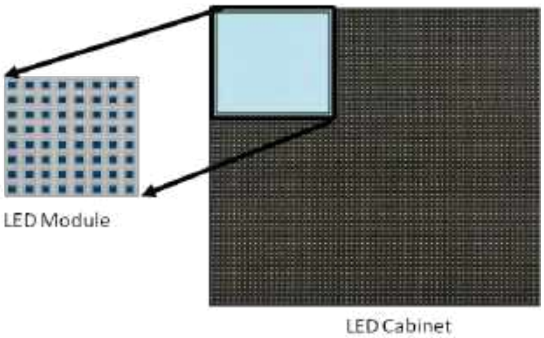


Figure No: 9

A module is a square or rectangle piece of cluster of LEDs in an array of SMD LED packages on the front and electronics on the back. These modules are attached to composite or metal frame cabinets that hold all the circuitry needed to drive and manage the LED lights, and communicate with the controlling hardware and software.

The modules and cabinets are tied together and connected by cabling or docking systems. The cabinet engineering varies for things like servicing, some modules requiring rear access for servicing, while others offer front access or both. Some of the cabinets are connected by wiring harnesses while others effectively dock and interconnect with their neighboring modules.

MEDIA SIGNAL *(Ref Figure No: 10)*

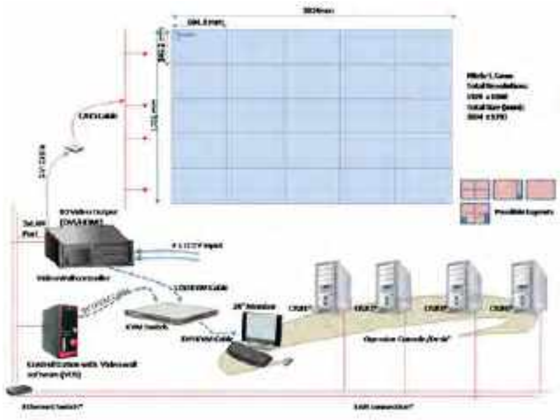


Figure No: 10

LED display gets its signal from different sources like HMI/OWS and CCTV cameras,

Setup Box etc. *(Figure No: 1&9)* that goes through dedicated display control device. This manages media signal and process the desired resolution to map it over the screen with the help of pixels.

HOW & WHERE LED VIDEO WALL ARE BEING USED ?

Fine pitch LED is under evolution from a premium, niche product to a more mainstreamed display – that transition is driven by the steady lowering of costs and broader awareness and acceptance of this technology.

Utilities and other large companies, particularly in India, have installed fine pitch LED walls, replacing LCD or older DLP rear projection display cube technology

NTPC, PGCIL ONGC, ISRO Etc.

Process Plant Control Rooms – Many of the heavy industries in the segment like Power (generation /transmission/distribution), Oil & Gas (pipeline/refinery/ petro chemical plants) metallurgical plants use video wall for displaying and controlling process parameters at Main Control Desk from their respective server over LAN inside control room.

Defense - By making usages of today's Latest information Technologies and satellite connectivity, live positions and war related information's can be viewed over the video wall at safe centralized location and necessary command can be decided immediately to implement effective strategy of war. Example many surgical strikes have been commanded and monitored in live *(By USA Osama bin laden and by India Uri attack).*

Broadcast Studios – Using tiled modules as seamless backdrops on live sets for news channels and talk formats in the background of host or presenter to achieve real time scenario.

Smart City Surveillance Control Room- Used as complete monitoring of Disaster Management, City Traffic, Communication, Water, Electricity and Sewerage via SCADA system and system at centralized location.

Corporate – Used as architectural Façade, displaying of business data, information & Images in the lobbies of MNC companies, Hotels, Hospitals, Universities, Museums, Banking and also in board room for video conferencing.

LOCATION AND ENVIRONMENTAL CONDITIONS

LED is an optimal solution for locations like retailers, airports and office tower lobbies that gets a lot of natural sunlight through big street-side windows and atrium glass. LED does a very good job of fighting against brightness and glare.

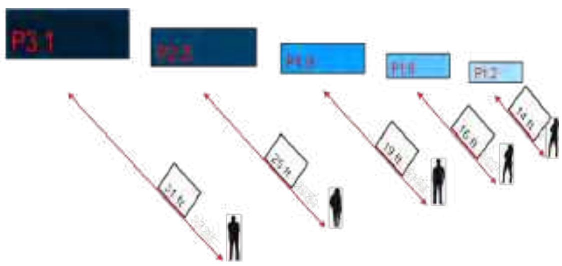
LED video walls does not do well in those kinds of locations, where the displays are within easy reach of the general public – because the tiny LED mounted surface light packages on video walls may get easily tempered and damaged, notably at the perimeters of the display clusters. Many OEM provides masking and transparent epoxy solution for the protection of LEDs.

Generally, the SMD packages on modules can be field-repaired, but maintenance costs can add up if the walls are steadily exposed to accidental or purposeful abuse. Unlike LCD displays that have hard glass faces, LEDs don't have protective glass. They need to be glass-free to allow the LED lights to vent off the heat they generate.

There are some appliances and sensors which enable video walls to develop touch LEDs screen features. Screen having a permeable film layer and sensor over the LED screen that enable touch, provide protection and allow it to dissipate heat. Still, it's best to position fine pitch SMD-based walls so that they are not within reach of curious hands or be at steady risk of bumping by equipment like carts.

DISTANCE MATTERS *(Ref. Figure 11)*

Establishing some distance from viewers is necessary for best view of content over the video wall.

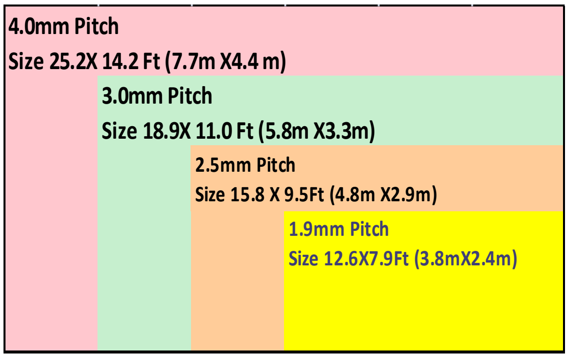


(Figure No:11)

The above figure elaborate best viewing distance for the viewer to view particular pixel pitch video wall. The premium 0.9mm pixel pitch displays now being sold are still best viewed from several feet back – probably 5 feet at a minimum and optimally 8-10 feet back.

Seen from any closer, people will start to visually pick up the individual light pixels of the display, degrading the viewing experience.

The conventional rule of thumb is that 1mm of pitch equates to about 10 feet of viewing distance. That means a 1.5mm pitch display is best seen from 15 feet away or more, 2mm at 20 feet, and so on.

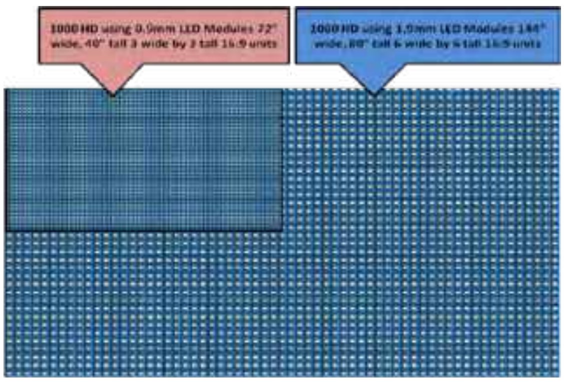


(Figure No:11.1)

DETERMINING RESOLUTION

(Ref. Figure No:12)

LED display makers, and particularly system integrators and Audio Visual designers approach project consultant & End User with specific questions about the intended resolution for providing LED video wall display solution. They don't lead with pixel pitch. That's because the desired resolution has a direct impact on the physical footprint of the video wall.



(Figure No:12)

Typical Video Wall Resolution						
Pitch size	3 x 3	4 x 4	5 x 5	6 x 6	8 x 8	12 x 12
0.7	2304 × 1296	3072 × 1728	3840 × 2160	4608 × 2592	6144 × 3456	9216 × 5184
0.9	1920 × 1080	2560 × 1440	3200 × 1800	3840 × 2160	5120 × 2880	7680 × 4320
1.2	1440 × 810	1920 × 1080	2400 × 1350	2880 × 1620	3840 × 2160	5760 × 3240
1.5	1152 × 648	1536 × 864	1920 × 1080	2304 × 1296	3072 × 1728	4608 × 2592
1.8	960 × 540	1280 × 720	1600 × 900	1920 × 1080	2560 × 1440	3840 × 2160
2.5	720 × 405	960 × 540	1200 × 675	1440 × 810	1920 × 1080	2880 × 1620
Typical Video Wall Size (WxH)						
Feet *(ft)*	5.9×3.3	7.9×4.4	9.8×5.5	11.8×6.6	15.7×8.9	23.6×13.3
Meters *(m)*	1.8×1.0	2.4×1.3	3×1.6	3.6×2.0	4.8×2.7	7.2×4.0
Area *(sqm)*	1.82	3.24	5.06	7.29	12.96	29.16
Diagonal	81"	108"	136"	163"	217"	325in

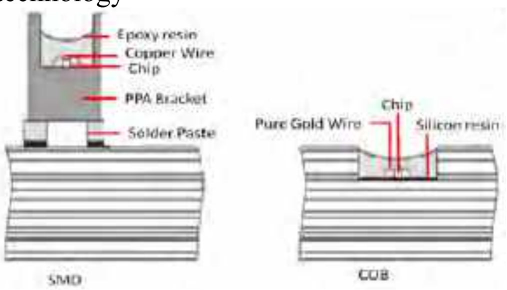
(Figure No:12.1)

With LED, finer the pixels pitch of display modules, the more pixels are packed into each of those modules.

This graphic shows how the footprint of a 1080P HD LED display can be dramatically different based on the pitch and pixel count.

UPCOMING LED CULTURE TECHNOLOGY *(Ref. Figure No:13)*

There are two other upcoming LED display technologies that we will experience soon in the market as the future for fine pitch LED technology



(Figure No:13)

CHIP ON BOARD (COB)

New technology already being used by at least a pair of companies involves a newer process called Chip On board (COB).

COB batches of the bare LED chips are directly bonded to the printed circuit board substrates, removing the interim step of that SMD packaging and mounting. The main selling propositions for this technology are to achieve cost reductions and how COB makes modules more durable, and produces better visuals. COB also results in much higher densities of LED being packed into the same physical area.

MICRO LED

Micro LED is seen in some circles as the future for fine pitch display, but it may be a very distant future because of the relative infancy of the technology, severe manufacturing limitations and, as a result, extraordinary costs.

Micro LEDs emit light just like SMD LED technology. Instead of the LEDs being packaged for surface mounting, the LED chips are not packaged but directly picked and placed on large back plates or substrate

DETERMINANT FACTOR FOR LED VIDEO WALL BUDGET

There are several factors which play very important role for selection of video wall and are co- related with each other like deciding value, performance and return on investment.

All these parameters are explained precisely below for better understanding.

RESOLUTION

The display resolution of a device is the number of distinct pixels in each dimension that can be displayed.

Some Standard display resolutions sets are SVGA/SXGA/HD/FHD/4K/8K which may vary from device to device. In LED video wall resolution is set using fixed picture-element (pixel) arrays.

BRIGHTNESS

We use candelas per meter square, written as cd/m² or nits (1 nit = 1 cd/m²). So a brightness of 500 cd/m², or 500 nits, is equivalent. LED video wall may provide brightness up to 2000 Nits, but we have to adjust the brightness as per control room lighting lux level and ambience. Whatever technology you choose, brightness is a crucial consideration for a control room display wall. You want a display that's crisp, clean and bright, nearly 0.9 to 4 times brighter than the ambient light reaching operators' workstation, as measured in nits. Display walls in that brightness range will allow operators to work comfortably and efficiently, helping them effectively collaborate in the most critical situations. As the condition varies, real time evaluations of lux level studies need to be carried out at every installation by the system integrator.

ASPECT RATIO

A 16:9 ratio is a specific aspect ratio, because it is today's standard ratio for film and display. The 16:9 ratio replaced the old 4:3 ratio (available in CRT Monitors) in the early 2,000s.

The terms such as 1080p HD, 720p HD, and 4K UHD, these terms all refer to 16:9 ratios. For example, a 1080p HD display refers to a screen resolution of 1920x1080p. There for many OEM provide LED cabinets with similar aspect ratio of 16:9 to achieve complete video wall of same aspect ratio to make solution cost effective.

SHAPE

LCD displays are somewhat constrained by their shape, though there are limited numbers of square and wide-stretched displays on the market. LED modules, on the other hand, are like tiles. The tiles tend to be smaller than LCD displays, and can more readily fit into spaces with odd and varied dimensions.

With smaller cabinet size one can achieve curved or concave shape to video wall.

Depending upon the base material now LED display can be enjoyed in flexible formats also transparent displays and sphere shape can also be created with different solution available in market.

DISTANCE

As already elaborated in figure 10, in the fine pitch LED, if viewers will be 25 feet away, a relatively low cost 2.5mm pixel pitch LED wall will deliver big, rich and seamless visuals, with no visible difference in clarity as compared to a LCD wall.

PHYSICAL CONSTRAINTS

A big DLP video wall fills an area like a building lobby or feature wall in a store, if the technical design is not carefully considered and there will be issues in installation and servicing. Whereas in the LED wall this drawback is not there as they are serviceable from front as well and have thin profile.

LED VIDEO WALLS THE REAL PRICE OF DIRECT VIEW LED

Direct View LED is an increasingly popular video wall solution because of its ability to deliver seamless images in a wide variety of dimensions with impressive viewing angles. When deciding on which LED video wall solution to purchase, price can be a factor, and can vary depending on the type of content source image quality, back end-solution and options available. Options on the lower end of the cost scale can seem attractive, but what is the true price for the lower price? Additionally, what are you willing to sacrifice for a lower cost? What options are worth more?

TECHNICAL CONSIDERATIONS

The most visible - and fragile - part of your LED video wall are the LED pixels, comprising of up to 65% of the Total market cost of an LED video wall. Large or clear LED pixels come with lower price points, but can Sacrifice Quality and performance. These low priced LEDs often result in poor black base color, contrast level & high reflection, which lead to poor Viewing angles and color levels

Uses of high-quality LEDs in the field of LED displays, developing new ways to deliver seamless images and ways to make video walls look great and elegant from any angle. Content which needs to be delivered on video wall should also match the resolution and aspect ratio to achieve better output from video wall.

CONCLUSION

Large LED “Video Wall” displays have been around for many years. The concept is quite simple: LED are built into modules, and these modules are stacked into a frame called cabinets to create the desired wall size without any seam in between which provides viewer a single logical screen appearance. These video wall displays have been used for control room application and outdoor Information display applications

LED walls with required brightness range as per ambience will allow operators to work comfortably and efficiently, helping them in critical situations.

LED video wall solution are now available at competitive costs depending on back end solution and has got low cost of ownership because of zero consumable requirement post installations, hence it’s return of investment is very high as compare to DLP as it has got longer life time of 16-20 Years (Indoor application).

In LED walls, competition, buyer's awareness and competitive prices will see more and more LED video wall in near future.

"***As Display is the Future***
The world is going to be lit by LEDs"

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ACRONYMS

DLP: **D**igital **L**ight **P**rocessing.
DMD: **D**igital Micro **M**irror **D**evice.
COB: **C**hip on **B**oard.
CCTV: **C**losed **C**ircuit **T**elevision
LCD: **L**iquid **C**rystal **D**isplay.
LED: **L**ight **E**mitting **D**iode.
NOC: **N**etwork **O**peration **C**entre.
SMD: **S**urface **M**ount **D**iodes.
HMI: **H**uman **M**achine **I**nterface
OWS: **O**perating **W**ork **S**tation
HD: **H**igh **D**efinition (1920×1080 pixels)
THD: **T**hrough **H**ole **D**iodes.
UHP: **U**ltra-**H**igh-**P**ressure lamp.
SVGA: **S**uper **V**ideo **G**raphic **A**daptor. (1024X768 pixels)
SXGA: **S**uper **E**xtended **G**raphics **A**rray. (1280X1024 pixels)
SCADA: **S**upervisory **C**ontrol and **D**ata **A**cquisition.
4K: **4K** display is around 4 times the Resolution of 1080p. (1920 × 1080, Full HD).

BIOGRAPHIES

- Kuldeep Singh Rathore has got total working experience of 25 years in IT and Display solution.

- He is having an Exclusive experience in the Control room Video wall display solution for more than 10 years with Pyrotech electronics Pvt. Ltd Udaipur.
  Had provided Control room Video wall solution into power generation, transmission distribution. Oil and gas, City surveillance, and smart city projects control room.

FTIR – For Process and Stack Measurement

FTIR is a modern spectroscopic method which operates in the IR (molecular vibrations and rotations energy).
The "FT" in FTIR gives the wavelength selection method (Fourier Transformation).
FTIR is versatile: can choose many spectral collection parameters unlike any other IR method.
FTIR is fast: ~ 1 spectrum per second typical.
Identification is achieved by a combination of sample chemistry knowledge and in identifying spectral features.

Thermo Fisher Scientific - MAX-iR Overview

MAX-iR FTIR Gas Analyzer

The MAX-iR is a Fourier-Transform Infrared (FTIR) based gas analyzer with a wide dynamic range, capable of measuring impurities in bulk gas from ppt to percent levels. The MAX-iR analyzer measures gases by absorption spectroscopy and for a given temperature and pressure, a compound's absorption is constant, meaning the FTIR calibration curve is transferable from instrument-to-instrument and should be valid for the life of the instrument.

The MAX-iR was specifically designed to perform with minimal operator requirements and is composed of three main sections: (1) an FTIR ***spectrometer*** using moisture impervious ZnSe optics and a solid-state (VCSEL) laser for timing, (2) a temperature-regulated 0.456L multiple pass ***gas cell*** with 9.86m path length which can operate under pressures from 1 to 5 atmospheres, and (3) an infrared ***detector***.
The MAX-iR does not require liquid nitrogen to cool any of the three detector versions available (DTGS, MCT, or InAs) depending upon the application.

DETECTORS

DTGS detector provides linear response over a very wide range of FT-IR throughput, which is beneficial in qualitative and quantitative FT-IR sampling. Thermal detectors are generally less effective for kinetic measurements because their signal is inversely proportional to data collection speed.
Low-throughput experiments (less than 20% of IR beam reaching the IR detector) benefit from the use of a quantum detector, such as the Mercuric cadmium telluride (MCT) detector.
High MCT sensitivity will produce a large signal in a low-flux measurement. Furthermore, the MCT detector demonstrates a relatively constant signal versus data-collection speed and is, therefore, ideal for kinetic measurements.

The average detectability D* of the MCT detector is approximately 237 times more sensitive.

MAX Analytics Software Package

- Single Software to control all MAX modules
- User Customizable Alarms
- Built in MODBUS capabilities
- Methods transferrable between other MAX Systems or other MAX Product Configurations
- Peak Deconvolution Algorithms to improve quantitation accuracy
- Manual Validation Tool for removal of broad interferants(water)

- Peak Find Tool for Identification of Unknown Components
- Customizable Work Flows with automation capabilities
- Over 250 compounds in MAX Quant library
- Software also includes EPA/NIST Library

MODELS – VARIANTS

CONTINOUS EMISSION MONITORING SYSTEM - EMS 10

The Emission Monitoring System (EMS-10) is a fully automated continuous emissions monitoring system. It uses the FTIR-based MAX-iR Gas Analyzer which is capable of accurately analyzing many gaseous compounds ranging in concentration from percent (%) to parts-per-billion (ppb) without any liquid nitrogen needed to cool the detector. The indoor EMS-10 has two models: the EMS-10S (configured with a single input channel) and the EMS-10X (accommodates up to four input sample channels).
The integrated design of the EMS-10 multiplexer controls the flow and switching of all gas streams. The system can handle hot and wet non-condensing exhaust gas samples up to 150°C, making it ideal for use in a wide variety of stationary source continuous emission monitoring applications.
The entire system is controlled by the user-friendly MAX Acquisition software. The Factory Interface Module (FIM) provides input and output connections from the EMS-10 to a facility's distributed control system (DCS) providing remote data access, control, and reporting.
The touch screen monitor and keyboard allow the operator to easily view all sample data, system diagnostics, and alarms either at the unit or via remote access. The concentration data and alarms can be exported to a DCS via Modbus TCP/IP.

AUTOMATED SAMPLE CONSOLE - ACS 10

The Automated Sample Console (AMS-10) is integrated with MAX-IR analyser for various applications like:

Environmental applications: Source testing, continuous emission monitoring and testing, and ambient air monitoring and testing
Vehicle and Engine applications: Engine dynamometer testing, vehicle interior air quality (VIAQ) analysis and sealed housing evaporative determination (SHED) testing
Industrial applications: Process stream monitoring and testing

The ACS 10 can be configured for 20 streams.

Applications and Models:

- Industrial Process Monitoring – Solutions (MAX IR Analyser)
  - Acid fluoride process monitoring
  - Acetylene impurity in bulk ethylene
  - Propyne impurity in bulk propylene
  - HCl impurity in vinyl chloride
  - Monitoring of HCN sparge process

- Environmental– Solutions (EMS-10)
  - Ethylene oxide continuous emissions monitoring
  - Source testing (US EPA Method 320)
  - Other CEM Applications (NOx, NH3)
  - Formaldehyde emissions testing (YYYY)
  - Semiconductor abatement efficiency testing
  - Fluorinated GHG monitoring

- Industrial Gas / Air Separation – Solution (MAX-Bev)
  - ASU bulk gas certification (N2, Ar, He)
  - Beverage grade CO2 Certification
  - Hydrogen purity
  - Monitoring CO2in HyCO
  - Semiconductor specialty gas analysis

- Industrial Hygiene and Safety – Solution (MAX-iAQ)
  - Monitoring fluorinated VOCs, CTFE, in air
  - Workplace HAPs monitoring
  - Monitoring ethylene oxide in air (Sterilization)
  - Monitoring phosgene in air (BASF)

About Author

General Manager- Environment & Process Monitoring
Thermo Fisher Scientific India Pvt.Ltd.
Email:
bhavya.srivastava@thermofisher.com
Phone: 91-9990550450

Mr.Bhavya Srivastava holds a B.Tech degree in Electronics & Communication and further did Masters in Marketing & Operations Management. He is a result-oriented professional with over18 years of experience in the Process Automation & Instrumentation Engineering and presently associated with Thermo Fisher Scientific India Pvt. Ltd. Mumbai, India (Wholly Owned subsidiary of Thermo Fisher Scientific Inc. USA).

His key focus area of work is around analytical solutions which enables the customer and stake holders making the world healthier, greener and safer. He has been continuously working in the field of On-line Monitoring in the applications such as Stack Emission- CEMS, Ambient Air Monitoring, Process Monitoring, Water Quality Monitoring across Business segments such as Research and Development Labs, Academia, Regulatory Bodies and Heavy Industries mainly; Power, Cement, Steel, Mining, Oil & Gas, Petro- Chemicals etc.

He is highly Skilled into Product Management, People Management and Strategic Project driven activities across various industry verticals and working around to create a Gold Standard of Environment & Process Monitoring in India, so that right Measurement Techniques could be deployed.

ISA Delhi Petroleum & Power Automation Meet.

26th & 27th April 2024.

Eros Hotel New Delhi.

Title

Coal Mill Operations – challenges arriving from Biomass addition & AMETEK Land's Solution

by

AMETEK Land

Nitin Gupta National Sales Manager

Coal is prone to spontaneous combustion, which occurs by self-heating, due to exothermic internal reactions rapidly accelerating to high temperatures resulting in auto ignition. The heating of coal particles further enhanced due to friction in pulverised in a Coal Mill.

As per Government of India's new guidelines, Power Plants will have to consider using upto 10% of Biomass, which only worsens the situation in the pulverizing mill, as Biomass will largely and rapidly contribute to the high temperatures.

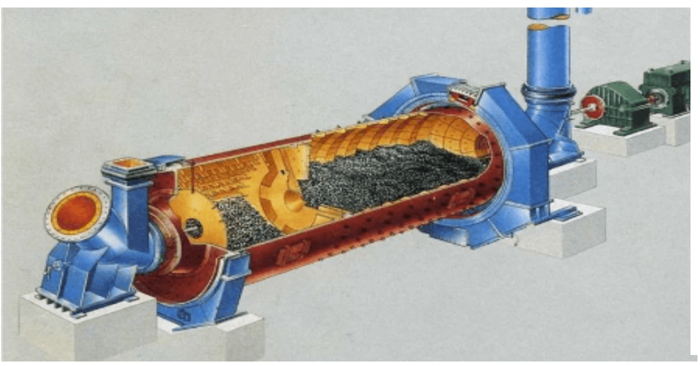
Similar condition exists at the Storage level, such as Coal / Biomass Silos.

We will discuss AMETEK Land's unique and proven solution the Millwatch / Silowatch. This is a great tool to provide advance warning of onset of combustion through the early detection of Carbon Monoxide (CO) at Mill Outlet and inside Silos. This advance warning allows Plant Operators to quickly administer preventive actions such as reduction of load, inerting the enclosure, steam dousing, etc.

Briefly discuss the importance of CO measurement as against the temperature measurements in the Pulvarizing mill with a case study of 500MW coal fired Thermal Power plant.

Summery:

- Introduction to source of heating of coal/Biomass.
- Indicators of early stages of combustion.
- Detection methodologies.
- Customer experience.
- Product features.
- Indian references.



Technological Marvels: A Deep Dive into Petrochemical Advancements through Instrumentation, Control, Automation, and IT Integration

Subir Mandal, Tanu Arora
HPCL-Mittal Energy Limited, Phullokhari, Talwandi Saboo, Bathinda

ABSTRACT

HMEL petrochemical facility is embarking on a technological innovation journey, incorporating cutting-edge technology to improve operations, boosting efficiency, sustainability, and competitiveness in a rapidly changing industrial world. In this study, several technologies that contribute to petrochemical advancement are discussed.

KEYWORDS

Universal Input/Output Modules, Cloud based engineering, Server virtualization, State of the Art control room with optimized operators, Implementation of Cable sheller, Giant Screens, Integration with IT-OT.

INTRODUCTION

Technology drives innovation and success in the field of petrochemical breakthroughs. Historical petrochemical operations challenged with flexibility and hardware usage caused by separated I/O modules, physical server inefficiencies, and conventional engineering techniques. This resulted in prolonged project timeframes, higher costs, and ongoing maintenance of obsolete equipment, which worsened operational inefficiencies and safety issues. We look at how instrumentation, control, automation, and IT integration have altered the petrochemical industry. These technological advancements are not only changing the way petrochemical plants operate, but also raising the bar for sustainability, safety, and efficiency. As a result, detailed engineering must be done before any plant implementation takes place.

EXPLORING TECHNOLOGY

a) Universal Input /Output Modules: Universal Process IO and Universal Safety IO Modules in Industrial Instrumentation. Equipped with Universal Channel Technology for seamless integration with various control systems.

1. Offers a range of functionalities including Analog Output (AO), Analog Input (AI), Digital Input (DI), and Digital Output (DO) on any channel.
2. Provides proven redundancy features for uninterrupted operation despite component failure.
3. Can withstand extreme temperatures ranging from -40°C to +70°C, suitable for hazardous environments.
4. Equipped with HART 7 protocol support for advanced communication capabilities.
5. Hold SIL3 TUV certification for additional safety assurance.
6. Offer transformative solutions for petrochemical and industrial operations.

Universal IO revolutionizes operations by minimizing hardware, infrastructure, and engineering demands. Its adaptability mitigates delays caused by late-stage changes, ensuring smoother project execution. With fewer spare parts required, costs are lowered, and risks are reduced. Furthermore, the implementation of standardized builds and compressed schedules enhances efficiency, ultimately improving overall project schedules. This comprehensive approach not only streamlines processes but also bolsters resilience, making Universal IO a cornerstone of modern industrial operations.

The study was conducted for the HMEL Petrochemical plant, comparing standard IO to Universal IO, with the following details.

DCS PLC F&G IO Count			
Plant / Group / Location	DCS	PLC	F&G
DFCU-Group-IA & IB / SRR # 85	5908	2956	520
DFCU AU & CT-4-Group-IC / SRR # 86	3525	1678	270
LLDPE / HDPE SWING-Group-II / SRR # 82	9490	7612	530
BUTENE-1-Group-III / MCR	1200	835	150
HDPE Group-IV / SRR # 84	3021	1182	510
PP Group-V / SRR # 81	3372	1449	680
U&O AND FLARE Group-VI / CR # 88, CR # 90, CR#92.	2571	2318	657
Total IO count	29087	18030	3317
Grand Total	**50434**		

With respect to the above IO count, following are the details of benefits of Universal IO over Conventional IO.

Conventional IO	**Universal IO**	**Benefits**
DCS (total 3150 modules) Separate AI, AO, DI, DO	DCS 2126 UIO modules	Reduction of 1024 IO modules - Compress project schedule by 14 weeks – Reduced commissioning time for HART devices – Lesser HVAC & power requirement
SIS (total 1890 modules)	SIS 1065 UIO modules	Reduction of 825 IO Modules
153 System Cabinets for ICS 784 Marshalling Cabinets	128 System cabinets for ICS 560 Marshalling Cabinets	Reduction of cabinets - Lesser HVAC, power, and space requirements - Standard UIO cabinets reduce manufacturing time by 2 months
Maintenance Spare 250	Maintenance Spare 180	Reduction in Spare Inventory by 30%

Difference between Conventional IO and Universal IO

b) Virtualisation of Servers & PC: In modern industrial settings, the virtualization of servers and PCs represents a cutting-edge technological concept that offers a multitude of benefits for efficiency, cost-effectiveness, and sustainability. Traditionally, each PC or operator's console within a control room setup is accompanied by separate physical servers to manage data processing and storage, along with third-party devices such as Human-Machine Interface (HMI) systems. However, through the adoption of server and PC virtualization, this conventional setup can be revolutionized. Virtualization involves creating virtual instances of servers and PCs, allowing multiple virtual machines to run on a single physical server. This consolidation of computing resources leads to a reduction in the number of physical servers required, thereby minimizing space requirements and lowering energy consumption**. With fewer physical servers in operation, there is a notable decrease in heat generation and HVAC (Heating, Ventilation, and Air Conditioning) demand, resulting in reduced operational costs and a smaller carbon footprint for the facility.** Furthermore, virtualization **offers effective obsolescence management of hardware**. Instead of being tied to specific hardware configurations, **virtual machines can be easily migrated between physical servers, ensuring seamless scalability and adaptability to changing technological requirements.** This flexibility not only extends the lifespan of existing hardware but also facilitates upgrades and updates without disruption to operations. **From a practical standpoint, the elimination of separate servers for each PC or console simplifies maintenance and management tasks.** System administrators can centrally monitor and manage virtualized servers and PCs, reducing administrative overhead and enhancing overall system reliability. Additionally, the centralization of resources enables more efficient allocation of computing resources, optimizing performance and responsiveness for critical control and monitoring applications.

In HMEL Petrochemical Plant. Entire DCS and ESD operation is implemented with Virtualisation of servers.

c) Cloud based detailed engineering until FAT: Cloud-based detailed engineering is a new approach to project execution, particularly in system integration and factory acceptance testing (FAT). This method eliminates the need for extensive physical movement and travel, allowing for more efficient and cost-effective project execution. This has been implemented in HMEL and has optimized 60% of FAT execution cost. Cloud-based platforms, such as virtual design environments or collaborative project management systems, enable remote detailed engineering activities, eliminating the need for extensive travel and physical presence at vendor facilities. The benefits of cloud-based detailed engineering extend beyond cost and time savings. It provides real-time access to critical information, fostering transparency and accountability throughout the project lifecycle. Cloud-based collaboration tools enable efficient communication and decision-

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making, facilitating rapid iteration and refinement of design concepts. Additionally, cloud-based detailed engineering enhances agility and scalability, allowing project teams to adapt to evolving requirements and unforeseen challenges. With remote access to engineering data, stakeholders can respond promptly to changes, minimizing disruptions and ensuring project continuity.

In HMEL Petrochemical Project, we have done physical FAT only for 3 Units(U&O, HDPE and PP. Rest of the unit DFCU & associated units ,SWING(LLDPE & HDPE) have been conducted through cloud. FAT punch points for all the plants have been resolved and witnessed through cloud.

d) Giant Screen along with connectivity to DCS & CCTV: The integration of giant screens in control room environments, coupled with seamless connectivity to Distributed Control Systems (DCS) and Closed-Circuit Television (CCTV) systems, is a significant advancement in industrial visualization and monitoring capabilities. This technology optimizes giant screens by leveraging advanced display technologies, such as LED or laser-based projection systems, which offer extended operational lifespans, superior brightness, and enhanced colour reproduction, ensuring visual clarity and reliability. Optimizing giant screens requires careful consideration of maintenance requirements and longevity. Selecting durable display solutions streamlines maintenance tasks and minimizes replacement frequency. Remote monitoring and diagnostic capabilities enhance maintenance ease, allowing proactive identification and resolution of potential issues. Connectivity to DCS and CCTV systems offers enhanced functionality and versatility in control room operations. Operators gain real-time process data and control parameters, enabling informed decisions and rapid response to operational changes. CCTV systems provide comprehensive surveillance capabilities, enhancing situational awareness and security monitoring within the control room environment.

e) Implementation of Cable sheller concept in Instrumentation: Instrumentation is crucial for industrial facilities' smooth operation, but managing cables in rack rooms and control rooms can be a challenge. Traditional methods often result in a mess of cables, known as 'spaghetti,' which can impede maintenance efforts, hinder troubleshooting, and compromise safety. The cable sheller concept addresses this by implementing a systematic approach to organize and manage instrumentation cables within rack rooms and control rooms. This aims to streamline cable routing, optimize space utilization, and enhance accessibility for maintenance and inspection tasks. The implementation of the cable sheller begins with a thorough analysis of the instrumentation layout and cable requirements, assessing the types and quantities of cables needed and identifying potential pathways and access points for cable routing. The design phase involves developing a layout plan that integrates cable

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trays, conduits, and other cable management accessories, ensuring efficient routing and minimizing cable congestion and tangling. The implementation phase involves installing cable trays, conduits, and other cable management infrastructure according to the approved layout plan, with special attention paid to cable labelling, bundling, and segregation for easy identification and maintenance. The benefits of implementing cable sheller include eliminating clutter, improving aesthetic appeal, enhancing operational efficiency, promoting safety, and simplifying cable tracing and identification, facilitating faster fault isolation and resolution.

In HMEL Petrochemical plant A small fire that occurred in one of our plants during the commissioning of the petrochemical facility severely damaged cables, affecting a few lengths of multicore cable. Replacing the multicore cables in a matter of days demonstrated the benefits of utilizing a suitable cable sheller; the traditional method would have taken much longer.

f) State of the Art control room with optimized operators: The control room configuration in a petrochemical plant is critical for ensuring efficient operations and safety compliance. As India's premier facility, it adheres to the stringent standards (**ISO 11064 'Ergonomic design of control centres'**) established by for maximum functionality and reliability. ISO 11064, " offers a comprehensive framework for optimizing the design of control rooms to enhance operator performance, comfort, and safety. It covers various crucial aspects, including **control room layout and design, environmental conditions, display and control interfaces, workspace design, and emergency preparedness.** Console includes a sit/stand functionality with integral large screen displays. With this option, each individual operator has their own integrated large screen display located at their console, which primarily displays the daily analysis, continuity of flare ignition, and business parameters, such as How much naptha is cracked solely for management observation etc .

Console with Integral Large Screen Displays

The standard emphasizes creating an ergonomic layout that minimizes unnecessary movement and maximizes visibility of critical information. It provides guidance on environmental factors such as lighting, noise control, temperature regulation, and air quality management to reduce operator fatigue and enhance concentration. Additionally, ISO 11064 addresses the design of displays and control interfaces to support intuitive operation and effective decision-making. It offers recommendations for workstation design to minimize the risk of musculoskeletal disorders and other ergonomic-related

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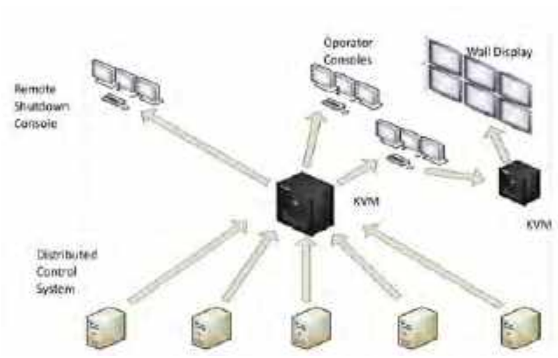
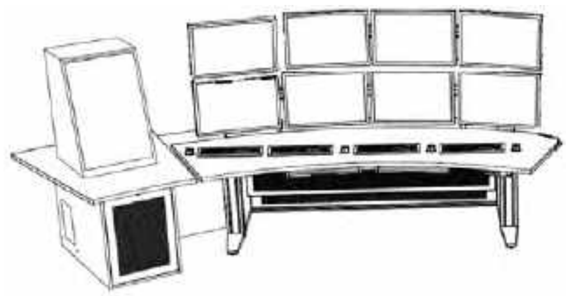
injuries. Furthermore, the standard includes provisions for emergency procedures, evacuation plans, and safety features to ensure rapid response to emergencies and protect the well-being of operators.

Along with, In Petrochemical, we engaged an external consultant to recommend the architecture of a control room equipped with advanced KVM (Keyboard, Video, Mouse) technology, which is widely regarded as the best in India's industrial sector. This technology enables the seamless control and monitoring of multiple processes and systems from a single location. With the use of the KVM network of extensions and switches, operators have dynamic control of the information displayed on the large wall panel screens. Likewise, at individual operating consoles, operators have the ability for functional selection of displays on multiple screens.



Use of KVM

The KVM setup is tailored to the specific needs of each unit, such as the DFCU (Dual Feed Cracker Unit, Butene Unit, Utilities Unit, OMS and PPU), HDPE, and Swing. Each unit's KVM installation is intended to allow for precise control and monitoring of its respective processes, resulting in optimal performance and safety compliance. To ensure continuous operation, redundancy measures are built into the KVM configurations. In the petrochemical plant's control room setup, various architecture options, categorized as Type A and Type B, are available to cater to specific needs. For units like the DFCU, OFFSITE, and UTILITIES, a configuration involving PCs for dual stack or triple stack operations is utilized, complemented by operator peripherals and CCTV inputs. Conversely, units such as PPU, SWING, and HDPE feature an expanded setup, incorporating PCs for extruder control in addition to the components. This tailored approach ensures that each unit's requirements are met efficiently within the control room infrastructure.



Original Console Configuration

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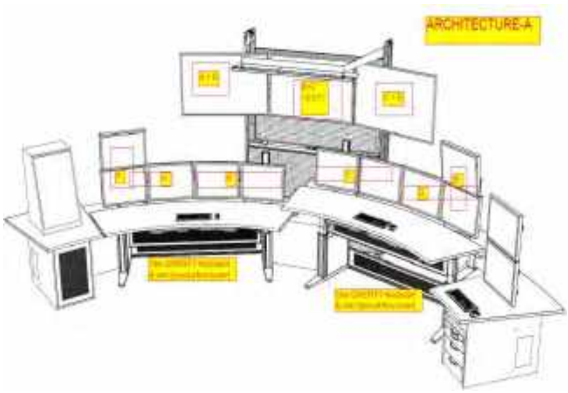

Architecture of KVM

g) Integration with IT-OT : In terms of petrochemical plant safety, the confluence of IT/OT cybersecurity as per standard **ISA/IEC 62443**, the separate platform, and APMS represents a paradigm shift toward a safety-focused operational framework. This combination not only improves the plant's defenses against cyber threats, but it also alters safety management through data-driven insights and real-time optimization. Cyber threats such as malware assaults, deceptive emails, unpatched software, weak configurations, and so on have serious consequences, including property loss (data loss), economic damage to the company, and safety system failure. Hence, there is a need for IT-OT security.

The separate platform serves as a guardian, methodically monitoring and analyzing operational data streams throughout the whole facility. This comprehensive picture enables the early detection of safety abnormalities and deviations, providing plant operators the foresight they need to manage potential problems.

The comprehensive system, developed in conjunction with APMS, a leader in real-time process optimization, allows operators to optimize operations not just for efficiency but also for safety.

Strengthening Safety in Petrochemical -Plants :

OISD-163(SAFETY OF CONTROL ROOM FOR HYDROCARBON INDUSTRY): These standard lays minimum requirement(s) for prevention of damage to Control and Communication system located within the control room from accidental fire / blasts and also ensuring protection to personnel working inside the control room.

IEC 61511 also known as the Functional Safety Standard for the Process Industry, provide guidelines for the design, implementation, and maintenance of safety instrumented systems (SIS) to mitigate risks in hazardous processes. These standard addresses aspects such as safety integrity levels (SIL), hazard and risk assessment, safety instrumented functions (SIF), and verification and validation of safety systems.

The Cyber Security of DCS **ISA/IEC 62443** as there are numerous chances of malware attacks on DCS that effect our functioning of DCS. These are the main safety standards that has been implemented in HMEL for control room.

CONCLUSION

Prior strategic planning during basic engineering is done for above seven technologies discussed. By harnessing the power of these key technologies and integrating them into strategic planning processes, the industry can pave the way for sustainable growth. This has resulted into faster project implementation, long term benefits of state of art technologies, optimization of space in control room, rack rooms , warehouses, optimizing in inventory and furthermore taking care of extended life of instrumentation system.

ACRONYMS

IT-OT	Information Technology and Operational Technology
HMI	Human-Machine Interface
FAT	Factory Acceptance Test
LED	Light Emitting Diode
SIS	Safety Instrumentation System
SIL	Safety Integrity Level
KVM	Keyboard, Video, Mouse
DCS	Distributed Control System
SIF	Safety Instrumented Functions
APMS	Advanced Process Management System

BIOGRAPHIES

Subir Mandal, a graduate of the Indian Institute of Technology, Kharagpur, has 28 years of experience in the refinery and petrochemical industries. He began his career with HPCL Refinery Mumbai, then moved on to Haldia Petrochemicals, Reliance, SABIC, and ADNOC, and presently works at HPCL Mittal Energy Limited. Throughout his long tenure at HMEL, HALDIA Petrochemicals, Reliance, and Borouge - ADNOC, he played an important role in the finalization and detailing of instrumentation , as well as IT-OT systems and its procurement. Throughout his extensive career, he has successfully completed the engineering and commissioning of Naptha Crackers, HDPE, LLDPE, LDPE, and plants. He presently leads the Petrochemical Engineering Instrumentation team at HMEL.

Ms Tanu Arora was born in Ambala, India in the year 2001. She graduated in Electronics and Communications Engineering from UIET, Chandigarh. She joined the HPCL Mittal Energy Ltd in June 2023 as a GET (Graduate Engineer Trainee). She currently works in the Petrochemical Engineering Department's Instrumentation team.

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Telephone: +91 22 6661 7272 | Email: marketing.india@blackbox.com

Abstract – Technical Paper on "Workers' safety in Oil & Gas Industry using RTLS"

With stricter safety requirements being administered regularly, the importance of complying with industrial safety in hazardous areas is becoming progressively more essential.

Real Time Location Systems, or RTLS, uses wearable tags for people and asset tags for movable assets, and monitors the location and status information of personnel and assets in real time, providing the latest business intelligence to inform everything from crisis decision-making to mustering during emergencies.

RTLS offers solutions by providing real-time visibility of personnel locations, identifying safety issues, enabling emergency assistance, facilitating mustering, and offering insights into workflow optimization

Few features of RTLS that enhances occupational safety in hazardous environments

Quickly locate missing or injured personnel and send help to their location - RTLS allows you to locate workers across your entire site, with information about each individual's location. In addition to this, you also gain the ability to quickly identify specialist workers, such as first responders, to send assistance to others instantaneously.

Enhanced situational awareness - The deployment of an RTLS allows visual access to all sections of your site from one simple interface – giving you complete control and understanding of all business activities in relation to both personnel and asset tracking.

Real time information for optimised decision making - In the event of an emergency, rapid response can increase the chances of a best-case outcome. Optimised decision making is a key advantage of deploying an RTLS, with the ability to receive immediate alerts.

Dynamic counts of mustered and non-mustered workers in an emergency - Individual personnel tags are used to monitor when an employee, contractor or visitor enters the proximity of a muster point, thus providing real-time access information on what employees are in a 'safe zone' and understand the number of people required to safely muster.

Alerts for unauthorized access to hazardous zones – Any unauthorized access to restricted or hazardous areas by any employee contractual or otherwise is immediately captured by RTLS wearable and alerts goes off both locally and centrally.

Virtual gate solution - Control entry/exit for high-risk environments and receive real-time lists with location information whether under/above ground, in each gallery, tunnel or zone.

Lone Worker safety – RTLS is the key technology to get real-time situational awareness about the maintenance, patrolling staff or other employees working remotely and alone.

RTLS works using a range of technologies like, GNSS for outdoor location, BLE (Bluetooth Low Energy), Wi-Fi or UWB (Ultrawide Band) for indoor location, LoRaWAN or other LPWAN technologies for communication. The RTLS integrates with access control functionalities seamlessly.

RTLS is a proactive approach to workplace safety, specially in challenging environments like Oil & Gas industries, be it the refineries, mines, distribution areas or pipelines.

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DESIGNING COLLABORATIVE AUTOMATION FOR NEW GREEN THERMAL GENERATING UNITS OF DEVELOPED INDIA

Abstract

This is draft of a paper on collaborative automation based on Digital twins, IIoT & Cyberphysical systems and Generative AI for developing Green thermal generating units of Developed India.

SUMIT KUMAR HALDAR

sumitkumarhaldar@ntpc.co.in

Contents

<u>Designing Collaborative Automation for New Green Thermal Generating Units of Developed India</u>

<u>Authors</u>: Sumit Kumar Haldar, NTPC Ltd.

1.0 Preamble

The transition towards sustainable energy sources is a global imperative, and India, as a rapidly developing nation, must play a crucial role in this endeavour. This paper explores the concept of **collaborative automation** for **new green thermal generating units** in India. It delves into the integration of advanced technologies, policy initiatives, and operational strategies to enhance the efficiency, reliability, and environmental impact of thermal power plants. Collaborative automation for energy transformation refers to the integration of advanced automation technologies and collaborative approaches to drive efficiency, sustainability, and innovation within the energy sector. It involves leveraging automation tools, such as artificial intelligence, robotics, and IoT (Internet of Things), along with collaborative strategies among various stakeholders, including governments, industries, research institutions, and communities, to accelerate the transition towards cleaner and more sustainable energy systems. This paper aims to search for new avenues in NTPC and the nation's other upcoming new supercritical and ultra-supercritical thermal generating units for induction of cutting edge technologies for a deterministic transformation of these energy hubs into green entities and thus being a core proponent for Energy Transformation.

Thermal Power Plants are known to be the principal polluting agents in today's world. Out of the total GHG Emissions of 50 Bn tonnes in 2022, total CO_2 emissions stood at 37 Bn tonnes i.e. around 74 % and the energy sub-sector contributed to 71%. There is no other way out in the near future that thermal generating units can be so easily replaced and the ever-increasing demand for energy necessitates that, novel strategies are crafted out to convert the liabilities into opportunities. Therefore, there is an ever-increasing necessity to collaborate, co-innovate and co-create Green Thermal Power Generating units of the future which would implement technologies of the future to revolutionize. Collaborative Automation is here to play an increasingly significant role.

2.0 Introduction

Published reports indicate that Power generation alone contributes to over 41% of the global carbon dioxide emissions, largely fuelled by coal. Despite several sustainability actions set in motion, coal is expected to provide at least 22% of global power even in 2040, accounting for nearly 68% of emissions. Applying right technologies will help thermal power plants reduce up to two gigatons of CO_2 emissions. India's energy landscape is evolving, with a growing emphasis on clean and renewable sources. However, thermal power plants, particularly those fueled by coal, continue to be a significant part of the energy mix. To achieve sustainable development, collaborative automation is essential. This paper outlines the key aspects of collaborative automation for new green thermal generating units in developed India.

3.0. Decarbonization Initiatives

India's action plan for power sector decarbonization outlines ambitious targets:

- Achieving a non-fossil fuel energy capacity of 500 GW by 2030.
- Fulfilling at least 50% of energy requirements through renewables.

- Reducing CO_2 emissions by 1 billion tons by 2030.
- Paving the way for net-zero emissions by 2070.

The need to abate global warming mandates prudent usage of fossil fuels. Coal powered thermal power plants are under pressure to perform efficiently and reduce emissions. Currently, the power generation sector alone is responsible for nearly 41% of global CO_2 emissions, with coal power being the largest contributor of nitrogen oxides (NOx), Sulphur oxides (Sox), mercury (Hg) and particulate matter. Increased deployment of carbon capture, sequestration, and utilization (CCUs) technologies can improve the sustainability quotient but may be insufficient to meet the climate goals set in the Paris agreement. Coal is still expected to provide 22% of global power and account for 68% of carbon dioxide (CO_2) emissions even in 2040.

Leveraging the right technology can help thermal power companies reduce up to 2 gigatons of CO_2 emissions. Adoption of the latest digital technologies can help improve thermal plants' performance by reducing the consumption of fuel, auxiliary power, consumables, and greenhouse gas emissions. Existing thermal power plants, therefore, need to be equipped with these technologies to mitigate global warming.

4.0 Challenges with Thermal Power Plants

Thermal power plants consist of large and complex equipment for power generation such as pulverizers, boilers, steam turbines and gas turbines. Pollution control equipment like selective catalytic reduction (SCR) converters, flue gas desulphurization (FGD) units, electrostatic precipitators as well as efficiency improvement equipment like air preheaters (APH), condensers and cooling towers make up its landscape.

Even with advanced control systems in place, monitoring, optimizing performance, and periodic maintenance of these equipment becomes challenging due to:

- Complex plant dynamics
- Interconnected equipment with interacting operations
- Variability in coal quality due to diverse sources and inadequate blending
- Flexibility to accommodate transient and sharp variations in power demand
- Gradual degradation and faults of equipment over time
- Tightening and evolving emission standards and safety regulations

5.0 Collaborative Automation: A Holistic Approach

Collaborative automation involves synergizing various components to optimize power plant operations. Here are the critical elements:

5.1. Digital Twin Technology

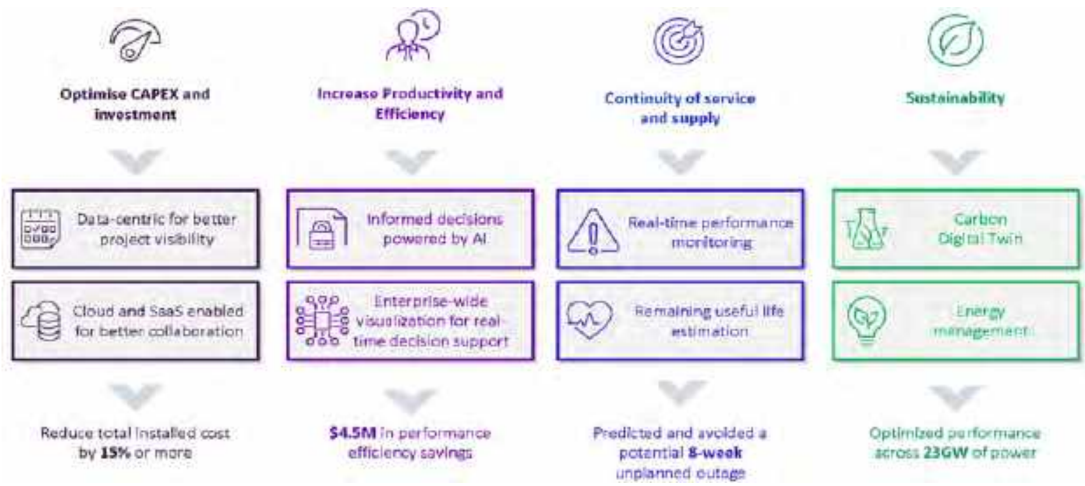
Digital Twin technology is a singular most significant intervention which has an impact on almost all business priorities and goals of a Power Generating company. Digital twins, powered by IoT, AI, and cloud technologies, create virtual replicas of physical assets. In thermal power plants, digital twins simulate equipment behaviour, monitor real-time performance, and predict maintenance needs. They serve as catalysts to improve the performance of power plants across functions. These could include monitoring of equipment and processes, optimizing operations in real time, and improving availability. Digital twin solutions can assist in better operation and maintenance of applications such as boiler, gas turbine, flue gas desulfurization system, selective catalytic reduction system, and air preheater. By leveraging historical data, operators can make informed decisions to enhance efficiency and reduce emissions.

5.2. Gaining Digital Line of Sight

There are 4 major business priorities and goals Power Generation companies face:

1. Optimize CAPEX and investment: Power companies must invest in "green" facilities, while upgrading or phasing out legacy facilities. This requires better portfolio management while improving execution and collaboration. Plant operators need better visibility and control to monitor budgets and schedules to enhance operations.
2. Increase Productivity and Efficiency: Digital workforce is imperative for ensuring business resilience and continuity. Organizations need to improve operational efficiency, agility and profitability through collaboration centres and multilevel optimization solutions.
3. Continuity of service and supply: Security continuity of supply and service is a critical component for successful power generation companies, with the ability to predict failure and mitigate service disruptions, one of the key capabilities that need to be achieved.
4. Sustainability: Power companies are under increasing pressure from regulators and share holders to reduce their carbon footprint and optimize energy use. Digital technologies play a critical role in enhancing supply chain transparency and accelerating sustainable outcomes.

Digital technologies are a key enabler to meet these goals.

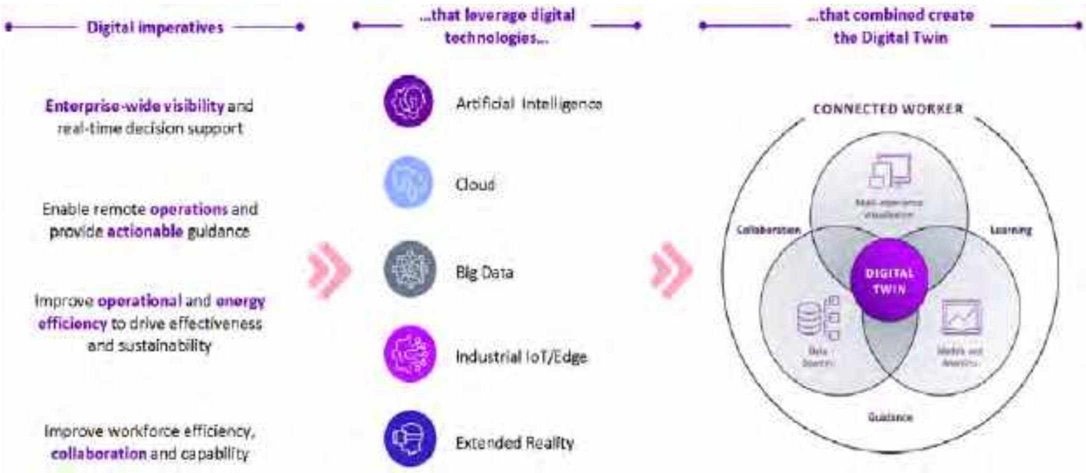


Courtesy: AVEVA

5.3 Digital Twin Applications

Digital Twin is an organized collection of physics-based methods and advanced analytics that is used to model the present state of every asset in a Digital Power Plant. The models start by providing guidance on "design limits" of a power generation unit at the commissioning stage or inferring the design limit for an existing plant/fleet by matching the equipment to thousands of other similar equipment in the database.

Included in the Digital Twin models are all necessary aspects of the physical asset or larger system including thermal, mechanical, electrical, chemical, fluid dynamic, material, lifting, economic and statistical. These models also accurately represent the plant or fleet under a large number of variations related to operation — fuel mix, ambient temperature, air quality, moisture, load, weather forecast models, and market pricing. Using these digital twin models and state-of-the-art techniques of optimization, control, and forecasting, applications can more accurately predict outcomes along different axes of availability, performance, reliability, wear and tear, flexibility, and maintainability. The models in conjunction with the sensor data give the ability to predict the plant's performance, evaluate different scenarios, understand trade-offs, and enhance efficiency.



Courtesy: AVEVA

As the plant is operated, the Digital Twin continually improves its ability to model and track the state of the plant. The Digital Twin allows plant operators to optimize the instantaneous and transient control of the plant for efficiency or performance, make informed decisions regarding performance versus part life, assign loads and line-ups through time, and perform the right maintenance tasks at the ideal time. Many organizations like GE have created the most advanced and functional Digital Twin that integrated analytic models for components of the power plant that measure asset health, wear and performance with customer defined KPIs and business objectives. The Digital Twin runs on an Industrial platform designed to ingest massive volumes of machine sensor data to manage industrial data at scale. Further, this environment is integrated with business applications designed to allow plant executives, plant managers and workers to interact with the Digital Twin in real time. These business applications are designed to increase asset performance, enhance operations and improve energy trading decisions to create additional revenue and cost reduction opportunities. The applications fall into the following categories:

5.4 Asset Performance Management (APM):

Transform data into actionable intelligence by combining robust analytics with domain expertise. Create a single source of data for all power generation or renewables assets across a fleet, utilizing predictive analytics to identify issues before they occur, reducing downtime and extending asset life while still balancing maintenance costs with operational risk.

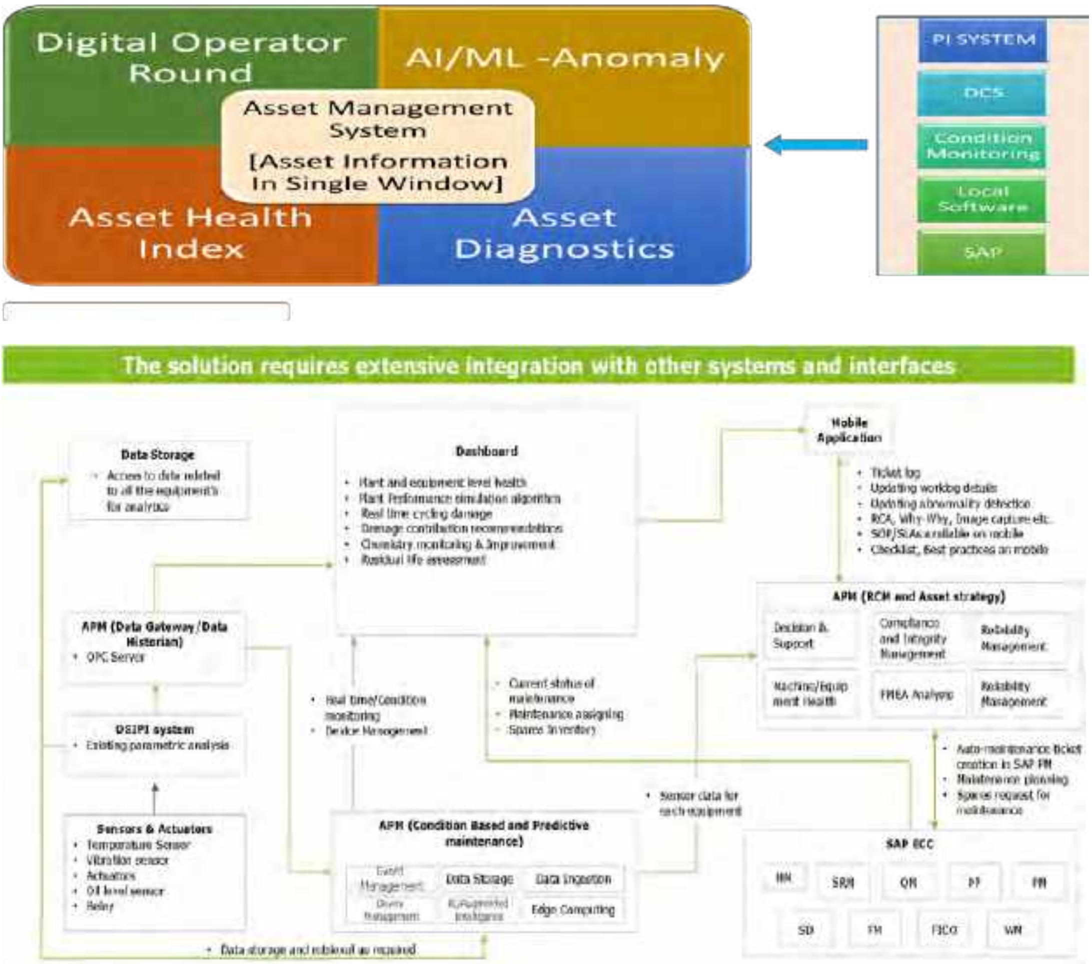


Figure – Asset Performance Management Digital Twin Courtesy: Delloite

5.5 Operations Optimization:

Deliver enterprise data visibility across power plant and fleet-wide footprints, providing a holistic understanding of the operational decisions that can expand capabilities and lower production costs. Empower operators and plant managers with KPI driven insights to raise overall productivity.

5.6 Business Optimization:

Reduce financial risk and maximize the real potential of the power fleet toward greater profitability with intelligent forecasting for smarter business decisions.

5.7 Advanced Controls/Edge Computing:

Control power plant operations with advanced technologies. Analytics based solutions manage grid stability, fuel variability, emissions, compliance, and other challenges to reduce costs and maximize revenue.

5.8 Cybersecurity: An advanced defence in depth system designed to assess system gaps, detect vulnerabilities, and protect critical infrastructure and controls in compliance with cyber security regulations.

5.9 Digital Twin Application Suite:

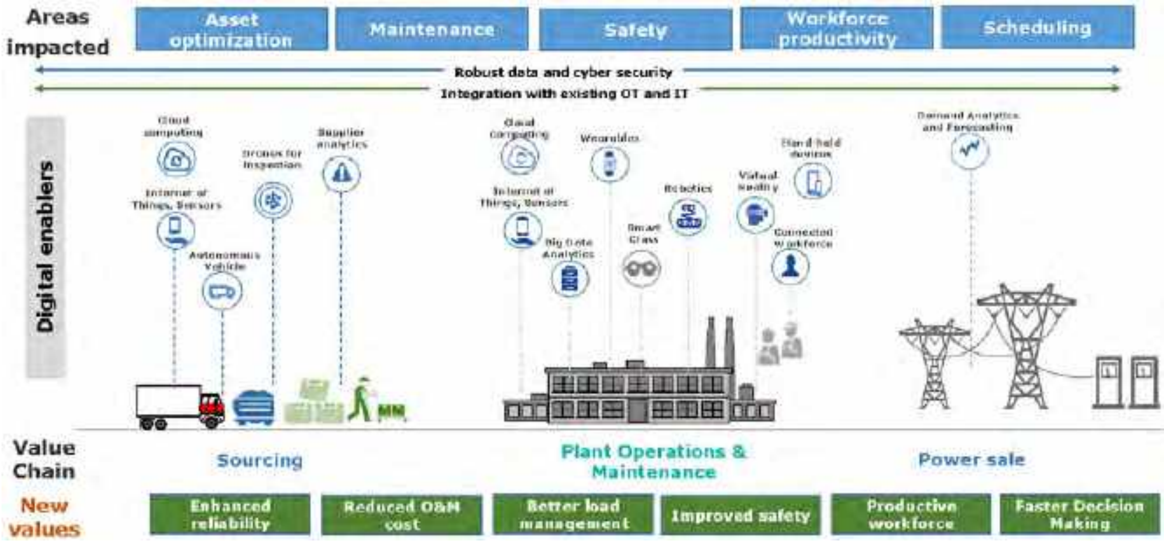
A set of applications interfacing with Digital Twin analytic models and application capabilities of Asset Performance Management, Operations Optimization, Business Optimization and Advanced Controls to bring insights and actions together for business benefits. The use of high efficiency and low emission (HELE) ultra-supercritical technologies have a limited impact in efficiency improvement and emission reduction, however digital initiatives and typically digital twins have the potential to further create strides in efficiency improvement and emission reduction. There are numerous such success stories.

Courtesy : NTPC

5.10 Development of an Integrated Energy Management Platform based on digital Twin Technology:

AI / ML techniques which are at the core of Digital Twins are slated to be used for development of an Integrated Energy Management Platform for demand forecasting, operational performance, fuel management, power generation, scheduling, and commercial management of a power station. In a nutshell, this solution is intended to integrate various digitalization and AI / ML solutions across various diversified areas in a Power Plant to automate the various processes and generate collective intelligence aiding decision making at a macro level.

In the Fuel Management portion of the Integrated Energy Management Architecture of NTPC, Analytics driven procurement planning can potentially reduce the landed cost of coal. Analytics based Procurement planning should account for dynamic nature of market-based dispatch, multiple coal sources, real time access to coal quality, landed cost & supply realization as the primary objective of ensuring optimum stock in stockyard is to be met.



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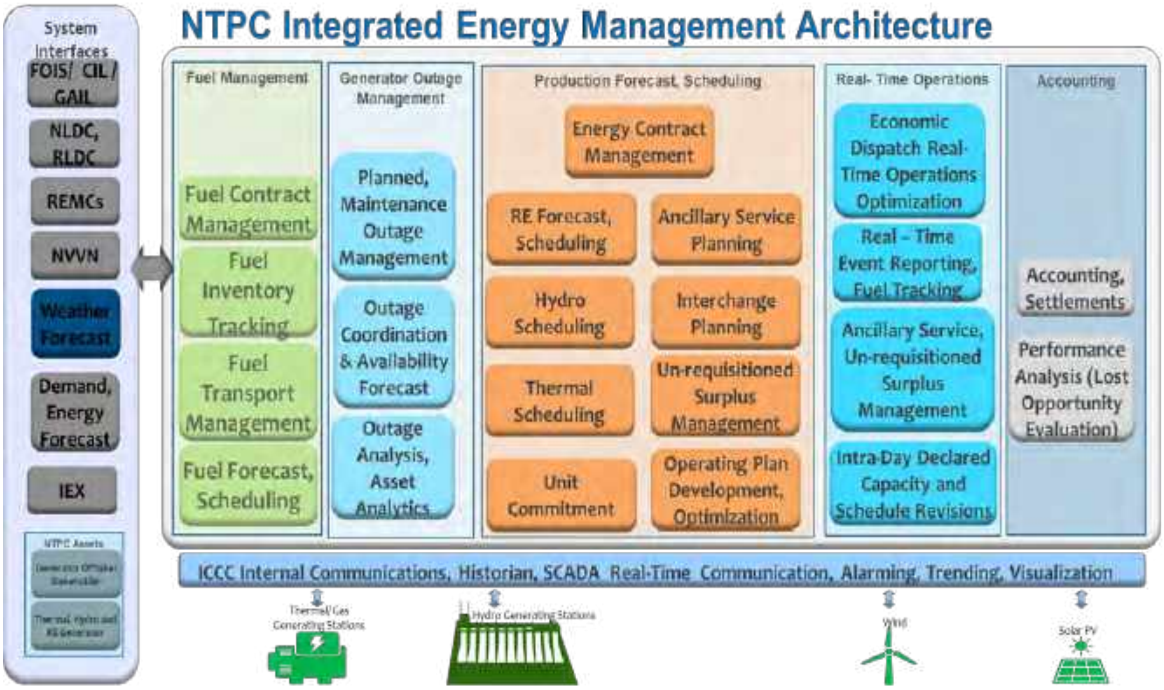


Courtesy: NTPC

Equipment	Function	Digital twin			
		Objectives	Challenges	Recommendations	Benefits
Coal fired boiler and pulverizer	Burns coal/oil to produce steam (largest emitter of CO_2, NOx, Sox, and particulate matter)	• Maximize efficiency • Minimize emissions • Ensure safety	• Fluctuating load • Varying coal quality	• Real-time detection of coal change • Real-time optimization in response to variations	• 8-10% of NOx reduction • Cut annual OPEX by $1 million • Reduced reagent usage downstream
Gas turbine	Burns gas to produce power (cleanest fossil fuel power)	• Maintain efficiency • Detect anomalies	• Fluctuating demand • Environmental variations • Highly dynamic equipment faults	• Real-time optimization in response to variations • Real-time detection, diagnosis of faults	• 0.4-0.6 % increase in thermal efficiency • Avoid forced outages
Flue gas desulphurization (FGD)	Reduces SOx from exhaust gases using limestone (important for coal as it generates 90% of SO_2 from all power sources in the US*)	• Minimize energy consumption • Minimize limestone usage	• Varying SOx emissions • Varying gas flow from boiler • Expensive limestone	• Real-time optimization of number of pumps and limestone usage in response to variations, while maintaining efficiency and pH	• Save up to $30 million annually on energy consumption and limestone costs
Selective catalytic reduction (SCR)	Reduces NOx using ammonia and catalytic beds (critical because 76% of power industry emissions in US*)	• Maintain low ammonia usage and slippage	• Invisible catalyst degradation in SCR • Inaccurate ammonia slip measurements	• Real-time soft sensing of catalyst degradation and ammonia slip • Optimized catalyst replacement schedule	• Better environmental compliance by minimization of NOx and ammonia
Air preheater (APH)	Enhances efficiency by heat recovery (saves coal worth $15-20 million annually)	• Forecast APH fouling in advance	• Unpredictable fouling of APH	• Advance forecast of APH fouling patterns	• Save $30-40 million annually by avoiding forced outages due to ammonia slip and APH fouling

Reference: https://www.eia.gov/todayinenergy/detail.php?id=37752

5.11 Dynamic Steam Turbine Modelling

Steam turbines are central to thermal power generation. Their dynamic model parameters vary with generation schedules. Traditional studies assume constant parameters, but our approach computes these parameters for actual 500 MW thermal units at different schedules. This dynamic modelling improves automatic generation control (AGC) system performance.

5.12 IIoT & Cyber Physical Systems: Industry 4.0 Technologies

The real power and benefit of IoT is the long-term insights it can provide to business leaders. Consider the vast number of IoT sensors that can be distributed throughout equipment, vehicles, buildings, campuses, and municipal areas that enable better long-term insight through advanced analytics -- the back-end computing processes capable of evaluating and correlating a huge quantity of seemingly unrelated data to answer business questions and make accurate predictions about future circumstances.

Source: Internet

The data collected can also be used to train ML models, supporting the development of AI initiatives that achieve a deep understanding of the data and its relationships. For example, the varied sensors distributed in an industrial machine can be analysed to detect variations in operation and condition, which might suggest the need for maintenance or even predict an impending failure. Such insights enable a business to order parts, schedule maintenance or make proactive repairs while minimizing the disruption to normal operations. The advantages of IoT can be summarized in the following bullet points:

1. Lower operating costs
2. Higher employee productivity
3. Better customer experiences
4. New consumer insights

5.13 Industrial Transformation through IoT

The convergence of Operational Technology (OT) and Information Technology (IT) is driving new methodologies for monitoring production processes to improve performance, lower costs and minimize risk. Mere connectivity of devices already allows valuable enhancements such as remote service and predictive maintenance, but, ultimately, the goal is to analyse data and gain detailed and comprehensive insights from assets, processes, and products.

For modern manufacturers, data needs to become an integral part of the control and operating system. They require technology providing an optimum interface for planning and maintenance programs running in the plant. Manufacturers seek “digital intelligence” to manage hundreds or even thousands of assets from a single site or across an enterprise to address crucial operating demands. This includes effective tools to transform process data into real-time knowledge regarding process performance, equipment health, energy consumption, and emissions monitoring. Now, more than ever, industrial firms need to make sense of vast quantities of data having a critical impact on their performance. To support the variety of applications necessary within a manufacturing facility, information must be delivered with context so it can be understood and used in various ways by a variety of people.

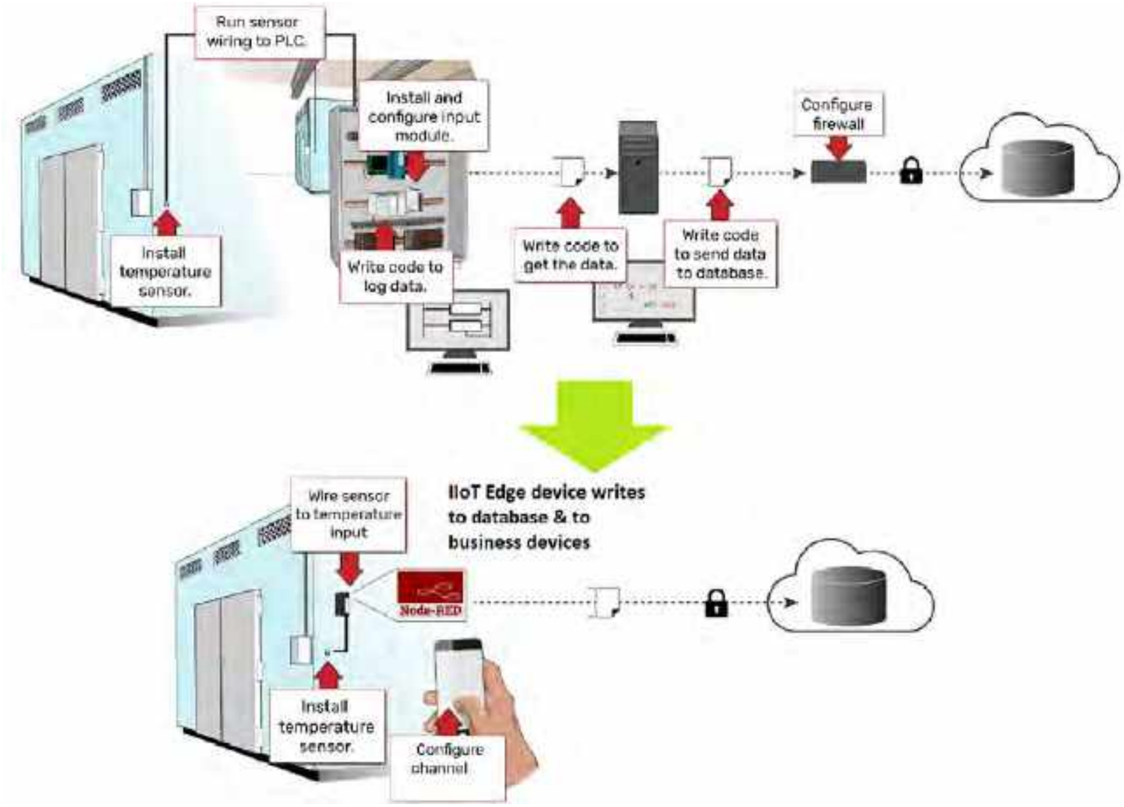
During the past 15 years, the growth and diversification of the Internet has redefined business-to-consumer industries. In the next 10 years, it will dramatically alter manufacturing, energy and other industrial sectors of the economy.

Dubbed the Industrial Internet of Things (IIoT), and in tandem with Industry 4.0 practices, the latest wave of technological change will bring unprecedented opportunities to business and society. It combines the global reach of the Internet with a new ability to directly control the physical world, including the machines, facilities and infrastructure that define the modern landscape. The adoption of the IIoT is being enabled by the improved availability and affordability of sensors, processors and other technologies that have helped facilitate capture of and access to real-time information. As the next big step in industrial performance and operations, the IIoT offers a wide range of potential uses and benefits:

- Enabling businesses to leverage the vast amounts of data provided by modern automation and control systems to make strategic decisions
- Providing trained personnel with improved remote monitoring, diagnostic, and asset management capabilities
- Enhancing data collection even in the most dispersed enterprises
- Improving decisions about the actual health of assets
- Reducing the time and effort for configuration and commissioning
- Minimizing the need to troubleshoot device issues in the field
- Bringing production fields online faster

Communication protocols and standards form the backbone of the IIoT in that they enable the secure integration and interoperability of devices and software applications. This results in an always-connected framework with applications such as machine health, predictive analytics, performance monitoring, and asset monitoring readily layering on top of this infrastructure.

In the world of process automation, the IIoT started with smart connected devices with unique identifiers communicating using a realtime digital network. This led to: having more sensors using fewer wires; more measurements in every instrument, with real- time status; the ability to freely add devices to a junction box without having to run cables all the way to the Input/Output (I/O) cards or add the I/O cards themselves; the ability to monitor self-diagnostics in an instrument from an office on the other side of the world; and the ability to put an indicator on the network to display values from transmitters and valves in inconvenient locations, or compute tank inventory or compensated flow from multiple sensors.



Source: Internet

Without question, the possibilities of smart connected devices within an industrial plant are endless, and once a connection across the Internet is also provided this value can be extracted to varying levels within the organization.

5.14 Industrial IoT is an Evolution not a Revolution

The IIoT is often presented as a revolution that is changing the face of industry in a profound manner. It is an evolution that has its origins in technologies and functionalities developed decades ago. This technology has been evolving under different names, but there is now a wider acceptance on the market under the common umbrella IIoT. Many manufacturers that have invested in smart instrumentation and control systems (i.e., HART and FOUNDATION Fieldbus) are now looking to leverage existing assets with the IIoT, rather than abandon or change them. There are also several organizations that have a long history in the advancement of automation products, driving innovation in open architectures and digital communication technologies that have been helping to guide companies through the IIoT transformation.

Since the introduction of the first smart transmitter in the 1980s, the market has seen continual growth of intelligent field devices that are now referred to as “things” with the IIoT. While the adoption of these “things” has increased, the approach to developing a more efficient, profitable, and intelligent automation system is something that many stakeholders have been championing for decades.
Field level data can provide huge amounts of information, which, if mined, routed to higher levels, and put into perspective is indispensable for the success of the IIoT. If the data can be

presented in the proper context to a variety of different users, it can add real value to plant operations.

In the process industries, end user consortiums like the German chemical industry association NAMUR have put forth their vision for the IIoT, Industry 4.0 and the digital future. They acknowledge that while the large installed bases of legacy 4-20 mA devices are going to continue to exist, there is a strong justification for Commercial-off-the-Shelf (COTS) Ethernet to be used with field devices along with a common, deterministic network above the field level, and a management layer providing integration technology and functioning as a gateway to serve data to various enterprise applications via the OPC Unified Architecture (UA).

Other stakeholders view industrial wireless technology as the answer to retaining large numbers of 4-20 mA HART-enabled instruments and still moving digital information into plant networks. Depending upon an organization's role in the automation eco-system, its outlook on digital advancement is likely to be very product specific, very architectural, or totally aspirational.

5.15 Value of Digital Transformation

Digital transformation – the use of technology to radically improve performance or reach of enterprises – is becoming a hot topic for companies around the world. Manufacturers are using digital advances such as analytics and smart embedded devices – and improving their use of traditional technologies – to change customer relationships, internal processes, and value propositions.

Industrial systems that interface the digital world to the physical world through sensors and actuators that solve complex control problems are commonly known as cyber-physical systems. These systems are being combined with "Big Data" solutions to gain deeper insight through data and analytics.

Successful digital transformation comes not from implementing new technologies but from transforming industrial organizations to take advantage of the possibilities that new technologies provide. It also results from reshaping operational strategies to leverage valuable existing assets in new ways.

To get the most out of IIoT and Industry 4.0 technologies, and to get past square one with a digital business model, companies will have to adopt a new way of thinking. It starts with recognition that in-place analog solutions are sub-optimal and not provide the information needed to run complex industries facilities, coupled with the belief that networking and software technologies underpinning the Internet have a place in process automation. Finally, there is the act of leveraging global manufacturing technology initiatives by deploying disruptive new technologies to improve safety and performance.

The IIoT is enabling digital transformation by making use of the information contained in installed smart measurement devices. Simultaneously, industrial wireless continues to be a valuable, cost-effective solution for quickly adding more measurements to systems.

Contributing to digital transformation of measurement data, wireless is being used for monitoring local and remote assets, safety, environmental and many different mobile and rotating measurements.

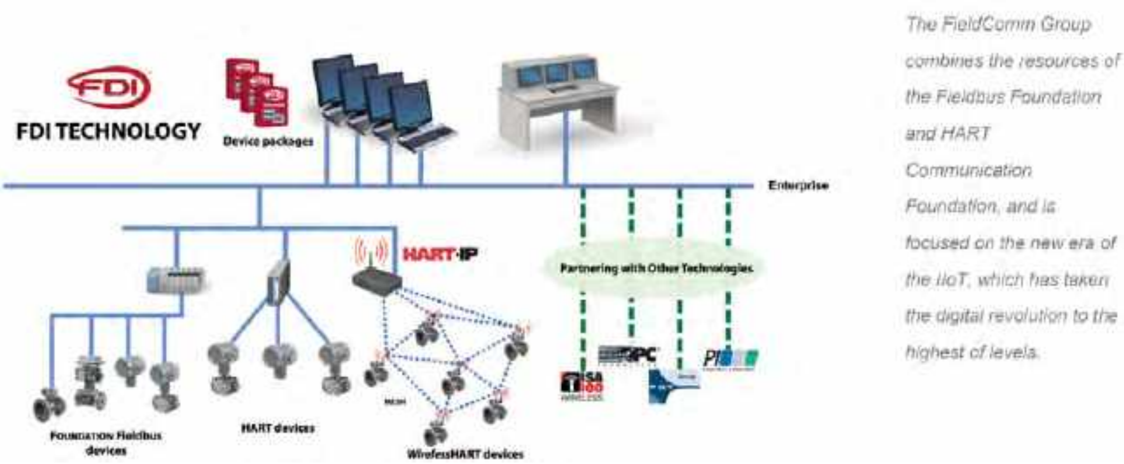
With a larger, consolidated data set, manufacturers can apply higher analytics for more detailed insight, scale the data as needed to meet the varied needs of single-site or enterprise-wide operations and leverage a wider pool of data experts for monitoring and analysis.

Ultimately, digital transformation will help manufacturers eliminate unplanned shutdowns, maximize output, minimize safety risk and optimize supply chain strategies.

5.16 Role of Communication Protocols & Integration with DDCMIS

The FieldComm Group, formed in 2015 with the merger of the Fieldbus Foundation and HART Communication Foundation, is dedicated to developing, managing and promoting global standards for integrating digital devices into automation system architectures while protecting process automation investments in the HART and FOUNDATION Fieldbus communication technologies.

The mission of FieldComm Group is to provide a unified vision for a smarter industry. No single automation protocol addresses all industrial use cases – particularly with wireless. Instead, today's environment requires secure plant floor to executive office data integration. FieldComm Group technologies provide the means to connect and integrate digital information. They enable a connected framework using intelligent field devices to reduce waste, improve safety and increase operational efficiency and have for over 20 years.



Courtesy: Fieldcomm Group

Digital down to the sensor level, FOUNDATION Fieldbus has been at the forefront of digital transformation since its inception. The technology provides an all-digital communication infrastructure for process automation, with powerful multivariable measurement capabilities, robust device diagnostics, and the ability to integrate wireless devices across multiple networks. Its block structure is unique, enabling true distributed functionality, improved data management, and alarm and alert management.

FOUNDATION Fieldbus allows industrial organizations to unlock the full capabilities of their existing assets. By providing the means to leverage immense amounts of data generated by modern automation systems, the potential uses, and benefits are numerous. They range from enhanced data collection and improved remote monitoring, diagnostics and asset management, to reduced configuration and commissioning effort.

Designed for use with analog instruments, HART technology offers a proven, reliable, long term solution for plant operators who seek the benefits of intelligent devices with digital communication, while preserving existing investments in analog instrumentation and plant wiring. Much more than a communication protocol, with HART technology process plants have access to a wealth of digital process, maintenance and diagnostic information that is valuable throughout the plant lifecycle from design to installation and configuration, through operation, and finally maintenance.

The bi-directional HART Communication Protocol provides two simultaneous communication channels – one analog, the other digital – and enables data access between intelligent field instruments and host systems. Communication occurs between two HART enabled devices, typically a smart field device and a control or monitoring system. Standard 4-20 mA wiring practices assure reliable communication.
WirelessHART and HART-IP deliver the benefits of intelligent devices with digital communications while preserving existing infrastructure, training, control system and operational investments. WirelessHART is a wireless communications protocol that uses mesh network technology for process automation applications. It adds wireless capabilities to HART technology while maintaining compatibility with existing HART devices, commands, and tools. HART-IP enables the HART protocol to run over any Internet Protocol (IP)-based connection, offering valuable HART data at the speed of Ethernet and supporting intelligent device management for smart process instrumentation.

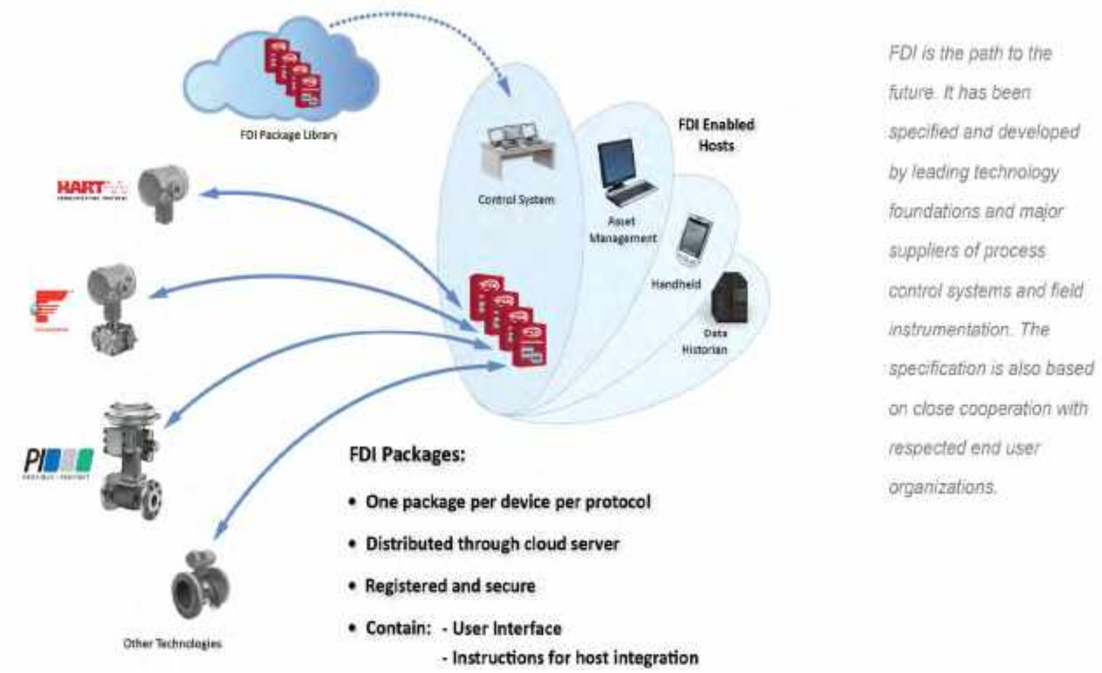
Source: Internet

5.17 Solution for System Integration

Today's field instruments look more and more like embedded computers. Intelligent, microprocessor-based devices deployed across a wide choice of networks transmit a broad range of data that has never been available before. But increased data creates an information management dilemma. How can users take the huge volume of data created by intelligent devices and turn it into actionable information?

The first step is to simplify the procedures needed to access field device information by higher-level control or host systems. These procedures, known as integration, must be completed to assure proper device management by the host, including device configuration, replacement, maintenance, and diagnostics. They must be standardized, usable across all systems, and independent of device suppliers, system suppliers, or vendor-specific tools.
Leading process industry foundations, including FieldComm Group, PROFIBUS International, and the OPC Foundation, jointly developed the Field Device Integration (FDI) standard to solve the problem of integrating field devices with the multitude of networks, operating systems

and control systems commonly used in process plants. FDI takes account of the various tasks over the entire lifecycle for both simple and complex devices, including configuration, commissioning, diagnosis, and calibration.



Source: Fieldcomm Group

FDI Device Packages can be processed in FDI hosts as well as in an FDT2® Frame Application. This allows device suppliers to create a single FDI Device Package for their devices – instead of separate Device Type Managers (DTMs) and Device Descriptions (DDs) – while still providing users the choice of either an FDI host or an FDT host environment.

By including all tools, documents, and interfaces in a single device package, FDI improves system integration efficiency and allows easier access by IT organizations to OT information. Moreover, it unifies device drivers, configuration tools, diagnostics, and documentation regardless of operating system with an independent and downloadable software package compatible with any FDI-registered host system.

Manufacturers and other industrial firms deploying IIoT applications can connect to valuable information in intelligent field devices – regardless of protocol – by using FDI to integrate the information in a process control system, asset management tool or Enterprise Resource Planning (ERP) system; then visualize and evaluate the data; and ultimately take action based on the information to prevent shutdowns, lower operating costs, reduce maintenance expenses, and become more predictive in how plants are run.

5.18 New Control System Architectural Model with IIoT:

The Purdue Enterprise Reference Architecture has been a defining architecture for instrumentation, automation, manufacturing operations and business planning and logistics systems since its introduction in the 1990s. This pyramid model describes various "levels" of applications and controls in a manufacturing enterprise. It describes components from the physical levels of the plant (Level 0) through control equipment and strategies (Level 2). Level

3 describes the manufacturing control level, and Level 4 is the domain of Enterprise Business Planning, or Enterprise Resource Planning (ERP) systems.

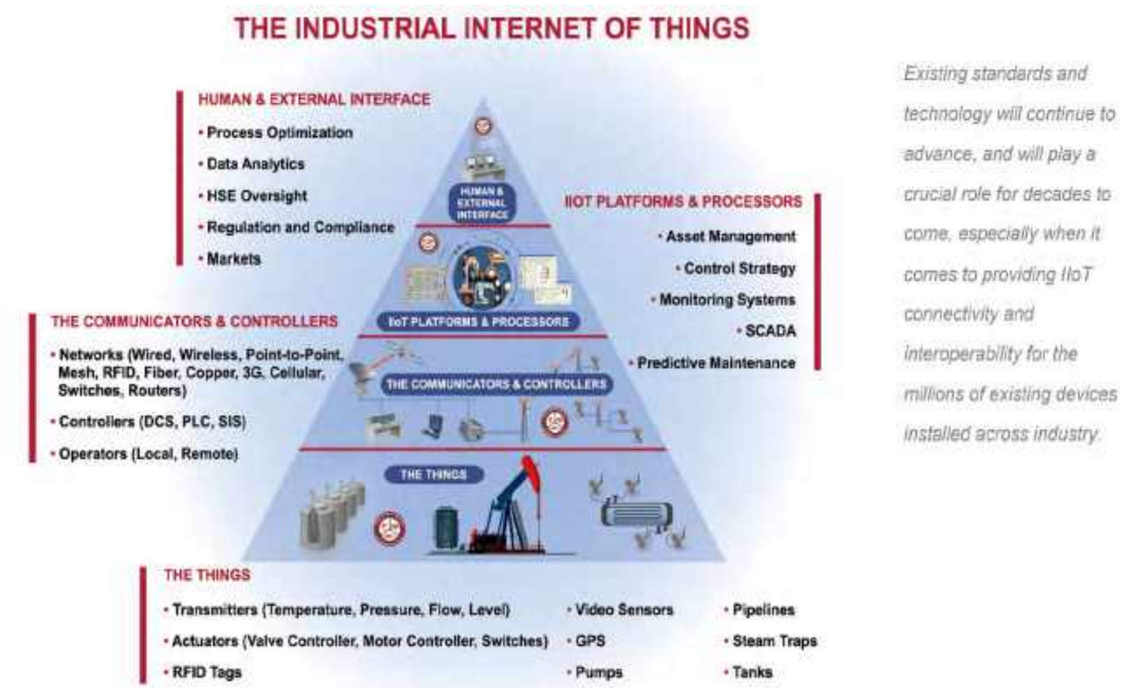
With the emergence of the IIoT, however, and rethinking of the traditional process network view, two crucial questions for the automation industry are:

• Where will digital transformation occur?
• Where should the Internet Protocol (IP) network exist?"

Some believe digital transformation is most appropriate at the field device level of sensors and actuators with digital-capable devices, while others think the IP network should reside all the way down in safety-critical systems. In either case, security is an overriding factor.
Undoubtedly, the classic automation architecture is undergoing profound changes to accommodate IIoT operational strategies. It starts with the ability to connect data and integrate it across the enterprise – only then can value be captured. FieldComm Group protocols and technologies play a vital role at different layers of the new architectural model and assist with a well-balanced IIoT approach that can be deployed today and effectively maintained well into the future.
At the bottom of the IIoT pyramid are "things" like transmitters, actuators, valves, controllers, monitoring systems, and other familiar equipment, as well as more recent developments such as video sensors and Global Positioning System (GPS) systems. Above the physical layer is a fabric of communication and control systems that manage field-level devices. This includes DCS, PLC and safety systems utilizing wired and wireless networks, Radio-Frequency Identification (RFID) networks, fiber optics and copper wiring, and run by local or remote operators. The third layer consists of IIoT platforms and processors that take information from a plant or multiple facilities, aggregate the data, and then support tasks such as predictive maintenance, asset management, advanced control, and Supervisory Control and Data Acquisition (SCADA). While all this information is valuable, it is not really actionable without a human & external interface at the highest layer that gleans insights from the various systems in place. These insights help decide what type of analytics to run, what processes to optimize, etc.
Based on the IIoT architectural model, system requirements include:

- Intelligent assets, connected intelligently by the appropriate communication protocol for a given application
- Data communications infrastructure with a span from the plant floor to the executive suite, and a scope that captures process data and intelligent asset information
- Analytics and applications to integrate asset data and deliver information

One of the core elements of the FDI specifications is an optional OPC-UA server that can be built into compliant products to seamlessly present data from field devices to higher-level systems. In the future, the FieldComm Group plans to offer a developer kit for connecting WirelessHART and HART-IP devices into cloud-based systems. This would include a server platform allowing an IIoT content delivery gateway to provide information from devices on the plant floor up into cloud computing platforms and services like Microsoft Azure.



Source: Internet

Beyond the afore mentioned system requirements, there is no substitute for an invested and capable workforce that is trained and knowledgeable in enterprise systems. Operational executives are charged with making data-driven decisions, and Subject Matter Experts (SMEs) must interpret intelligence from all available information. These and other people make the difference for the business, whether it's business and risk analysis, or enterprise and supply chain planning.

5.19 Generative AI Technologies for Green Thermal Power Plants

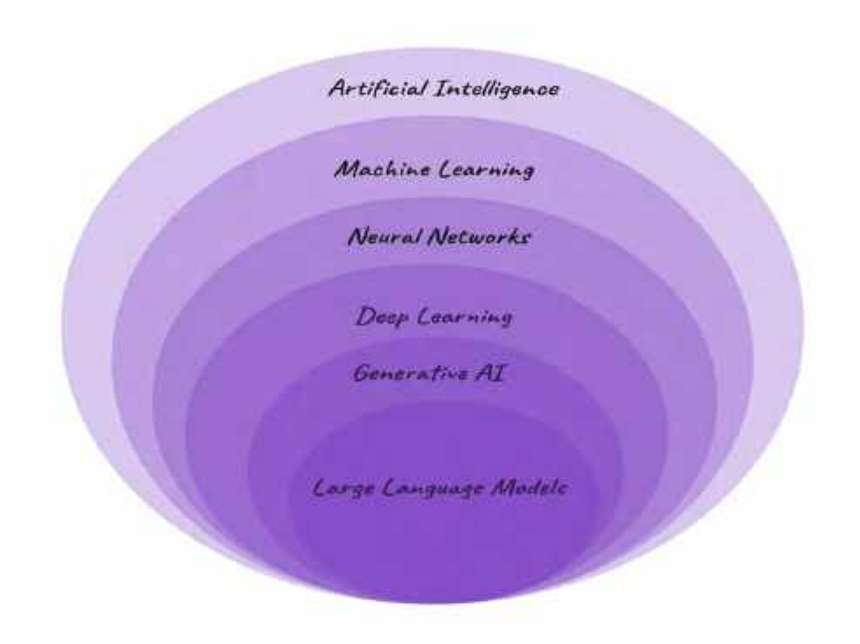
Generative AI (Gen AI), with its ability to create new things and optimize processes, holds immense potential for tackling environmental challenges. However, the very power that drives its innovation also carries an environmental cost.

5.20 The Greener Side of Gen AI

Gen AI offers a multitude of benefits for sustainability:

- **Optimizing Resource Use**: AI can analyze vast datasets to identify inefficiencies in manufacturing, transportation, and energy production. This can lead to significant reductions in material consumption and energy waste. Imagine AI designing innovative steam flow paths, boiler turbine configuration trains, new regenerative feed heating architecture or optimizing steam flow path to minimize fuel usage.
- **Revolutionizing Renewables**: Gen AI can accelerate the development of renewable energy sources. It can design more efficient solar panels, predict weather patterns for optimal wind turbine placement, and even discover new clean energy solutions.

- **Precision Agriculture**: AI can analyze soil conditions, predict crop yields, and recommend optimal planting and irrigation strategies. This reduces water waste and promotes sustainable farming practices.



Source: Internet

In summary, **Artificial Intelligence (AI)** is a branch of computer science that involves creating machines with human-like thinking and behavior. **Machine Learning (ML)**, a subfield of AI, allows computers to learn patterns from data and make predictions without explicit programming. **Neural Networks (NNs)**, a subset of ML, mimic the human brain's structure and are crucial in deep learning algorithms. Deep Learning (DL), a subset of NN, is effective for complex problem-solving, as seen in image recognition and language translation technologies. **Generative AI (GenAI)**, a subset of DL, can create diverse content based on learned patterns. **Large Language Models (LLMs)**, a form of GenAI, specialize in generating human-like text by learning from extensive textual data.

Generative AI and Large Language Models (LLMs) have revolutionized the field of artificial intelligence, allowing machines to create diverse content such as text, images, music, audio, and videos. Unlike discriminative models that classify, generative AI models generate new content by learning patterns and relationships from human-created datasets.

At the core of generative AI are foundation models which essentially refer to large AI models capable of multi-tasking, performing tasks like summarization, Q&A, and classification out-of-the-box. These models, like the popular one that everyone's heard of-ChatGPT, can adapt to specific use cases with minimal training and generate content with minimal example data.

The training of generative AI often involves supervised learning, where the model is provided with human-created content and corresponding labels. By learning from this data, the model becomes proficient in generating content similar to the training set.

Generative AI is not a new concept. One notable example of early generative AI is the Markov chain, a statistical model introduced by Russian mathematician Andrey Markov in 1906. Markov models were initially used for tasks like next-word prediction, but their simplicity limited their ability to generate plausible text.

The landscape has significantly changed over the years with the advent of more powerful architectures and larger datasets. In 2014, generative adversarial networks (GANs) emerged, using two models working together—one generating output and the other discriminating real data from the generated output. This approach, exemplified by models like StyleGAN, significantly improved the realism of generated content.

A year later, diffusion models were introduced, refining their output iteratively to generate new data samples resembling the training dataset. This innovation, as seen in Stable Diffusion, contributed to the creation of realistic-looking images.

In 2017, Google introduced the transformer architecture, a breakthrough in natural language processing. Transformers encode each word as a token, generating an attention map that captures relationships between tokens. This attention to context enhances the model's ability to generate coherent text, exemplified by large language models like ChatGPT.

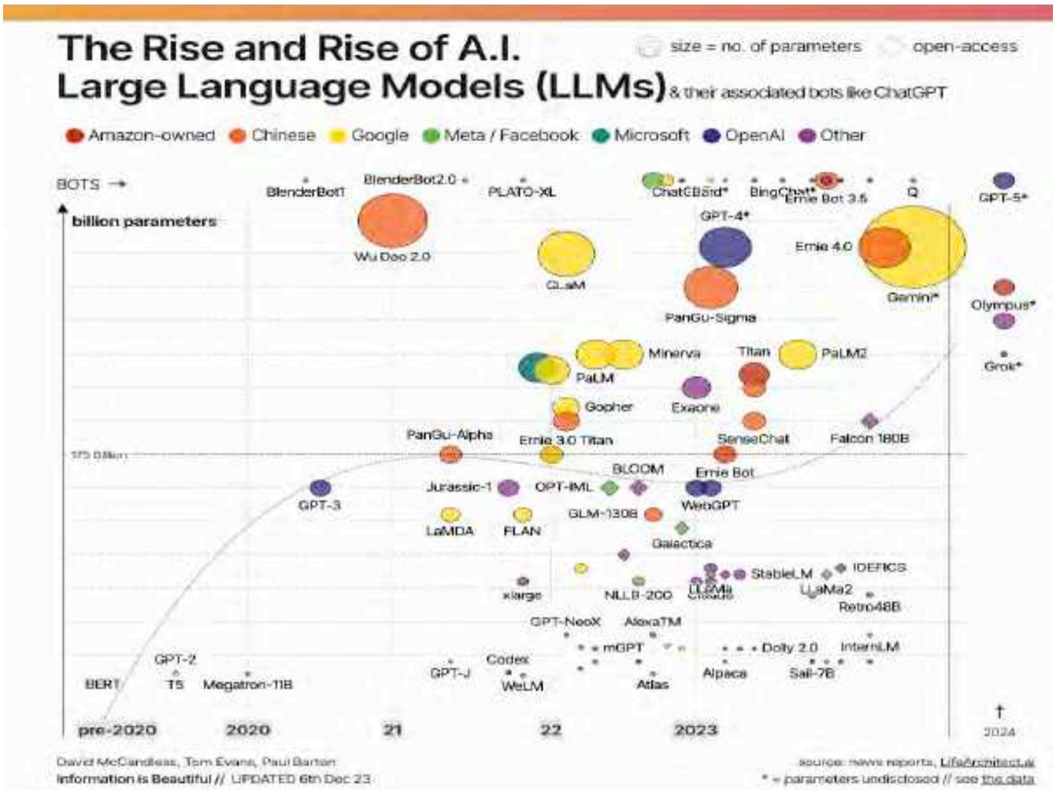
The generative AI boom owes its momentum not only to larger datasets but also to diverse research advances. These approaches, including GANs, diffusion models, and transformers, showcase the breadth of methods contributing to the exciting field of generative AI.

5.21 Large Language Models

The term "Large" in Large Language Models (LLMs) refers to the sheer scale of these models—both in terms of the size of their architecture and the vast amount of data they are trained on. The size matters because it allows them to capture more complex patterns and relationships within language. Popular LLMs like GPT-3, Gemini, Claude etc. have thousands of billion model parameters. In the context of machine learning, model parameters are like the knobs and switches that the algorithm tunes during training to make accurate predictions or generate meaningful outputs.

Now, let's break down what "Language Models" mean in this context. Language models are essentially algorithms or systems that are trained to understand and generate human-like text. They serve as a representation of how language works, learning from diverse datasets to predict what words or sequences of words are likely to come next in a given context.

The "Large" aspect amplifies their capabilities. Traditional language models, especially those from the past, were smaller in scale and couldn't capture the intricacies of language as effectively. With advancements in technology and the availability of massive computing power, we've been able to build much larger models. These Large Language Models, like ChatGPT, have billions of parameters, which are essentially the variables the model uses to make sense of language.



Generative AI has a capability of completely revolutionizing Power Generation sector. In a recent paper on Blue Coal Power Plants by NTPC published in the International Journal of Science and Research (IJSR) emphasis has been laid on various steps which include the following:

1. Phasing out inefficient coal based plants.
2. Biomass co-firing in coal bases power plants
3. Low carbon fuels for co-firing.
4. HELE technologies in new plants
5. Carbon capture and Utilization technologies
6. Augmentation of SMR at CRH Steam Interface

Generative AI can actually revolutionize the above technologies like HELE, CCUS and SMRs and in true sense lead to the transformation of Blue Coal Plants to Green Coal Plants.

5.22 The Environmental Cost of Power

Despite its potential, Gen AI's development and operation come with an environmental cost:

- **The Training Drain**: Training massive Gen AI models requires enormous computing power, translating to high energy consumption and carbon emissions from data centers. As models become more complex, this impact is likely to grow.

- **The Efficiency Paradox:** While Gen AI can improve efficiency in other sectors, its own energy footprint needs to be addressed. We need to find ways to power AI with renewable energy sources and develop more energy-efficient training algorithms.

5.23 The Road to Sustainable Gen AI

To ensure Gen AI becomes a net positive for the environment, we need to:

- **Focus on Green AI Infrastructure:** Investing in renewable energy sources and energy-efficient data centres is crucial for powering Gen AI sustainably.
- **Develop Eco-Friendly Training Techniques:** Research into techniques that reduce the computational power required for training Gen AI models is essential.
- **Prioritize Transparency:** Understanding the environmental impact of Gen AI development and deployment is crucial for making informed decisions and mitigating negative effects.

6.0 Discussions and Conclusions:

Boston Consulting Group identified nine key enabling technologies of Industry 4.0, whereas the EU identified six enabling technologies of Industry 5.0. These technologies can be identified as

- Artificial Intelligence and Machine Learning
- Robotic Process Automation (RPA)
- Edge Computing
- Quantum Computing
- Virtual Reality and Augmented Reality
- Blockchain
- Internet of Things (IoT)
- 5G
- Cyber Security

While we take a pause today and revisit the technological growth our country has witnessed in the last 75 years of our independence, we surely have our reasons to feel proud of our momentous achievements and celebrate the same with grandeur, however it is time to be ever watchful and wary of the kind of technological disruptions taking place in and around us and the blitzkrieg speed at which they are changing the processes and practices in and around the world. Agile, Sustainable and Resilient are becoming the new buzz words for industry taking a leapfrog in the future.

It is pertinent to mention that even though **Industry 4.0** has not clearly set it's feet in Indian context and it's industries and while we are still in the phase of experimenting and part adoption, still uncertain and apprehensive of the reals fruits of Digitalization, taking one step at a time, certain sections of the world are already abuzz with the possible advent of **Industry 5.0** which is promised to be powered by Artificial General Intelligent Operations (AGI OPs), Quantum ML, Evolutionary Robotics, 5G and WiFi-6. Many Organizations from different part of the world are working on solutions and projects incorporating Natural Language Processing, Computer Vision, Deep Learning, Reinforcement and Online Learning, Quantum computing, 3D printing, Collaborative Robotics, unmanned autonomous technologies at a whopping scale, beyond imagination in the history of Industrial revolution which bear the potential to completely change the way the world functions and industries operate.

We might have our own reasons but there should not be any shame in accepting that today's developing India is atleast 20 years behind the developed west. This gap is not just to be filled but also exceeded if India as a nation wants to stand on it's own feet, achieve self-reliance in everything and truly become "Atmanirbhar". The 4th Industrial revolution belongs to Cyber-physical systems, belongs to Automation. It witnessed the changing scenario where electronic instrumentation, Automation, Wireless networking and Industrial Internet became core to anything and everything related with us. No singular area was left untouched. Industry 5.0 aims to redefine Automation which would stand for "Autonomous robots as intelligent agents collaborating with humans at the same time, in the same workspace for agile, flexible and sustainable operations". Industry 5.0 powered by Artificial Intelligence and related technologies would be the key for sustainable industry within planetary boundaries.

Case Study: Green Thermal Units

We need to start adopting Industry X.0, consider a realistic 500 MW thermal unit and apply collaborative automation principles to try and convert the same to Green units:

- Real-time monitoring of equipment health.
- Predictive maintenance using digital twins.
- Optimization of operations based on dynamic steam turbine models.
- Integration with renewable energy sources.

Benefits and Challenges

Benefits

- Reduced CO_2 emissions: Collaborative automation can cut up to 2 gigatons of CO_2 emissions.
- Cost savings: Annual operational and maintenance expenses decrease significantly.
- Enhanced reliability: Real-time insights lead to better decision-making.

Challenges

- Technological adoption: Existing plants need upgrades to incorporate digital twins and automation.
- Policy alignment: Regulatory frameworks must incentivize green practices.
- Skilled workforce: Training personnel for collaborative automation.

Conclusion

Collaborative automation is the bridge between traditional thermal power plants and a sustainable future. By embracing digital twins, dynamic modeling, and decarbonization initiatives, India can lead the way in green energy generation.

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Setting the Standard for Automation™

HIPPS VALVES

Manufacturer's Considerations

By: Ravindra Patil

Delval Flow Controls Pvt. Ltd

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

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Contents

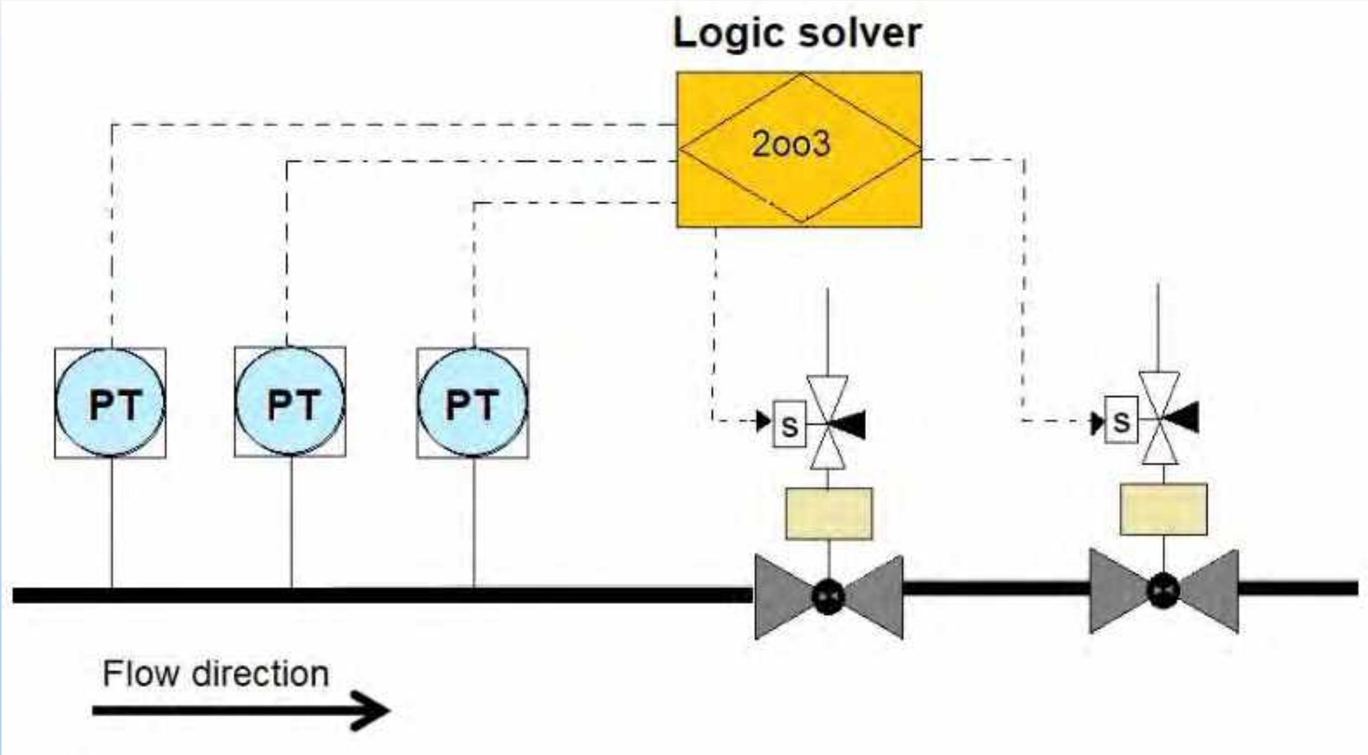
- What is a HIPPS System
- Advantages of installing a HIPPS system and comparison with other conventional systems
- Important components of a HIPPS System and their functions
- Features that a manufacturer shall include in a valve for HIPPS application and maintenance

HIGH INGETRITY PIPELINE PROTECTION SYSTEMS

- Safety System against surge pressure protection
- Isolation of downstream vessels
- Quick operation of safety shut off valve to close position
- Surge venting system
- Designed in compliance with IEC 61508 and IEC 61511
- Third party validated failure safety data

HIGH INGETRITY PIPELINE PROTECTION SYSTEMS

- Pressure sensors and transmitters
- Logic Solver
- Safety Shut-off Valves



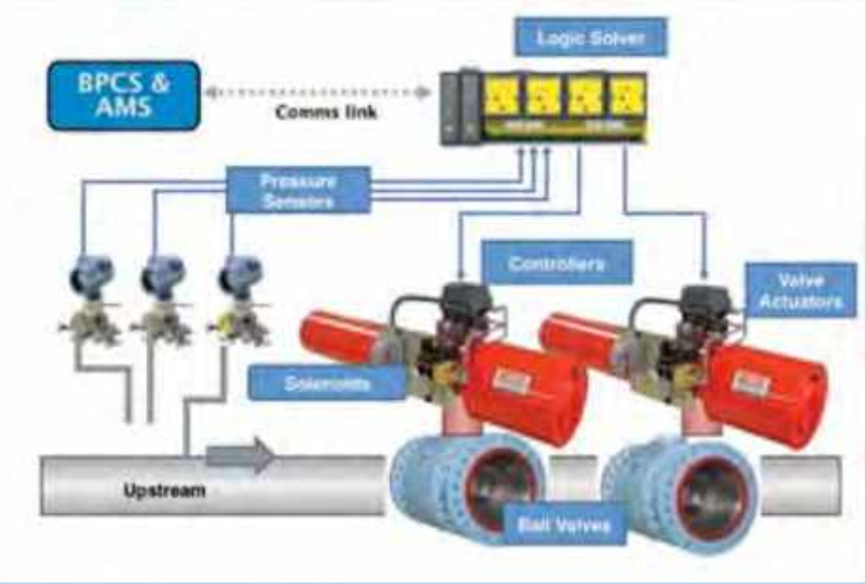
Slide – 4 Advantages of a HIPPS System over conventional

HIPPS System	**Traditional Pressure relief systems**
Stops the flow of excess fluid and holds it from entering in the system	Removes excess inflow of fluids in the system and needs flares
Only HIPPS shut off valves to be designed with withstand surge pressure	Entire piping system including relief valves to be designed for surge pressure
Cost effective overall	Expensive overall
Fast closure of shut off valve within 2 seconds	Depends on set pressure relief and safety relief valve
No limit of distance between transmitters and final element	Multiple use of pressure relief devices
Possibility of integrated monitoring and communication with Plant Safety System	Too complex to achieve communication with plant safety system

Slide – 5 Components and functions of a HIPPS System

- Pressure sensors and Transmitters (Initiators)
  - Sense and transmit pressure to the logic solver
  - Measure to the required accuracy
  - No data transmission time lag

- Dedicated Logic Solvers
  - Hardware needs to comply with minimum SIL 3



Slide – 6 Components and functions of a HIPPS System

- Block Valves
  - May be one or more in number. For better reliability two block valves are used in series
  - Valves must have a minimum SIL level 3
  - May have a PST device to ensure better reliability
  - Quick closing action usually within 2 seconds irrespective of the size.
  - Shall have a pressure rating equal to or more than the surge design pressure

- Independent HIPPS Safety Logic from the basic process controls system (BPCS)

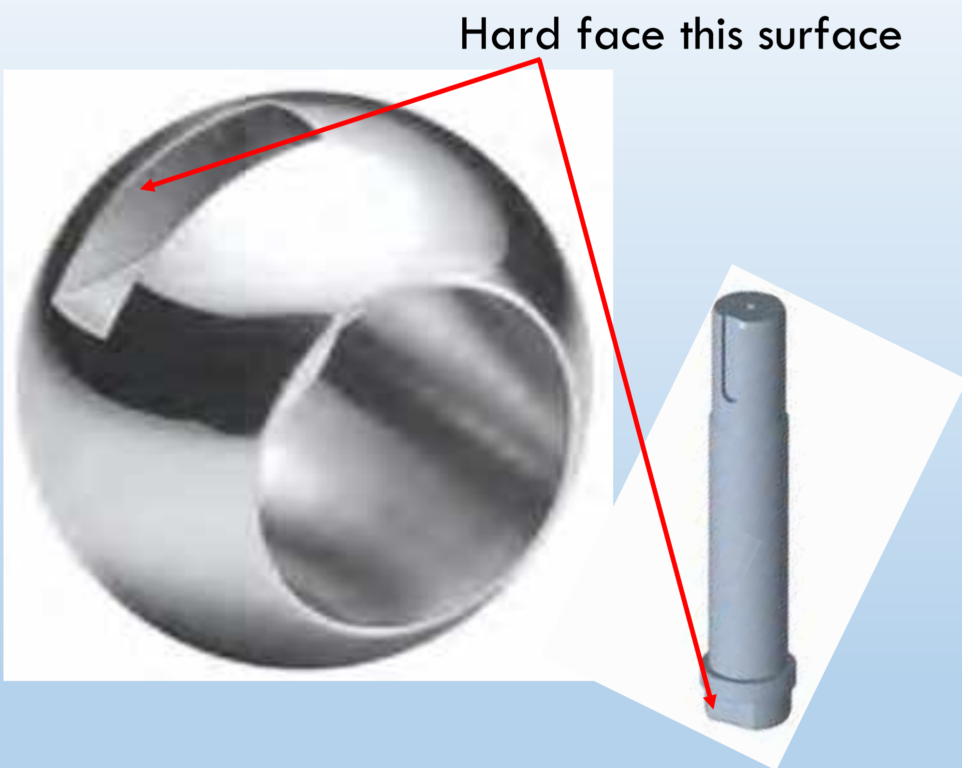
Slide – 7 Components and functions of a HIPPS System

- Block Valves (Ball Valves)

- Hard facing is recommended at the ball to stem engagement faces or at drive engagements including keyways

- Stellite / Tungsten Carbide / Chromium Carbide

- Takes care of heavy impact loads due to least operating times



Q & A

! THANK YOU !

Best Wishes

Setting the Standard for Automation™

ISA™

COLLABORATIVE AUTOMATION

for ENERGY TRANSFORMATION

Rittal Energy Efficient Products & Digitization

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

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ISA Delhi Section

Agenda

1	**Rittal Brief Introduction**
2	**Rittal New Ex Range of Enclosure**
3	**Rittal Energy Efficient Enclosure Fan and Filter Units & Cooling Units**
4	**Rittal ePocket**

Fully Compatible System

Rittal – The System.

Enclosures	Power Distribution	Climate Control	IT Infrastructure
• Enclosures • Small enclosures • Command Panel & support arm systems • Console systems • Stainless steel & industry solutions • Outdoor enclosures	• Modular system for low-voltage switch-gear up to 6300 A • Busbar systems for switchgear and controlgear up to 1600 A • Distribution enclosures	• Wall & Roof mounted cooling units • Re-cooling systems • Air/air, air/water heat exchangers • Fan systems • Enclosure heaters	• Integrated DC solutions • Network & server racks • IT wall-mounted enclosures • Consultancy & planning • Structural design • Physical security • IT climate control • IT power distribution • Monitoring systems

Fully compatible system accessories

ENCLOSURES › POWER DISTRIBUTION › CLIMATE CONTROL › IT INFRASTRUCTURE › SOFTWARE & SERVICES ›

RITTAL

Certification TYPES within Hazardous Locations

- **IECEx- Rittal can offer** ***(IECEx ITS 23.0007U)***
- **ATEX - Rittal can offer** ***(ETL23ATEX0183U)***
- **PESO -** ***In Process*** ***(Expected by Apr/May '24)***
- **UL Hazloc-** ***In Process*** ***(Expected in Q3 '24)***
- cETL - Canada
- ECAS Ex or EQM - UAE
- EAC – Russia, Armenia etc.
- IN METRO - Brazil
- CCC Ex - China

Rittal Ex - Label

Gas Atmospheres

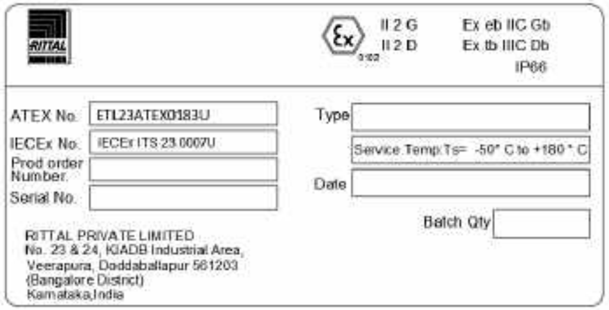
ZONE 1 - An area in which an explosive gas atmosphere is likely to occur in normal operation occasionally

ZONE 2 – An area in which an explosive gas atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only

Dust Atmospheres

ZONE 21 - An area in which an explosive dust atmosphere in the form of a cloud of dust in air is likely to occur in normal operation occasionally

ZONE 22 - An area in which an explosive dust atmosphere in the form of a cloud of dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only



II 2 G – Explosive gas atmosphere
II 2 D – Explosive dust atmosphere

EX eb IIC
eb – Increased Safety
IIC - Atmospheres containing hydrogen or gases of an equivalent hazard (acetylene)
Gb- Equipment protection level applicable for Gas Zone 1

EX tb IIIC
tb – Protection by enclosures
IIIC - atmospheres containing combustible conductive dusts
Db- Equipment protection level applicable for Dust Zone 21

The temperature class identifies the hottest temperature that the equipment can obtain in normal operation.
The enclosures are suitable for use in service temperature range of -50 ° C to + 180 ° C.

Temperature Class	Maximum Temperature Limit (°C)
T6	85
T5	100
T4	135
T3	200
T2	300
T1	450

Made In India
Std. & Spl.

ISA Delhi Section

Ex - SMALL ENCLOSURES

Ex Small Range

IP 66

- Minimum Dimension 200mm W x 300mm H x 150mm D
- Maximum Dimension 1000mm W x 1600mm H x 500mm D
- Material of construction & Grade : Stainless Steel 304 & 316L
- Thickness : 1.5 & 2mm
- Optional
    - Direct cut-out/ holes
    - Cover plate with Cut-out/holes
- Service Temperature Range : -50 to + 180 Degree Celsius “T3”
- Zone- 1 & 2 Gas, 21 & 22 Dust
- Marketing Material : Sales Tool Kit & Boucher Available
- Rittal Name Plate :

II 2 G D
Ex eb IIC Gb
Ex tb IIIC Db IP66
Service temperature: Ts = -50°C to +180°C

✔ Made In India
Std. & Spl.

Ex - LARGE ENCLOSURES

Ex Large Range

IP 66

- Minimum Dimension 600mm W x 1600mm H x 400mm D
- Maximum Dimension 1000mm W x 2200mm H x 1000mm D
- Material of construction & Grade : Stainless Steel 304 & 316L
- Thickness : 1.5 & 2mm
- Optional
  - Direct cut-out/ holes
  - Cover plate with Cut-out/holes
- Service Temperature Range : -50 to + 180 Degree Celsius “T3”
- Zone- 1 & 2 Gas, 21 & 22 Dust
- Rittal Name Plate :

Made In Germany

Ex Enclosure Plastic - With Hinged Door

Ex Enclosure

IP 65 / NEMA 1,3R,3RX,4,4X,

- Minimum Dimension Width : 250/300/400/500/600/800 mm W
  Height : 350/400/600/500/800/1000 mm H
  Depth : 150/200/300 mm D
- Material of construction & Grade : Housing: Glass Fiber reinforced unsaturated polyester, surface resistance: < 10^9 Ω
  Door: glass fiber reinforced unsaturated polyester, surface resistance: < 10^9 Ω
  foamed silicone all around -Seal
  mounting plate: sheet steel, galvanized
- Thickness : Enclosure Body & Door – 3.00 mm , Mounting Plate – 2.50 mm
- Service Temperature Range : - 40 to + 70 Degree Celsius "T6"
- Zone- 1 & 2 Gas, 21 & 22 Dust
- Rittal Name Plate :

Ex II 2 G Ex eb IIC Gb
Ex II 2 D Ex tb IIIC Db IP65


Blue e+ fan-and-filter units
Output categories from 20 – 1,160 m³/h
ISA
ISA Delhi Section
Most powerful.
Most sustainable.
Most dependable.
FRIEDHELM LOH GROUP

Blue e+ fan-and-filter units

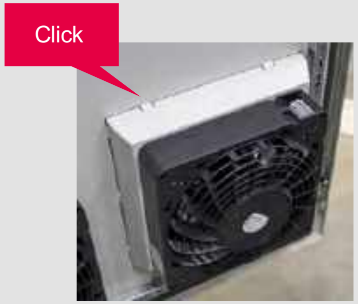
Output categories from 20 – 1,160 m³/h

Optimisation of mechanical design

Unlocking mechanism

- Improved opening mechanism for simple filter changes

Assembly



- Improved enclosure mounting, snaps into position more easily

Design

- Seamless design analogous to the vertical louvred grille in the Blue e+ S cooling units

Blue e+ fan-and-filter units

Output categories from 20 – 1,160 m³/h

EC features at a glance

3 Safety **New**

Improved EMC immunity 3 kV (previously 2 kV)

2 Energy efficiency

Minimal power consumption thanks to maximum motor eficiency

1 Flexible power supply **New**

Wide voltage input 100–240 V*

4 Control via interfaces

- Analog: 0–10 V or PWM signal
- **Digital:** **Connection to IoT interface or customer's own systems via ModBus interface** **New**

5 Monitoring

- Analog: Speed evaluation via tachometer signal **New**
  Alarm relay to notify malfunctions directly
- Digital: **IoT compatibility with exclusive new functions** **New**

* Only for fan-and-filter units 3240.900–3244.900
3245.900 is still available in 230 V and 115 V

All previous interfaces will be retained for maximum compatibility.

Blue e+ fan-and-filter units

Output categories from 20 – 1,160 m³/h

Demand-based filter maintenance

The filter mat’s replacement interval is individually ascertained based on the fan’s virtual operating time.

- The running time and speed are permanently recorded
- Cf. distance to empty in a car

Aim:

To reduce servicing costs with optimum maintenance intervals and more accurate planning

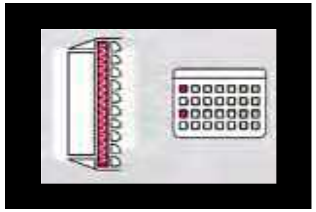
Important:

Maintenance periods are set once only for individual use.

Possible applications

Fan-and-filter units are fitted at remote locations

Companies aiming for demand-based maintenance

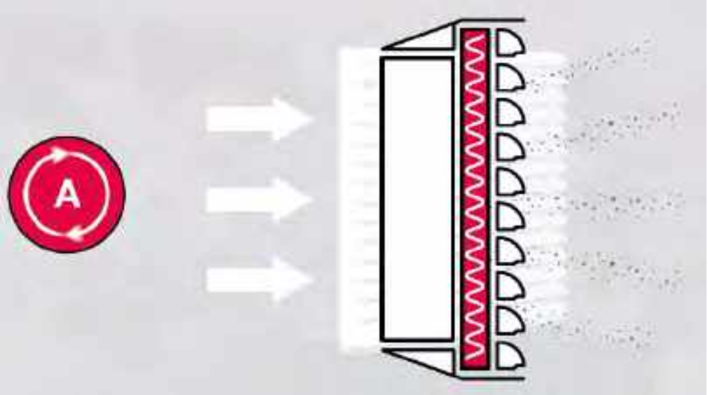


Blue e+ fan-and-filter units

Output categories from 20 – 1,160 m^3/h

Filter cleaning

Periodically blow out the filter by briefly reversing the rotational direction of the fan to remove fine dust particles.



Aim:

To reduce servicing costs by extending the filter life

20%

longer filter life

Rittal enclosure cooling units

10x

higher carbon savings
per year in operation
compared to
manufacturing footprint

1 t CO_2

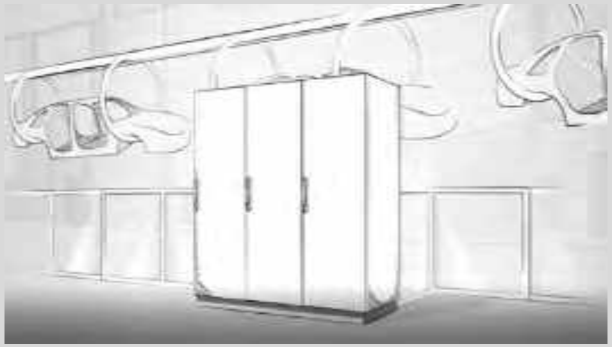
savings per unit/year
corresponds to CO_2
absorption of a beech
tree over 80 years.

ISA Delhi Section

What is meant by Blue e+ technology?

In 2015 Rittal launched **Blue e+**, the most efficient cooling unit generation on the market. It offers energy savings over conventional systems averaging 75%

Blue e+ stands for innovative technology and a longer service life for the components installed due to lower temperature fluctuations, global applicability and future-proof prospects: The IoT interface is predestined for a variety of Industry 4.0 applications.



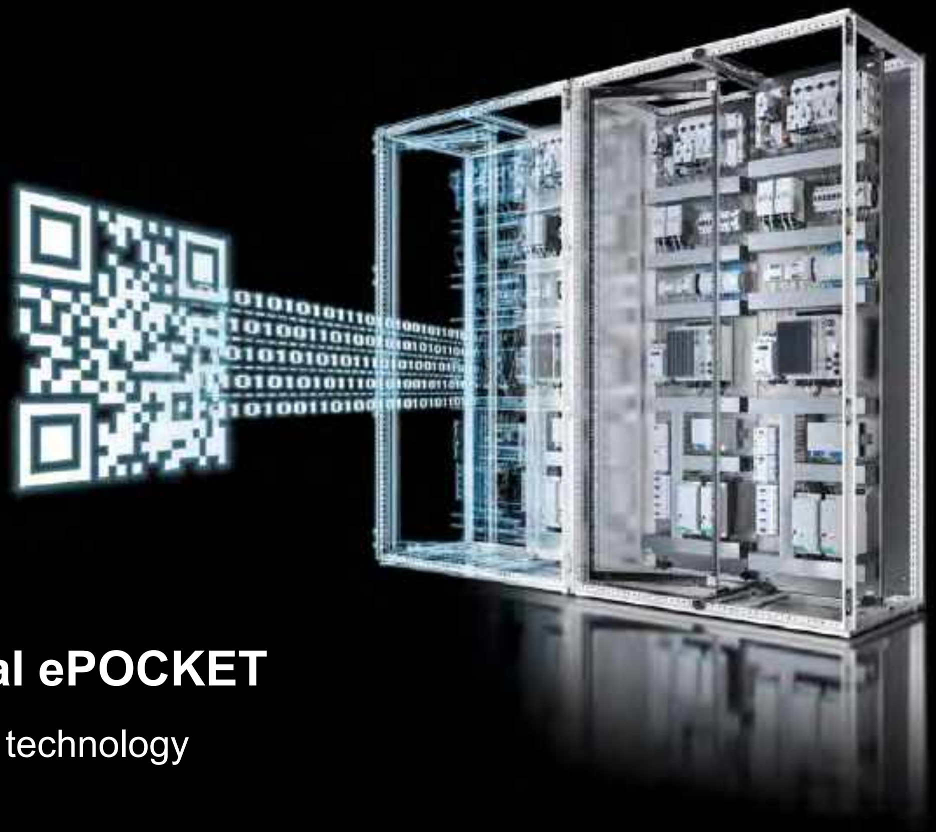
Blue e+ - Fast & Safe Assembly

Optimised handling

- Faster, easier assembly with foam gasket, lighter weight, and consistent mounting cut-outs
- Simplified shipping processing for the customer by printing the serial number on the packaging

Reduced maintenance costs

- Easy and quick access for maintenance and service, as well as a louvred grille with recessed handles for simplified filter replacement



Digital wiring plan Rittal ePOCKET

The digital home of automation technology

Introduction - Wiring Plan Pocket

Rittal ePOCKET

What is a wiring plan pocket?

- Complete documentation of a machine or plant
- Contains documents, such as:
  - circuit diagram
  - operating instructions
  - maintenance plans etc.
- Must be handed over to the operator with the commissioning (legal documentation obligation)
- Is placed in one of the enclosures of the machine/plant for quick access in case of service

Introduction - Wiring Plan Pocket

Rittal ePOCKET

Where is a wiring plan pocket used these days?

Manufacturing phase

Panel builder

- Orders enclosures and equipment
- Orders wiring plan pocket

OEM

- Consolidates the necessary documents
- Fills wiring plan pocket

Operation phase

Operator

- Fills / uses circuit diagram over the lifetime of the machine

What are challenges of conventional wiring plan pockets?

Rittal ePOCKET

Decentralized storage of documents in control cabinets in the workshop

Redundant service and maintenance process with media discontinuity

No up to date documentations

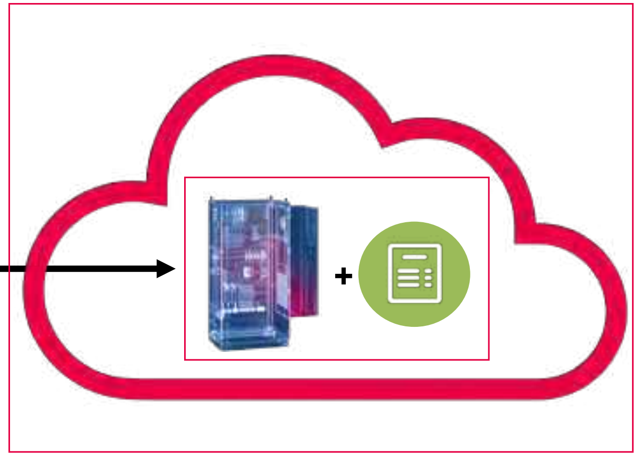
Error cases and solutions are **noted with a note at most**

No overview of **where** wiring plan pockets are located during or after modifications

No overview of current processes / **maintenance** / **services**

What is the digital wiring plan pocket and what advantages does it offer?

Rittal ePOCKET



EPLAN Cloud environment

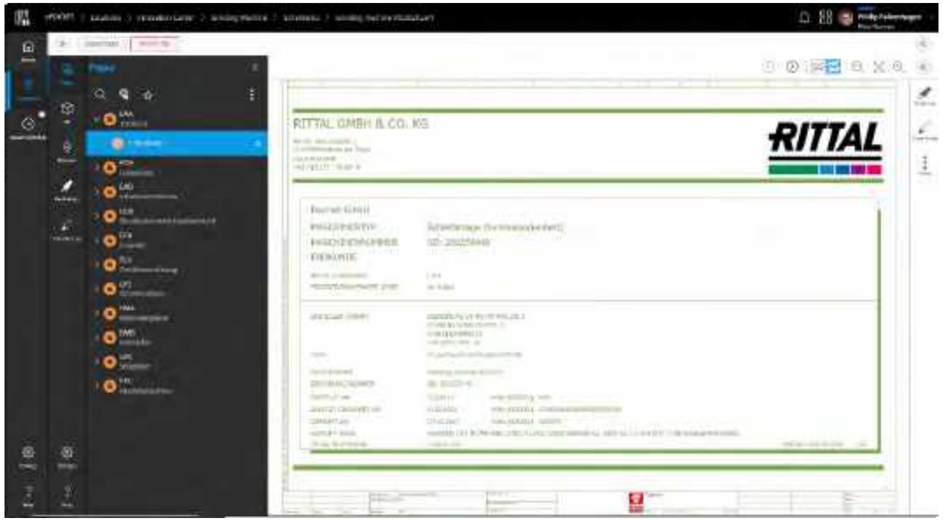
The **QR code connects physical Rittal enclosures with the digital circuit diagram pocket** in the EPLAN Cloud environment

Filing of **project-specific circuit diagram documentation** by the customer

What is the digital wiring plan pocket and what advantages does it offer?

Rittal ePOCKET

- **Maintaining an overview** through central storage of machine documentation
- **Fast workflow** through a completely digital process flow
- **Error-free work** through the use of the latest documentation
- **Know what has been adjusted** in projects through change tracking in the project including notifications
- **Easy access** to the complete machine or plant documentation by using the Rittal QR code



Why you should use the digital wiring plan pocket!

Rittal ePOCKET

1. Keep track of your wiring plan pockets through a central storage location
2. Faster workflow due to fully digitally mapped process without media breaks
3. Error-free work due to constant availability of the latest documentation
4. Always up-to-date through change tracking within projects incl. notifications
5. Easy access to projects by scanning the linked Rittal QR code
6. Resource-saving provision of the wiring plan pocket via a digital process
7. Simplified communication between internal employees as well as with external companies
8. Efficient error detection process through integrated EPLAN eView workflow

ISA Delhi Section

Thanks !!

Importance of Alarm Management in Petroleum and Power Generation

Presented By: Kapilkumar Gohil

An ISO 9001:2015 Certified Company

International Society of Automation
Delhi Section

SSM InfoTech Solutions Pvt. Ltd.

Agenda

01

Introduction

About Us

02

Current Automation state and Alarm issues

03

Alarm Management Life Cycle

Overview of Life cycle as per EEMUA/ ISA Guidelines

04

X-Force AIMS Technical

X-Force Alarm Management Software Overview

Who are We?

SSM InfoTech At a Glance

Serving Automation Industry for more than 22 Years

OEM : Our own IP (X-Force)

20+ Automation Software Products

Exclusive System Integrator of

- Automation
- Software
- IT / OT Technology

VALUE PROPOSITION

Comprehensive Modular Platform

End-to-End Turnkey Solutions

Strong Domain Expertise (SME)

In-house System Integration & Dev. Capabilities

Delivery Excellence

Robust Implementation Frameworks

Partners Eco System

Executed 50+ Turnkey Projects for Automation & Real-time C&C

300+ Satisfied Customer

250+ Employees

Registered in UAE since 2016 – Our partner Telectron UAE.

2001	Company Establishment
2002	First C&C (WW) System Integrator in India & Registered Our Own IP for AIMS
2004	Partnered with Schneider Electric for Automation Solutions in Process Industry
2010	Exclusive Partnership with Aveva
2014	Commissioned highest C&C Platform with Integration of 1M Tag in Asia Pacific
2017	Delivered C&C Platform for more than 2 Lac devices for largest Indian Company
2019	Commissioned Operations Centre for largest Oil & Gas Distribution Company
2020	Implementing C&C platform in Global Process Company

Current state of Automation and Alarm issues

Current Automation state and Alarm

As systems have evolved from hardwire to computer control, alarms have become easier and less expensive to implement leading to more and less purposeful alarms. At the same time certain issues are emerge in the plant operations like

- Increase meaningless Alarm
- Difficulties to handle and prioritize Alarm in timely manner.
- Add or remove Alarm without proper change of Management.
- Alarm lack any actionable response.

This condition is totally paradoxically as it creates more complexity for operator.

What have we neglected ?

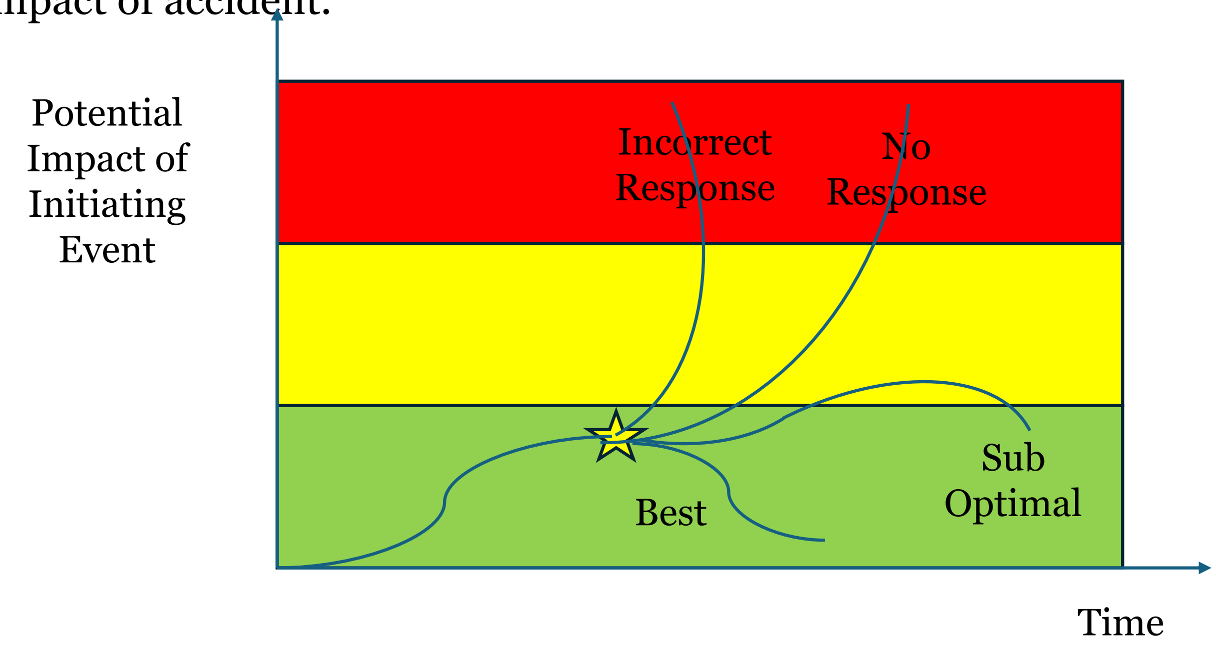
We have focused on the technology

We are still convinced that the more alarms we have the better protected is the plant

We have lost of “ the human in the loop”

Operator response and Potential impact

Overall, we need a better situational awareness in the current state of plant Automation. In this scenario, Good Operator Decision Support is paramount to success! Better situational awareness avert possible impact of accident.



Good decision Support

- Reduce errors
- Decrease time to implement response.
- Manages side effects .
- Increase awareness

How is your alarm system performing?

Before going to jump on Good Alarm Design some specific questions need to answer about current state of Alarm and its handling .

Do you recognize any of these behaviors?

- Operators acknowledge / silence alarms without looking at or acting on them?
- Incidents or near-incidents where operators missed alarms?
- Too many alarms without well-defined actions?
- Alarms disabled / suppressed for long periods without review?

Do you measure?

- Number of alarms / hour?
- Number of alarms disabled / suppressed?
- Time to silence / acknowledge?

How stressed are your operators?

Do you have a documented alarm philosophy?

Good Alarm Design

Clearly a well-designed Alarm System is key to identifying abnormal Situations and reacting appropriately within an adequate time.

So what guidance is there for Good Alarm Design?

Alarm Design Guidance

There are **numerous** sources which give guidance on good alarm system design but three are the major one.

- EEMUA 191
- ANSI / ISA 18.2
- IEC 62682

EEMUA 191
Alarm system- A guide to design management and procurement design and Management

ISA -18.2
Management of Alarm systems for the process industries.

IEC 62682
Management of Alarm system for the process industries.

Alarm Management Life Cycle

Alarm Management Life Cycle

Overall Alarm Management are divided in three major points:

Philosophy

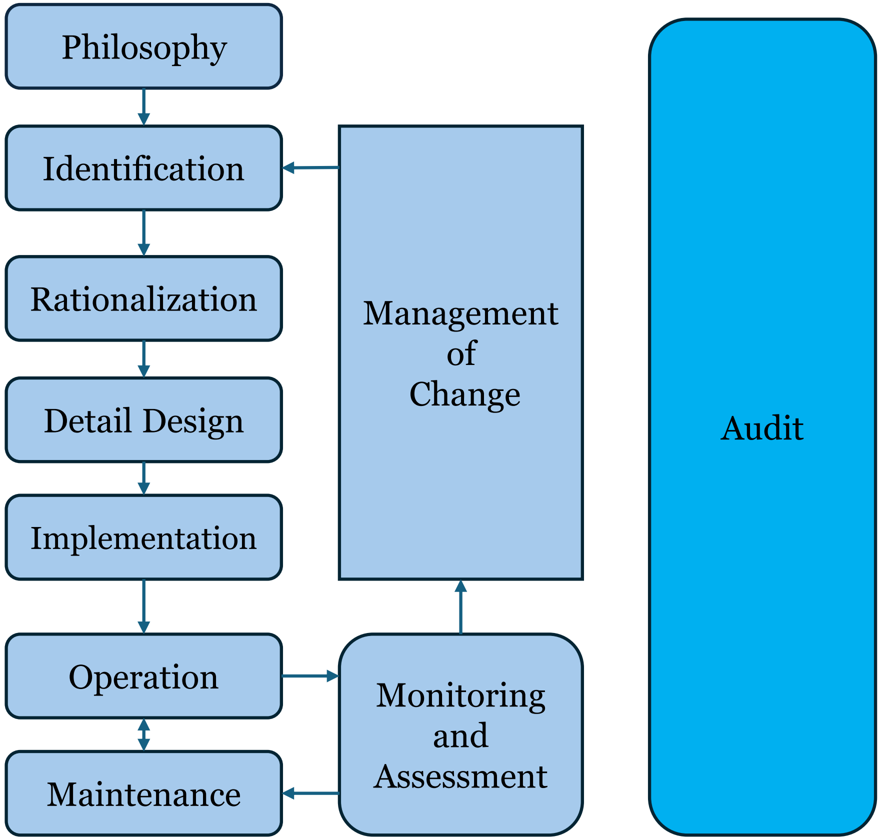
- Generally, an entry point for new installations.
- Can be used as the basis for the alarm system requirements specifications

Monitoring and Assessment

- Begin monitoring the existing alarm system and assessing performance.
- Problem alarms can be identified and addressed through maintenance or management of change

Audit

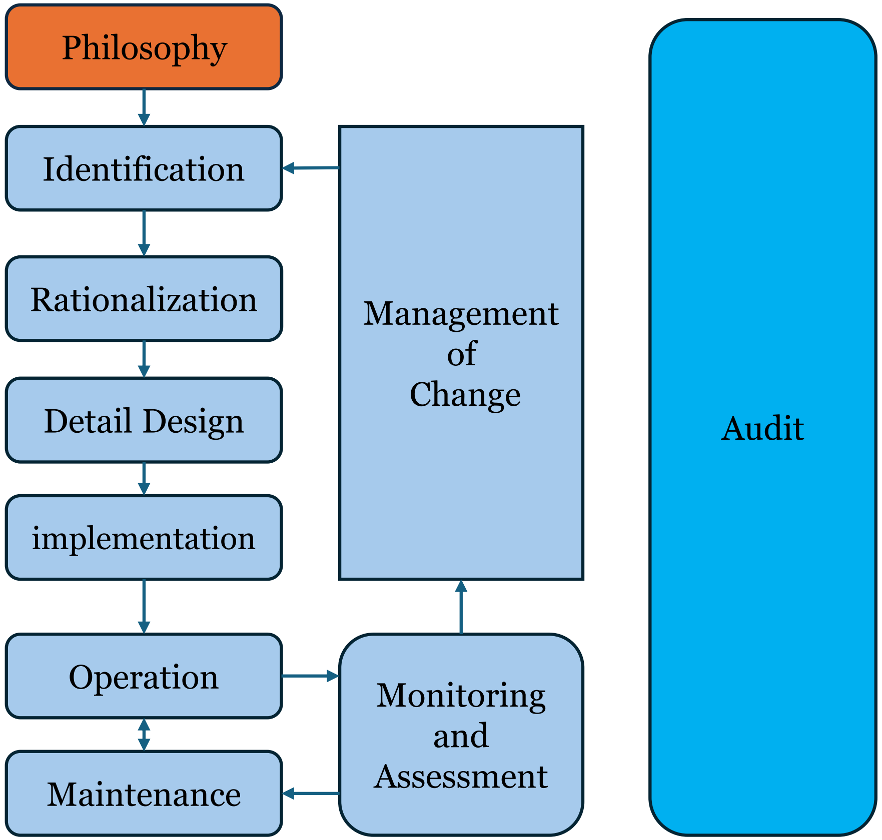
- Reviewing processes, etc in use.



Alarm Philosophy

Philosophy

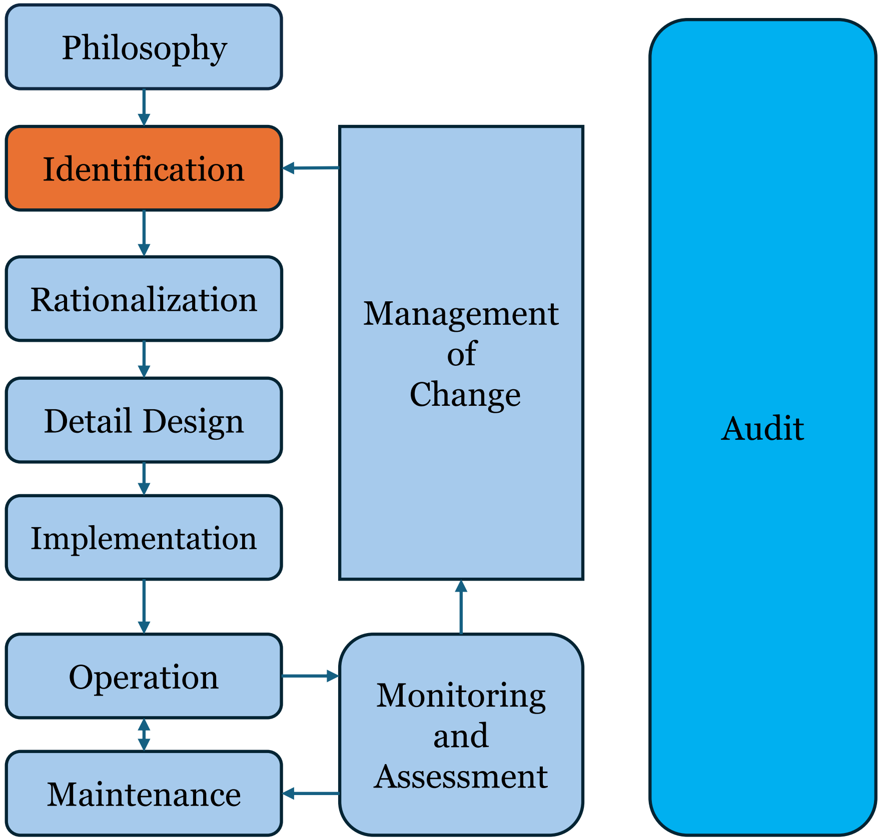
- Alarm philosophy documents the site approach to alarm management.
- Includes the definitions and principles.
- Details of the practices and procedures for each of the remaining life cycle stages.
- **This define your Target and How you intend to reach it.**



Identification

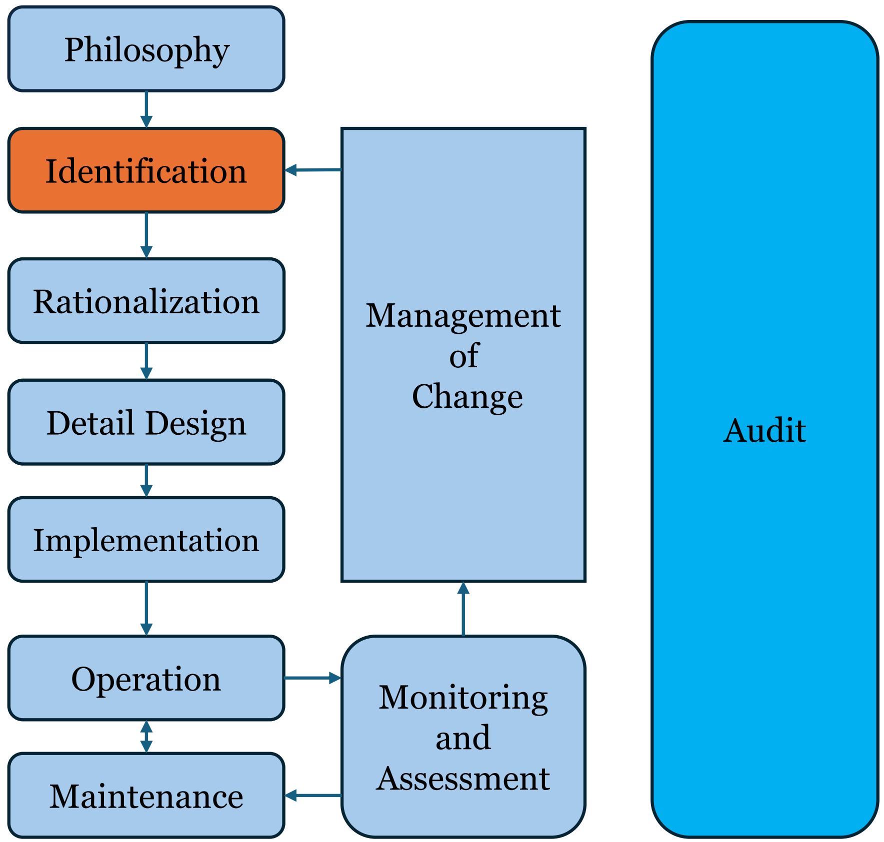
Identification is an important state to identify the current Alarm performance parameter which define the how current plant conditions with respect to guidelines. A standard performance benchmarking required given analysis with minimum 30 days alarm data.

1. Top 10 Bad Actor identification
2. Chattering Alarm
3. Stale Alarm
4. Duration Analysis of Alarm
5. Day / Shift wise Report
6. KPI Report



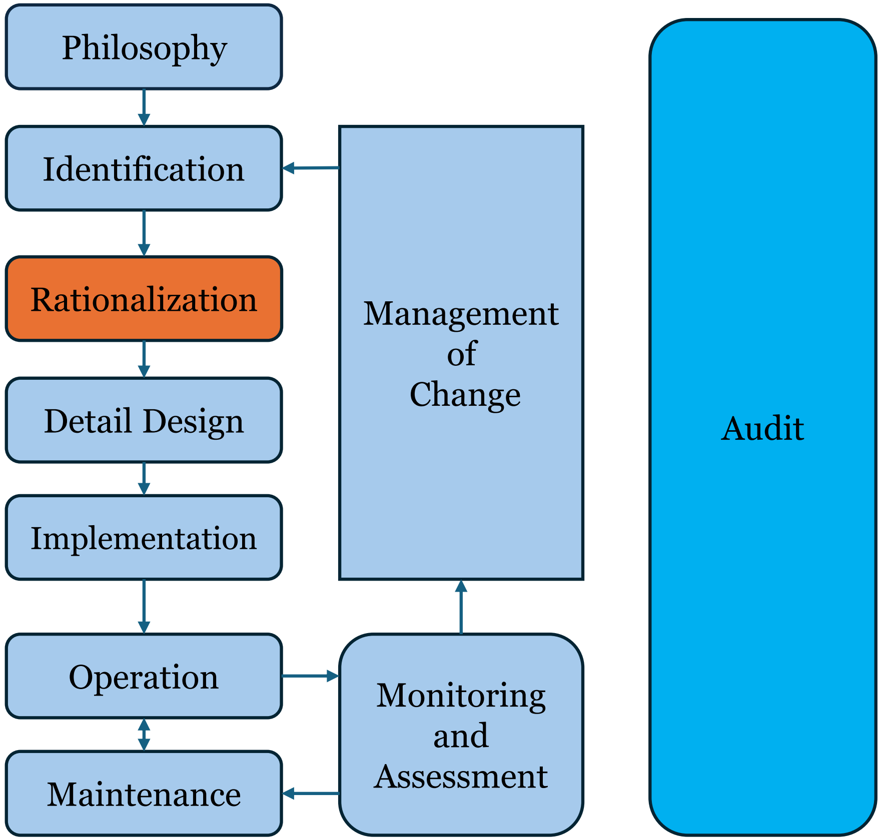
Identification

Alarm Performance Metrics Based upon at least 30 days of data		
Metric	**Target Value**	
Annunciated Alarms per Time:	Target Value: Very Likely to be Acceptable	Target Value: Maximum Manageable
Annunciated Alarms Per Day per Operating Position	~150 alarms per day	~300 alarms per day
Annunciated Alarms Per Hour per Operating Position	~6 (average)	~12 (average)
Annunciated Alarms Per 10 Minutes per Operating Position	~1 (average)	~2 (average)
Metric	**Target Value**	
Percentage of hours containing more than 30 alarms	~<1%	
Percentage of 10-minute periods containing more than 10 alarms	~<1%	
Maximum number of alarms in a 10 minute period	≤10	
Percentage of time the alarm system is in a flood condition	~<1%	
Percentage contribution of the top 10 most frequent alarms to the overall alarm load	~<1% to 5% maximum, with action plans to address deficiencies	
Quantity of chattering and fleeting alarms	Zero, action plans to correct any that occur.	
Stale Alarms	Less than 5 present on any day, with action plans to address	
Annunciated Priority Distribution	3 priorities: ~80% Low, ~15% Medium, ~5% High or 4 priorities: ~80% Low, ~15% Medium, ~5% High, ~<1% "highest" Other special-purpose priorities excluded from the calculation	
Unauthorized Alarm Suppression	Zero alarms suppressed outside of controlled or approved methodologies	
Unauthorized Alarm Attribute Changes	Zero alarm attribute changes outside of approved methodologies or MOC	



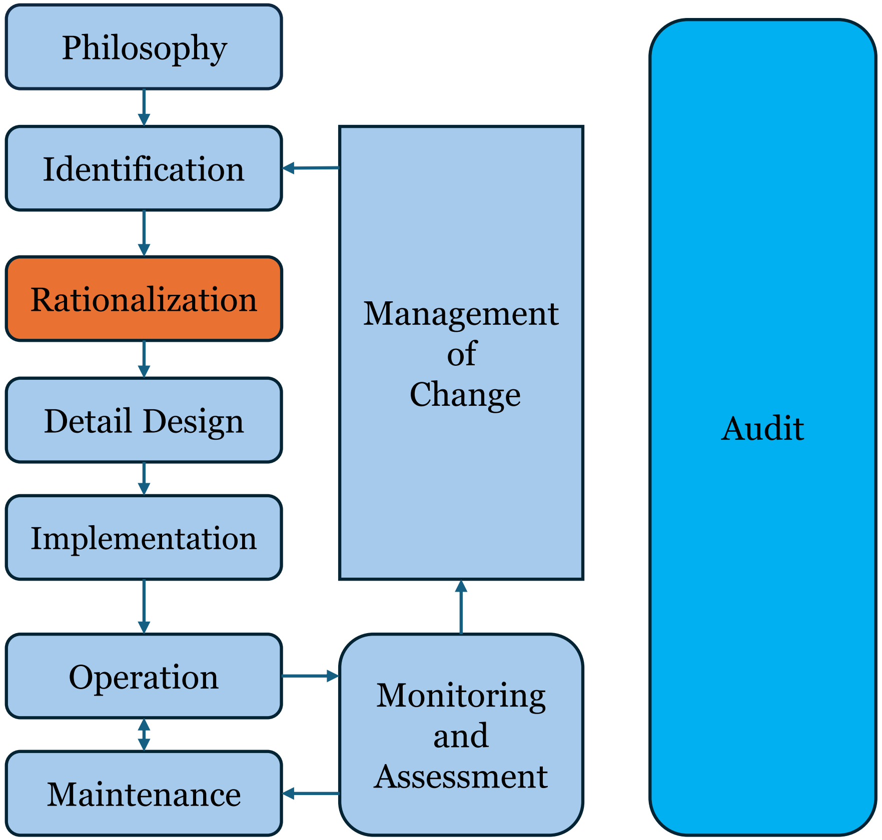
Rationalization

- Form team to review all alarms
- Define purpose of each alarm – some alarms may be
- reclassified as events
- Define new priority using EEMUA and ISA recommendations.
- Determine required operator response and alarm
- description
- X-Force AIMS Create a Master Alarm Database (MADB) for guidance and training purpose.



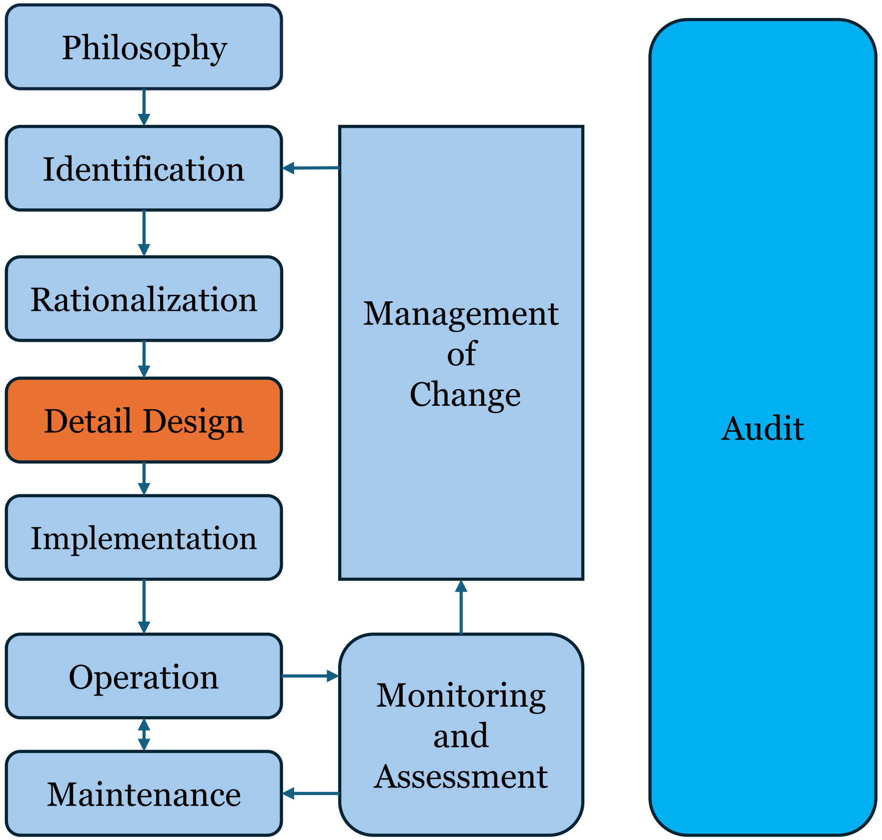
Rationalization

Tag ID	FI 2009
Tag Description	PB Feedwater Flow
Location	Area 1
Range	to Unit: kg/hr.
Alarm Type	High Alarm
Priority	Advisory
Limit	250 Kg/hr.
Time to Respond	15 minutes
Classification	General
Causes	
Confirmation	
Consequence of No Action	
Corrective Actions	
Alarm Type	Low Alarm
Priority	Warning
Limit	100 kg/hr.
Time to Respond	10 minutes
Classification	Safety Critical
Causes	
Confirmation	
Consequence of No Action	
Corrective Actions	



Detail Design

- Basic configuration of alarms
- Human machine interface (HMI) for alarms and Dashboard for accessing real time and history trend of Alarm
- Advanced methods of alarm management line dynamic alarm suppression and shelving.



Implementation

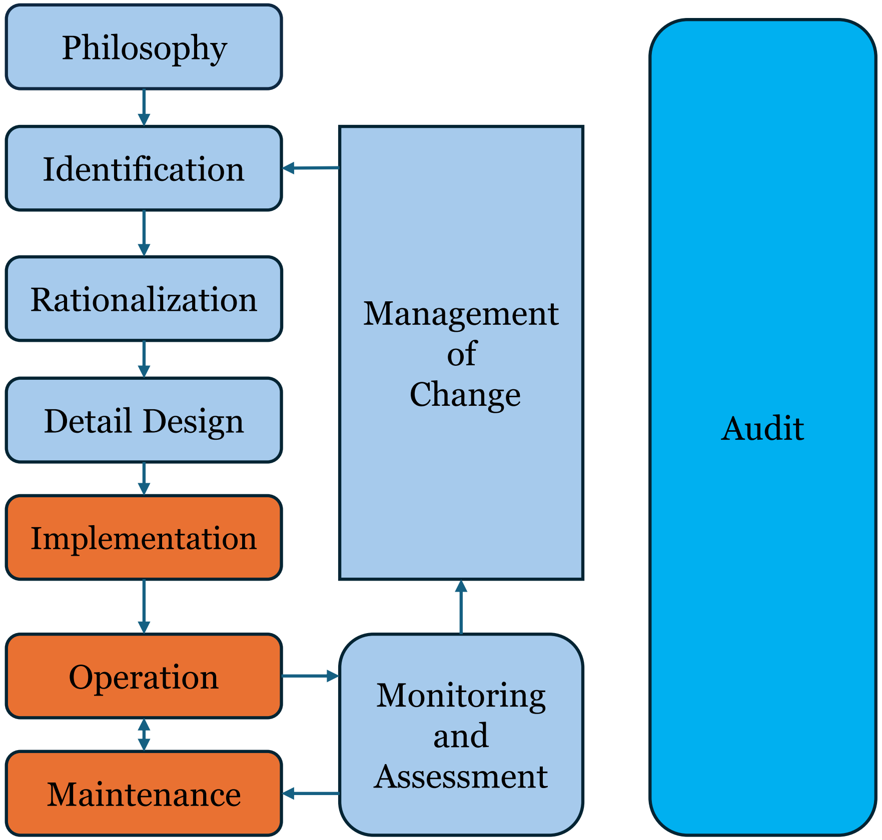
- Stage where the design is put into service
- Training for the operator included
- Initial testing of the alarm system functions

Operation

- Alarm is in service
- Reporting abnormal conditions to the operator

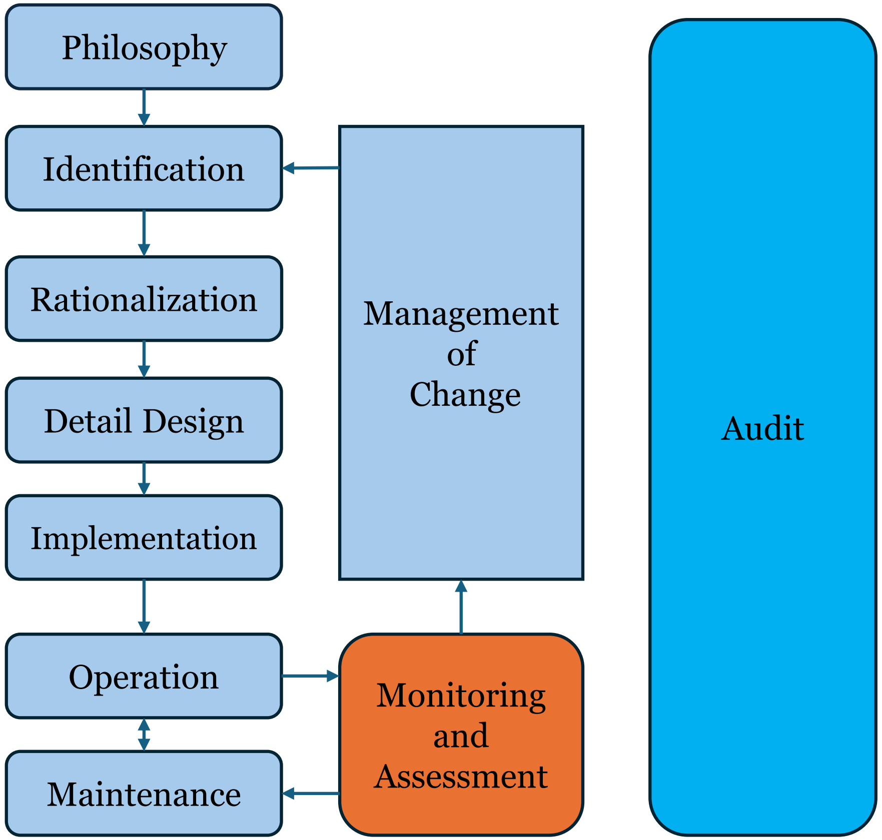
Maintenance

- Process measurement instrument may need maintenance
- Repair frequency can be scheduled or determined by monitoring
- Periodic testing is a maintenance function



Monitoring and Assessment

- Periodic collection and analysis of data from alarms
- Should take place frequently (daily or weekly)
- Primary method to detect problems; nuisance alarms, stale alarms, and alarm flood.
- Require **Alarm reports like Frequency analysis report, KPI report, Chattering Alarm report** etc.
- Alarm Management Software Tool will be helpful in this assessment task.

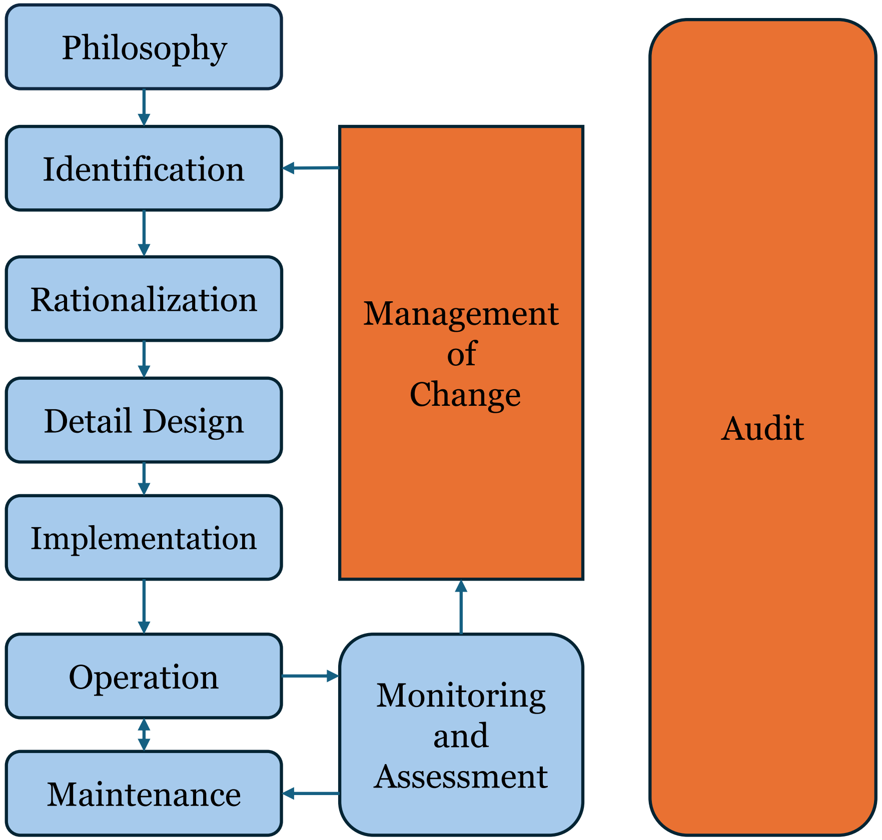


Management of Change

- Structured process of approval and authorization
- Make additions, modifications, and deletions of alarms from the system

Audit

- Periodic audit of the alarm system and the processes detailed in the alarm philosophy
- May determine the need to modify processes, the philosophy, the design guidance



Key features criteria for Alarm Management Tool

Given points must be consider before selection Alarm Management Tool.

1 Comply with the standard: EEMUA 191 / ISA 18.2 / IEC 62682

2 Able to integrate with all kind of DCS / PLC / SCADA

3 Actionable reporting for performance assessment.

4 Have a user-friendly dashboard to visualize current and historical alarm trend

5 Rationalization features to check alarm validity and documentation.

6 Tool must have tested at max level of Alarm incoming (15 Lakh / per day)

7 Compatible with future technology like Data Diode

8 Critical Alarm Handling through LVS for better situational awareness.

X-Force
Alarm Information Management System

X-Force : Alarm & Information Management Software

Enhanced Operator Efficiency

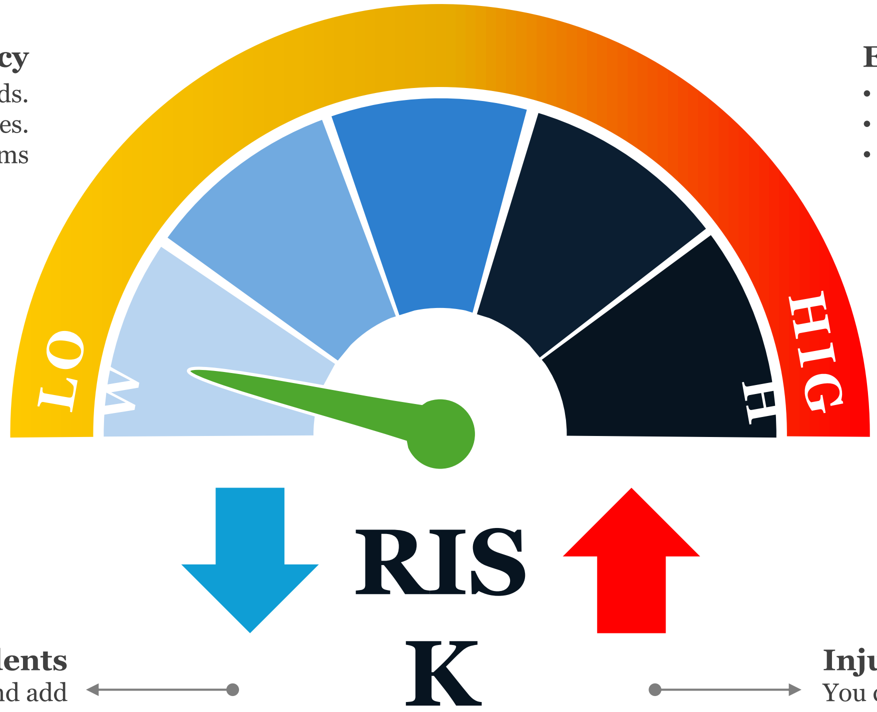
- Avoided alarm floods.
- Identified root causes.
- Eliminated nuisance alarms

Enhance Profitability

- Reduced variability
- Maximized plant up time
- Prevented equipment damages

EEMUA-191

IEC 62682



ANSI / ISA 18.2

EPRI 2005

Environmental Incidents
You can simply impress your audience and add a unique zing and appeal to your Presentations.

Injury to personnel
You can simply impress your audience and add a unique zing and appeal to your Presentations.

Features

Compliance

- EEMUA 191
- ISA 18.5
- IEC 62682
- EPRI (2005)

Technology

- Postgres / MSSQL Support
- AD Authentication or SSO
- Role based authorization
- IT Friendly – Patch Management , Backup, Server hardening

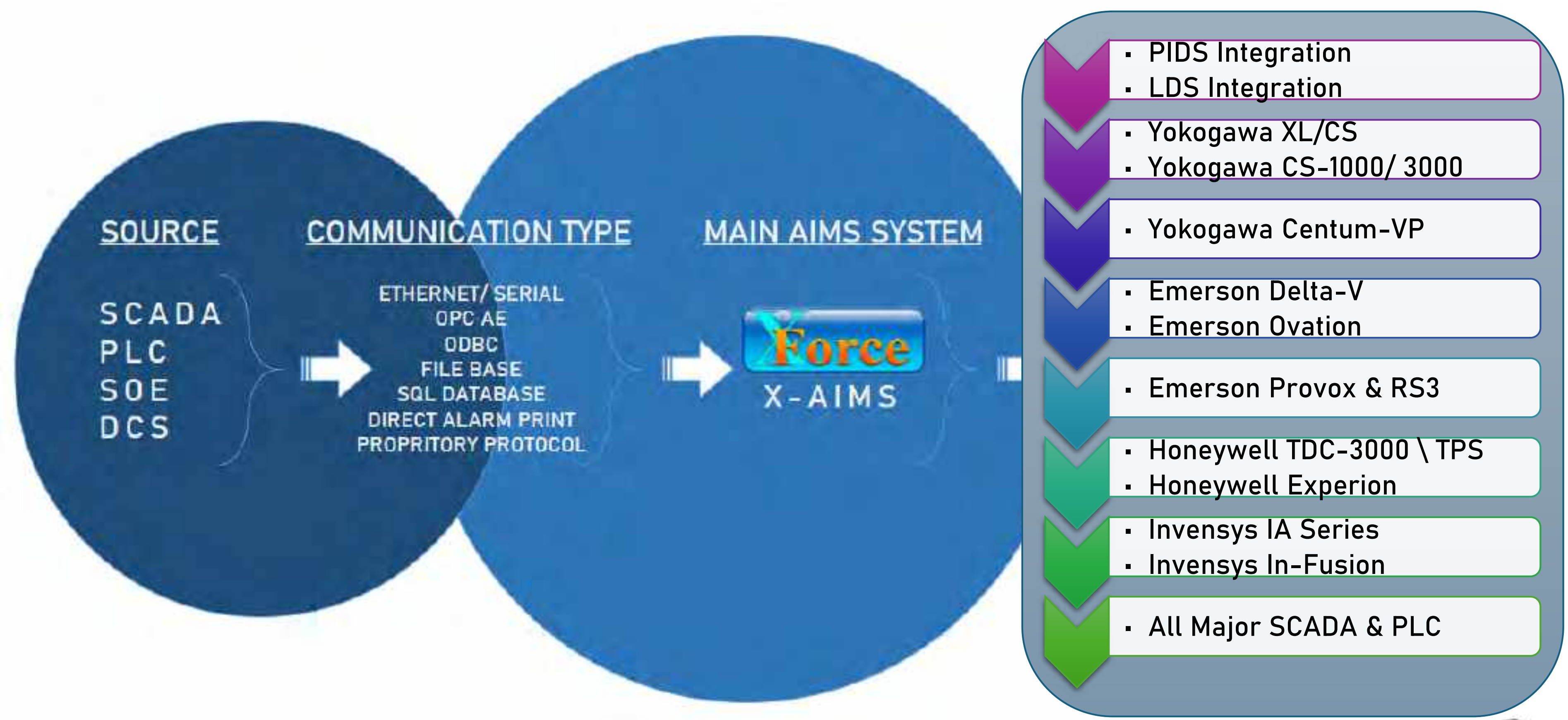
Full Alarm Life cycle coverage

- Master Alarm Database
- Rationalization and Documentation
- Change Management
- Root Cause Analysis

Enterprise Features

- Cyber Security Support
- Tired Architecture – 2 or 3 Level
- Enterprise Dashboard
- Enterprise Integrations

CONNECTIVITY AND INTEGRATION- WORK FLOW



Operator Guidance / Decision Support

Tag Name : LIC-9101 Alarm Type: Low Area: 9100 (Tank Farm)

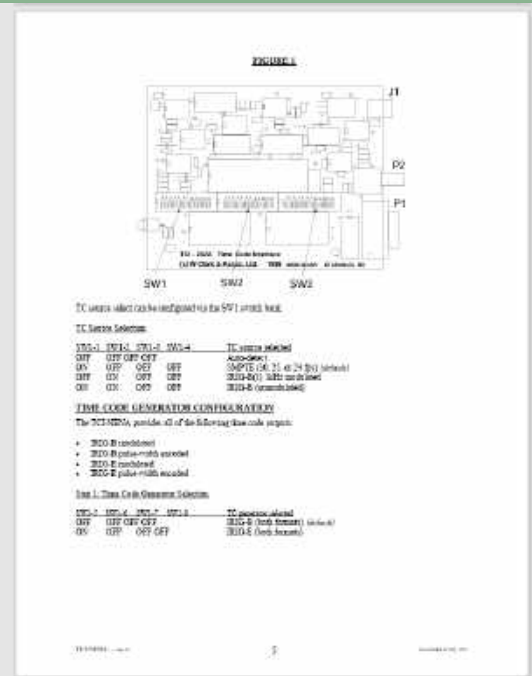
Description : Tank 9101 Water Level Low Alarm

Classification : Process Alarm Current : 7.2 (Limit:8.0) CM

Consequence of No-Action
Temperature can rise due to low water level in tank.
Safety Hazard

Cause -1
Water Inlet valve stuck
Check valve output for VLV-9102
Manual opening from field Location OPX22

Cause -2
No water flow from day tank
Check level of day tank LI-9002
Call Utility Operator for water level in TK-9002



Centrifugal Pump Repair and Maintenance Procedure- Part 1

Instrument : Mr. Paresh – 9998823941

Utility : Mr. S Ghosh – 9998823941

Situational Awareness - Control Room Large Display Software

Critical Alarm Handling

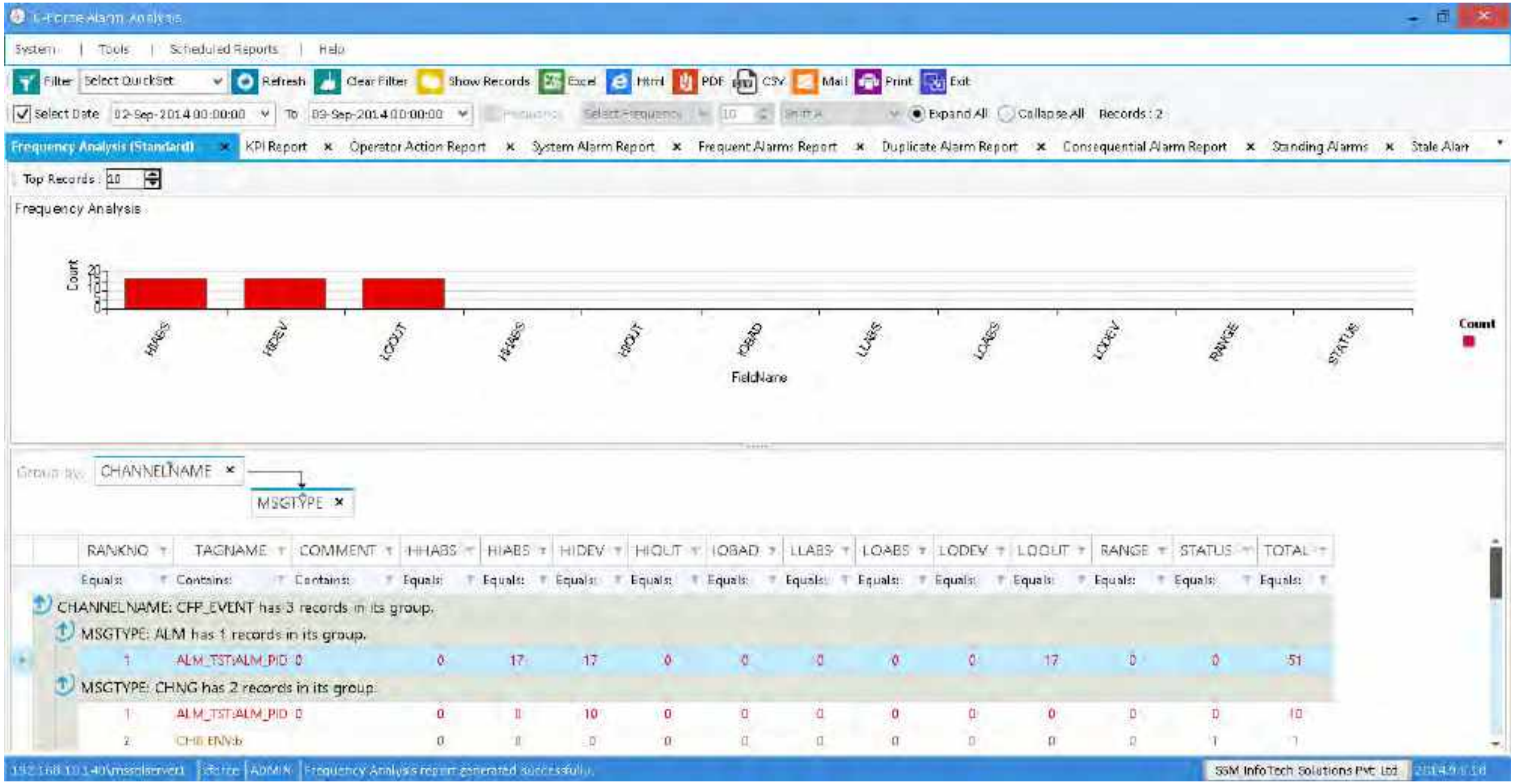
Reports

- Summary
  - System Performance
  - KPI Report – SA 18.2 / EEMUA
  - X-Force Summary Report
- Alarm Count
  - Alarm Burst
  - Alarm Flood
  - Top N Alarms by Tag + Type (Frequency Analysis)
  - Top N Alarm by Tag Vs Type
  - Trip Analysis
  - Tree-map Analysis
- Alarm Rate
  - Alarm Rate
  - Pick Alarm Rates
  - Alarm Rate > 30/Hour
  - Monthly Rate Analysis
  - Yearly Rate Analysis
- Co-Relations
  - Chattering
  - Consequential
  - Duplicate
  - Operator Action Analysis
- Priority
  - Priority -> Count
  - API Scatter Chart
- Type
  - Type -> Count
  - Tag / Type -> Count
- Durations
  - Time to Return
  - Time to Acknowledge
  - Standing Alarms
  - Stale Alarms

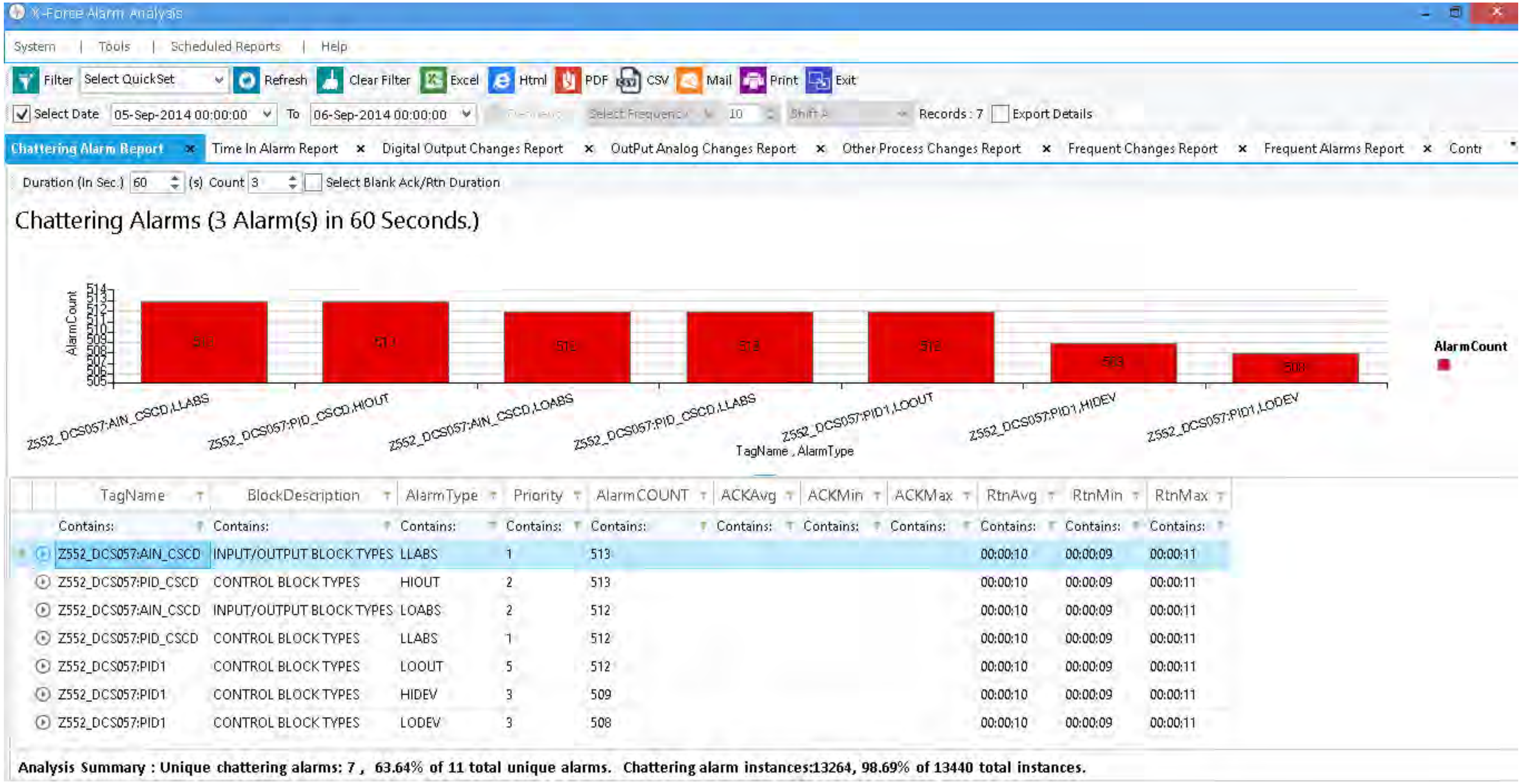
Reports

- Event
  - Event Analysis
- Operator Action
  - Operator Changes
  - Configuration Changes
- System Diagnostics
  - Current Alarms
  - Count by Types
- Configuration Analysis
  - Tag Configuration (Enable, Suppressed, Priority, Alarm Limits)
  - Priority wise distribution
  - Type wise distribution
  - Type + Priority distribution

Frequency Alarm Analysis - Report



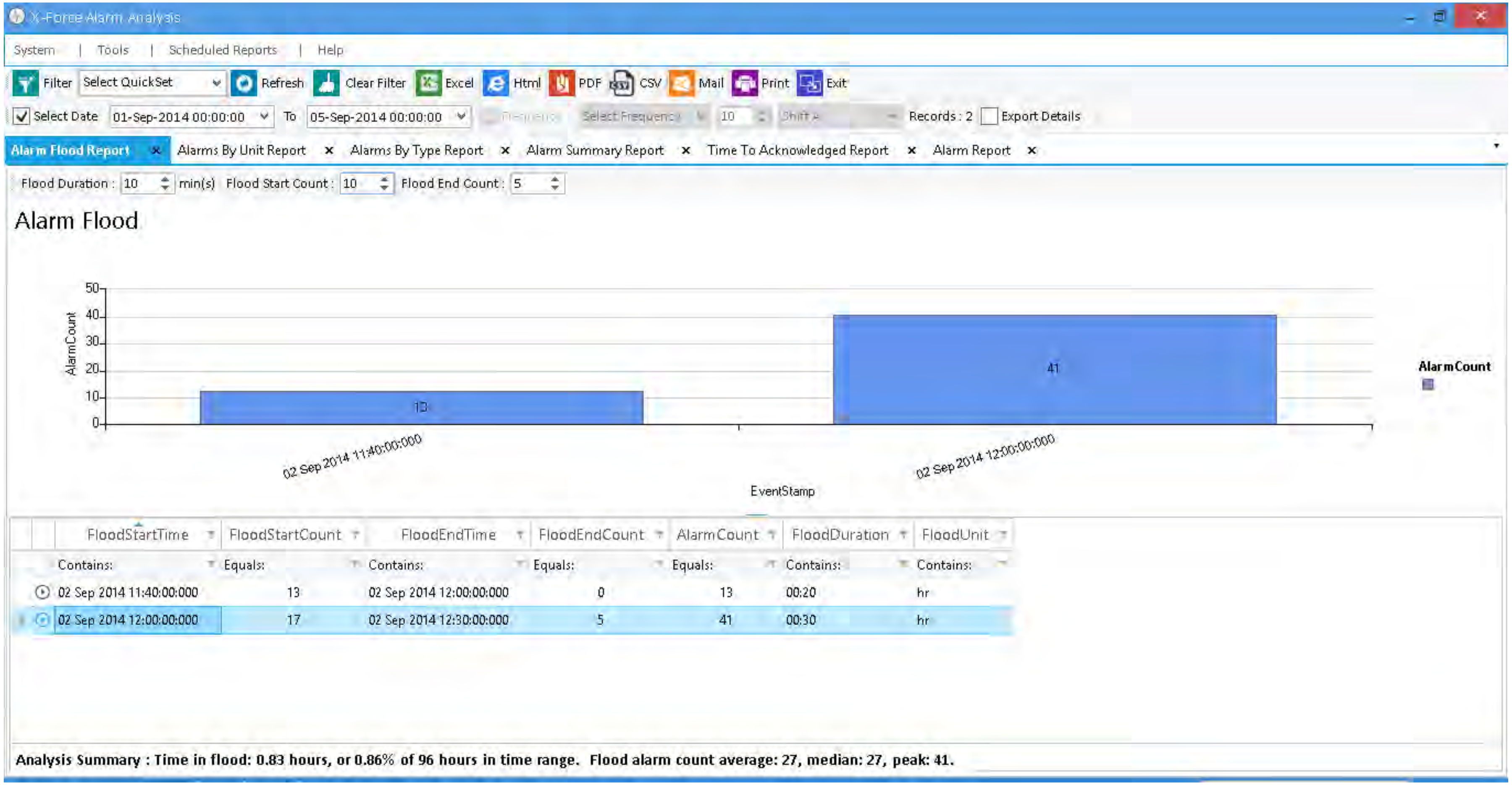
Generated Reports – Chattering Alarm Report



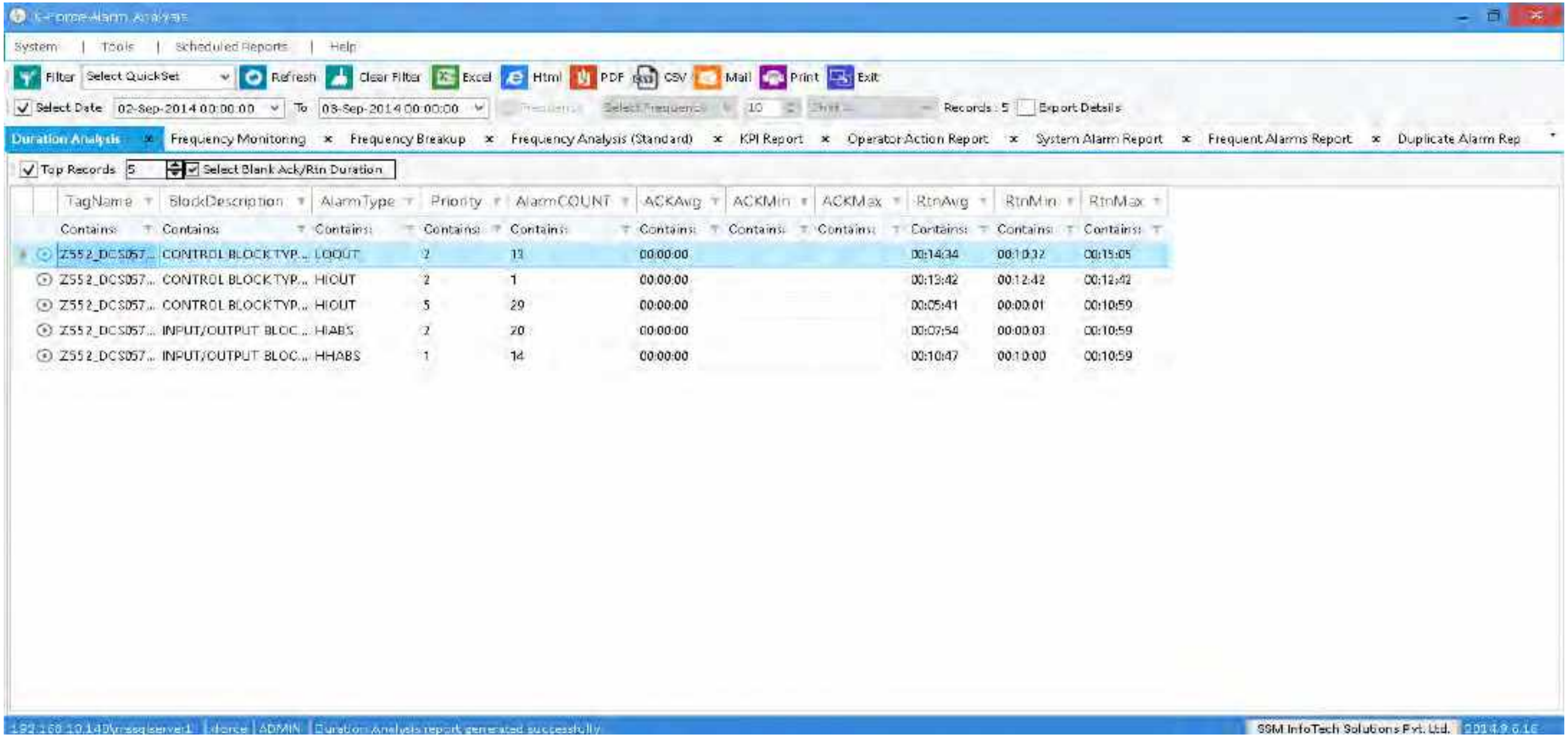
TagName	BlockDescription	AlarmType	Priority	AlarmCOUNT	ACKAvg	ACKMin	ACKMax	RtnAvg	RtnMin	RtnMax
Contains:	Contains:	Contains:	Contains:	Contains:	Contains:	Contains:	Contains:	Contains:	Contains:	Contains:
Z552_DCS057:AIN_CSCD	INPUT/OUTPUT BLOCK TYPES	LLABS	1	513				00:00:10	00:00:09	00:00:11
Z552_DCS057:PID_CSCD	CONTROL BLOCK TYPES	HIOUT	2	513				00:00:10	00:00:09	00:00:11
Z552_DCS057:AIN_CSCD	INPUT/OUTPUT BLOCK TYPES	LOABS	2	512				00:00:10	00:00:09	00:00:11
Z552_DCS057:PID_CSCD	CONTROL BLOCK TYPES	LLABS	1	512				00:00:10	00:00:09	00:00:11
Z552_DCS057:PID1	CONTROL BLOCK TYPES	LOOUT	5	512				00:00:10	00:00:09	00:00:11
Z552_DCS057:PID1	CONTROL BLOCK TYPES	HIDEV	3	509				00:00:10	00:00:09	00:00:11
Z552_DCS057:PID1	CONTROL BLOCK TYPES	LODEV	3	508				00:00:10	00:00:09	00:00:11

Analysis Summary : Unique chattering alarms: 7 , 63.64% of 11 total unique alarms. Chattering alarm instances:13264, 98.69% of 13440 total instances.

Generated Reports – Alarm Flood Report



Generated Reports –Duration Analysis Report



X-Force Web Dashboard

X-Force AIMS Dashboard having various types of Web Dashboard:

- ✓ Major Dashboard :
- ✓ Daily
- ✓ Weekly
- ✓ Monthly
- ✓ Yearly
- ✓ SITE KPI Dashboard :
  - Alarm KPI Dashboard as per EEMUA 191 & ANSI/ ISA Alarms Guidelines

Web Analytical Dashboard :

(Site KPI / Plant Dashboard / Daily Dashboard / Weekly Dashboard / Monthly Dashboard)

SITE KPI DASHBOARD

All Location's accessibility at single click- Centralized dashboard for Head Office

Key Performance Indicator

AxiNation Group of Companies, AxiPharma Devision, Ankleshwar

EEMUA 191 - KPI Report

<u>13-Nov-2023</u>

Force

ALARMS / DAY / OPERATING POSITION	ALARMS / SHIFT / OPERATING POSITION	ALARMS / HOUR / OPERATING POSITION	ALARMS / 10 MINUTES / OPERATING POSITION	% OF TIME ALARM SYSTEM IS IN FLOOD POSITION	% OF HOURS CONTAINING MORE THAN 30 ALARMS
139	47	6	1	2.76%	4%
Limit < 144	Limit < 48	Limit < 6	Limit < 1	Limit < 1% of Time	Limit < 1% of Time
% OF 10 MINUTE PERIOD CONTAINING MORE THAN 10 ALARMS	NUMBER OF CHATTERING ALARM	NUMBER OF STANDING ALARMS	1ST (HIGH) PRIORITY ALARM	2ND (MEDIUM) PRIORITY ALARM	3RD (LOW) PRIORITY ALARM
5.78%	1	7	2.60%	18.90%	78.50%
Limit < 1% of Time	Limit < 48	Limit < 10	Limit < 5%	Limit < 15%	Limit > 80%

SSM

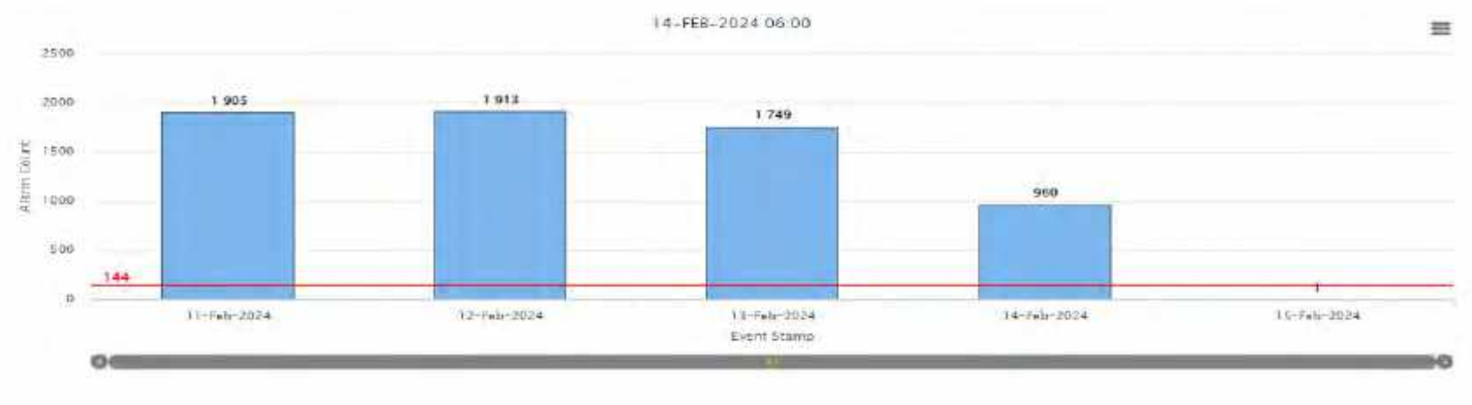
Web Analytical Dashboard : Screens

PLANT DASHBOARD

KPI Details

KPIDescription	AcceptableLimit	ActualValue	Deviation
ANNUNCIATED ALARMS PER DAY PER OPERATING POSITION	< 144 ALARMS / DAY / OPERATING POSITION	960.5	816.5
ANNUNCIATED ALARMS PER SHIFT PER OPERATING POSITION	< 48 ALARMS/ SHIFT / OPERATING POSITION	320.17	272.17
ANNUNCIATED ALARMS PER HOUR PER OPERATING POSITION	< 6 ALARMS / HOUR / OPERATING POSITION	40.02	34.02
ANNUNCIATED ALARMS PER 10 MINUTES PER OPERATING POSITION	1 ALARM / 10 MINUTES / OPERATING POSITION	6.67	5.67
PERCENTAGE OF TIME ALARM SYSTEM IS IN FLOOD POSITION	< 1%	93.75%	92.75%
PERCENTAGE OF HOURS CONTAINING MORE THAN 30 ALARMS	< 1%	100%	99%
PERCENTAGE OF 10 MINUTE PERIOD CONTAINING MORE THAN 10 ALARMS	< 1%	77.78%	76.78%
NUMBER OF CHATTERING ALARM	1	4	3
1ST (HIGH) PRIORITY ALARM	< 5%	0%	0%

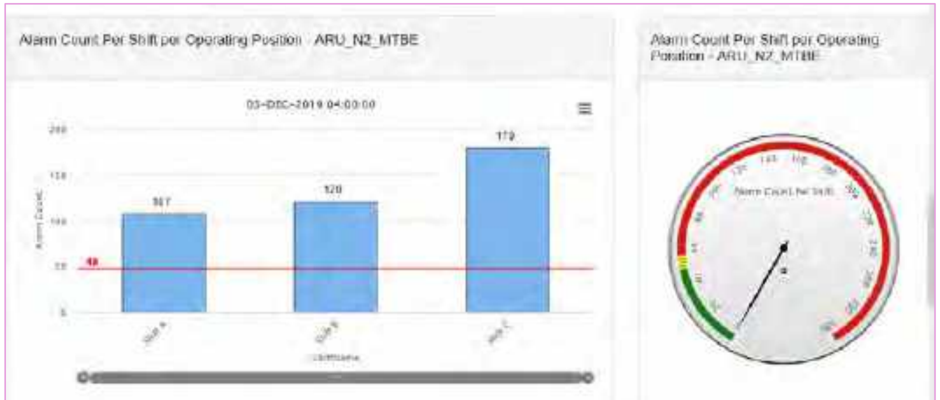
Total Alarm Count per Day per Operating Position



Total Alarm Count per Day per Operating Position

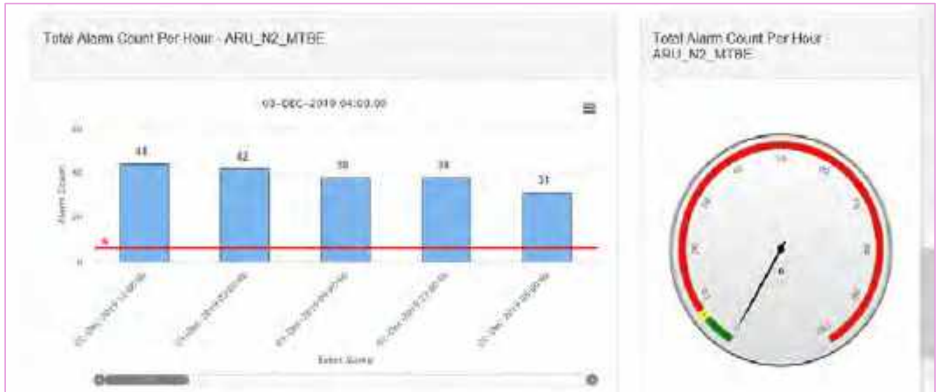
Web Analytical Dashboard : Screens

PLANT DASHBOARD



Alarm Count Per Shift Per Operating Position

Percentage of hours having more than 30 alarms

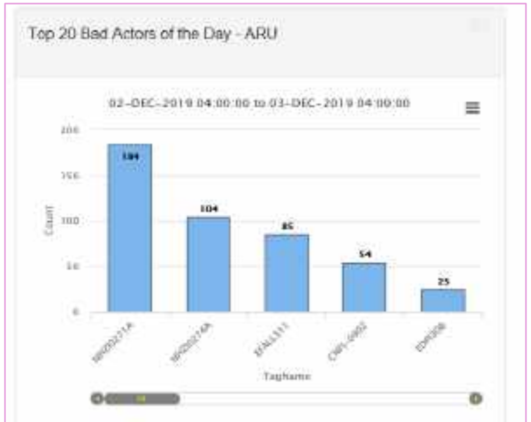


Total Alarm Count per Hour

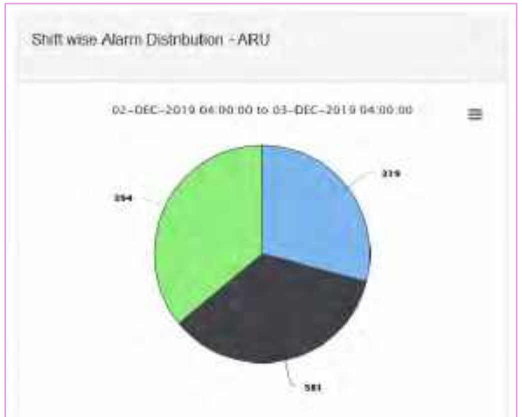
Annunciated Alarm distribution

Web Analytical Dashboard : Screens

DAILY DASHBOARD

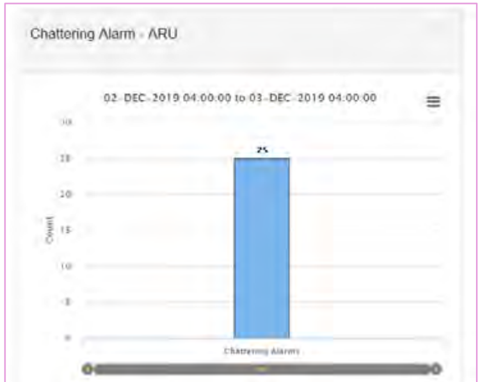


Top 20 Bad actors for the Day

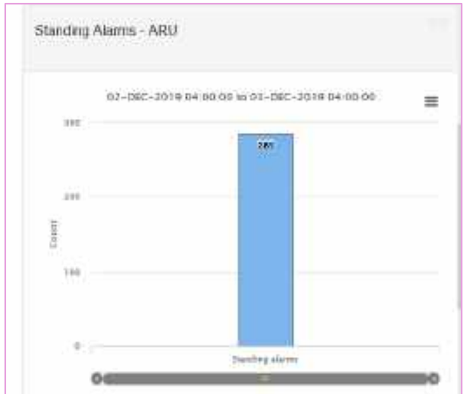


Shift Wise Alarm Distribution

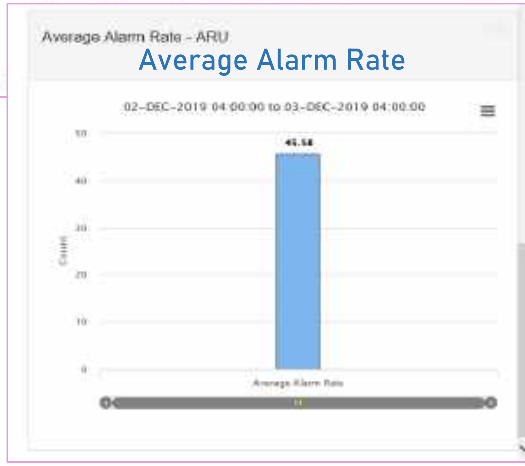
Alarm Flood Timeline



Chattering Alarms



Standing Alarms

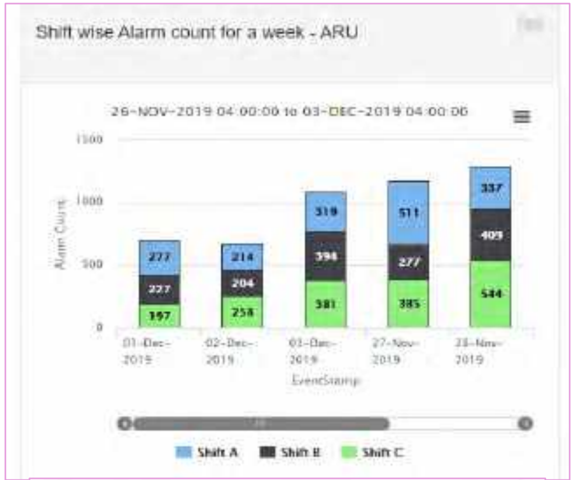


Average Alarm Rate

Web Analytical Dashboard : Screens

WEEKLY DASHBOARD

Shift wise Alarm Count for the week

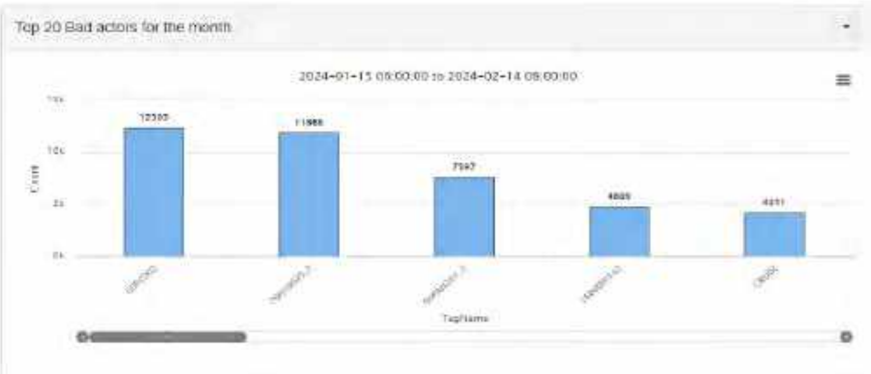


Standing Alarm For the Week

Web Analytical Dashboard : Screens

MONTHLY DASHBOARD

Top 20 Bad actors for the Month

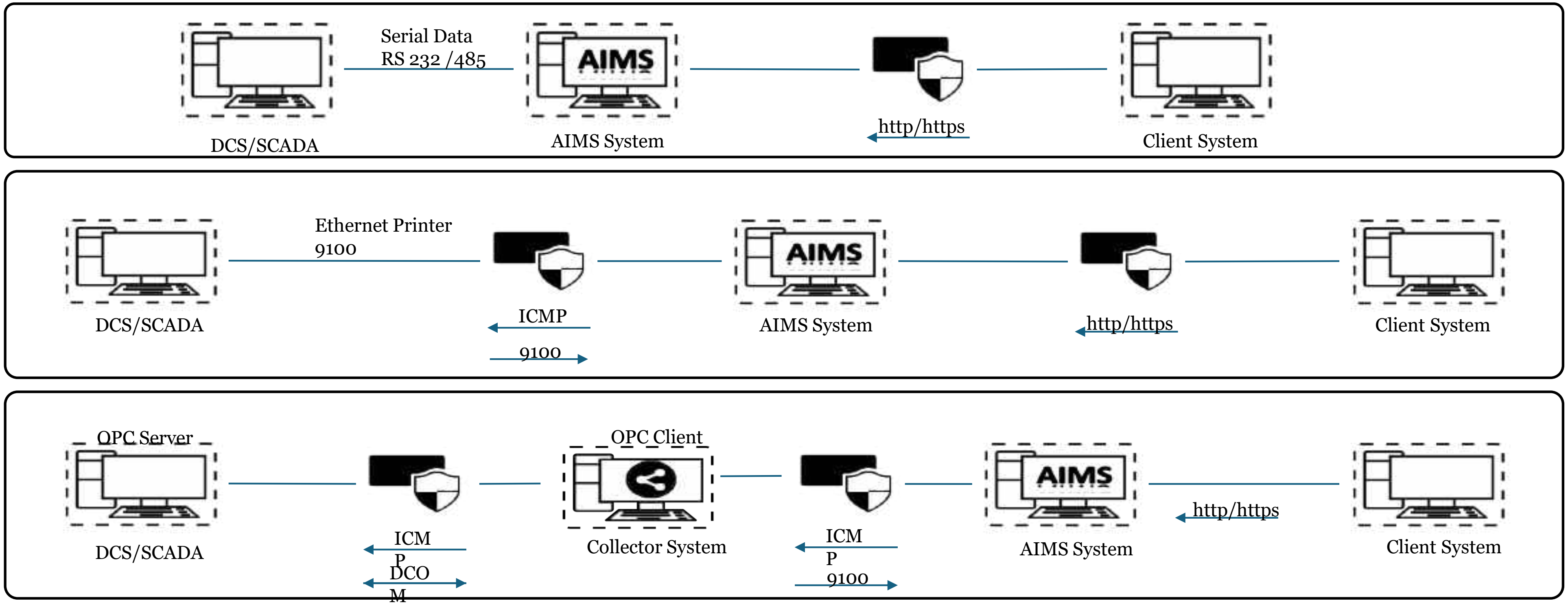


Standing Alarm For the Month

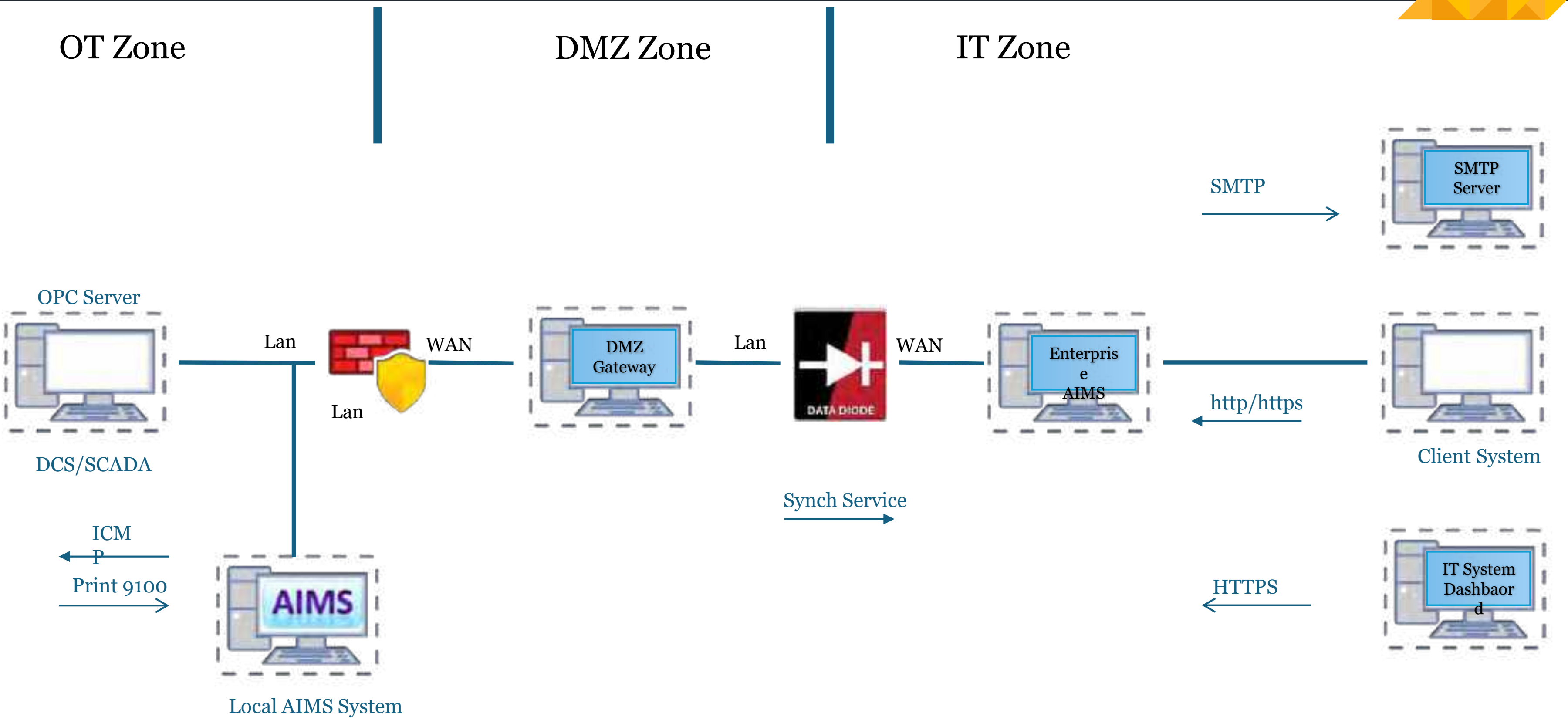
Priority wise Alarm Count for the month

High Alarm Count (more than 144) for the month

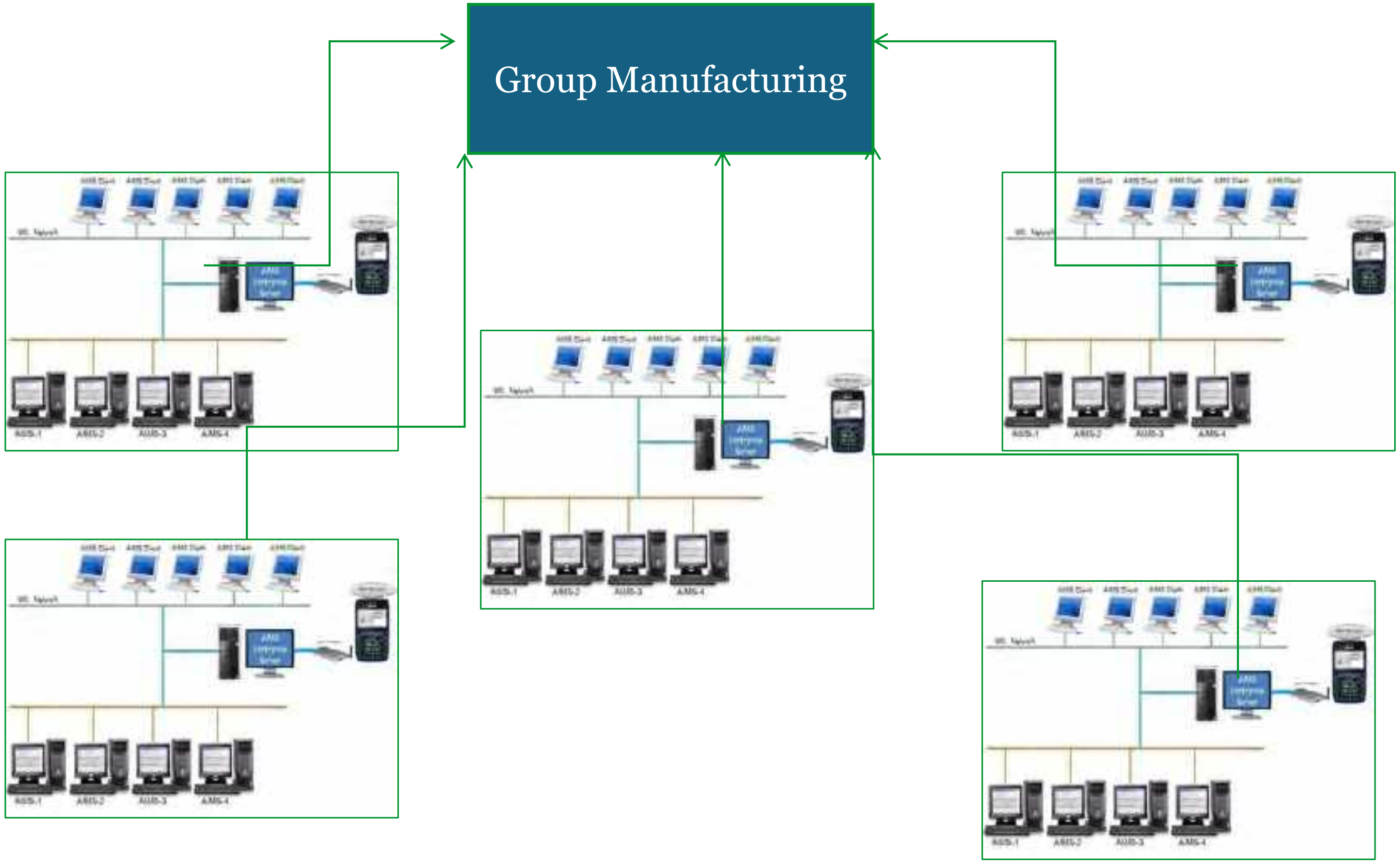
Live Connectivity : Scenario



Future Ready Technology for Data Diodes



Enterprise Level Connectivity



Cyber Security Compliance – IEC 62443

How it is achieved:-

- Identification and Authentication control
  - Human User Identification
  - Multifactor Authentication and Active Directory Integration
  - Software process and device identification
  - Unified Account Management
- Development Environment Security and Secure Release Management
  - Secure development environment using hardware firewall which restrict the internet connectivity and created the secured development environment
  - We have standard software release process to release the software with password protection for implementation and testing.
- Vulnerability Testing
  - X-Force portal is complied with the VAPT compliance and internal tested through the VAPT guidelines.
- Restricted Data Flow and Network Segmentation

Consolidation

AMS provides single window for first out analysis

Alarms from DCS

01-JUN-2008 10:20:00	TI-1002	INLET TEMPERATURE	HIHI
01-JUN-2008 10:20:10	TI-1001	COMP TEMP HIGH	HI
01-JUN-2008 10:20:33	MTR-1001	MAIN MOTOR STOPS	OFF

Alarms from SCADA

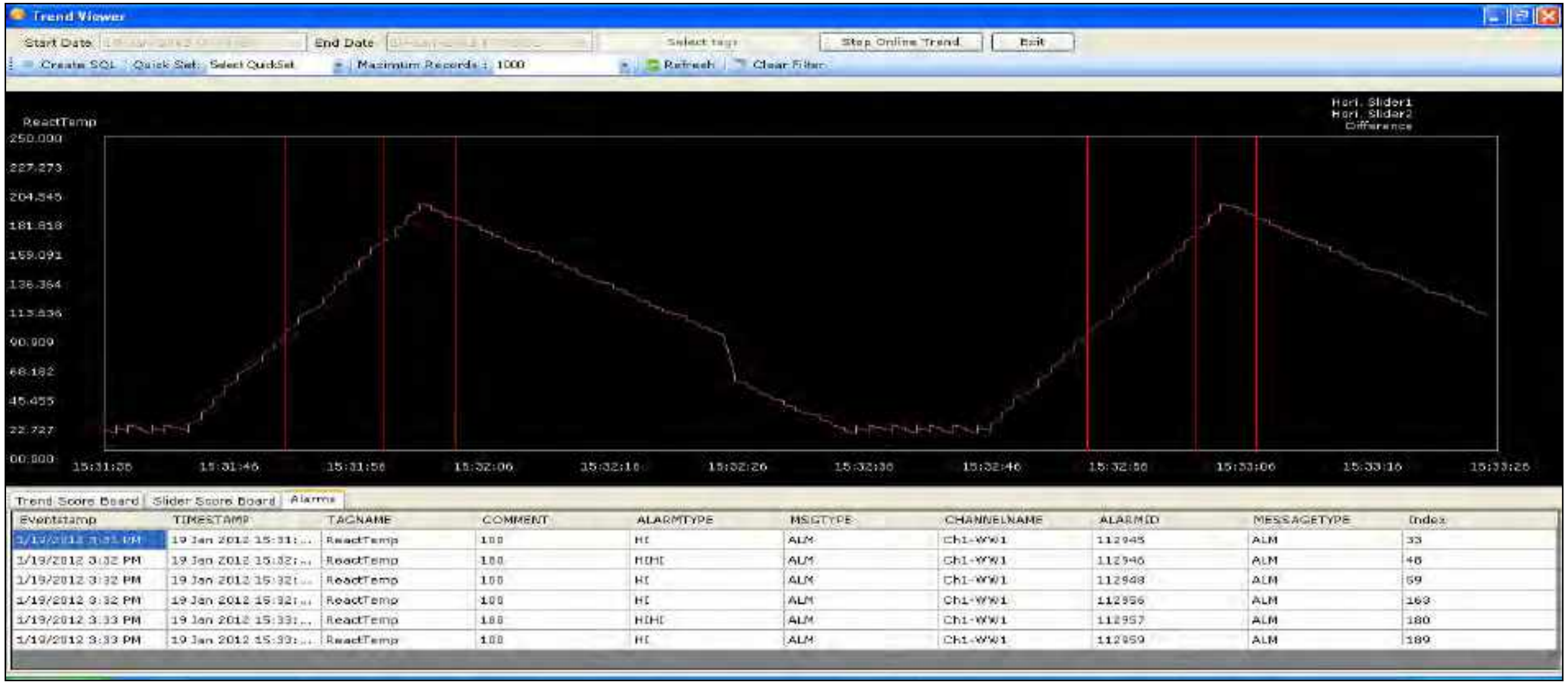
01-JUN-2008 10:10:00	FI1203	LUB OIL FLOW	LO
01-JUN-2008 10:10:05	TI1203	LUB OIL TEMP	HI

Alarm View –Consolidated

01-JUN-2008 10:20:00	TI-1002	INLET TEMPERATURE	HIHI
01-JUN-2008 10:10:00	FI1203	LUB OIL FLOW	LO
01-JUN-2008 10:20:10	TI-1001	COMP TEMP HIGH	HI
01-JUN-2008 10:10:05	TI1203	LUB OIL TEMP	HI
01-JUN-2008 10:20:33	MTR-1001	MAIN MOTOR STOPS	OFF

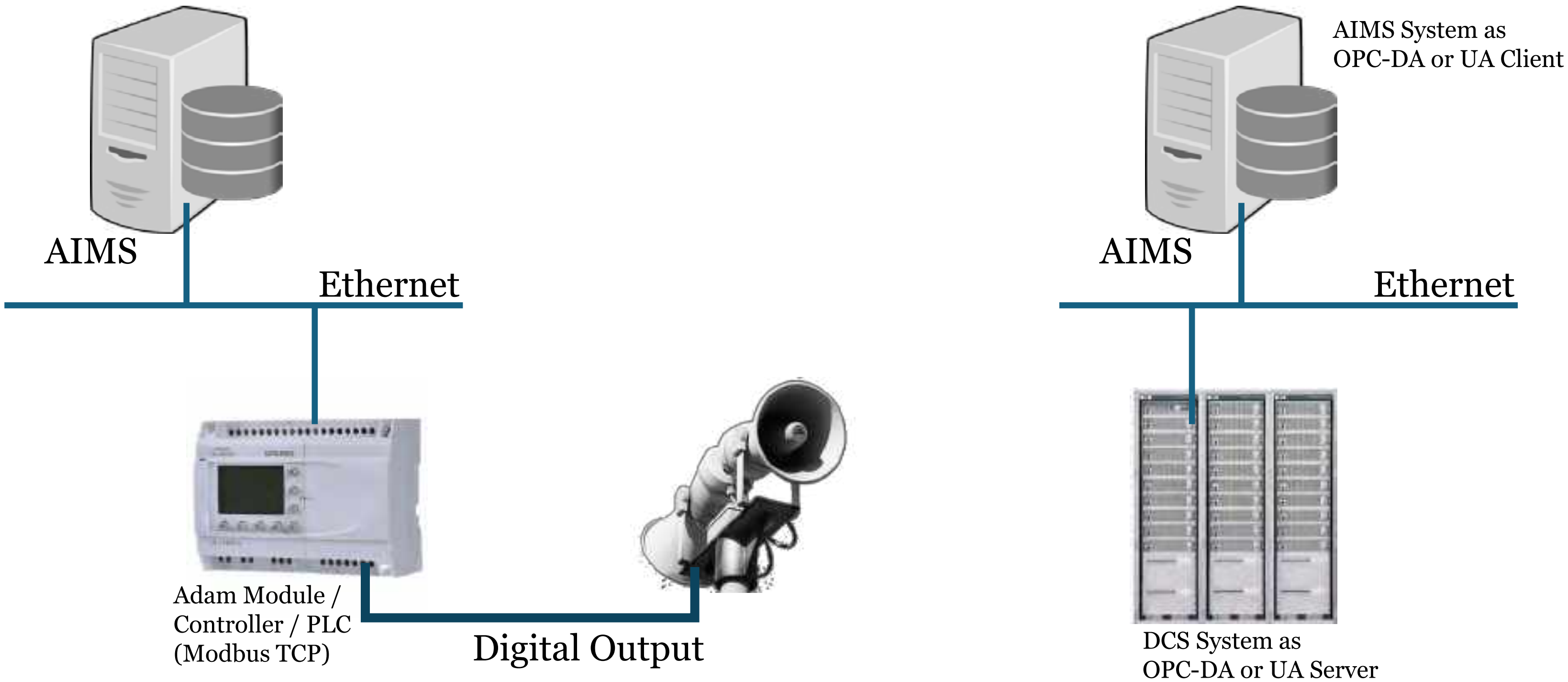
Composite view of Alarms and Trend

Capability of displaying real-time as well as historical alarms and trends in composite window for particular tag or group of tags.



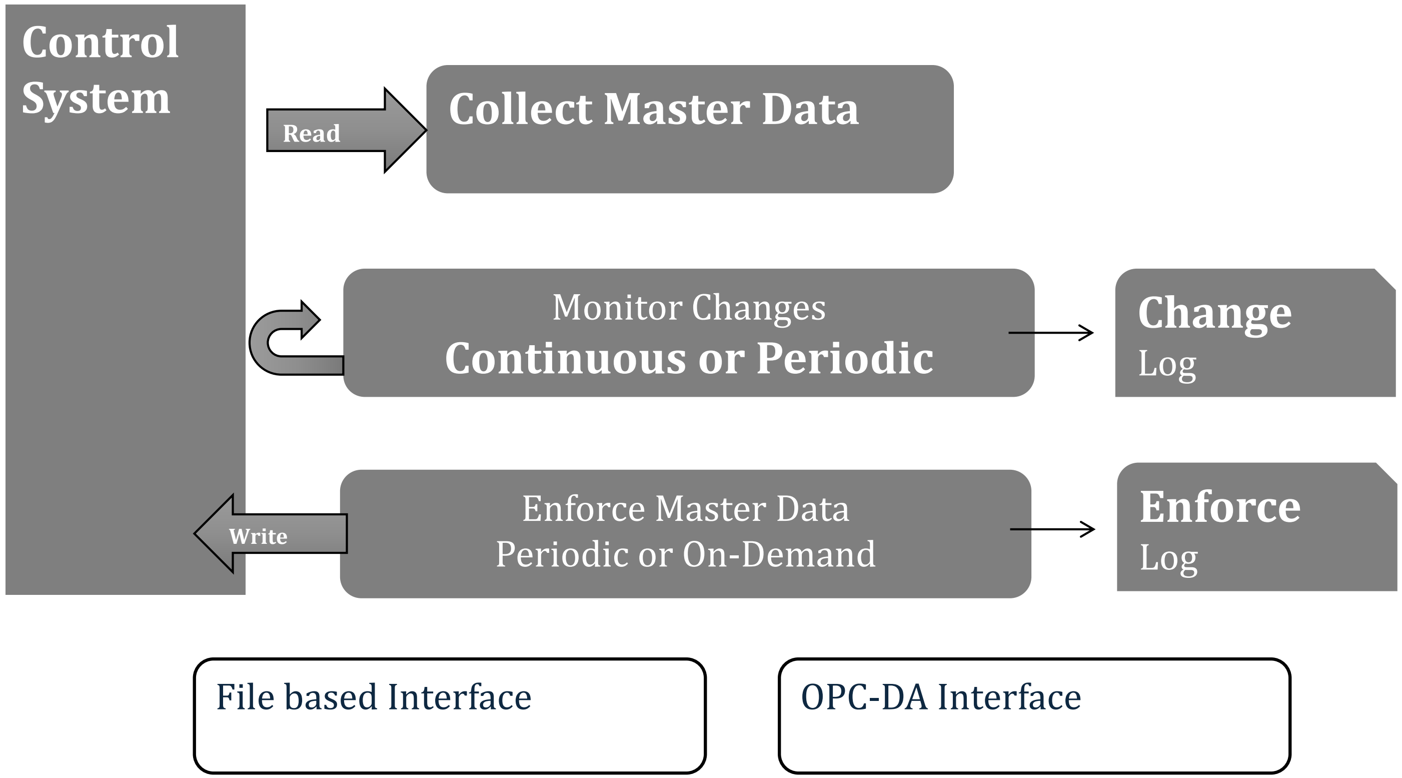
Mobile Application

Hooter Connectivity



Change of Management

Change Management Architecture



Industries we served

Customer @ UAE | Africa | Egypt

Oil and Gas

FMCG

Chemical & Fertilizers

Power & Steel

EPC

Life Science

OEM

Thank You

Contact us on sales@ssm-infotech.com

Setting the Standard for Automation™

Make in India

Industry Expectations

Rajiv Gupta *ISA Delhi*

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

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Make in India *Industry Expectations*

- *Since launch in 2014, Make In India* is Industry's heart and soul, Stride towards Atmanirbhar Bharat, Vocal for Local and Global Supplier as a result of Domestic contents, GTE and PPP policies of GOI.

- *Huge opportunity exists to increase the domestic portfolio by promoting manufacturing where No or only few Indian Suppliers/Vendors exist*.

- As the infrastructure already exists, all stakeholders Consultant, EPC, Supplier and End User have to come together to enable existing Suppliers increase portfolios to areas where No or only few Domestic Suppliers/Vendors exist.
  It is time to take a look and fill the gaps for Better Opportunities & Golden Future.

Make in India *Industry Expectations*

So, Let Us See What has changed

Make in India *Industry Expectations*

Collaborative Studies should be conducted for new applications or difficult applications where ***Limited or No Domestic suppliers*** are available to find out best domestically available equivalent. Few examples:

(i) Special Field Instruments, Detectors, CCTV Cameras, Large size/special Valves, special MOC's, special services (Urea, Polymer, Green H2, Bio Fuels)

(ii) Use of Fugitive emission certified packings in all services as it reduces emissions and saves energy as well as Environment.

(iii) Use of Metal Seated zero leakage valves for all services to reduce energy consumption and maintenance costs.

(iv) Use of Triple Offset Butterfly Valves in Large sizes where so far Gate valves are being used as it reduces dimensions/weight of the equipment and supporting structures. This is evident in Flare, Terminals and may be encouraged for Utility Headers, Fire Water, Isolation, Battery Limit isolation and plant Shutdown applications.

MII *Industry Expectations* from End Users, PMC's & EPC's

- *Tenders/Requisitions contain Specs and Classical Qualifying Criteria.*

Under Public Procurement Qualification maybe based on a qualifying PTR (MII) for Existing manufacturers in case of limited availability

- *Pre Tender Meets maybe held to establish qualifying criteria*

- *For Tenders having multiple items like Field Instruments, Detectors, CCTV Cameras, Large size/special Valves, special MOC's, special services (Urea, Polymer, Green H2, Bio Fuels), Tender/Supplier List/Project Vendor List may have* No or only few Domestic Suppliers/vendors for few items

Domestic bidders may not qualify the Tender/Requisition

- *Level playing field doesn't exist in Public Procurement and EPC procurement as Qualifying Criteria/MII benefit may not be available in EPC executions*

MII *Industry Expectations* from End Users, PMC's & EPC's

- Industry Leaders like EIL have commendable notification

"*Atmanirbhar Bharat @ EIL- Introduction of new item Categorisation"*

where no Indian vendor or few Indian vendors in Item Category,

An Evolved Qualification Criteria is notified for Enlistment under MII

- The item categories having multiple items like Field Instruments, Detectors, CCTV Cameras, Large size/special Valves, where no or only few Domestic Suppliers/Vendors are available for few items *should also be available for Enlistment/Enhancement as MII*

Make in India : Manufacturers Challenges in Indigenisation

- *Keep pace with technological development,* market requirement*, technical specifications, MOC and Testing requirement as well as Qualifying requirements for new applications*
- *Development of Skills, Collaborations and Facilities.*
- Locating Sub Suppliers (Materials & Components), Testing Agencies
- *Investment in the field of Research & Development*
- *Financial challenges*

Collaborative studies will lead to One Time solution, optimisation of resources & schedule, ease of uncertainties and better opportunities
More effective Qualifying Criteria, Enlistment and Supplier Lists

ISA Delhi may offer platform for collaboration and cooperation

Make in India *Industry Expectations*

! THANK YOU !

Best Wishes

TECHNICAL PAPER

COLLABORATIVE AUTOMATION for ENERGY TRANSFORMATION

PREFACE:

Before we delve into the intricacies of the main technical paper lets first try to come in terms with the basic terminology of the subject topic:- **COLLABORATIVE AUTOMATION for ENERGY TRANSFORMATION**

Collaborative automation has become a versatile, cost-effective, and user-friendly technology that allows businesses of almost any size (and any level of technical expertise) to increase productivity improve quality, and respond to changing customer demands.
The benefits of collaborative automation are undisputed – more profitability, productivity, flexibility, higher quality, and even more employee satisfaction. Given the current economic landscape, manufacturers need these advantages now more than ever.

Description:

The evolution of cobots reached new heights with manufacturers integrating artificial intelligence (AI) into their models.

Until this point, cobot technology has predominantly concentrated on singular functionalities, like aiding workers in tasks such as lifting and packaging products. **The integration of AI brings forth numerous advantages for cobots, propelling the fields of AI and robotics forward.** Here are the key benefits and the significance they hold:

The ability of collaborative robots to be aware of their surroundings,stands as a crucial capability. These applications necessitate robots to adeptly detect obstacles within their surroundings and respond appropriately to ensure safety and efficiency.
Functionaliies like 3D machine vision, **enabled by AI**,empowers cobots to identify an object's size, shape, orientation, and depth. This advancement significantly widens the scope of cobot applications. In some set ups, companies deploy stationary collaborative robots, with workers partnering closely with robotic arms to execute repetitive tasks side by side.
AI plays a crucial role in making cobots well-suited for operation in busy environments, ensuring their safe and efficient navigation without disruptions that could impede workflows.Moreover, **artificial intelligence simplifies the process** for users to instruct cobots about their surroundings. Once the machine has mapped its

environment, it can adeptly adapt to minor changes without requiring training.

Advancements in artificial intelligence have been pivotal in enhancing the safety, capabilities, and versatility of cobots. **AI empowers robots to handle diverse tasks, providing company leaders with the assurance that these machines can operate safely and efficiently alongside humans.**

As researchers go deeper into innovative uses of AI, we anticipate witnessing further remarkable achievements in the realm of cobots. Moreover, when designers, engineers, and other professionals apply AI to their cobot projects, they're likely to uncover novel applications of this technology beyond collaborative robots, paving the way for intriguing possibilities in various domains.

With the dynamic landscape for energy production, Artificial Intelligence (AI) provides powerful benefits across the entire value chain in the oil and gas sector.

Whether it is using AI tools for oil production, transportation or improving the safety standards at work artificial Intelligence and machine learning are helping compamies solve challanges in many areas.

Applications:

AI helps Oil and gas companies assess the value of specific reservoirs, customize drilling and completion plans according to geology of area and assess risks of each individual well,

AI (Artificial Intelligence), ML(machine learning),cloud networks etc help the oil and gas industry enhance enterprise resource planning (ERP), optimize inventory, logistics and ware house management.

What types of technologies are in our future?

Industrial Internet of Things (IIoT)

We've talked a lot about the Internet of Things (IoT) and the Industrial Internet of Things (IIoT), but it's all about connecting devices, assets and people to each other to cut down time and increase intelligence without human interaction.

This type of interconnected technology can help you know what's happening within your equipment and assets before you physically take a reading.

Artificial Intelligence (AI)

Artificial intelligence is expanding what we can do through machine learning.With the more advanced analytics coming out of today and tomorrow's systems, you can make better decisions operationally that are based in data. A good example is auto-trigger part

reorder points that use big data to
calculate hyper-accurate failure thresholds. This can keep your inventory stocked for exactly what
you need. This type of intelligence can also help you establish more true HYPERLINK "https://www.brightlysoftware.com/blog/creating-successful-predictive-maintenance-program" \t "_blank"predictive maintenance in your facility.

Interface of Things

The interface of things includes tools like:

Virtual reality

Augmented reality

Assisted reality

Wearables

Gesture recognition

Although these technologies may not be impacting your operations today, they will change the way you do maintenance in the future.

See more of what these technologies look like in HYPERLINK "https://www.brightlysoftware.com/blog/important-trends-you-should-know-preventive-predictive-maintenance" \t "_blank"this blog.

A good example is remote mentorship – the ability for an expert technician to assist a lesser- experienced teammate remotely. Imagine wearing an assisted reality device on your hard hat that has a small monitor in eye view, as well as a camera and microphone. While wearing this device, you can work on an asset that you don't know much about with the instructions and guidance of your boss back at her desk, coaching you through what to do and even providing visuals on your screen.Real time and hands free. This will help manufacturers as the experts continue to age and the next generation needs mentorship.

3D Printing

What if you could create any part or inventory piece that you needed, right on site?

That may be possible soon with 3D printing technology. This technology could be a good way for operations professionals to have the parts they need to fix assets and avoid stockouts – right at their fingertips, without having to wait for them to be shipped or pay extra fees.

ARTIFICIAL INTELLIGENCE: TOOL OF FUTURE

The oil and gas industry has long been known for its complexity and challenging operational environments. With facilities spread across the globe, managing them all effectively has become a daunting task. However, the integration of Artificial Intelligence (AI) has brought about a significant change in the industry.

And this changing scenario is very well evident now with various examples cropping up from around the world to support this fact:

In November 2021, a strategic collaboration was announced between Baker Hughes, an energy technology company, and AIQ, the artificial intelligence (AI) joint venture of ADNOC, Abu Dhabi's national oil company. The aim of the collaboration is to create advanced analytical solutions to meet the needs of the global oil and gas industry.

A company like Baker Hughes uses technologies such as the InForce surface control system, which combines hydraulic technologies to activate downhole tools with control logic to manage an intelligent well system. Through the use of PLC, the system can perform remote operations via an existing SCADA for complex completion configurations.

In August 2021, Aramco, one of the world's leading energy and chemical production companies, implemented computer vision solutions based on the FogHorn Lightning Edge AI platform at several of its sites to improve safety, equipment failure monitoring and automation of drilling equipment and processes

In November 2021, Infosys announced its collaboration with Shell and the launch of its first product for customers in the energy sector. This innovative solution is based on artificial intelligence and allows companies to optimize stock levels in their warehouses based on their consumption history. Through improved demand planning, this solution significantly reduces the time and labor required for maintenance operations, while reducing operating costs.

Some of the uses of AI(Artificial Intelligence) in oil and gas applications and how it is helping business in Oil & Gas to grow on a steady pace are indicated below:

1.Accelerating the discovery of natural gas and crude oil

Finding the best places to extract natural gas and crude oil is a labor and time-intensive process. Fortunately, artificial intelligence tools improve their performance as the amount of data used increases. Oil and gas artificial intelligence applications can gather information about an area's geology, geophysics and other specifics. AI software can then present that data in an easily understandable format, helping people determine the most appropriate places to extract oil and gas. This data can also inform decisions such as the amount of oil likely within a reservoir or how profitable it'd be to set up a new offshore oil rig in a certain location.

2) Detecting oil well and pipeline leaks

Leaks from oil wells and pipelines happen much more frequently than people outside of oil and gas companies may expect. That's why leak detection is an AI application gas industry professionals and related experts are particularly interested in pursuing. These applications can reduce false positives and are ideal for monitoring pipelines and oil wells in remote areas. Those locations usually don't have humans present all the time. However, people can get data in real time from AI tools, allowing them to spot problems sooner. That could reduce the lost resources or even prevent loss.

3) Reducing maintenance costs

Many applications of AI in oil and gas center on helping users reduce costs and avoid unwanted outcomes. One of the ways they do that is through predictive maintenance. It involves placing connected sensors on oil and gas equipment and deploying algorithms that learn what constitutes normal behavior. AI can then flag abnormal characteristics. People may also use HYPERLINK "https://indatalabs.com/services/big-data-analytics-services"Bigdata analytics with predictive maintenance to track trends over time and prevent unplanned downtimes. Doing that could tell them the average life span of specific components based on usage. Then, plant managers could replace parts before they fail. Maintenance-based AI applications in oil and gas can fundamentally change how people handle the upkeep of critical equipment by helping them become more proactive.

4) Cleaning oil spills

Prompt responses to oil spills are essential for minimizing environmental damage and mitigating resource losses. Experts use various methods to tackle oil spills, depending on if they happen at sea or on the shore. Chemical dispersion and skimming are two options for HYPERLINK "https://oceanservice.noaa.gov/facts/spills-cleanup.html"removing oil from the water surface. Once the oil reaches the land, cleaning crews use everything from industrial vacuum trucks to special sponges to soak it up. However, an emerging option is to use AI-powered robots to assist with the efforts. Scientists are interested in using the machines as swarms, making dozens or more robots work towards a shared goal. This application of AI in oil and gas industry tasks could reduce the number of people needed to clean up after an oil spill. It could also get the job done more efficiently, limiting the adverse effects.

5) Improving plant safety

Working in the oil and gas industry means accepting inherent hazards and following the correct procedures. However, things go wrong even when employees consistently remain conscientious, aware of their surroundings and alert to potential problems. Choosing appropriate ways to use AI in oil and gas industry companies can improve safety by enhancing visibility.

For example deploying an HYPERLINK "https://indatalabs.com/blog/predictive-maintenance"AIpredictive maintenance solution could prevent explosions, fires, toxic emissions and other issues that could put people at risk due to poor upkeep. Additionally, some oil and gas workers receive wearables that

gather information in real time and alert them to dangers they'd otherwise not notice until it's too

late. AI-powered robots can also support risk reduction by doing some of the hazardous tasks normally given to humans.

6) Managing quality control needs

Quality control shortcomings can be highly problematic for companies in the gas and oil sector, particularly if people only discover those issues relatively late in a project's workflow.For example, the technology can detect cracks in various materials, including metal. Using AI in oil and gas this way lets people verify products such as vessels for the energy sector meet minimum standards and will not fail at critical points.

Some companies also use computer vision to supplement the visual checks humans do. Adding strategic steps to a quality control process with human input and artificial intelligence is an excellent way to promote company resilience and bolster its reputation.

7) Enhancing worker training

Preparing employees for the oil and gas industry means ensuring they have the right workforce education to be adequately equipped for their roles. Artificial intelligence applications in oil and gas industry education can make employee training more personalized by detecting which topics a person should review or know well. Providing the right educational content with AI applications can also lead to more-empowered employees. Then, organizations can reduce costs and improve job retention, among other benefits. An AI software application for oil industry workers could give customized feedback, helping people stay motivated and take pride in the learning experience.

8) Streamlining operations

People often combine data science with artificial intelligence to find opportunities for continuous improvement.Together big data platforms and artificial intelligence can find bottlenecks,unnecessary expenditures and time-consuming processes.Imagine an AI software application for gas industry employees that allows leaders to see activity across worldwide facilities. If it works in the cloud and on smartphones or tablets, people can keep tabs on operations even if they're nowhere near physical sites. Besides improving how individual facilities operate, leaders can use AI to ensure each plant follows requirements.

9) Raising decision-making confidence

Running a gas or oil company can be daunting at times. People must assess various factors and determine the best steps to take to increase profits and marketplace competitiveness while minimizing all unwanted outcomes. Fortunately, the AI applications in oil and gas companies can ensure people have the information to make appropriate choices under pressure. The digital twin is one application of artificial intelligence that can help people make the right choices in challenging circumstances. Digital twins are computerized versions of real-life assets. They allow people to see the effects of specific changes before approving them. That might mean determining where to place a new piece of equipment or even assessing the layout of an entire oil plant before production begins.

10) Strengthening cybersecurity

Cybersecurity experts warn that the oil and gas industry is a prime target for online criminals. That's why many leaders approach HYPERLINK "https://indatalabs.com/services/ai-software-development"AIdevelopment specialists to learn about ways to build their cyber defenses. Such applications of artificial intelligence in oil and gas industry enterprises enable screening networks for signs of unusual activity. Many such efforts rely on a branch of AI called machine learning (ML). It involves building and using algorithms that work similarly to how humans learn. Such examples of AI and ML in oil and gas industry use cases detect potential network intrusion events.They often automatically categorize them for humans to review. People can also embark on a HYPERLINK "https://indatalabs.com/blog/impact-of-big-data-on-business"Bigdata business transformation by using specialized tools to monitor cybersecurity trends.

11) Tracking sustainability efforts

AI in oil and gas can help leaders operate more sustainably. This sector is like most others in that national and state governments have tasked it with gradually reducing its emissions to meet published targets. Many corporate leaders have made AI and machine learning part of their HYPERLINK "https://indatalabs.com/blog/role-ai-digital-transformation-strategy"digital transformation strategies, knowing that doing so could mean taking a significant step toward better sustainability.

12) Handling inspections

Any application of AI in oil and gas industry workflows should ideally connect to several overarching company goals. Its then easier to justify the associated investments of hiring a machine learning consulting firm, deploying the solution and setting aside the time for employees to learn to use it. Using AI to inspect equipment or infrastructure within the oil and gas industry is one excellent area to consider. For example, AI-powered robots can often go places humans can't, increasing the likelihood of finding flaws that would otherwise get overlooked.

13) Answering queries

AI applications in oil and gas industry settings can also extend to chatbots made for workers or customers. Many people are so accustomed to communicating by text that they'd prefer doing that to picking up the phone. People can program AI software to recognize and respond to customers or employees' most common questions.In many cases, the chatbots handle the entire conversation, giving users the answers they need within seconds. Leaders at oil and gas companies can also set aside time for analyzing data to identify what's going well or needs improvement from a customer service perspective.

14) Reducing manual tasks

Even the most conscientious workers often make mistakes while engaging in manual tasks. That could happen due to anything from carelessness to calculation errors. However, a well-built application of artificial intelligence in oil and gas industry responsibilities could minimize mistakes. For example, artificial intelligence in oil rig robots can collect information about equipment and the environment. Humans would still need to review it, but the gathering aspect can happen automatically with help from AI. Artificial intelligence and machine learning can also eliminate manual calculations about oil and gas industry trends, ranging from prices to production levels.

15) Achieving better communications outcomes

Many oil and gas companies have locations across the globe. People must know how, when and what to communicate to stakeholders while managing such a gigantic business presence. Artificial intelligence can help make those critical choices. While using AI applications, oil industry communications professionals might rely on smart tools to check for spelling and grammar errors or ensure they use the best words to distribute the intended message. These professionals may also aapproach big data development teams to discuss using options like sentiment analysis. It can determine how the public responds to specific communications efforts or which industry-related issues they often discuss on social media platforms. Understanding what matters to people is vital for communicating effectively with them.

16) Optimized procurement

AI-driven specialized procurement solutions can help Oil &Gas firms build interconnected digital supply networks (DSNs), enabling dynamism, flexibility and efficiency in their planning and execution. AI can augment procurement experts' decision-making capabilities with additional insights from data crunching and analysis of extremely complex and large sets of data to solve traditional problems. Leveraging an AI-based solution can alleviate some of the current challenges in Oil &Gas procurement by helping firms in understanding major procurement spend categories; automate purchase-to-pay; identify critical and noncritical supply chain bottlenecks; and gain visibility into planned and actual figures by the supplier, material, geography, and other company-specific dimensions, to name a few.

17) AI in ERP (Enterprise Resource Planning)

AI in ERP is the application of artificial intelligence software and tools to ERP solutions. AI tools used in ERP software include interactive chatbots, intelligent process automation, and AI-infused financial planning.AI-enabled ERP refers to ERP software solutions taking full advantage of AI technologies. Here, AI is an integral part of the ERP solution. The AI-enabled ERP vendors are leading the way toward the future in ERP solutions.AI tools provide significant improvements to many data processing problems. However, AI does not replace ERP's data processing capabilities; AI adds additional intelligence to ERP systems. The digital framework is the crucial link between global operations and supply chain, beginning at the oil well right up to the gas station. There is therefore, an immense potential to achieve efficiency and cut costs through various digital initiatives.

18) AI application: Smart Track and Trace-Warehouse management

The use of AI and ML in asset tracking systems improves the way humans perform their day-to-day jobs by simplifying and streamlining tasks such as the process of searching for equipment, and so much more. By being able to quickly identify and visualize historical data, AI can use predictive and preventative analytics to enhance workplace processes. AI technology can also help with use cases such as product quality inspections and demand planning within facilities. Using AI in an asset tracking system allows users to make more informed decisions within their UI. An example of how these technologies can be used in an asset tracking system is inventory or ware house management.When a company needs to purchase more inventory they want to be sure they order the correct amount of items needed. Companies don't want to over-order and waste money, but they also don't want to under-order and not have enough stock, resulting in disappointed consumers. Using an asset tracking system with machine learning allows users to look at historical data and see inventory purchase history. You can then base your upcoming purchases on patterns.

19) Artificial intelligence (AI) in Cloud Computing/Networks: is a set of technologies that help machines complete tasks requiring human intelligence. It can be used to automate tasks, improve decision-making and increase productivity. AI on the cloud is a powerful technology that can automate repetitive tasks, improve decision-making invested in AI or will do so in the next two years. important parameters to be considered specifically in the field of oil and gas. by solving complex problems using algorithms. These algorithms learn from large data sets, which are processed through CPUs depending on their type of application. The algorithms are trained using a large data set, and then they can perform tasks requiring human intelligence. For example image recognition or speech analysis can be performed by solving problems using algorithms and eventually play a big role in maintaining safety & security of offshore platforms.

CONCLUSION:

AI is a promising technology slated to play a key role in the future of Oil & Gas.

Sensor-rich oil fields are already cashing on the immense opportunities leveraging the data analytics from the big-data engines. Oil field personnel are already connected with mobile devices that have infiltrated our daily lives. Combining these technologies will result in a connectivity revolution for oil fields, and AI will prove to be a great enabler.

Considering the AI's potential to augment or even replace some human competencies, it's not a surprise that a recent HYPERLINK "https://www.ey.com/en_gl/oil-gas-digital-skills-survey/how-to-unlock-value-in-oil-and-gas-capital-projects-in-any-environment" \t "_blank" \o "EY survey"survey points that 92% of oil & gas companies are either already and increase productivity which are very

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HYPERLINK "https://www3.technologyevaluation.com/research/article/how-ai-is-transforming-erp.html"https://www3.technologyevaluation.com/research/article/how-ai-is-transforming-erp.html

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https://www.linkedin.com/pulse/ai-key-exponential-technology-smart-era-jacques-ludik

Setting the Standard for Automation™

HAC SYSTEMS

EATON CCTV SYSTEMS

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

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Eaton EATON HERNIS

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

Eaton CCTV solutions


EATON HERNIS™ is a CCTV system supplier, delivering turnkey solutions in the harshest of environments.
We make vision work.*
H_2

Eaton EATON HERNIS CCTV – markets today

Offshore
- Drilling units
- Production Platforms
- FPSO/FLNG
- Windfarms
- Special Projects

Marine
- LNG / LPG / FSRU/ Shuttle Tankers
- Offshore Support Vessels
- Navy and Coastguard vessels
- Special Vessels

Onshore
- Drilling units
- Production Plants and refineries
- Harbour and Storage Facilities
- Pipeline projects
- Special Projects

All major Global Oil & Gas End Users & EPC's

Global scale and customer service

in region spare availability and in region technical assistance

EATON HERNIS™ Flex CCTV system

EATON HERNIS™ Flex system - turn-key solutions

Equipment → Software → Engineering → Documentation → Commissioning → Service & repair → Customer support → System upgrades

EATON HERNIS™ Flex system - turn-key solutions

Equipment → Software → Engineering → Documentation → Commissioning → Service & repair → Customer support → System upgrades

- EX - Safe – Thermal area cameras
- Subsea cameras
- Wifi cameras
- Multi-cables
- Field equipment
- Network components
- Central components
- Cabinets
- Operator stations
- Customized products
- NORSOK standards

EATON HERNIS™ Flex system - turn-key solutions

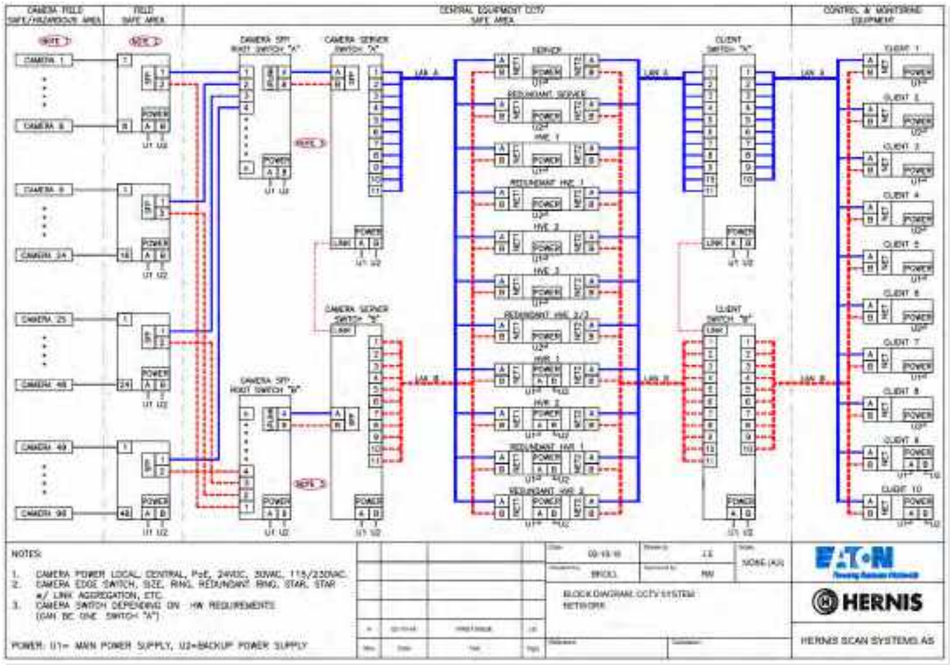
Equipment | Software | Engineering | Documentation | Commissioning | Service & repair | Customer support | System upgrades

- FLEX
- Virtual Machines
- Crane CCTV Systems
- Satellite solutions
- Radar tracking systems
- VMD
- Flare monitoring
- Third party integration
- SDK, REST
- SNMP
- Modbus, NC/NO I/O
- Customer adaptations
- 4K monitor
- Touch based control

EATON HERNIS™ Flex system - turn-key solutions

Equipment → Software → **Engineering** → Documentation → Commissioning → Service & repair → Customer support → System upgrades

- Complete System Engineering
- Block diagrams
- Engineer To Order equipment
- Network know-how – Bandwidth planning
- Customized/customer templates



EATON HERNIS™ Flex system - turn-key solutions

Equipment → Software → Engineering → **Documentation** → Commissioning → Service & repair → Customer support → System upgrades

- Complete System Documentation
- User manuals
- Tag-list
- IP-list
- Installation instructions
- Maintenance procedures
- Training material
- Custom documentation packages

EATON HERNIS™ Flex system - turn-key solutions

Equipment → Software → Engineering → Documentation → **Commissioning** → Service & repair → Customer support → System upgrades

- System Commissioning
- Site Acceptance Test
- System Burn-In test
- System health-checks
- Software upgrades
- System optimalization
- On-site repair
- Site-surveys
- Training

EATON HERNIS™ Flex system - turn-key solutions

Equipment → Software → Engineering → Documentation → Commissioning → **Service & repair** → Customer support → System upgrades

- Field equipment repair
- Rebuild and upgrades
- Equipment maintenance
- Spare parts


EX286W from 2007 upgraded to Ethernet-over-Coax

EATON HERNIS™ Flex system - turn-key solutions

Equipment → Software → Engineering → Documentation → Commissioning → Service & repair → Customer support → System upgrades

- Remote maintenance
- Software upgrades
- Debugging
- On-site and remote trouble shooting
- System restore
- License handling
- Complete System lifetime support

EATON HERNIS™ Flex system - turn-key solutions

Equipment → Software → Engineering → Documentation → Commissioning → Service & repair → Customer support → System upgrades

- System Lifetime Support
- Unbeatable Systems ROI
- 40 years of technical expertise
- Analog to digital conversion
- Ethernet-over-Coax
- Enterprise upgrades

CCTV system, additional slides

EATON HERNIS™ Camera stations range, EX and Safe area

- IP technology
- Full High Definition (1080p and higher) - clearer image
- Flexible installation, as example hanging
- In-built VMD, home position, audio, alarm
- Reuse old cabling with Ethernet over Coax (EoC)
- Power, video and data across single cable with PoE
- ONVIF compliant
- Power PoE, 24VDC, 24/30AC, 110/230VAC
- Cyber security updates including codesigning firmware
- Renowned EATON HERNIS quality
- 15 years spare parts availability
- Designed for 25 years operational service

EATON HERNIS™ Explosion proof camera stations

Ex certified • Electro polished stainless steel • Thermoelectric heating

EATON HERNIS™ Weatherproof camera stations

Stainless steel • Scratch proof tempered glass • Thermoelectric heating

EATON HERNIS absolute positioning tracking

Also used in our Radar Tracking System

Client Applications

- **HWIN Operator Station**
  - General CCTV operator station with multiple video display
  - Map navigation
  - Alarm management
  - Touch control
- **HSM System Management**
  - Working status report for system components
  - Upload of firmware to system components
  - System logs
- **HLSA Large Screen Application**
  - Standalone display station with multiple video display
  - Controllable from HWIN using Large Screen Controller
  - Controllable from OK450 control panel
- **HAS Administration Software**
  - Configuration of system database for the CCTV system

Thermal Camera, Leakage detection

Leakage detection

FLEX multi site with HERSAT

Functionality overview

Supports multiple video streams per remote site (Ship, rig, facility…)

Video streams are transcoded to a fault tolerant format using limited bandwidth

Support for forward error correction (FEC) on video stream

Designed for problematic network environments with long transmission delay, delay variations, packet reordering and packet loss

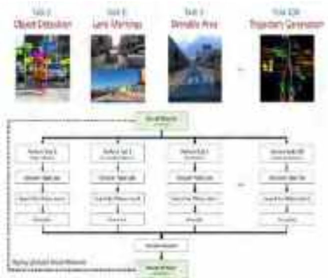
Requires EATON HERNIS MVE server to do transcoding and computation of FEC data

Vision Analytics Overview

NextGen Technology

Edge Based System for CCTV Surveillance Systems used in harsh and hazardous environments with

- AI based advanced Vision analytics algorithms(ex: Multi-Task Learning) that generate notifications and highlight correct/incorrect behavior
- Bio Inspired Optimization Techniques to identify and track location of objects of people in real-time



End-User Value Proposition

- **Improved safety, security, productivity and associated costs with a state-of-the-art accuracy and minimal number of false alarm rate**
    - Reduced routine site inspection visits
    - Improved incident response, faster reporting and reduced risk
    - Remote automated asset utilization monitoring

Applications

Oil and Gas

Industrial surveillance

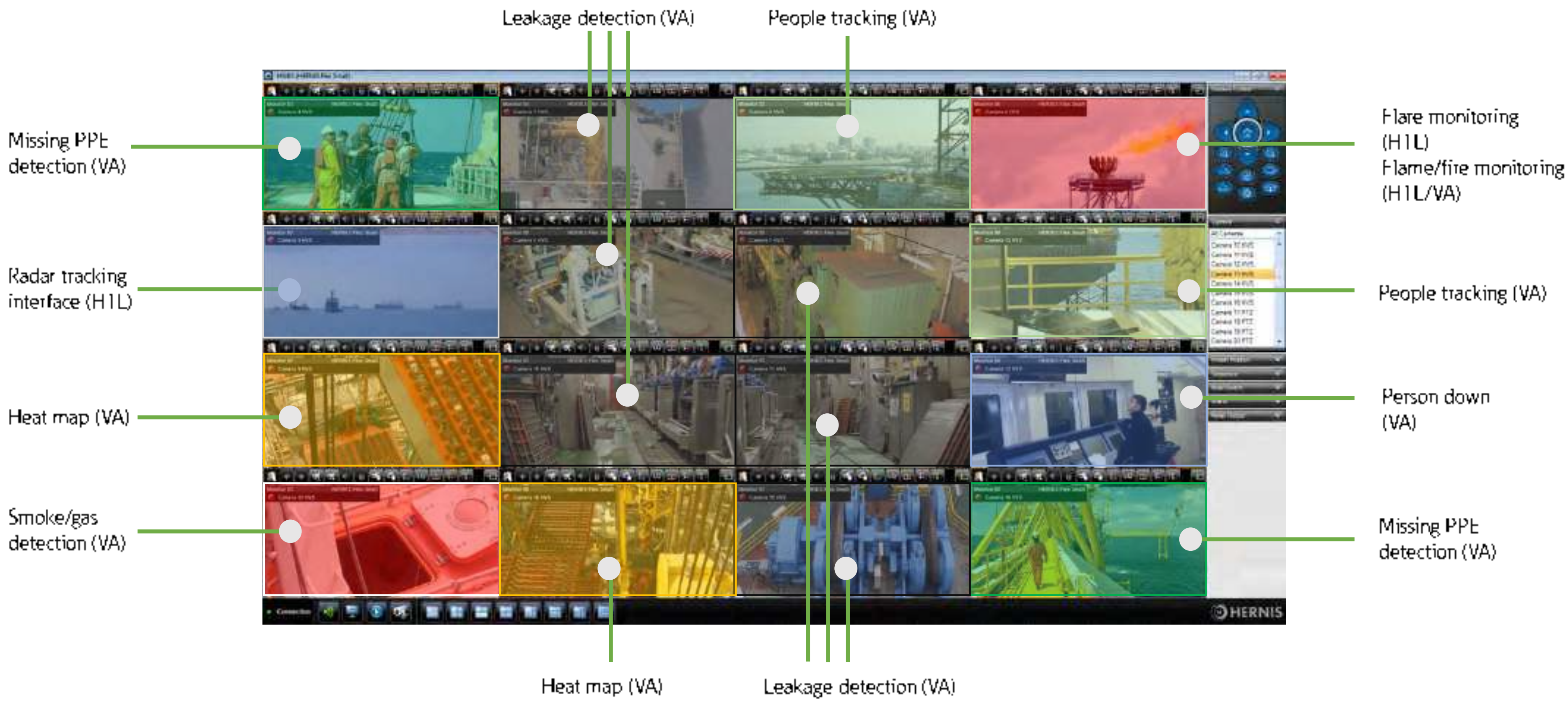
Eaton's on-premises video analytics solution for safety and security for the EATON HERNIS CCTV System

Main features

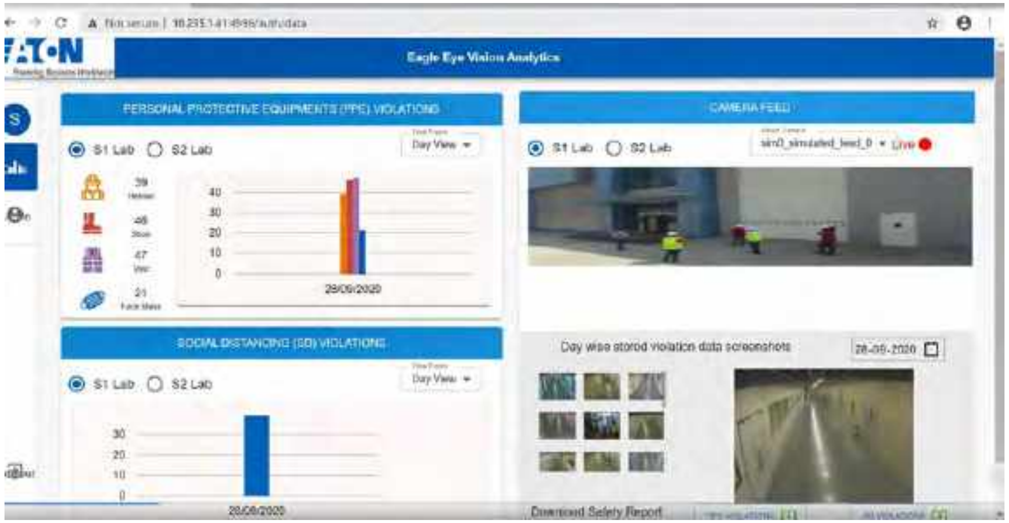
- These features are higher level descriptions and may consist of sub-features which could be uniquely identified
- E.g. Object left behind, Quick moving, People gathering – all are a part of the tracking and heat map functionality

Ref	Name	Description
1	Flame/fire monitoring	Identify a flame on/flame out scenario without the use of a thermal imaging camera
2	Leakage Detection	Oil leakage detection from machinery & pipelines - specific to Oil & Gas industry / refinery
3	Smoke/gas detection	Basic smoke and gas detection via an optical camera
4	People tracking/tagging	Tagging and tracking targeted individuals through multiple camera scenes
5	Person down /person overboard	Either alone or restricted worker which has fallen to the ground and is not moving
6	Heat map / path map	Specific to tracking people/persons across a field of view - used in conjunction with people tracking, loitering and tailgating
7	Loitering detection	To detect if people stop/stay too long in key areas of interest (controlled access doors etc.)
8	Missing PPE detection	Missing PPE detection - based on core criteria (E.g., hard hat - safety glasses - high visibility vest)
9	ANPR/LPR	Automatic Number Plate Recognition / License Plate recognition
10	Tailgating	A person or persons following close by another person or vehicle in order to gain access to a restricted/controlled area

EATON HERNIS™ FLEX integration



Reporting



- Easy-to-use statistics
- Flexible data export functionality
- Download complete safety reports in multiple formats
- Violation analysis and incident investigations
- Use for training and prevention

We make safety surveillance work.

Eaton Camera stations-Make in India

CCTV solutions for the harshest of environments

IYHH30B

IYHPTZ41B-1/IYHPTZ41B

EACF-101B & MineCam

We make safety surveillance work.

EATON CCTV- INDIA range

CCTV solutions for the harshest of environments

Fixed camera range

PTZ camera range

Dome camera range

CCTV accessories

IYHH30B fixed camera range

EATON
CCTV

IYHH30B - Fixed Camera Station

Benefits:

- Multiple transmission options give flexibility either new construction or retrofit projects.
- Designed for cybersecurity which ensures safety of customer's digital assets.
- Suitable and proven in use for harsh environments - specifically for marine & offshore where ingress protection and vibration resistance is paramount.
- Camera adheres to the ONVIF standard, ensuring effortless integration with a wide range of third-party devices and video management systems.

Features:

- ATEX & IECEx certified
- PESO CERTIFIED
- BIS CERTIFIED
- IP66/68
- -45 to +65 ºC
- 3MP / 5MP résolution option available
- 22x / 33x zoom option available.
- Optional PoE, FO, Wiper
- 316L Stainless Steel
- Available for both Safe & Ex-Proof
- NDAA compliant.

IYHPTZ41B-1/IYHPTZ41B PTZ camera range

EATON
CCTV

IYHPTZ41B-1/IYHPTZ41B - PTZ with/ without Integral IR Illuminator

Benefits:

- Multiple transmission options give flexibility either new construction or retrofit projects.
- Designed for cybersecurity which ensures safety of customer's digital assets.
- Suitable and proven in use for harsh environments - specifically for marine & offshore where ingress protection and vibration resistance is paramount.
- Camera adheres to the ONVIF standard, ensuring effortless integration with a wide range of third-party devices and video management systems.

Features:

- ATEX & IECEx certified
- PESO CERTIFIED
- BIS CERTIFIED
- -40°C ~ +65°C
- IP66/68
- Second housing for illuminator
- 0~360degree endless pan movement and +/-90degree tilt movement
- IR range up to 200 meter
- 316L Stainless Steel
- Available for both Safe & Ex-Proof
- 3MP / 5MP resolution option available
- 22x / 33x zoom option available.
- NDAA compliant.

EACF-101B - Mining ex proof camera range

EATON
CCTV

EACF-101B - Mining ex proof camera range

Benefits:

- Certified with group I, II, and III fits both mining underground and surface hazardous area.
- Designed for cybersecurity which ensures safety of customer's digital assets.
- Suitable and proven in use for harsh environments - specifically for marine & offshore where ingress protection and vibration resistance is paramount.
- Camera adheres to the ONVIF standard, ensuring effortless integration with a wide range of third-party devices and video management systems.

Features:

- IECEx certified
- IP66/68
- 316L Stainless Steel
- -40 to +60 ºC
- Compact size only 225mm length.
- Light weight: 4.5KG for ex version and 3.5KG for non ex version.
- 3MP / 5MP resolution option available
- 22x / 33x zoom option available.
- NDAA compliant.

MineCam - Mining ex proof camera range

EATON
CCTV

MineCam - Mining ex proof camera range

Benefits:

- Ex ia designed for Zone 0 hazardous area and certified with group I and II fits both mining underground and surface hazardous area.
- Dual certification through both DNV and ExTesting.
- Good video quality under low light conditions.
- Designed for cybersecurity which ensures safety of customer's digital assets.
- Camera adheres to the ONVIF standard, ensuring effortless integration with a wide range of third-party devices and video management systems.

Features:

- ATEX/ IECEx certified
- IP66/67
- 316L Stainless Steel
- -30 to +60 °C
- HD resolution up to 4 mega pixels.
- Wide horizontal angle of view up to 86.7degrees.
- Wide voltage input and certified from 10.5VDC to 15.4VDC.
- POE and wifi option available.

Cybersecurity has never been more important!

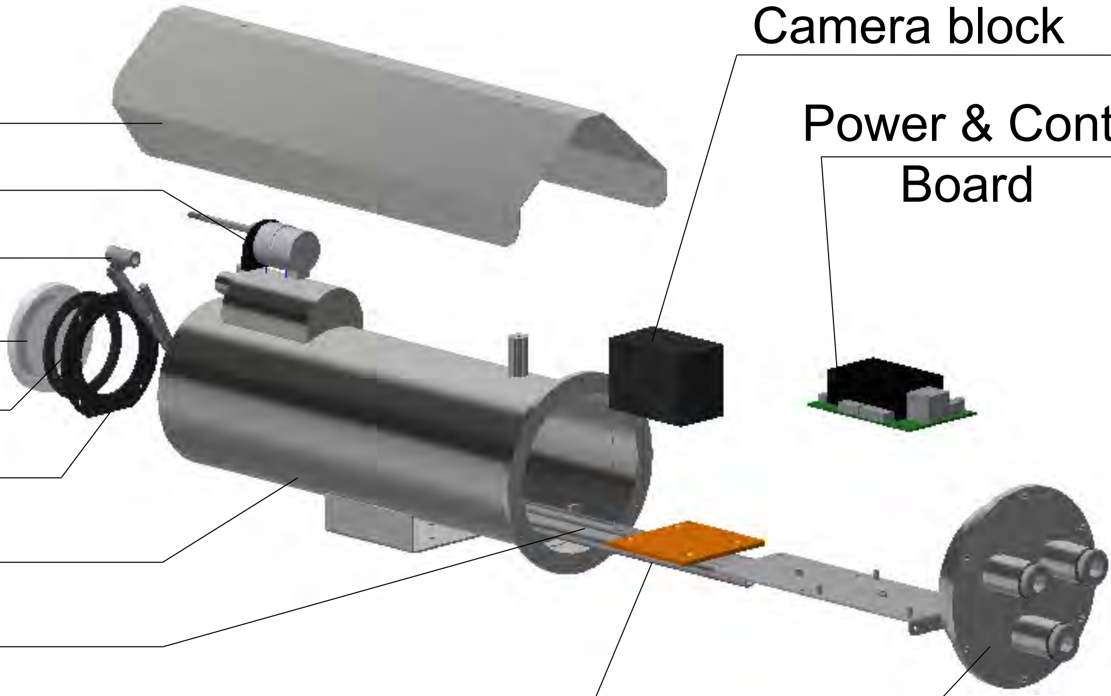
More than physical safety surveillance, we bring the benefits with trusted cybersecurity for the digital assets.

More security leads to less uncertainty

- Secure file system
- Secure access
- Secure user experience
- Secure life cycle

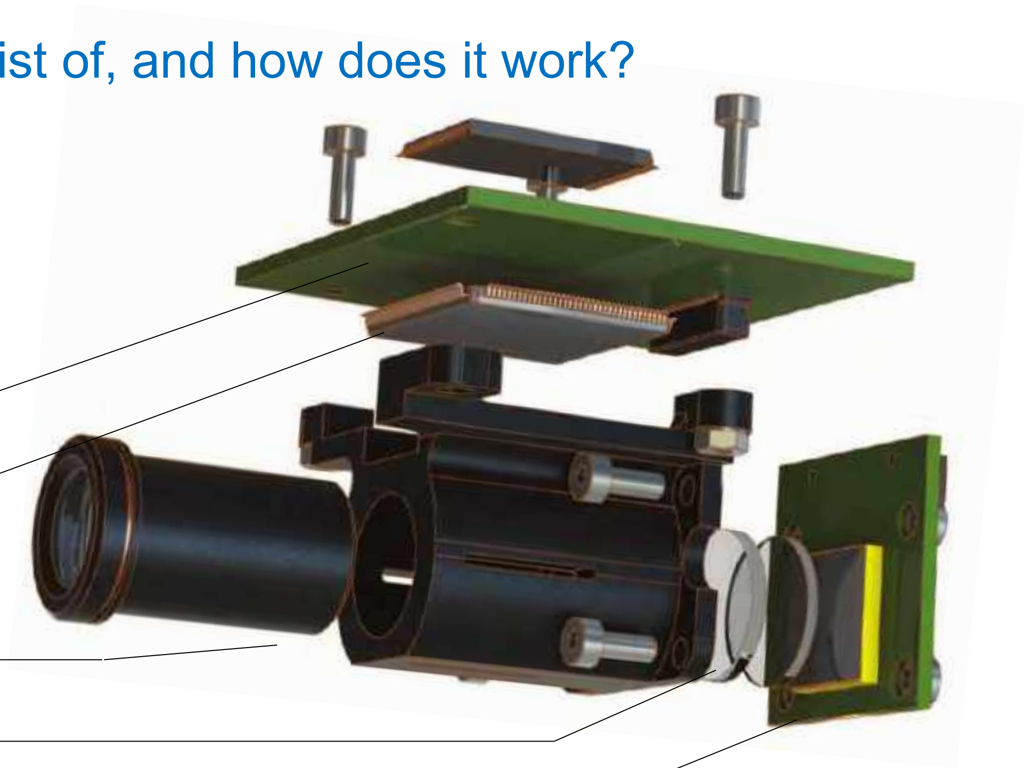
Field camera introduction

What's a typical fixed camera consist of?



Camera block introduction

What’s a typical camera block consist of, and how does it work?



Encoder board

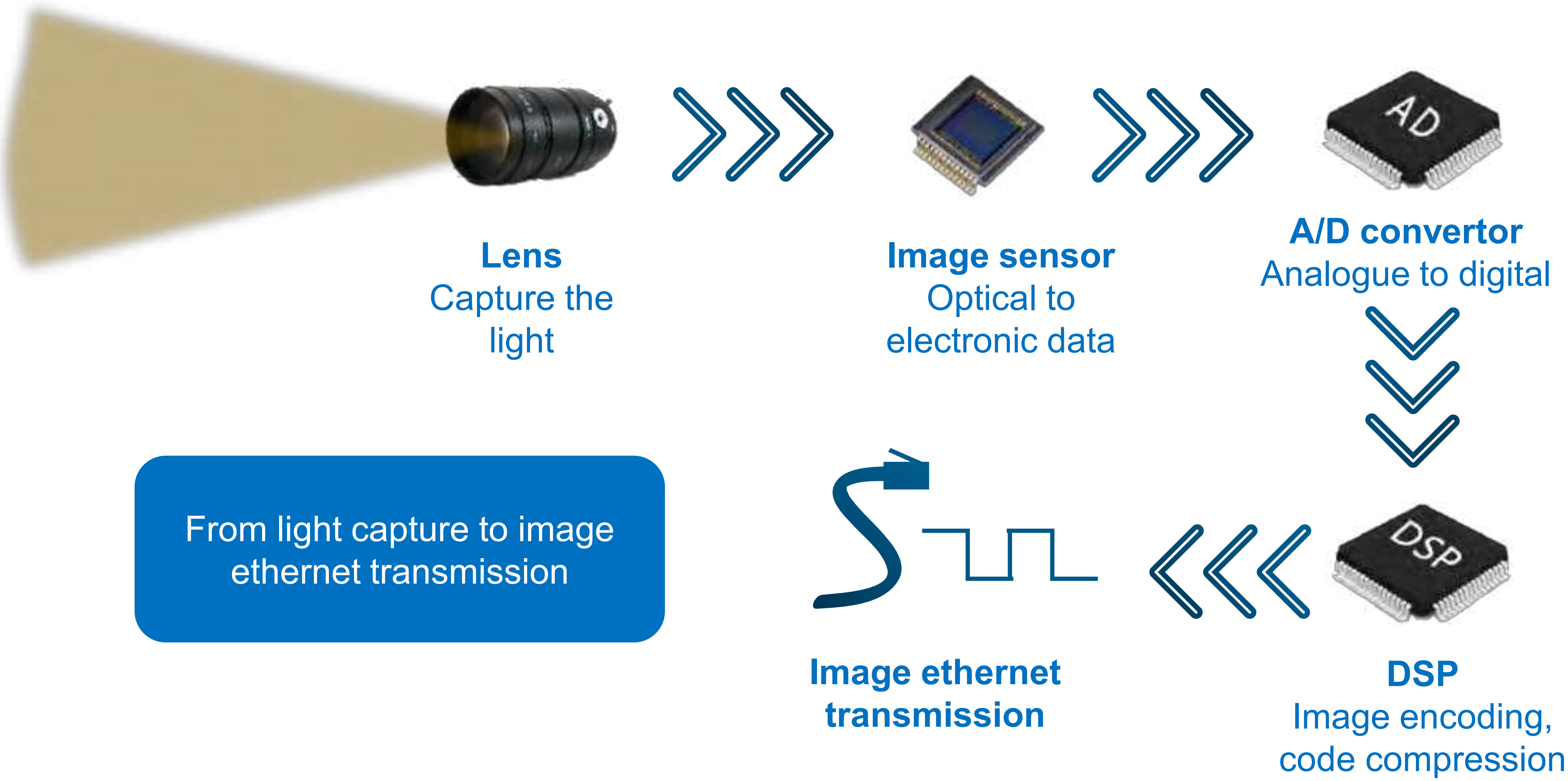
SoC(System on Chip)

Motorized lens module

IR cut filter

Image sensor board

IP camera – optical image digitalization



Camera tender specification

EXPLOSION PROOF FIXED CAMERA - TYPE 1

GENERAL	1.	Tag No.	See index table
	2.	Service Area	See index table
	3.	Location/Drawing	See index table
	4.	Area Classification	See index table
	5.	Certification	ATEX / FM / UL/ IECEx
	6.	Ingress Protection	IP56 as minimum
	7.	Equipment Description	Surveillance and security devices
	8.	Quantity	03
	9.	Explosion Protection	Ex'd', Zone 1/2, Gas Group IIA, T3
SERVICE	10.	Operating Temp. Rg.	0 °C to 60 °C
	11.	Operating Humidity Rg.	62% to 98% RH
CAMERA & LENS	12.	Camera mode	True Day / Night camera (No infrared LED); Automatically removable IR-cut filter
	13.	Pick Up Element/Sensor	1/3" progressive scan RGB CMOS or better
	14.	Lens	Fixed with variable 4 – 10 mm, F1.5 or better
	15.	Angle Of View	Horizontal: ≥75° ± 2° @ min focal
			Vertical: ≥ 45° ± 2° @ min focal
	16.	Minimum illumination	0.15 lux (Color) & 0.03 lux (B/W) at 50 IRE F1.5
	17.	White balance	Automatic and Manual
	18.	Wide Dynamic Range	120 dB depending on scene, highlight compensation
	19.	Shutter	1/33500 s to 1/5 s
	20.	Resolution	2592x1944 (5 MP) or better,
	21.	Compression Tech	H.265/H.264, Motion JPEG, advance compression
	22.	Video streaming	Multiple, individually configurable streams, advance compression stream (Note 4)
	23.	Network security	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1Xa network access control, etc. (Note 4)
	24.	Supported protocols	IPv4/v6, HTTP, HTTPS, QoS Layer 3, etc (Note 4)
	25.	Analytics Functions	Video motion detection, Motion Guard, Fence Guard, Loitering Guard auto tracking, active gate keeper, Object removed, Enter/Exit detector.
	26.	SoC/Memory/Storage	At least 1 GB RAM, 512 MB Flash, Support for SD/SDHC/SDXC card and SD card encryption
	27.	Power Consumption	Typical 10W
	28.	Power supply	Power over Ethernet class 3 comply
CAMERA HOUSING	29.	Cable Entries/ Gland	½ NPT (Note 3)
	30.	Camera Weight	approximate 15 kg or lighter
	31.	Material & Finish	SS316
ACCESSORIES	32.	Mounting bracket	Pole Mounting
	33.	External SD card	Surveillance microSDXC Card 128 GB at least
	34.	Surge Arrestors	Yes
PURCHASE	35.	Manufacturer	VTA
	36.	Model	VTA

OUTDOOR MARINE PTZ CAMERA – TYPE 2

GENERAL	1.	Tag No. / Service Area	See index table
	2.	Location/Drawing	See index table
	3.	Area Classification	See index table
	4.	Certification	No
	5.	Ingress Protection	IP56 as minimum
	6.	Equipment Description	Surveillance and security devices
	7.	Quantity	01
	8.	Explosion Protection	N/A
SERVICE	9.	Operating Temp. Range	0 °C to 50 °C
	10.	Operating Humidity Rg.	62% to 98% RH
CAMERA & LENS	11.	Camera mode	True Day / Night camera (No infrared LED); Automatically removable IR-cut filter.
	12.	Pick Up Element/Sensor	1/2.8" progressive scan RGB CMOS or better
	13.	Pan/Tilt/Zoom	Pan 360° with endless / Tilt 220° with 1.8°-450°/s speed, Recall/predefine position function.
	14.	Lens	x30 optical zoom, Auto IRIS and auto focus
	15.	Angle Of View	Horizontal: ≥ 65° ± 1° @ min focal
			Vertical: ≥ 39° ± 1° @ min focal
	16.	Minimum Illumination	0.1 lux (Color) & 0.002 lux (B/W) at 30 IRE F1.6
			0.15 lux (Color) & 0.003 lux (B/W) at 50 IRE F1.6
	17.	White balance	Automatic and Manual
	18.	Wide Dynamic Range	120 dB depending on scene, highlight compensation
	19.	Shutter	1/11000s to 1/3s
	20.	Resolution	HDTV 1080p 1920x1080 to 320x180
	21.	Compression Technology	H.265/H.264, Motion JPEG, advance compression
	22.	Video streaming	Multiple, individually configurable streams, advance compression stream (Note 4)
	23.	Network security	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1Xa network access control, etc.
	24.	Supported protocols	IPv4/v6, HTTP, HTTPS, QoS Layer 3, etc (Note 4)
	25.	Analytics Functions	Video motion detection, Motion Guard, Fence Guard, Loitering Guard auto tracking, active gate keeper, Object removed, Enter/Exit detector.
	26.	SoC/Memory/Storage	At least 1 GB RAM, 512 MB Flash, Support for SD/SDHC/SDXC card and SD card encryption
	27.	Power Consumption	Typical 65W
	28.	Power supply	Power over Ethernet comply
CAMERA HOUSING	29.	Cable Entries/ Gland	½ NPT (Note 3)
	30.	Camera Weight	approximate 10 kg or lighter
	31.	Material & Finish	SS316
ACCESSORIES	32.	Mounting bracket	Pole Mounting
	33.	External SD card	Surveillance microSDXC Card 128 GB at least
	34.	Surge Arrestors	Yes
PURCHASE	35.	Manufacturer	VTA
	36.	Model	VTA

What is a camera block all about

Spectrum

WDR

ONVIF

White Balance

Edge analytics

IR Cut Filter

Frame rate

Image resolution

Bandwidth

Field of View

PPF/PPM

Video compression

Camera deep dive

Powering Business Worldwide

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

Setting the Standard for Automation™

HAC SYSTEMS

EATON CCTV SYSTEMS

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

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Eaton FHF Phone Portfolio Overview

Reliable communication, whatever the environment

Be heard | Be informed | Be safe

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)


The future of industrial
communications is here

Making yourself heard in a noisy, busy environment is always a challenge. But in harsh and hazardous industrial environments, it is a safety imperative. Personnel must be able to communicate clearly and unambiguously in order to stay safe and keep operations running efficiently.

Meet the FHF product line - part of Eaton's Crouse-Hinds series portfolio

Eaton's world-renowned FHF product line was born and is still, 125 years later, manufactured in Germany.

Delivering reliable and highly functional telephones, the portfolio includes IP, analogue, weatherproof and explosion proof options to suit every application.

Our robust, high quality industrial telephones are designed to withstand high temperatures, shock, vibration, dust and humidity and are manufactured to the highest accreditation standards.

We make what matters work.*

*Our goal is simple: to provide unique solutions across a wide range of markets that keep businesses on the leading edge of change.

Over the years, we have also expanded our expertise and portfolio of products, services and systems by integrating the competencies of some of the world’s most respected names. We have built the brand you can trust to meet your toughest power management challenges.

We’re a power management company, but more importantly, what we do improves quality of life and the environment. Our products, technologies and services make a difference in the world.

Cybersecurity is constantly front-of-mind during Eaton system development, resulting in the highest levels of protection for users of our solutions.

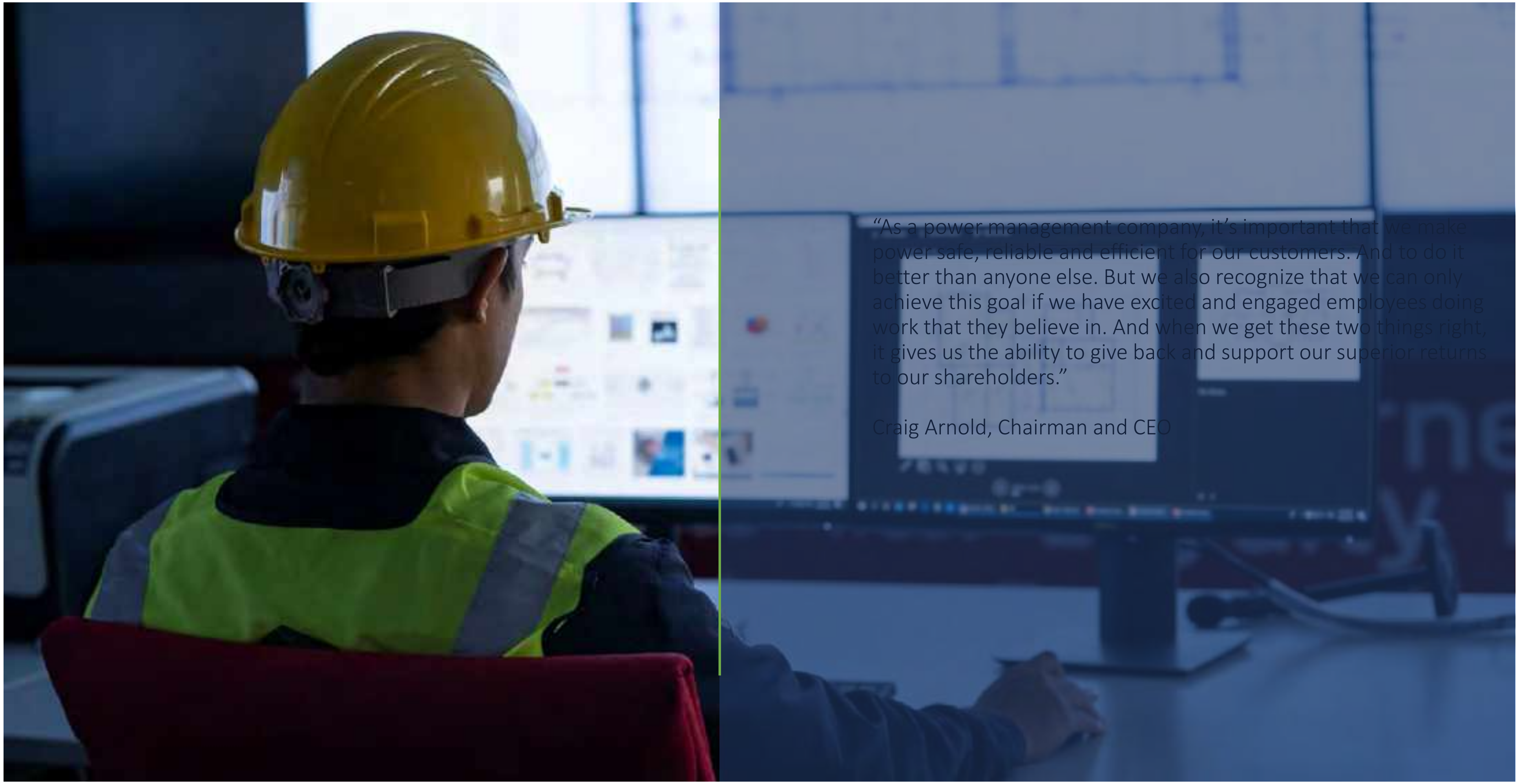
Our innovation strategy is advancing our responsibility to cleaner, lower carbon technology and solutions - all while increasing reliability, durability and safety.

Our promise of doing business right reflects our unwavering commitment to the highest ethical practices and standards of behaviour.

We are committed to improving the quality of life and the environment, by 2030 our target is to be carbon neutral and have zero waste manufacturing sites.

We are redefining our business by adapting digital technologies to transform power management for safer and more efficient power use.

We have global support teams who have the expertise to provide support and care 24hrs a day.



"As a power management company, it's important that we make power safe, reliable and efficient for our customers. And to do it better than anyone else. But we also recognize that we can only achieve this goal if we have excited and engaged employees doing work that they believe in. And when we get these two things right, it gives us the ability to give back and support our superior returns to our shareholders."

Craig Arnold, Chairman and CEO

An unparalleled history for over 125 years

- Eator ther a comprehensive
  portf est and most hazardous
  envir expertise across our
  globa decades of experience -
  you'r rotect your people and
  proce

- Eator rmany in 1897. Our
  deca passion in this
  chall

- With ide customers with the
  most available to ensure they
  can c els in
  all en

Onshore/Offshore | Oil & Gas | Industrial
Marine | Transportation - Railways & Road Tunnels
Chemical Processing | Pharmaceutical Manufacture
Alternative Energy | Power Generation | FPSOs

Reliable in any environment

Noise. Vibration. Extreme operating temperatures. Humidity. Corrosive chemicals. Salt spray. Explosive atmospheres. No mains power.

Whatever the challenge, Eaton has an FHF phone to cover it.

An introduction to the range

Our versatile FHF range includes three main models:

ExResistTel and ResistTel

Our highest specification phone for extreme environments.

- ExResistTel IP4 Explosion Proof Telephone
- ResistTel IP4 Weatherproof Telephone
- ExResistTel Explosion Proof Telephone
- ExResistTel MB Explosion Proof Telephone
- ResistTel Weatherproof Telephone
- ResistTel MB Weatherproof Telephone

An introduction to the range

Our versatile FHF range includes three main models:

FernTel

Our mid-range solution, practical and programmable.

- FernTel IP4 Z2 Explosion Proof Telephone
- FernTel IP4 Weatherproof Telephone
- FernTel 3 Z2 Explosion Proof Telephone
- FernTel 3 Weatherproof Telephone
- FernTel-W Weatherproof Telephone

An introduction to the range

Our versatile FHF range includes three main models:

InduTel

Our entry-level phone for basic, reliable communications environments.

- InduTel IP4 Weatherproof Telephone
- InduTel (LED) Weatherproof Telephone

We make trusted connections work.*

*Cybersecurity is constantly front-of-mind during Eaton’s system development, resulting in the highest level of protection online for users of our hazardous area communications solutions.

Our experienced team of cybersecurity leaders identify and address gaps in your processes and personnel training programs to minimize your overall attack surface. You can be confident in us that we have the capabilities to protect your people and processes by addressing high cyber threats in advance. We have robust and evolving protection with stringent follow-up procedure in place should a potential breach be detected.

The principle of Eaton’s defence in depth strategy is to implement multiple layers of security controls around a product or system instead of single control. Deploying this design in a layered manner provides superior protection and often discourage a cyber-attack. With this level of security, it makes severe security vulnerabilities difficult to exploit in a real system and minimize the overall damage and chance of a full compromise to occur.

Defence in depth layers

Policy and procedures

Risk management, Incident response, Supply chain management, Audit & assessment, Trainings etc.

Physical security

Access control, ID cards, Fences, CCTV etc.

Network security

Firewalls, IDS / IPS, Sandboxing, Monitoring and alerting etc.

Host security

Secure configurations, Restricting unwanted and insecure services, Whitelisting etc.

Application and data security

Security updates, Secure communications,

Data encryption etc.

Secure by design

Our FHF line has cybersecurity at the core of its "secure by design" philosophy and it is embedded in all intelligent power products and platforms we bring to market. Our FHF products are carefully designed and meticulously tested in our accredited laboratories with online security in mind. You can be confident that our devices are compliant with the highest industry cybersecurity requirements before they are installed in your critical systems.

Our IP4 telephone range offers security standard such as DTLS 1.2, TLS 1.2 (1.2 with next revision), X.509 certificates and Kerberos based authentication which provides ultimate protection you can trust and rely on.

Ex-ResistTel and ResistTel Phones

FHF ResistTel telephones are the ideal choice for really tough industrial environments, including offshore and petrochemical applications. Available in weatherproof or Ex-rated versions, these phones are designed to support the highest levels of operational and personnel safety and are available in different housing colours.

FHF ResistTel phones are resistant to seawater, alkalis, acids and lubricants. Their tough GRP housings are impact resistant and the robust V4A stainless steel keypads withstand the stresses of industrial use. These phones are equipped with a steel-armoured handset cord for high tensile strength.

For explosive atmospheres, users can also choose from a range of approved accessories that will enhance phone functionality even further.

Models available

ExResistTel IP4 Explosion Proof VoIP Telephone

- Indoor and outdoor used in zones 1, 2, 21, 22
- Protection class IP66 according to IEC60529
- Ambient temperature
  - -40 °C to +60 °C with armoured cord
  - -30 °C to +60 °C with spiral cord
- Ring tone ≥ 95 dB(A) in 1 m distance
- Pixel-based luminous OLED display
- V4A alphanumeric keypad
- Web-based monitoring (operating, handset, hands-free and ringing function)
- User-friendly menu structure
- VoIP Protocols: SIP, H.323 (UDP, TCP, TLS), RTP, SRTP (SDES, DTLS),RTCP, ICE
- Power supply: PoE or external
- Connection to 10/100/1000-BASE-T Ethernet
- Hands-free operation
- Two built-in independent relay contacts
- Different housing colours

Models available

ExResistTel Explosion Proof Telephone

- Certified for dust and gas exposure
- Ideal choice for petrochemical and offshore applications
- 21-key V4A stainless steel keypad designed for use with gloves
- Hands-free operation
- Locking function with PIN
- Temperature range -25 °C to +60 °C
- IP 66 according to EN 60529
- Different housing colours
- Option available without keypad

Models available

ExResistTel MB Explosion Proof Telephone

- 3 direct dial keys (freely programmable)
- Certified for dust and gas exposure
- Ideal choice for petrochemical and offshore applications
- 21-key V4A stainless steel keypad designed for use with gloves
- Hands-free operation
- Temperature range -25 °C to +60 °C
- IP 66 according to EN 60529
- GRP housing

Models available

ResistTel IP4 Weatherproof VoIP Telephone

- Protection class IP 66 according to IEC60529
- Ambient temperature -40 °C to +70 °C
- Ring tone 95 dB(A) in 1 m distance
- Pixel-based luminous OLED display
- V4A alphanumeric keypad
- User-friendly menu structure
- VoIP Protocols: SIP, H.323 (UDP, TCP, TLS), RTP, SRTP (SDES, DTLS),RTCP, ICE
- Power supply: PoE or external
- Connection to 10/100/1000-BASE-T Ethernet
- Relay built-in (SPST)
- Relay module (optional) 2x SPDT
- Hands-free operation
- Different housing colours

Models available

ResistTel Weatherproof Telephone

- Locking function with PIN
- Hands-free operation
- Temperature range -25 °C to +60 °C
- Display
- IP 66 according to EN 60529
- V4A stainless steel keypad
- GRP housing
- Different housing colours
- Option available without keypad

Models available

ResistTel MB Weatherproof Telephone

- 3 direct call keys (freely programmable)
- Hands-free operation
- Amplified listening in 7 steps, 0-12 db(A)
- Telephone book
- IP 66 according to EN 60529
- V4A stainless steel keypad
- GRP housing

FernTel Phones

Eaton's FHF FernTel is equally at home as a desk phone inside or used outside as a wall-mounted phone. The elegant housing is made of impact and shock-resistant plastic. Acids, alkalis or lubricants cannot harm the high-quality components of this eye-catching desk/wall telephone.

Versatile and easy to use, the FernTel range offers a wide range of options, such as variants with 16 keys and no display, or 21 keys with display; a spiral cord or armoured cord, and a hotline (ZB) phone with call tone unit. There's also a model for installing into a control room desk or alarm room panel. For applications on moving machines, e.g. on ships, a handset stabilisation bracket is available.

Striking signal colours ensure that FernTel phones can be readily identified during an emergency - even in poor weather and light conditions. FernTel phones are available as weatherproof analogue, weatherproof VOIP, Ex analogue and Ex VOIP versions.

Models available

FernTel IP4 Z2 Explosion Proof Telephone

- Suitable for potentially explosive areas zone 2 and 22
- Impact resistant thermoplastic housing
- IP 65 according to IEC60529
- Ambient temperature -20°C to +55°C
- Pixel-based luminous OLED display
- Illuminated keypad
- Intelligent and user-friendly menu structure
- Call tone ≥ 95 dB(A) in 1 m distance
- VoIP Protocols: SIP, H.323 (UDP, TCP, TLS),   RTP, SRTP (SDES, DTLS), RTCP, ICE
- Power supply: PoE or external
- Connection to 10/100/1000-BASE-T Ethernet LAN
- Different housing colours

Models available

FernTel 3 Z2 Explosion Proof Telephone

- Suitable for potentially explosive areas zone 2 and 22
- Impact resistant thermoplastic housing
- Protection class IP65
- Stabilization bracket (optional)
- Ambient temperature -20 °C to +55 °C
- Ringing volume ≥ 95 dB(A), 1 m
- Explosion protection type
    - II 3G Ex nA ic IIC T5 Gc
    - II 3D Ex tc ic IIIC T80°C Dc
- Different housing colours
- Versions with or without display available
- Spiral or armoured cord

Models available

FernTel IP4 Weatherproof Telephone

- Ingress protection class IP65 according to IEC60529
- Ambient temperature -40°C to +60°C
- Ringing volume ≥ 95 dB(A) in 1 m distance
- Pixel-based luminous OLED display
- Illuminated keypad
- Intelligent and user-friendly menu structure
- VoIP Protocols: SIP, H.323 (UDP, TCP, TLS), RTP, SRTP (SDES,DTLS), RTCP, ICE
- Power supply: PoE or external
- Connection to 10/100/1000-BASE-T Ethernet
- Relay built-in (SPST)
- Relay module (optional) 2x SPDT
- Hands-free operation
- Different housing colours

Models available

FernTel 3 Weatherproof Telephone

- Housing made of impact-resistant plastic (polycarbonate)
- IP 65 according to IEC60529
- Ambient temperature -25 °C to +55 °C
- Call tone ≥ 95 dB(A) at 1m distance
- Optional handset locking (stabilization bracket)
- Easy installation
- Volume amplification
- PIN code
- Menu in 4 languages
- Different housing colours

Models available

FernTel-W Weatherproof Telephone

- Installs into desk or control panel as an emergency phone
- Ambient temperature -25°C to +60°C
- Connects to every telephone branch with analogue interface
- IP 65
- Optional keypad illumination
- 6 direct dialling keys (programmable)
- Stainless steel mounting plate

InduTel phones

Eaton’s FHF InduTel is a simple-to-operate, rugged phone for non-explosive environments. Both models are provided with a protective door and are suitable for indoor or outdoor use.

Its elegant design makes the InduTel weatherproof phone a great choice for indoor as well as outdoor applications. This phone is robust enough to withstand high humidity, exposure to seawater and severe mechanical strain. A protective door also ensures that the handset and keypad are always perfectly protected against contamination.

The analogue InduTel LED and InduTel IP offer handset rest flashes to indicate an incoming call, making it perfect for use in noisy environments. When the handset is lifted, the flashing light stops and the keypad is illuminated enabling operators to respond effectively even at night.

Models available

InduTel IP4 Weatherproof Telephone

- Protection class IP 66 according to IEC60529
- Ambient temperature -40 °C to +55 °C
- VoIP Protocols: SIP, H.323 (UDP, TCP, TLS), RTP, SRTP (SDES, DTLS), RTCP, ICE
- Relay built-in (SPST)
- POE or external power supply
- Optical call indication
- Illuminated keypad
- Different housing colours

Models available

InduTel (LED) Weatherproof Telephone

- Protection class IP 66 according to IEC60529
- Ambient temperature -40 °C to +55 °C
- Protective door in yellow, red or transparent
- PIN for change of settings
- Open listening function
- Connection for secondary sounder
- Optical call indication (LED version only)
- Illuminated keypad
- Different housing colours

HowlCall Sound-Powered Phone

HowlCall Phone

Eaton’s FHF HowlCall Telephones are battery-free and network-independent.
They feature a highly efficient dynamic transmitter and receiver modules offering reliable, remote communication without a power supply.

The call signal is generated by turning the rotary knob containing an audio frequency dynamo.
All our HowlCall phones have a sturdy, impact-resistant and weatherproof housing.

- Telephony without external power supply
- Weatherproof transmitters and receivers
- Range approximately 10km
- Protection class IP 54

Accessories

TWIN-EExII Explosion Proof Secondary Ringer

- Globally certified secondary telephone alarm and signal unit specifically designed for hazardous areas, meeting ATEX and IECEx certification standards
- Housing made from seawater-resistant cast aluminium providing durability and longevity
- Protection class IP 66 according to EN 60529

Accessories

ExResistTel Accessories Set

- Highly certified explosion proof receiver and headset designed for use in hazardous environments. With protection type II 2G Ex ia IIC T6 and II 1G Ex ia IIC T4 Ga
- Robust corrosion-free housing which is field-proven and meets ATEX standards
- Highly efficient solution reducing surrounding environmental noises

Accessories

mTAR Explosion Proof Telephone Relay

- Telephone connecting relay which is designed specifically for application in potentially explosive areas
- Meeting ATEX and IECEx standards with explosion protection II 2G Ex e ib mb IIC T4 Gb and II 2D Ex tb IIIC T135°C Db
- Robust housing manufactured from glass reinforced polyester (GRP). Durable and reliable material to perform in the roughest conditions

Accessories

Explosion Proof Secondary Bell

- Ex secondary telephone bell is a high-volume explosion proof telephone call signalling for indoor and outdoor installation in hazardous areas
- Highly certified meeting ATEX and IECEx standards with protection type Ex em [ib] IIC T6
- Housing manufactured from die-cast aluminium providing superior reliability

Accessories

Industrial Accessories Set

- Weatherproof secondary receiver and headset ideal for use in harsh environments in industrial areas
- Headset with approx. 15 m connection cable allows making telephone calls possible while carrying out tasks that require the use of both hands

Accessories

TWIN-LED Industrial Secondary Ringer

- Weatherproof telephone alarm and signal unit specifically designed for application in rough environments in industrial areas.
- Corrosion-resistant housing manufactured from aluminium provides a robust and reliable solution.
- Compact design with easy installation process and long-life cycle. Minimum maintenance required reducing overall costs

Accessories

Telephone Hoods

- Our telephone protection hoods are an excellent aid to improve audibility in noisy surroundings in industrial areas where telephones have been installed
- Manufactured from either synthetic, stainless steel or glass-reinforced polyester (GRP) material

Accessories

TAR 22 Industrial Telephone Relay

- Telephone connecting relay which is designed specifically for application in rough and harsh conditions in industrial areas
- Durable housing manufactured from glass-reinforced polyester (GRP)
- Degree of protection IP 66 in accordance with EN 60529

Accessories

Industrial Secondary Bell

- Weatherproof secondary telephone bell is designed for operation in indoor and outdoor applications in rough industrial environments
- Robust design manufactured from die-cast aluminium this secondary telephone bell is resilient to the hardest conditions
- Compact design with easy installation and minimal maintenance required

The power of communication

- Eaton's electrical business is a global leader with deep regional application expertise in power distribution and circuit protection; power quality, backup power and energy storage; control and automation; life safety and security; structural solutions; and harsh and hazardous environment solutions.
- Eaton's leading FHF product line includes both telephones and signalling products. Manufactured in Germany, it boasts a long and distinguished history in the field of communicatio devices.
- The FHF product line is part of the Eaton Crouse-Hinds series from Eaton which offers the broadest portfolio of electrical and instrumentation products for harsh and hazardous applications in the industry.

Visit Eaton.com to see Eaton's full range of signalling from the Crouse-Hinds series FHF and MEDC product lines.

Get in touch with your Eaton representative for order placement.

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Eaton FHF Funke + Huster Fernsig GmbH Gewerbeallee 15-19 D-45478 Mulheim an der Ruhr Germany Telephone: +49 208 8268 0 Fax: +49 208 8268 286 Orders: FHF-orders@eaton.com RFQ: FHF-sales@eaton.com www.eaton.com	Eaton Singapore Office 100G Pasir Panjang Road #07-08, Interlocal Centre Singapore 118523 Telephone: +65 6645 9888 Orders: HACAsia@Eaton.com	Eaton 14825 Northwest Fwy Houston TX 77040 USA Telephone: +1 (713) 937 9772 Fax +1 (713) 937 9773 Technical Sales Enquiries: HACAmericaSales@eaton.com

Zero Downtime Engineering

Innovative Pneumatics for continuous Process Plants

Nirav Shah

Content

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Praises

"The content presented by Nirav Shah has been really interesting, especially the smart solenoid valve which predicts its failure and 3 solenoid valve 2oo3 design. I personally found some of these ideas worth deploying in Reliance"

Dr. Kartik Fojdar
Vice President
Head Centre of Excellence – Instrumentation
Core Engineering & Reliability
Reliance Industries Limited

"The presentation by Nirav shah really blow lot of LED bulbs in our team. We till now used to use international brand but we will not exploring this upgraded technology of redundant valve block of our launching pad at Sri Hari Kota"

Arun VM
Assistant Manager Instrumentation
ISRO Sriharikota

About Me

I am a pneumatic System reliability expert, working in this field since 2007 post completing of my mechanical engineering from NIT Warangal as Gold medallist. Having served over 7000 customers across 81+ countries directly or indirectly and delivering over 1.4 Million solenoid valves every year excite me the impact we create to the world.
Solving customer problems has been my passion and till date has helped our customers saved over 335 cr on person ground and over 2000cr at company level. Being raised in the family which for 3 generations has been working towards providing pneumatic solutions since 1967 to process industry inspired me also to continue the legacy from very childhood. Post joining my family business there has been no looking back in this mission to serve as I directly able to see the impact it is able to create to growth of nation and individuals.
Having visited over 10 refineries and over 40+ continuous process plants from various industries like Chemical, pharma, Cement, Thermal Power, Metal etc on personal ground gave me insight of what is the ground reality at these plants and problems & struggle they face. Many of such struggles are considered as part of life with no solution expected. These help me to put my thought over and develop ground breaking solutions which resolved many such problems around pneumatic systems which basically then impacted uptime and efficiencies of the plants in big way. These initiatives were very much appreciated by industry due to its simple at the same time out of box idea behind it. These lead to multiple awards and recognitions from CII, Economics Times, E&Y etc and multiple invites for paper presentation like IEC meetings, ISA meetings, International Refinery &Petrochemical Technology forum etc. I am thankful to my Family members, company team, clients, channel partners, Agents, suppliers to help me earn a name in process industry world and referring me confidently.

Introduction

Well design pneumatic systems with right electronic algorithm can help reduce the plant down times dramatically; my claim reduction in downtime up to 37% is coming from actual experience of deployment. Trust me, I talk my experience....

Hello, my name is Nirav shah. I am a pneumatic system reliability expert, a pass out from NIT Warangal (Gold Medallist). My tryst with pneumatic systems began early on in my career as mechanical design & application engineer in 2007. Post completing my MBA from SPJAIN in FMB format where 10 days you learn from the college and rest of 20 days you deploy what you learn equipped me with idea of understanding customer & their problems. At that time I develop special solution for automotive segment to start with which grew from humble 2 cr business in 2012 to over 100cr business in 2022 in just 10 years with same approach of solving customer problems. Post 2021 onwards I started focusing on industrial continuous process plants which was majorly till then handled by my father and survey over 10 refineries and over 40 process plants from Chemical, pharma, Cement etc plants in understanding their pain points and developing solutions. I filed 18+ patents on various pneumatic solutions which help industry resolved their burning issue. I found all of them are facing distinct problems but they still carry a common theme too. Even though solutions did exists in market but majority of them are found to be unaware to those solutions. Many of the plant instrumentation professionals found to be not even aware to problems which they are going through as they found them to be way of life and their duty.

When I made presentation to over 100+ such instrumentation professionals in two IEC (instrumentation Executive Club) meetings and over 30 plant presentations all of them thanked me to given them a solution to come out of their daily and critical problems and helping them meeting their KRA of reduced downtime and improving safety. Ever since then these expert has never failed to impress me in terms of establishing lasting relationship with my clients but also in terms of generating leads for my business.

I live and breathe pneumatic system design and which in 2022 also awarded me with CII design excellence award at all India level. Also in 2023 one of the reputed automotive customer Ashok Leyland awarded me with Golden supplier award for 1st time right and fasted development of pneumatic system for Defence Trucks. Also recently in Jan 2024, I have been awarded by Industry and commerce Minister Shriman Piyush Goyal as "Leader of Tomorrow" in the event organize by Economics Times, E&Y and Bennet University. Here over 20K applications were collected and 70 were called for one to one interview and at last I was one of the 18 winners in my category.

Over the years, I have given numerous presentation to end user plants and help them improve their plant reliability and safety. Also guided them with one to one guidance on deployment of these ideas and in many places even supplied those solutions.

The journey so far has been brilliant !

You must be wondering why I wrote this book as solution does exist in the market. But as discussed the information is quite spread out and in very difficult language. Due to the same they are found to be very rarely deployed in the plants. One, being in love with pneumatic system reliability science, it breaks my heart to see how plant instrumentation struggle with pneumatic systems and their control. Due to the same how complete plant output is restricted and safety is compromised. So I want to put maximum instrumentation professionals on the right path.

Two I am unable to coach everyone personally due to time constrains, so this book is my gift to instrumentation professional and plant heads that shares 12 valuable lessons that I have learnt and deployed in various plants during my journey as pneumatic system reliability expert.

I hope these lessons will steer you to the path of success with upgrading pneumatic system reliability and thus ultimately reducing your plant downtime and improving safety.

So without further ado, let's explore 12 lessons I learn about pneumatic system reliability enhancement ...

Your friendly pneumatic system reliability expert

Nirav Shah

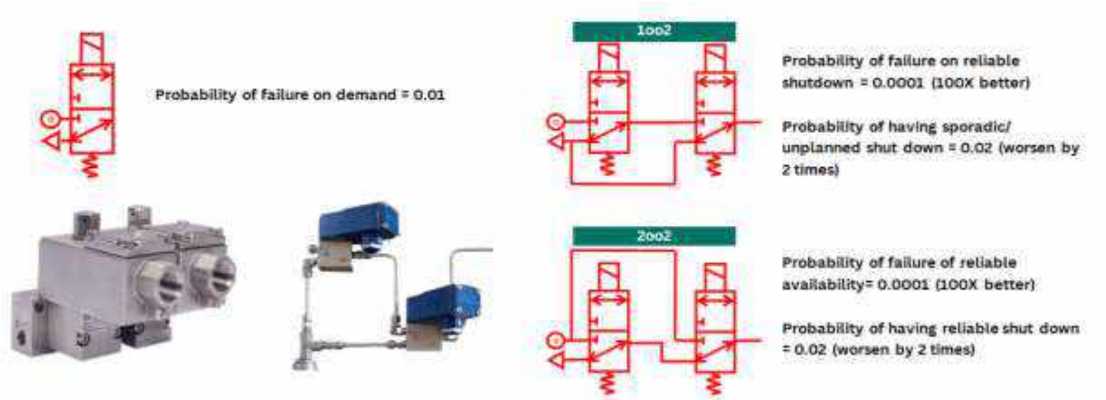
Tech1: 33X Your safety Shutdown Valve safety and reliability

A safety shutdown valve (SSV) is a critical component of a safety system. It's also known as an emergency shutdown valve (ESDV) in critical process industry. This valve is activated in case of any emergency happening within the plant or in the supply pipe lines. This valve plays utmost importance with respect to safety and reliability of the plant. In case if this valve is not operated at the time of emergency, it can lead to a disastrous impact onto the continuous process plant. It can Cause multiple or even thousands of lives into danger and also curse a fire hazard into the plant. Thus for such operation low probability of failure on demand is of utmost important. A Valve with actuator is utilised and the actuator is operated through a critical solenoid valve. (Picture of Safety shutdown valve with Rotex SOV)

This solenoid valve is kept always in energised condition to achieve fail safe condition i.e. No matter what valve is design to have reliable shutdown, any electrical fault or air fault will make it close whether there is an emergency or not. This is critical part of design because if solenoid valve is used other way around i.e. always in de-energized state and energized only when needed in such scenario any wire cut, loose connection, PLC output malfunction etc will not be detected till it is operated in the time of need. Always energized condition always make sure majority of systems are intact and working and any failure in any of such system will trip the plant giving us a signal that we need to correct the same ensuring valve is always ready for having safety shutdown when need arises. (picture of SOV connected to actuator diagram)

Now what about the scenarios where system which are kept in energized condition fail to close itself i.e. PLC output card is found to be shorted, DSM output found to be stuck or solenoid valve itself is found to be in stuck open condition. To overcome such scenarios solenoid valves are connected in 1oo2 configuration which is basically in series configuration. To make sure highest level of safety is maintain the individual solenoid valves are also supplied from different PLC output cards or DSM output card. Having this redundancy becomes ultra-critical to make sure in the event of emergency reliable shutdown happens.

Now opposite phenomena where one need high uptime or availability of the system i.e. on demand operation of the valve is critical in such scenario instead of two valves in series, two valves will be put in parallel to each other. This will ensure in case of any failure in complete loop starting from DCS to PLC, PLC output to wires and solenoid valves if any of the element is failed then also system will operate due to availability of the redundancy in place.



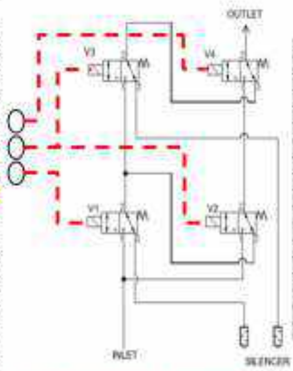
Now consider probability calculations. Let says for the complete loop for DCS to solenoid valve for single loop probability of any element failing for given period is 1%. Now if we have single loop system with single solenoid valve then it means for the given period out of 100 cases there can be 1 case which will fail to operate as per expectation.

Now when safety shutdown is critical then two valves are put in series and that assures that if with two such loops system which are connected in series at solenoid valve level if system to have non reliable operation then both the loop must have failures together in terms of not getting shut. Now such probability becomes 1 out of 10000 as it will be 0.01 X 0.01 = 0.0001. In case one wants to revise concept of probability one can refer https://youtu.be/KzfWUEJjG18 . At the same time probability of having fail safe scenario where even though command for shutdown is not given but still system goes for shot will double i.e. 0.1 + 0.1 = 0.2. This because if either of the loop has any issue in their element from DSC to solenoid valve they will make the system have shutdown. Now these possess a big challenge in the process plants as every such spurious or unplanned shutdowns cost a plant to restart and have loss of production. A typical refinery if have spurious shutdown then it will cost over 2 Million $ per day and it may take minimum 2 days to restarts. Similarly scenario may persists for the parallel connection for availability where availability improves in parallel connection by 100X compare to single solenoid valve system but probability of having spurious operation during shutdown (here probability of system not getting shut) will double which can also cost big in certain scenarios.

Thus there was a need which can provide high safety shutdown but at the same time higher reliability in terms of availability. That is where 2oo3 configuration came into picture.

	PFD	Scenarios (for 4 SOV 2oo3 solution)	for safety
SOV 1	0.01	SOV 1 and SOV 4 fail to close	0.0001
SOV 2	0.01	SOV 1 and SOV 3 fail to close	0.0001
SOV 3	0.01	SOV 2 and SOV 4 fail to close	0.0001
SOV 4	0.01	SOV 1, SOV 2 and SOV 3 fail to close	0.000001
		SOV 1,SOV 3 and SOV 4 fail to close	0.000001
		SOV 3,SOV 2 and SOV 4 fail to close	0.000001
		SOV 1, SOV 2 and SOV 4 fail to close	0.000001
		All SOVs fail to close	0.00000001
			0.00030401

	PFD	Scenarios (for 4 SOV 2oo3 solution)	for reliability
SOV 1	0.01	SOV 1 and SOV 2 fail to open	0.0001
SOV 2	0.01	SOV 1 and SOV 4 fail to open	0.0001
SOV 3	0.01	SOV 3 and SOV 4 fail to open	0.0001
SOV 4	0.01	SOV 1, SOV 2 and SOV 3 fail to open	0.000001
		SOV 1,SOV 3 and SOV 4 fail to open	0.000001
		SOV 1, SOV 2 and SOV 4 fail to open	0.000001
		SOV 3,SOV 2 and SOV 4 fail to open	0.000001
		All SOVs fail to open	0.00000001
			0.00030401



Ch1	Ch2		Ch3	output
V1	V2	V3	V4	
1	1	1	1	1
0	1	1	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	0	1
0	0	1	1	0
0	1	0	1	1
0	1	1	0	0
1	0	0	1	1
1	0	1	0	1
1	1	0	0	0
0	0	0	1	0
0	0	1	0	0
0	1	0	0	0
1	0	0	0	0
0	0	0	0	0

2oo3 Voting system became popular which increases safety and reliability (unreliable or unplanned shutdown) by 32.9X times

Now above system need SOV 2 and SOV 3 to be connected on single channel and with the same it was able to achieve 2oo3 configuration using 4 SOVs. Here due to the same safety and reliability improved from single solenoid system by 32.9X. This was a bit of compromised on safety compare to 2 solenoid valves in series but reliability enhanced to next level. Truth table of the above system can be understood as per picture above where 1 refers to ON and 0 refers to OFF. V1,V2,V3 and V4 refers to 4 Solenoid valves and Ch1, Ch2 and Ch3 refers to respective channels connected to these solenoid valves.

It is important to note that not all the places 2oo3 system is most appropriate to use. It all depends on cost of spurious operation. Here with 2oo2 system we are having 100X better availability but if cost of unreliable shutdown is not much then it is ideal to use 2oo2 system here as 2oo3 would have degraded this performance as it improves availability by 32.9X only.

Let's understand this with one example, let's say for a continuous process plant safety shutdown valve has cost of one spurious shutdown as 5 cr and that of unreliable shutdown (in safety shutdown valve, we can refer as unsafe shutdown) is 100 cr i.e. when valve needs to shut during safety incident if does not shut. Now for ease of calculation we have consider probability of safe and unsafe failure same but in reality they can be different which can be calculated through Lembda safe (for spurious shutdown) and Lemdba dangerous values (for not having a safe shutdown). Also considered some values of capital which goes in putting up a 1oo2 system and 2oo3 system – not just solenoid valve blocks but DCS outputs, cables, PLCs etc involved in operation of these system. Also their maintenance as 2oo3 system has higher components then 1oo2 system we will have even higher maintenance cost compare to 1oo2. Thus with below calculation shows up

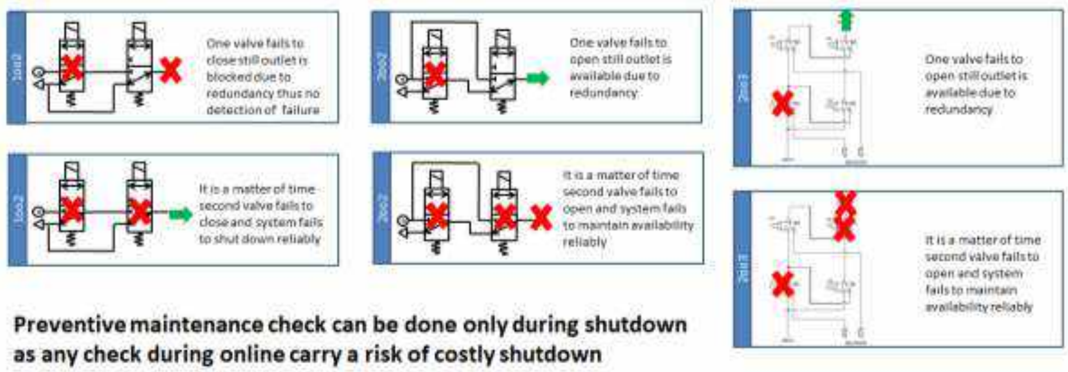
COST OF SAFETY ISSUE	100 CR INR		reliable shutdown					
COST OF SUPERIOR SHUTDOWN	5 CR INR		reliable availibility or working					
	for 5 years	for 5 years				for 5 years	one time	
Possible solutions	PFD For safety	PFD for Reliability	Probable Loss Due to Safety	Probable Loss Due to Spurious Shutdown	Total Loss (Lakhs)	Maintenance Cost (Lakhs)	Capital cost (Lakhs)	Total Cost of Ownership (Lakhs)
SINGLE SOLENOID VALVE	0.01	0.01	1	0.05	105	0.1	5.0	110.1
1oo2 Solution	0.0001	0.02	0.01	0.1	11	4.0	20.0	35.0
2oo2 Solution	0.02	0.0001	2	0.0005	200.05	4.0	20.0	224.1
2oo3 Solution (with 4 Sov)	0.00030401	0.00030401	0.030401	0.00152005	3.192105	8.0	37.5	48.7

Now in above scenario 1oo2 becomes the most ideal solution considering total cost of ownership considering 5 years of lifespan. Now in above same scenario if cost of spurious shutdown is increased to 15 cr then we can see how 2oo3 will be making more sense.

COST OF SAFETY ISSUE	100 CR INR		reliable shutdown					
COST OF SUPERIOR SHUTDOWN	15 CR INR		reliable availibility or working					
	for 5 years	for 5 years				for 5 years	one time	
Possible solutions	PFD For safety	PFD for Reliability	Probable Loss Due to Safety	Probable Loss Due to Spurious Shutdown	Total Loss (Lakhs)	Maintenance Cost (Lakhs)	Capital cost (Lakhs)	Total Cost of Ownership (Lakhs)
SINGLE SOLENOID VALVE	0.01	0.01	1	0.15	115	0.1	5.0	120.1
1oo2 Solution	0.0001	0.02	0.01	0.3	31	4.0	20.0	55.0
2oo2 Solution	0.02	0.0001	2	0.0015	200.15	4.0	20.0	224.2
2oo3 Solution (with 4 Sov)	0.00030401	0.00030401	0.030401	0.00456015	3.496115	8.0	37.5	49.0

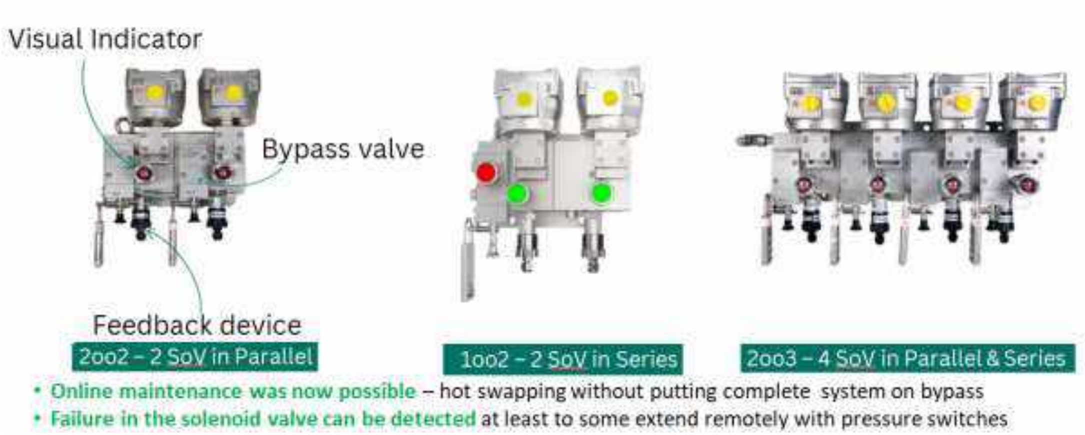
Thus lower the difference between cost of Safety vs cost of spurious shutdown 2oo3 becomes more and more viable but where such difference is huge then 1oo2 can be ideal.
Similar calculation and comparison can be made between 2oo2 system and 2oo3 system where cost of superior shutdown cost much larger than having a reliable shutdowns or in other words where on demand availability is more critical then spurious availability (i.e. not having proper shutdown of the system when needed). Classic example for such systems are fire fighting systems, here we fire safety solenoid valve to start operation on demand and remain available once energized but when system need to shut (example post fire is extinguish) then if the solenoid valve remains ON then one will just waste some water or form unnecessarily but that cost nothing compare to if it does not operate. Another example is rocket launching stations where on demand availability is most important at the time of Rocket launch as system need to release the Rocket at right time and right operations must take place at right time. Any failure can cost huge. Now in such scenario once the Rocket is launch and system needs to be reset to its original position and for that if there are any failure they cost nothing compare to failure at the time of launch. Thus in above cases, unlike safety shut down valve, valve remain ON on demand is more important than it getting shut reliably as cost of unreliable shut down is nothing compare to ON demand availability.

SERIOUS CONCERNS WITH RESPECT TO STANDARD 1oo2, 2oo2 and 2oo3 systems

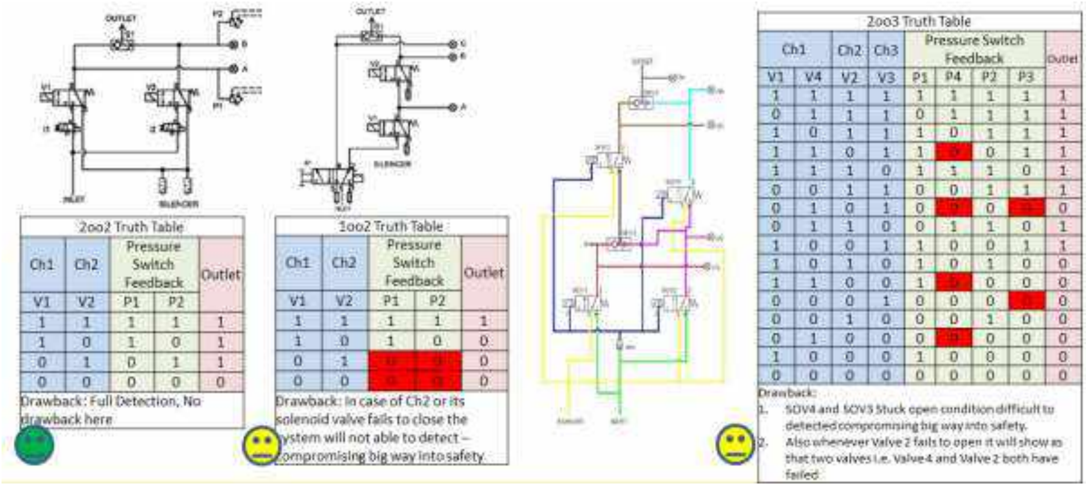


These 2oo2 (two system in parallel), 1oo2 (two system in series) and 2oo3 systems although quite reliable compare to single solenoid system becomes venerable as soon as any one of the solenoid valve fails within that system. These systems lack a detection methodology in case of any failure of the solenoid valve or loop. This is because any such failure will not impact system output and thus keeping such failures undetected as explain in the picture above. As with the failure the system loses its redundancy and its prone to failure on another failure of the solenoid valve. If such failures are not identified with frequent preventive maintenance practices and proper discipline during planned shutdowns, it can lead to disaster. As one cannot perform such checks during plant's running condition as that carries a risk of unplanned shutdown or safety thus only planned shutdown is the only time during which this activity can be carried out.

Thus there was a need for online diagnostic, online maintenance (maintenance without taking complete system on the bypass mode) and visual indicators (for onsite diagnostic) arise. This was addressed by the next generation of redundant systems



Here online diagnostic was achieved through pressure switches where pressure switches were attached to the outlet of the each solenoid valve. Also individual bypass valve were provided in 2oo2 and 2oo3 system which enabled online maintenance in case of any failure of the valve. 1oo2 system are not provided with any individual bypass as it will shut the system and thus overall bypass is provided which when operated bypass the 1oo2 system itself. Also against each solenoid valve visual indicator are provided so that in case of any failure of the solenoid valve onsite diagnostic can be carried out and right valve can be taken for maintenance.



2oo2 Truth Table

Ch1	Ch2	Pressure Switch Feedback		Outlet
V1	V2	P1	P2	
1	1	1	1	1
1	0	1	0	1
0	1	0	1	1
0	0	0	0	0

Drawback: Full Detection, No drawback here

1oo2 Truth Table

Ch1	Ch2	Pressure Switch Feedback		Outlet
V1	V2	P1	P2	
1	1	1	1	1
1	0	1	0	0
0	1	[illegible]	[illegible]	0
0	0	[illegible]	[illegible]	0

Drawback: In case of Ch2 or its solenoid valve fails to close the system will not able to detect – compromising big way into safety.

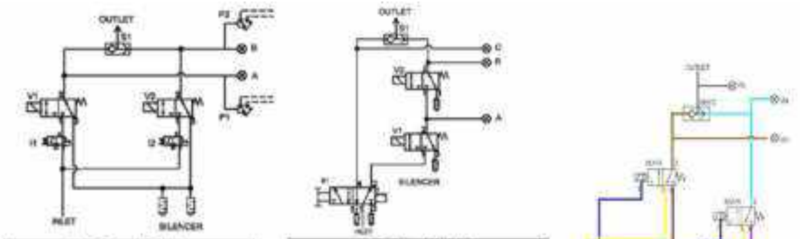
2oo3 Truth Table

Ch1		Ch2	Ch3	Pressure Switch Feedback				Outlet
V1	V4	V2	V3	P1	P4	P2	P3	
1	1	1	1	1	1	1	1	1
0	1	1	1	0	1	1	1	1
1	0	1	1	1	0	1	1	1
1	1	0	1	1	[illegible]	0	1	1
1	1	1	0	1	1	1	0	1
0	0	1	1	0	0	1	1	1
0	1	0	1	0	[illegible]	0	[illegible]	0
0	1	1	0	0	1	1	0	1
1	0	0	1	1	0	0	1	1
1	0	1	0	1	0	1	0	0
1	1	0	0	1	[illegible]	0	0	0
0	0	0	1	0	0	0	[illegible]	0
0	0	1	0	0	0	1	0	0
0	1	0	0	0	[illegible]	0	0	0
1	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0

Drawback:
1. SOV4 and SOV3 Stuck open condition difficult to detected compromising big way into safety.
2. Also whenever Valve 2 fails to open it will show as that two valves i.e. Valve4 and Valve 2 both have failed

Now this pressure switch base diagnostic works well for 2oo2 system but carry serious drawbacks which can lead to compromised safety in 1oo2 and 2oo3 systems. Here as valves in series receives the pneumatic pressure from the first feeding valve and if feeding valve is close then in spite of later valve remain open shows up as OFF when detected through pressure switch.

Thus upgraded version of 2oo2, 1oo2 and 2oo3 were introduced in the market which solved above mentioned problem. Here instead of using pressure switch, proximity switch was used to detect directly the solenoid valve component movement which then operated irrespective of inlet pressure supply from feeding valve. This system removed all drawback of the previous detection system and made it robust enough.



2oo2 Truth Table

Ch1	Ch2	Pressure Switch Feedback		Outlet
V1	V2	P1	P2	
1	1	1	1	1
1	0	1	0	1
0	1	0	1	1
0	0	0	0	0

Drawback: Full Detection, No drawback here

1oo2 Truth Table

Ch1	Ch2	Pressure Switch Feedback		Outlet
V1	V2	P1	P2	
1	1	1	1	1
1	0	1	0	0
0	1	0	1	0
0	0	0	0	0

Drawback: Full Detection, No drawback here

2oo3 Truth Table

Ch1		Ch2	Ch3	Proximity Switch Feedback				Outlet
V1	V4	V2	V3	P1	P4	P2	P3	
1	1	1	1	1	1	1	1	1
0	1	1	1	0	1	1	1	1
1	0	1	1	1	0	1	1	1
1	1	0	1	1	1	0	1	1
1	1	1	0	1	1	1	0	1
0	0	1	1	0	0	1	1	1
0	1	0	1	0	1	0	1	0
0	1	1	0	0	1	1	0	1
1	0	0	1	1	0	0	1	1
1	0	1	0	1	0	1	0	0
1	1	0	0	1	1	0	0	0
0	0	0	1	0	0	0	1	0
0	0	1	0	0	0	1	0	0
0	1	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0

Drawback: Full Detection, No drawback Here

There are many challenges which are seen with 4 SOV system as per below

1. When intrinsically safe system to be used as on single barrier two solenoid valves cannot be operated thus involved additional barrier working into loop. This added additional failure modes with respect to additional barrier and cables. This compromised safety and reliability in bigger way compare to non Exia version of 4 SOV system
2. Possible failure mode of connecting wrong 2 solenoid valves on single channel remain as out of 6 possible permutation combination only possible combination is connecting SOV 1 and SOV 4 on single channel which is valid as others results into compromised solution.
3. Also more the components higher the chances of failure and thus compromised reliability and safety
4. More components means more maintenance needed
5. It has complex truth table with visual indicator and pressure switch due to 4 solenoid valve system
6. One need to have additional bypass valve, feedback system or diagnostic system, cables etc making the whole system more capital intensive

Thus new innovation with 3 sov system was very much needed where 2oo3 configuration was achieved with the same which increased safety to 33.2X and also reliability to 33.2X level. This is consider to solve limitation of 4 SOV system and also provide additional advantages like below

1. Lower components thus lower maintenance
2. Lower cost of capital due to complete saving of communication channel and supply line
3. Compact design
4. Higher reliability & safety compare to 4 SOV 2oo3 system
5. Easy to interpret truth table with visual indicator or pressure switch
6. Better SIL3 ratings

Thus I recommend if you are considering 2oo3 system for your critical shutdown system you must go for 3 solenoid valves system then 4 solenoid valves one.

Also if you need more detail understanding you can download the PPT from LINK XXXXXXXX
In this PPT detail truth table, calculation, animated explanation is also provided which you can download from the above link providing your email address.

Working Demo Video | Ease of Service Video | 2oo3 advantage Video

Also you can scan above QR code to see a video animation on how 2oo3 with 3 solenoid valve system works and also working demo & how easy it is to service onsite.

Tech2: Zero down electrical failures due to water ingress

1. Do you face an issue where water is ingresses through cables spoiling solenoids?
2. Do you face an issue where technician does not fit the cable gland into the solenoid properly causing leakage around the same causing subsequent failure ?
3. Do you face an issue where technician does not fit cable within the cable gland causing leakages around the cable to solenoid terminal box causing subsequent failure ?

If you face one or all of the problems above then you are not alone almost 40% of the Process industry faces these issues and spends considerable huge amount into spares and more than that unplanned downtimes of their systems.

Solution
Best and Robust solution around the same is having a bottom cable entry for the solenoids. This makes sure in any of the above cases water will not travel upwards to terminal box spoiling the solenoid.

Industry many times uses special L bow fittings to convert a typical Horizontal cable entry into bottom but that becomes more space consuming, costly and adds a failure mode of having water ingress from the fitting joints itself.

Also many times bottom cable entry provision creates a space constrain forcing cabinet sizes to be larger than needed. Thus there is a need a market where as per position of the solenoid mounting we can make sure it always bottom cable entry.

Horizontal Cable Entry

Bottom Cable Entry

Special L bow fitting

Generally it is practically difficult to predict how the solenoid valve will be mounted which type of solenoid cable gland one should go for as even bottom cable entry solenoid may become top cable entry or side cable entry solenoid valve if mounting is not horizontal but vertical or upside down.

Thus although there was an attempt to solve a bottom cable entry problem but it does not assure all time it will be bottom cable entry. To resolve this Rotex designed a patented Flexible cable entry solenoid valve designed which resolved multiple concerns with prevailing solenoid valve designs.

Some the existing concerns with prevailing solenoid were as below

1. Getting always bottom cable entry assurance irrespective of the way solenoid is mounted i.e. flexible cable entry

2. Solenoid should be easily demountable when servicing of the valve side (there should not be need for disassembling the cable gland from the solenoid)
3. Cable gland termination should be easy, fast and reliable
4. Solenoid must have provision to provide LED
5. Solenoid should be upgradeable without changing complete valve and junction box
6. Any servicing of the solenoid should not ask for replacing of the complete junction box
7. Solenoid enclosure should able to bear harsh weather condition of Sea and other chemicals
8. Solenoid should have provision to be provided with inbuilt self-correcting Fuse to protect the solenoid against any high power fluctuations
9. Fully rectified circuits, lower power circuits or Intrinsically safe circuits etc should serviceable and should not ask for complete change of the solenoid
10. It should be light weighted and compact enough but at the same time provide enough space to keep additional wire from the cable gland

Rotex keeping above requirement in mind has developed a flexible cable entry solenoid which has solenoid section separate from junction box and thus make it easy to service valve without removing cable gland from junction box but just dismounting of the solenoid.

Also while serving of such solenoid valves there is no need open the electrical connection of the solenoid as Rotex solenoid valves are by default interchangeable and thus one just need to remove the coil mounting nut and remove the valve and replace it new valve or existing serviced valve block. Thus, substantially saving time during servicing and over howling of such solenoid valves.

It has simple quick connect connection for the wires from the cable gland making connection and disconnection in secured way in few seconds without the need for screwing or unscrewing the terminal junction.

It provides a big LED indicator for top and side view so that irrespective of way of mounting of the solenoid LED indicator is viewable.

Just by upgrading the circuit or PCB within solenoid one can convert high power solenoid valve to $1/4^{th}$ of the power or even as low as 0.4 W or even lower

In case of the solenoid failure or servicing one just need to remove one circlip and disconnect the connector and mount new solenoid and put circlip and connect the connector with board, no need to change complete terminal junction box for the same which in current Rotex solenoids one need to do it.

Solenoid enclosure is hard anodized aluminium and thus provides a very high corrosion resistance up to 400 hrs against white rust which is currently a big challenge in all the process plant having location near to sea shore even all such coils are powder coated. As corrosion makes solenoid unserviceable and also many times jams the junction box cover making electrical wire non accessible even for some diagnostics. Due to high corrosion resistance property this problem will be resolved to quite an extend.

Power fluctuation controlled in many of the modern power supplies but still there are many legacy systems or system run over direct AC supplies carries voltage fluctuation due to other inductive or capacitive equipment loaded onto it. Due to this and many other reasons like thunder strikes, input voltage fluctuations, transformer misbehaviours etc solenoid may see high voltage scenario which makes them fail and then solenoid failure reason becomes mystery to be resolved. To overcome such scenario Rotex has come with in-built self-correcting fuse design which on high power fluctuation opens up protecting the solenoid and now solenoid can be put back to life by replacing this fuse instead of whole of solenoid. This is ensure additional layer of protection over and above MCB making sure solenoid provides its claimed longer life irrespective of external scenarios.

Tech3: Predictive Maintenance ready Smart solenoid valve

Where there are many solenoid valves which are operated multiple times unlike process critical solenoid valve which are majorly energized and operated hardly once or twice in 3 years. But solenoid valves which are of higher criticality with high operating frequency need diagnostic which can help us predict the failure of the valve even before the failure is reported.

Such type of valves are designed with sensing of the moving elements within the solenoid where ON and OFF conditions are sensed and with the same one is able to measure the response ON and OFF time of the valve.

Following failure mode is possible to be measure here
1. If the response time goes up means contamination is slowing down the valve and it needs attention
2. If the response time goes down means there is wearing of the seals on the solenoid valve which again give attention for seal change
3. In case OFF signal does not come means solenoid is stuck in between and might be leaking
4. If ON signal does not come means solenoid element is not opening completely and thus might affect the flow rates of the valve due to contamination

Below is example of the valves with such feature which majorly used in Nuclear power application in the main valve as valve which is mounted over the actuator can get the feedback from the limit switch of the actuator also.

Tech4: Pipeless and fittingless - A new edge Modular skids

Such Skids are very common in process industries where they will operate ahead a control valve or ON OFF shut down valve or critical damper etc. Now although they are easy to build using standard components like pipes, fittings, small ball valves, solenoid valves and air operated valves etc but when they are to be serviced it becomes quite clumsy affair.

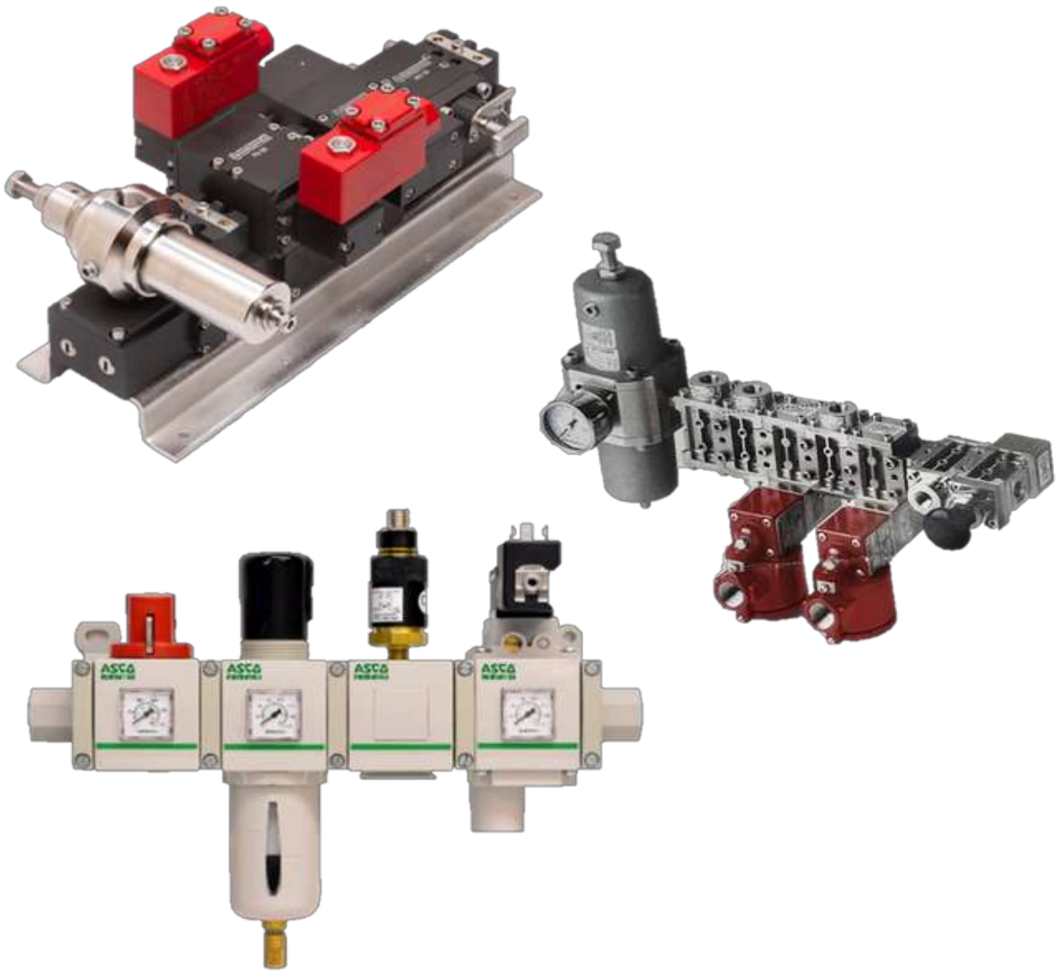
Example take one of the solenoid valve which need servicing in such case one need to open up all the fittings at the inlet and out and even exhaust port and the pull the hard stainless still pipe out – practically it bend it and then use of spanner remove all the fittings from the valve and also unscrew the valve from the mounting, remove the cable gland and internal solenoid connections. And while putting new one, one need to make sure one does proper fitment of the fitting over the threads and then installed the valve with screws and now adjust again the disturbed pipes and tight it right way so not to have any leaks from the fittings. These whole activities are reported to be 1 hr to 2 hrs job depending on installation of the valve and skills of the technician.

In case of unplanned shutdown scenario every minute counts as every minute plant remain not functional it is not producing and due to the same losses can be huge. Just for example a typical fertilizer plant if goes for spurious shut down, it will cost 8 cr to restart it and over 15 cr per day of production loss. Similar numbers are found for refineries depending on size of the refinery.

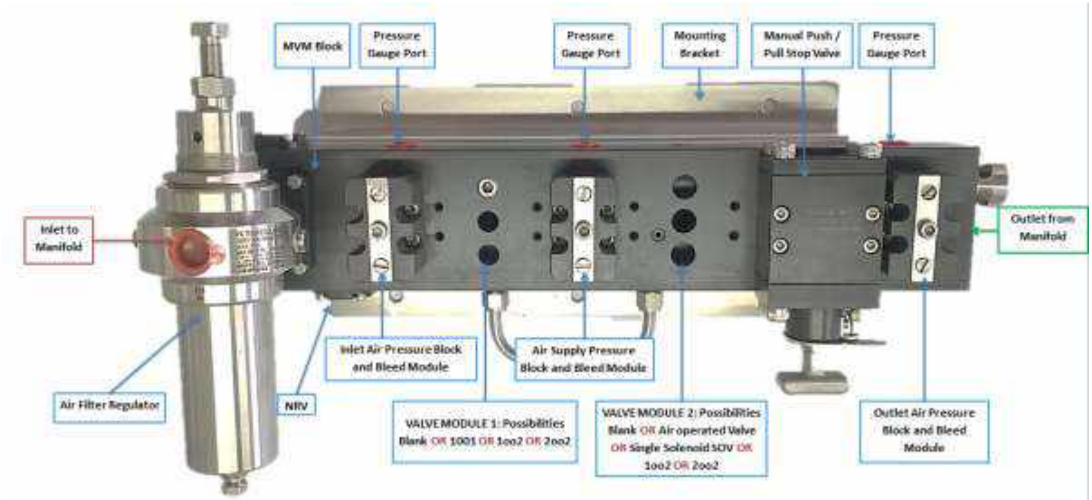
Also now let's say for diagnostic purpose one need to add a pressure switch or pressure gauge or sensor, can you imagine what hassle one need to go through ? One needs to cut the pipe precisely and use appropriate fitting to collect this pressure signal. Now this can be cumbersome and also risky as little here and there and one may need to replace the whole pipe and cutting pipe in the field is not that simple job.

Also size of cabinet and back plat needed to mount various components is huge and that means occupation of more space and higher capital cost for no reason. Also when you want to do overhauled of such system it becomes practically impossible to do it in-house and most time 3rd parties are involved due to intensity of work involved.

Thus there was a need in the industry which can resolve these concerns. Rotex research on this and found a solution which practically removes all piping and fittings and makes the whole solution very agile and plug in play like LEGO game. Although there were some solutions existed to resolve this but were not comprehensive as developed by Rotex.



As you can see the complete skid can be converted into a compact modular solution and that resulted into multi-fold advantage to the customer. Here Filter regulator, solenoid valves, relay or pilot valves can be easily service by just removal of 4 bolts.



There are following other advantages which customer can experience which are as followed

1. Each module is provided with bleed and block system which allows ease of servicing of the each valve blocks.
2. same manifold can be configured to be used as
   i. single solenoid valve
   ii. single solenoid valve with remote valve or relay valve
   iii. 2oo2 solenoid valve
   iv. 2oo2 solenoid valve with remote valve or relay valve
   v. 1oo2 solenoid valve
   vi. 1oo2 solenoid valve with remote valve or relay valve
   vii. Two 1oo2 in parallel
   viii. Two 2oo2 in series
   ix. No Sov system but just the manual valve

Some of the pictures of the configurations

3. Apart from individual valve even complete system can be put on bypass with isolation valve which comes as default in this system which helps during servicing of the downstream instruments ex Actuator or damper
4. Multiple port connection on the manifold provides the provision to connect the pressure gauges or pressure sensor whenever needed
5. Also the outlet and other port opening can be used to carry out additional piping needed to complete the more complex circuitry.
6. We can add additional manifold to incorporate more number of valves on the same to meet up a specific need of the customer
7. The space requirement reduces over 70% compare to standard tubing and fitting arrangement and thus lowers the cost of cabinet and mounting.

8. With reduced piping, joints and fittings the overall reliability of the SKID is enhanced multi-fold due to low components involved in the complete assembly.
9. Service of the valve block takes just around 1 min to change over compare to 1 hr to service a typical solenoid valve on pipelines. Scan QR code for viewing how easy it is to service

Time to replace complete 2oo2 or 1oo2 valve block

Time to replace Sov in 2oo2 or 1oo2 valve block

Tech 5: Diagnosing Solenoid valve with CCTV Camera

Have you think of what typically involves in diagnosing a failure which might cause actuated ball valve or butter fly valve to have mal operation? Those can be any of the following most prominent failures and even more

1. Pneumatic line rupture
2. Solenoid valve failure
3. Electrical cable breakage
4. PLC output card impacted
5. Relay failing
6. Loose connection in any place
7. False signal etc

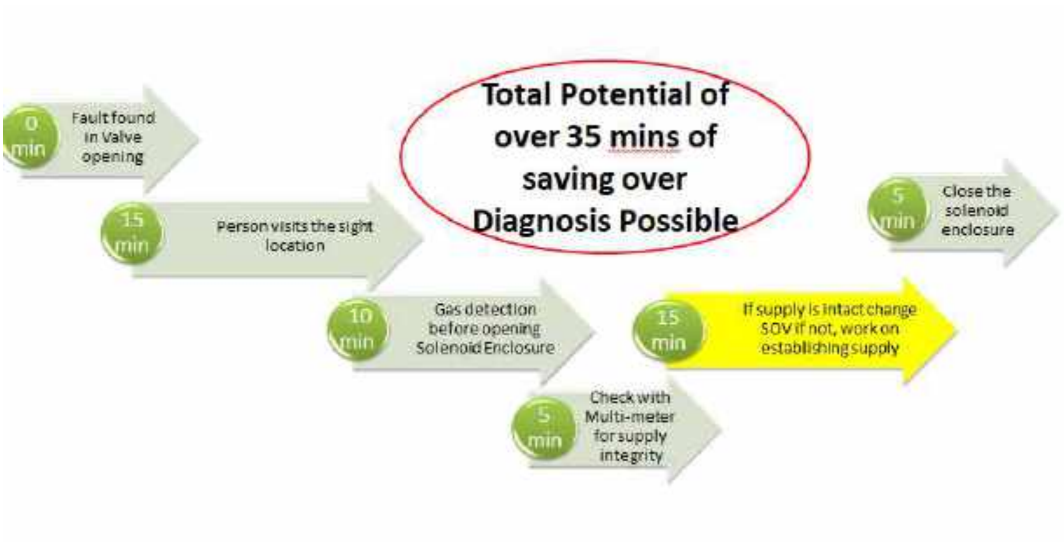
As a part of diagnostics the most common approach adopted in dealing with such issues are quite traditional. A typically personal capable of resolving has to rush down to failure sight and needs to double check for any gas presence. In case of EXD version of the solenoids this is of prime most importance as one need to open the EXD enclosure in live condition. If gas detection is not carried out then one risks the safety of the plant and also of oneself. In case solenoid is an intrinsically safe solenoid then such time is saved as due to ultralow power of Exia solenoids they are safe to open even in live condition.

Once that is done one need to check supply integrity with multimeter. Now there can be two scenarios

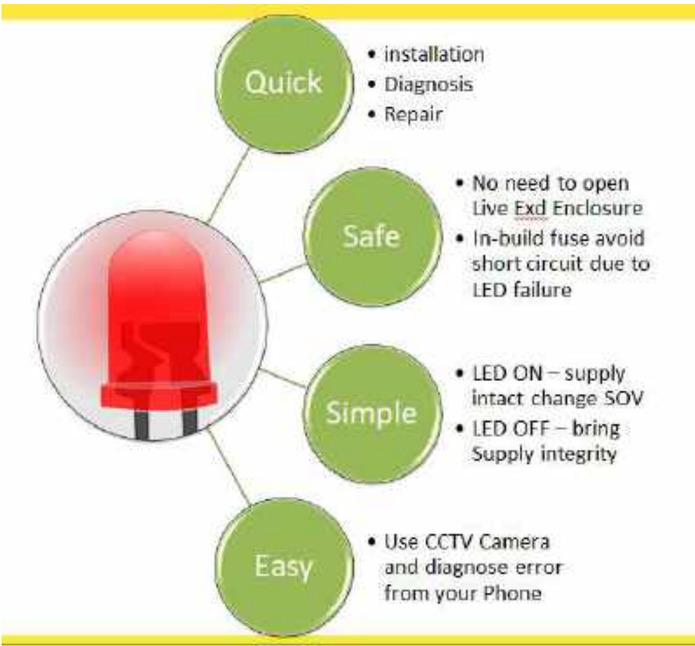
1. Scenario where multi-meter shows electrical connection but pneumatic actuator is still found to mal operated. Then causes like solenoid valve failure, pneumatic line failure can be the causes.
2. Scenario where multi-meter does not show electrical connection then one needs to investigate what all can cause electrical failure which can range from cable breakage to PLC output card failure or Relay failure to some loose connection.

Post the diagnostic is over and root cause is acted upon then again check with multimeter is done for supply integrity and terminal junction box is closed.

Now on an average in good & efficient organisation it will take around 50 min of time for whole of activity but out of all of these what if we are able to save 35 min? how much these can impact into reducing the downtime of the plant ? how much man hours can be saved during installation and preventive maintenance if 35 min of this can be saved ?



Here this is achieved with very simple technology which eliminates 5 of the above processes and that is provision of LED in Solenoids. Such a small enhancement comes with huge advantage which can be understood as below.



Quick: Installation, Diagnosis and Repair

During Installation or Post Repair or at the time of fault the prime most important point is to check supply integrity. Because of supply is not intact Solenoid valve cannot function. Here as one can see LED glowing in the solenoid the electrical supply integrity is quickly diagnosed. Thus this makes this whole operation almost 35 min potentially quicker than non LED solution.

Safe: While in operation....

Over 90% cases it has been observe that while opening the EXD enclosure with live wires instrumentation or maintenance engineer does not carry out gas detection test assuming that there is rare possibility of any flammable gas existence. Even though it is true but carry out such activity carries huge risk of fire and danger to lives. With LED in places the need of opening of EXD enclosure itself is avoided and thus ensuring enhanced safety for the people and plant.

Many even question, what about LED itself becomes cause of failure or safety concern? To answer this LED is very LED is mounted in parallel to supply assuring no way LED failure can become path of stopping the supply. Then question may arise what if LED itself gets short circuited causing sparks? To avoid this just ahead of LED in the circuit path, there is a thermal fuse used which opens the circuit path as soon as it defects short circuited condition ensuring safety for all time.

Simple to Diagnose ...

In case of any fault, one can quickly check LED status and check whether LED is glowing, if yes, then it is a solenoid valve or air supply fault needing its repair and LED is not glowing means supply integrity needs to be established to resolve the issue. Thus such LED makes fault diagnostics very easy and efficient. Whether it is during installation or preventive maintenance or repairs such simple diagnosis helps tons of time and efforts saving what to speak of in case of unplanned shutdown such feature dramatically helps reduced MTTR (mean time to Repair).

EASY: Diagnose Solenoid valve with CCTV Camera

With CCTV camera becoming very common in use during plant operation, if CCTV camera is used to diagnose a cluster of such LED enabled solenoid valves then one may not even visit sight to diagnose error. Just with the comfort of the office either on monitor or even on Mobile one can access CCTV camera and check the LED condition and go prepared with appropriate action.

Upgrading Existing Solenoid valves with LED is not expensive...

If you already have the solenoid valves without LED and wants to upgrade with LED but see budget as big constrain then there is a good news for you. There are many manufacturers Example Rotex which can upgrade the solenoid valves with LED just buy replacing the solenoids without changing the complete solenoid valve. This reduces the upgrade cost to over 70% making it really lucrative.

Even if you are looking for expansion and looking for going ahead with LED solenoid valves then such valves cost just over 5% of the regular non LED counterpart. And such additional cost can be recovered from even a single incident of electrical or solenoid valve failure with reduced MTTR involved in it.

Tech 6: Increasing Pneumatic Actuator life over 50%

Pneumatic Actuators are most commonly used in variety of the operations within process plants. Below are the some of the most important and well known applications where pneumatic actuators are invariably found to be used and become critical for their operations.

Valve Control: This is perhaps the most significant application of pneumatic actuators in industries such as oil and gas, chemicals, and pharmaceuticals. They are used to operate ball valves, butterfly valves, plug valves, and gate valves, which regulate flow paths, control process pressures, and manage fluid handling.

Damper Control: In HVAC systems within industrial settings, pneumatic actuators are used to control dampers in ductwork. This regulates air flow and contributes to maintaining environment conditions, crucial in processes requiring specific temperature and humidity levels.

Pump Operation: Some specialized pumps use pneumatic actuators for diaphragm control, essential for dosing and transferring precise volumes of chemicals, often in hazardous or sterile conditions.

Material Handling: In pharmaceutical and chemical manufacturing, pneumatic actuators are used in systems for the movement and handling of solid materials (like powders or granular substances) where cleanliness and avoiding contamination are critical.

Mixing and Agitation: Pneumatic actuators are applied in mixing operations, driving mixers and agitators in chemical reactors and formulation tanks in pharmaceutical production where precise control over mixing speed and duration is required.

Automated Production Lines: They are used extensively on automated production lines for driving mechanical movements such as pushing, pulling, lifting, and positioning components. This includes operations in packaging, filling, and assembly processes.

Safety Instruments: In emergency shutdown (ESD) systems, pneumatic actuators are crucial. They ensure rapid response capabilities, shutting down systems or isolating parts of the facility to prevent accidents and manage hazardous conditions.

Thus Pneumatic actuators operation life becomes critical for process industry as that indirectly relates to healthy & seamless operation of the plant.

TYPES OF PNEUMATIC ACTUATORS

There are two types of the pneumatic actuators, i. single acting actuator: Here on air failure the actuator returns to its default position and ii. Double acting actuator: here on air failure the valve remains in the stay put condition.

In most process industry majority of the time single acting actuators are widely used due to safety concerns as majority of the industry wants their actuator to return to default condition (most close) to maintain safety. Thus Over 80% of the pneumatic actuators found in such industries are of single acting in nature.

Here the return operation is achieved by use of spring which compresses when pneumatic compressed air is supplied but brings the actuator to default or return condition when such pressurised air is released.

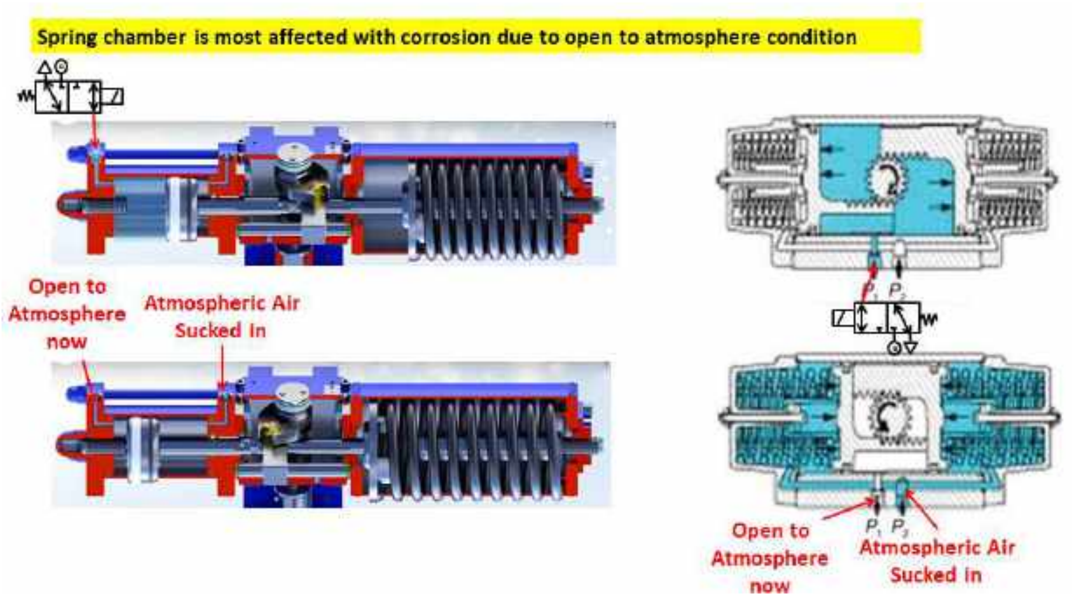
MOST COMMON PROBLEMS IN PNEUMATIC ACTUATORS

1. **Air Supply Issues**:
   - **Leakage**: One of the most common problems in pneumatic systems is air leakage. This can occur due to loose fittings, worn seals, or cracks in the hoses, leading to inefficient actuator operation or a failure to actuate at all.
   - **Inadequate Pressure**: Insufficient air pressure can prevent the actuator from developing enough force to operate the valve or machinery correctly. This can be due to issues in the compressor, incorrect system setup, or leaks.
2. **Contamination**:
   - **Dirt and Moisture**: Air that is not properly filtered can carry contaminants and moisture into the pneumatic system. Dirt can cause abrasion and premature wear of moving parts, while moisture can lead to corrosion and freezing in cold environments, impacting the actuator's performance and lifespan.
3. **Component Wear and Tear**:
   - **Seal and O-Ring Degradation**: Seals and O-rings can wear out over time, leading to internal and external leaks. Regular replacement and maintenance are required to ensure airtight operation.
   - **Cylinder and Piston Wear**: Continuous operation can lead to wear of the cylinder wall and the piston, especially if the air is contaminated with abrasive particles.
4. **Corrosion:**
   - **Corrosion of the internal surfaces:** Internal bore within the actuator can corrode over time, particularly if the air contains moisture or corrosive chemicals. Corrosion can increase friction & contamination, leading to the development of leaks.

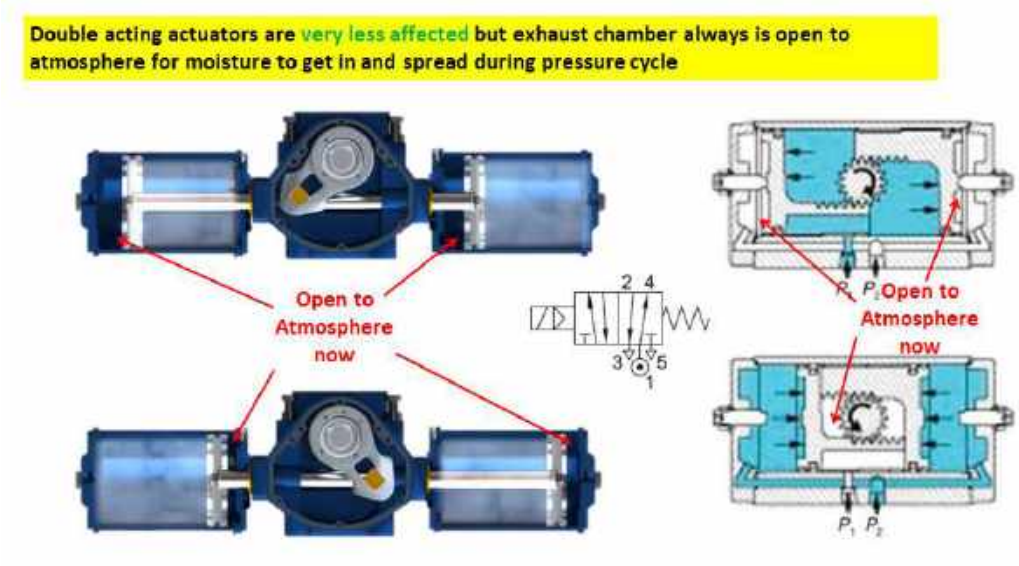
- **Corrosion of the internal components:** Internal components like Spring or YOKE or Gear Tooth etc can get corroded due to moisture or corrosive chemical in the air leading to their untimely failure

If you closely analyse all most all of them have something to do with moisture in the air or somewhere contamination coming and impacting the pneumatic actuator life. Even in cases where one uses AFR (air filter and regulator) still such issues are not found to be ending. The major reason is we are protecting pneumatic actuator from inlet side of contamination but do not act at all for the exhaust side.

Let’s understand this better from below pictures.



In single acting actuator when pressure side of the actuator is pressurised then spring chamber exhaust the air to atmosphere but then it remains open to atmosphere making it susceptible to atmospheric moisture and contamination.



Even in Double acting solution once the particular section of the actuator is exhausted then it becomes open to the atmosphere where that portion gets exposed to atmospheric moisture or contamination which spread across the chamber during pressure cycle. Above pictures are of rotary actuators but this same problem persists even in leaner actuators i.e pneumatic cylinders

Current Solutions used and their draw backs

1. **Mufflers are mounted over such ports**
   This can to some extend prevent lager size dust particle to come inside but cannot prevent moistures or water or micros dust particles (less than 1 mm). Now moisture itself can cause internal corrosion which itself becomes major cause of contamination then external contamination leading to leakages. Thus such solution although better than keeping port open but does not solve problem from root.
2. **Attaching a pipe and leaving down**
   This solution is much more effective then above one but do not still solve the problem of moisture get in and dust particles as here direct water entry is prevented during monsoon (which is a major drawback in above solution of muffler) but large opening let the dust particle sucked in especially during exhausting operation when piston moves forward creating a suction in the spring chamber.

Ultimate Solution: Exhaust Purge to Spring Chamber Solenoid valve design with smart Check valve

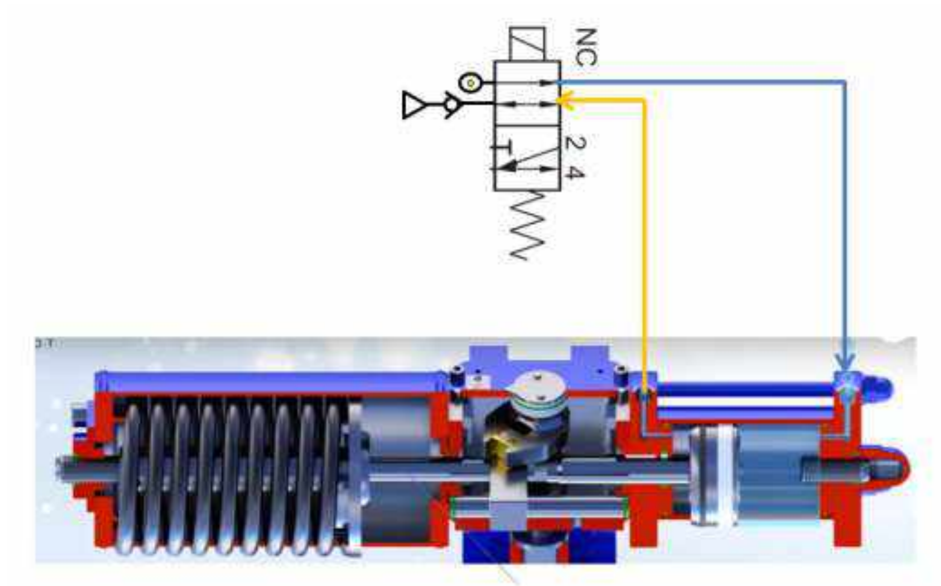
What if we are able to fed the spring chamber with filtered dry air without increasing any air consumption?

What if we are able to isolate the spring chamber or exhaust side of the chamber from the atmosphere for all the time ?

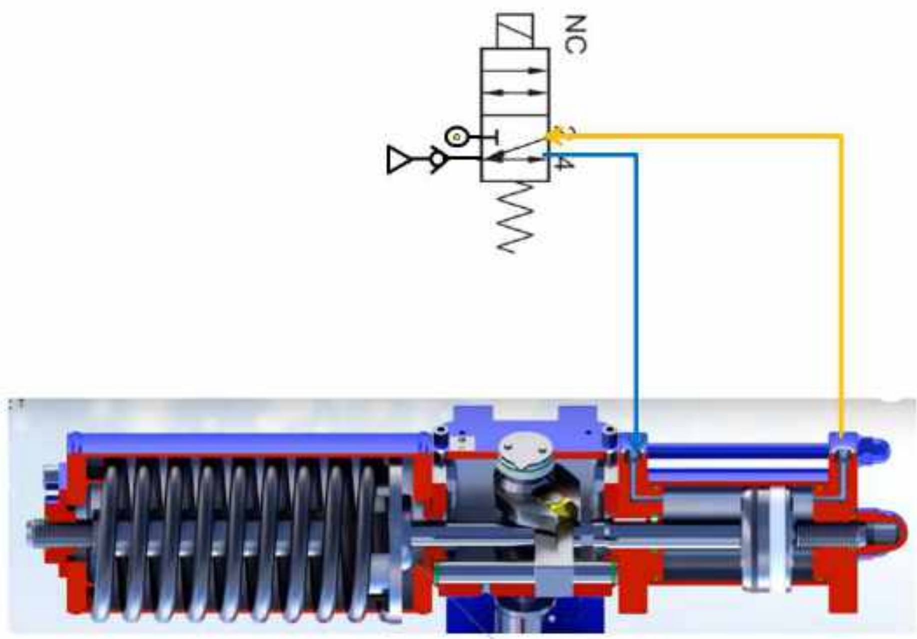
What if we are able to maintain a miniscule +ve pressure compare to atmosphere in both spring chamber and/or exhaust chamber side, making sure no way atmospheric air with its moisture or contamination enter inside of the actuator ?

If above objective is achieved then surely we are addressing major reason of failure of pneumatic actuators thus enhancing its life substantially

This is achieved by use of special solenoid valve which is called as solenoid valve with Exhaust purge to spring chamber provision. With this solenoid valve we are making sure whatever exhaust of the pressure chamber is only fed back to spring chamber instead of spring chamber port sucking atmospheric air from the atmosphere.

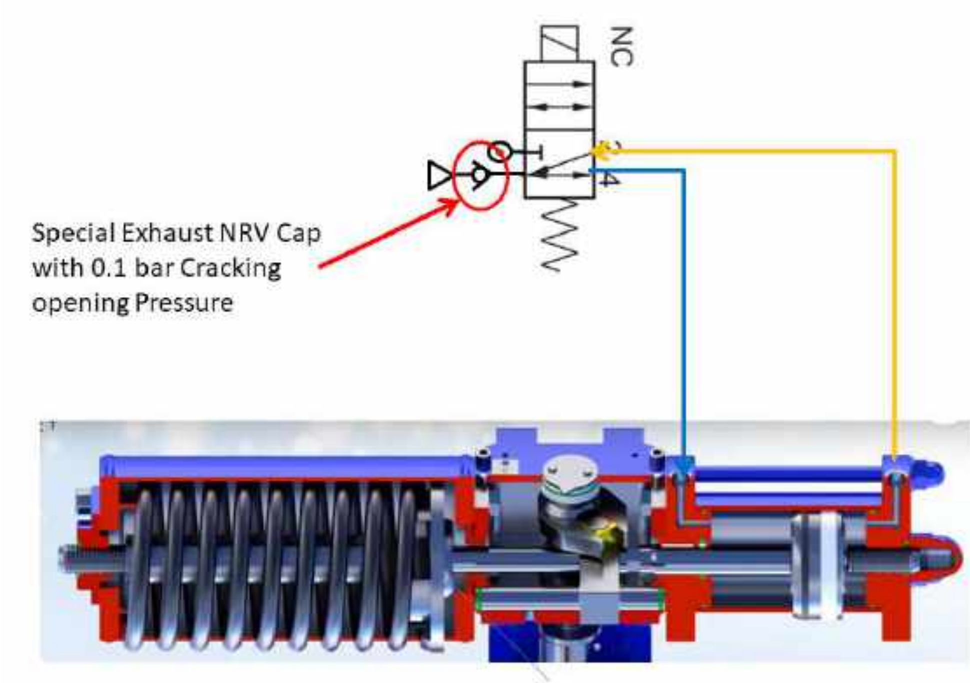


Above is an example of single acting Rotary actuator where we are seeing a special solenoid valve in energized state supplying air to the pressure side of the piston. Due to the same actuator is biased to one side and spring is compressed. Here on compression of the spring the air from this side gets exhausted from the exhaust port of the valve as shown in the above picture through yellow line.



Now when the solenoid valve is de-energized the pressurized air from the pressure side of the piston start getting exhausted and piston will start moving due to expansion of the spring. Due the same a vacuum is generated in this section now as this port is merging to the exhaust of the pressure side, the pure and dry instrumentation air is sucked into the spring chamber side. Thus exhaust of the pressure side is used for purging the spring chamber.

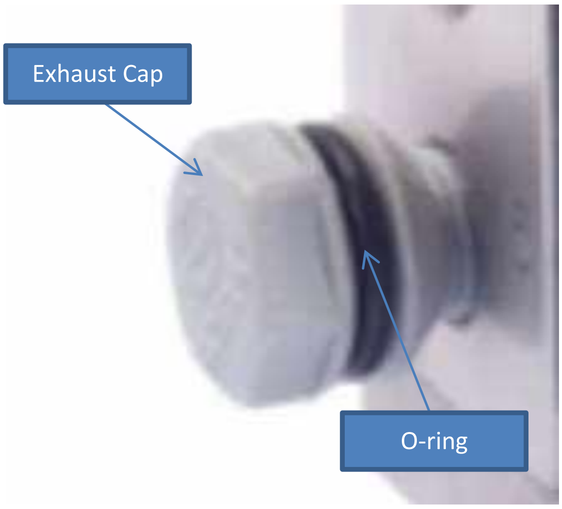
Now one may say that's it, this solve my problem as no more atmospheric air is sucked inside but it is found there is one more important element needed to be introduced. That is a check valve in the exhaust.



This check valve plays a pivotal role. As once the air is purge in the spring chamber if it is kept open to atmosphere then still moisture of the air can enter inside as there is nothing which can stop it due to concentration difference. Thus there has to be some elements which prevents atmospheric air to get in.

That is NRV at the exhaust. Due to this NRV, no travel of air is allowed in the reverse direction i.e. atmosphere to spring chamber. Also it has a small cracking pressure i.e. pressure above which NRV will crack open and allow flow, due to the same it will make sure both pressure side and spring side maintains minimum of pressure equivalent to cracking pressure which is in most cases is less than 0.1 bar. Due to this phenomenon we are making sure actuators are always having +ve pressure then atmosphere making sure no matter what atmosphere air does not enter into it.

Now question may arise, what if such NRV itself gets stuck and does not allow proper exhaust to take place as that can make actuator stuck in OPEN condition. To avoid such phenomena to least a very simple design of NRV is used which makes such possibilities to almost nil.



Here a very simple construction for NRV is made which involves just two components i.e. Exhaust Cap and O-ring. No spring, no puppet nothing of that sort. Now in the exhaust cap there is a grove and within a grove the air outlets are opening in multiple locations. O-ring is stretch to ID and thus under tension closes those open ports. When the pressure below it comes o-ring stretches itself a little and allows the exhaust to pass through around it. This construction is made such a way that it does not block the flow path at the same there is no possibility of o-ring able to withstand more than 0.1 bar pressure without lifting.

In worst case due to handling or severe weather conditions such o-rings are found to be broken exposing the holes below i.e. NRV exhaust cap losing its check valve property but no way it is found to be blocking the exhaust. Over 80,000 such caps are already supplied and customer with exhaust purge to spring chamber and with such caps installed found their actuator last substantially larger. Some of them have reported as high as 3X life especially if their plant is near to sea shore. Otherwise 50% life enhancement is obvious with this change

Tech 7: Dealing with Air contamination – A major driver of failures

Air contamination is a big devil to overcome in the process industry. Out of 20 process industries surveyed 19 of them reported to suffer from air contamination in spite of many of them having world class filtration systems and even FRLs ahead of their equipments. What concerns are reported due to air contamination are as below in short.

1. Compressors and Pneumatic Systems

- **Abrasive Damage**: Dirt particles are abrasive and can wear out the internal components of compressors and pneumatic systems, such as valves, cylinders, and pistons. This leads to premature equipment failure and increased maintenance costs.
- **Clogged mechanisms**: Dirt can clog the air pathways and reduce their flow handling capabilities thus reducing the efficiency of the equipment, which forces compressors to work harder, increasing energy consumption and operational costs.

2. Valves and Actuators

- **Seal Wear**: Dirt can settle on and erode the seals within valves and actuators, leading to air leaks and a loss of efficiency in controlling process flows.
- **Sticking Components**: Accumulated dirt can cause moving parts within valves and actuators to stick or jam, which may prevent them from operating correctly and disrupt process control.

3. Sensors and Control Instruments

- **Faulty Readings**: Dirt on sensor components can lead to incorrect readings, which can disrupt the accuracy of process monitoring and control systems.
- **Sensor Lifespan**: Accumulation of dirt can shorten the lifespan of sensors by interfering with their operational mechanisms.

Now being a solenoid valve expert I thought what can be done to protect solenoid valves from such contamination which just comes from nowhere. It is not air is not clean but occasional appearance of such contaminants creates havocs. Here maintenance person when attends to such solenoid valves, he just clears the contamination and reassembles the valve and problem is resolved. But every breakdown is a huge cost to process plant what to speak of technician’s time, risk of onsite service and disturbing the piping & fittings leading to additional issues.

To avoid such phenomena, I found automotive industry already has the solution and that is protective screens. These screen cannot replace filters but they are last mile guard against any unaccounted contamination coming in the pipeline passing through filtration system.

Above is an example of a protective screen guard. Now one may say what if my flow gets restricted due to the same ? Generally the open area of such screen is 36% higher than that solenoid valve orifice size i.e. if 6 mm is the orifice size then effective orifice of the screen is 7 mm. Thus effective area is 49/36 = 36% higher. For larger size this ratio even becomes larger as middle rib takes lesser space comparatively.

Size of such protective screen is kept 150 micron to 250 micron depending upon the design of the solenoid valve. Certain valves with smaller pilot orifice size like that of intrinsically safe solenoid valves the micron size is maintained to 150 microns while for other sizes it is kept at 250 micron. With 250 micron effective open area is even much larger.

With this question may arise, what if due to contamination these screens start clogging, what will happen ? First we have to appreciate that this screen cannot replace filter so if contamination is much larger in qty then what screen can handle, it will start giving you early symptoms of making solenoid valve slow i.e. allowing lesser air than normal. With this indication in hand one can prepare for preventive maintenance and open the inlet fittings & outlet fittings and remove the screen with simple tool and clean it with just compressed air. Once done they can reinstalled and this whole thing is possible without even dismounting of the solenoid valve from its location.

Also such filters if found to be broken, over a period of time, can be very easily replaced. Also they can be used in various other pneumatic equipment which are dust sensitive making them more robust against contamination.

SUMMARY

- MVM technology can give you freedom from piping and fittings. Also give you ease of working and ease of maintenance – help you save up to 5L per system
- With feedback devices on each solenoid valve you can be predictive maintenance ready and help you have over 1 cr depending on criticality of the operation by having higher uptime
- 2oo1, 2oo2 configuration can help you improve reliability or safety while 2oo3 configuration can help you improve reliability and safety with safety and individual isolation valve and feedback devices can help you have remote diagnostics and online maintenance
- Bottom Cable Entry is a POKAYOKE solution to be consider to deal with moisture coming from the line as that assure no wrong cabling take place and cable entry always happens from the bottom.
- Actuator life can be enhance substantially by having exhaust purge to spring chamber and having low cracking pressure NRV at the exhaust ports thus avoiding moisture entry from atmosphere into actuator
- A simple protective screen at the ports of the valve can help reduce random failures over 50% by preventing contamination entering inside the valve with ease of serviceability too.
- Adoption of LED in solenoids with CCTV camera can help in big and cost effective way to reduce MTTR and improve uptime without much of hassles

Two Choices

Post awareness of the knowledge the biggest challenge people in general face is the implementation. Changes bring people out of their comfort zone but many time such comfort zone becomes a death zone where most die a uncomfortable death; Death of their business, their career or their department.

Each of the described technology can help you big way improve your plant uptime; they are no brainer technology to adopt to, but biggest question may arise where all in my plant?

I am convince but how do I show it to my management its worth investment ?

What are the low hanging fruits within my plant to deploy and show case best ROI to my management with improved uptime ?

I have some other concerns in pneumatic system and looking for expert advice to guide us. How should I about it ?

Are there any successful implementations of these technologies where I can see them in action? Can I get some PTR, references and Options to buy for ?

Are you looking for Demo to be carried out at your plant ? or sample to purchase to explore its utility.

All above and many more question may arise in your mind and I feel I can be in yourside to resolve those and make sure you achieve the recognition which you deserve in your plant. With my over 18 years of experience specialize in pneumatic field, helping over 130 customers on one to one basis and over 7000 customers at organizational level, I think 1 hr meeting is the only bet to be put with our industry experts who are trained under me for over minimum 2 years. If they cannot resolve, I am there to resolve the same for sure.

Just Call on +91 87-9273-9273 and our team will book appointment for you with specific industry expert as per mutually convenient time or **Email at Enqbook@rotexautomation.com** to take it forward

Setting the Standard for Automation™

HAC DEVICES

EATON Signalling Products

ISA-D: "Petroleum & Power Automation Meet-2024" (PPAM-2024)

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Signaling products

Audible & visual field devices used to communicate status, warning and emergency conditions for safety systems (Fire – Gas – PAGA)

Sounders

Loudspeakers

Xenon Beacons

Manual Alarm Call Points

Combination Units

Heat Detectors

LED Beacons

Status Lights

Signalling

Input

- Call points (MAC)
- Heat Detectors

System

- Fire and Gas
- PAGA
- PLC

Output

Visual

- Beacons

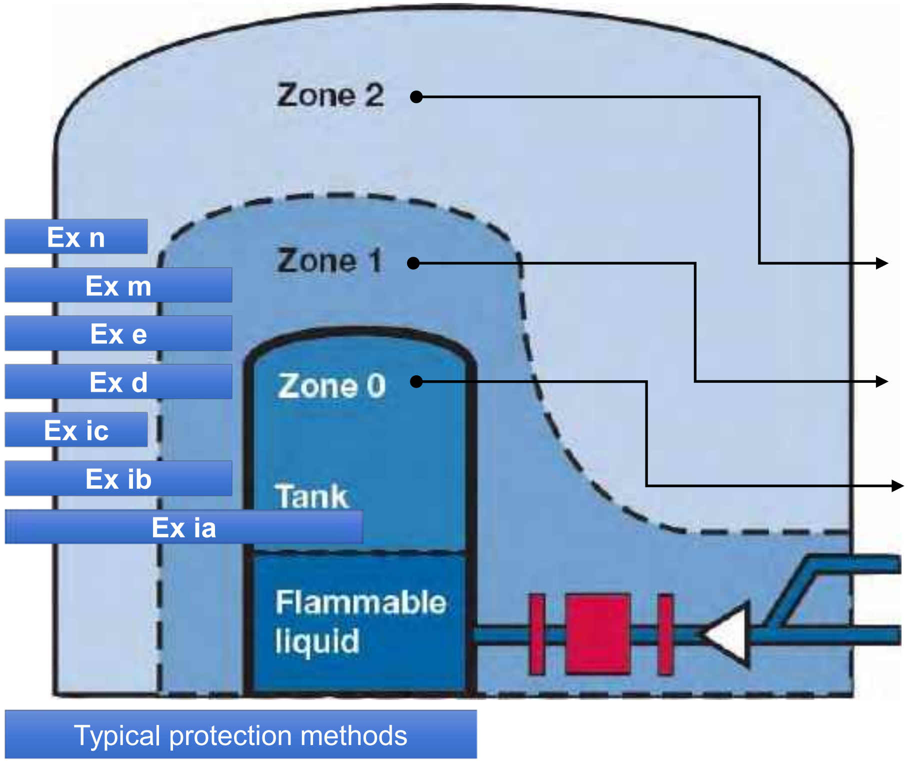
Audible

- Sounders
- Loudspeakers
- Hooters
- Bells
- Sirens

Multiple

- Combination Units
- Status lights

Zones and typical protection methods



Area, non-hazardous (safe area)

- Explosive atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus
- Explosive gas atmosphere is not likely to occur in normal operation, but if it does occur it will exist for a short period only.
- Explosive gas atmosphere is likely to occur periodically or occasionally in normal operation.
- Explosive gas atmosphere is present continuously or for long periods or frequently.

Customer Types

- Fire and gas OEM
- Fire and gas system integrator
- Specialist distributors
- PAGA OEM
- Telecoms system integrator

Beacons

Clear signals, zero confusion.

HAC range of beacons and strobes offer different types of visual alerting outputs. Built on years of experience from legacy brands MEDC and FHF, the series can be utilized to warn of potential hazards or status changes.
Able to operate as part of a systems (including F&G) or as standalone units a variety of configurations are available to suits all the applications.

Explosion Proof
Xenon

Heavy-Duty / Industrial
Xenon

Explosion Proof
LED

Heavy-Duty / Industrial
LED

Explosion Proof
Status Light

Beacon product overview

Explosion Proof Xenon

XB15

- Multiple certs (ATEX, IECEx, UL, INMETRO, SIL2, EN54, and more)
- PESO Certified
- 5, 10 & 15J versions
- Pipe mount or direct mount enclosure
- Wide temp range -55°C / +70°C
- Low inrush current characteristics

dSLB20

- ATEX / IECEx
- PESO Certified
- 5, 10J versions
- Aluminium, surface varnished or powder-coated

SM87HXB

- Multiple certs (ATEX, IECEx, UL, INMETRO, SIL2, and more)
- PESO Certified
- Stainless steel or marine grade alloy
- 5J in a compact enclosure

Beacons product overview

Heavy-Duty / Industrial Xenon

BLE / BLS

- Up to IP66 w/ compensation valve to prevent condensation of water
- 5J or 15J availability
- Suitable for continuous operation

XB13

- IP67 & IP67
- Corrosion resistant red painted GRP body w/ polycarbonate lens
- 10J High intensity flash
- Wide temp range -40°C / +70°C

BLK 32 / BLK 42

- Seawater-resistant aluminium, weatherproof varnish housing w/ IP66
- Extended temp range -50 °C to +50 °C
- 5J or 15J availability

Beacons

Ex output - Beacon products

Explosion proof xenon – direct mount – low to medium tube energy

XB15

- ATEX, IECEx, UL, ULC, CCC Ex/GB, INMETRO, EN54, CCCF
- PESO Certified
- 5, 10, 15J
- GRP enclosure
- Ex d IIC, Ex tb IIIC / C1D2
- SIL2

SM87HXB

- ATEX, IECEx, UL, CSA, CQST, INMETRO
- 5J
- PESO Certified
- Stainless steel or Marine grade alloy
- Ex d IIC, Ex tb IIIC / C1D1
- SIL2, compact enclosure


Beacons

Ex output - Beacon products

Explosion proof xenon – direct mount – high tube energy

XB12	XB4
	
• ATEX, IECEx, UL, INMETRO • 21J • PESO Certified • GRP enclosure • Ex d IIB / C1D2	• ATEX, IECEx, UL • 21J • PESO Certified • Stainless steel or Marine grade alloy • Ex d IIC, Ex tb IIIC / C1D1

Beacons

Ex output - Beacon products

Explosion proof xenon – bracket mount (tube type)

XB9

- ATEX, IECEx
- 5J
- GRP enclosure
- Ex d IIC
- 60Vdc option

XB10

- ATEX, IECEx, INMETRO
- 10, 15J
- GRP enclosure
- Ex d IIB / Ex de IIB
- Optional Ex e chamber

dSLB20

- ATEX, IECEx
- 5, 15J
- Marine grade alloy
- Ex d e IIC, Ex tb IIIC
- Replaceable coloured plastic lens covers

Beacons

Ex output - Beacon products

Explosion proof xenon – intrinsically safe

XB8

- ATEX, IECEx
- 0.5J
- GRP enclosure
- Ex ia IIB/IIC

Beacons

Ex output - Beacon products

Explosion proof LED – direct mount

LD15

- ATEX, IECEx, UL, ULC, INMETRO, CCC Ex/GB
- 60, 80,120fpm, double flash, steady
- GRP enclosure
- Ex d / C1D2
- SIL 2, conduit (pipe) mount available for UL

SM87LED

- ATEX, IECEx, CQST, INMETRO
- 90fpm, steady
- PESO Certified
- Stainless steel or Marine grade alloy
- Ex d / C1D1
- SIL2

Beacons

Ex output - Beacon products

Explosion proof LED – bracket mount (tube type)

ExpertLine LED	dSLB20 LED
	
• ATEX • Strobe, blinking, continuous • GRP enclosure • Ex e mb IIC	• ATEX, IECEx • Strobe, blinking, continuous, rotating • Marine grade alloy • Ex d e IIC, Ex tb IIIC

Beacons

Ex output - Beacon products

Explosion proof LED and xenon – zone 2 / zone 22

GH5	BZ2/BD22
	
• ATEX Zone 2 and Zone 22 • LED - Strobe, blinking, continuous • Polycarbonate enclosure • Ex nR IIC, Ex tc IIIC • Select between 5 colours	• ATEX Zone 2 and Zone 22 • Xenon – 15J • Polycarbonate enclosure • Ex nR IIC, Ex tc IIIC

Ex output - Beacon products

Beacons

Explosion proof miscellaneous – direct mount

FB15 (steady beacon)

- ATEX, IECEx, UL, INMETRO, CCC Ex/GB
- 60W filament bulb
- GRP enclosure
- Ex d IIC, Ex tb IIIC/ C1D2

TH12 (rotating beacon)

- ATEX, IECEx, INMETRO
- Rotating reflector
- GRP enclosure
- Ex d IIB
- 55W, 70W tungsten halogen bulb

Ex output - Beacon products

Beacons

Status Light

SL15	SL5	SM87SL
		
• ATEX, IECEx, UL • Various flash rates available for xenon & flashing, steady LED or 60W filament • GRP enclosures • Up to 4 ways	• ATEX, IECEx • Xenon, LED, filament • GRP enclosures • Up to 5 ways	• ATEX, IECEx, UL, INMETRO • Xenon or LED • Stainless steel or Marine grade alloy • Up to 5 ways • PESO Certified

Sounders

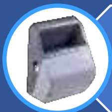
Clear alarms, zero confusion.

HAC Sounder solutions are globally recognized and trusted for their high quality and reliability. Used to warn of dangerous situations such as fire or for process-driven notifications. The portfolio include a wide range of selectable output levels and tones / sounds. Available in a broad range of configurations for commercial, industrial, and hazardous area.

Explosion Proof Sounders

Weatherproof Sounders

Explosion Proof Hooters & Sirens



Weatherproof Hooters & Sirens

Intrinsically Safe Sounders

Sounders

Sounder products

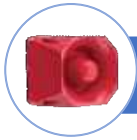
Explosion Proof Sounders

DB3B / DB3BM

- Multiple certs (ATEX, IECEx, UL, SIL2, INMETRO and more)
- Wide temp range -60°C / +85°C
- GRP, marine grade alloy and stainless steel

dEV20

- Up to 115dB(A), adjustable
- Aluminum housing
- 32 tones variance, 2-stage
- ATEX / IECEx
- Terminal compartment



Weatherproof Sounders

AX03 / AX05 / AX08

- High sound level of up to 120dB(A)
- Low current consumption (AC & DC)
- Choice of up to 42 different signal tones
- Robust and reliable in ABS
- Steady frequency rate

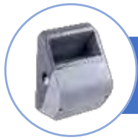
Sounders

Sounder products

Ex Hooters & Sirens

mHG11 / mHP11 / mHP12

- IP54 w/ protection class II
- Max volume approx. 108dB(A)
- Polycarbonate housing



WP Hooters & Sirens

HGK / HGW / HP / HPO / HPW

- Small dimensions vs output
- Low current consumption
- IP43 ingress protection
- Impact resistant thermoplastic

Intrinsically Safe Sounders

DB5 / DB7

- ATEX / IECEx including mining
- Wide temp range -55°C to +70°C
- GRP or ABS
- Up to 107dB(A)

Ex output - Sounder products

Sounders

Explosion proof sounders

DB3B

- ATEX, IECEx, UL, CCC Ex/GB, INMETRO, EN54, CCCF
- Up to 122 dB
- GRP enclosure, PC/ABS flare
- Ex db IIC/Ex d e IIC, Ex tb IIIC, C1D2
- SIL2, short flare, +85°C

DB3BM

- ATEX, IECEx
- Up to 116 dB
- Stainless steel or Marine grade alloy, PC/ABS flare
- Ex db IIC/Ex d e IIC, Ex tb IIIC, C1D1
- SIL2, short flare

dEV20

- ATEX
- Up to 115 dB
- Marine grade alloy, polyamide flare
- Ex d e IIB+H_2, Ex tb IIIC
- Omnidirectional

Ex output - Sounder products

Explosion proof sounders – intrinsically safe

DB5

- ATEX, IECEx, CCC Ex
- Up to 92 dB
- ABS enclosure
- Ex ia IIC
- Surface or mining

DB7

- ATEX
- Up to 107 dB
- GRP enclosure
- Ex ia IIB/IIC

Ex output - Sounder products

Sounders

Explosion proof sounders – bells and hooters

dGW21 (bell)	DB6 (bell)	dGH21 (hooter)
		
• ATEX • Up to 105 dB • GRP enclosure • Ex d e IIC	• ATEX, IECEx • Up to 109 dB • Cast iron enclosure • Ex d IIB	• ATEX • Up to 105 dB • GRP enclosure • Ex d e IIC, Ex tb IIIC

Loudspeakers

Clear alarms, zero confusion.

Hazardous, heavy-duty, industrial and commercial loudspeakers are designed to meet the requirements for public address, voice alarms (or evacuations), and background music distribution.

With years of expertise from legacy MEDC brand, each loudspeaker is designed for high-efficiency sound output featuring variety of models to meet any application requirement.

Explosion Proof
High Output

Explosion Proof
Low Output

Heavy-Duty / Industrial

Speakers products

Speakers

Explosion Proof High Output

DB4B / DB4BM

- Multiple certs (ATEX, IECEx, UL, INMETRO, SIL2, MIL-301D and more)
- Up to 25W w/ SPL of 124dB @1m
- Wide temp range -60°C / +85°C
- GRP, marine alloy and stainless steel

Explosion Proof Low Output

DB20

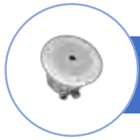
- ATEX / IECEx and INMETRO
- Up to 8W w/ SPL of 112dB @1m
- 100V, 70V and 8Ω versions
- GRP corrosion-free flamepath

DB20C

- ATEX / IECEx and INMETRO
- GRP and Flame-Retardant ABS corrosion free construction
- 100dB @1W @1m
- Ceiling mount

Speakers products

Speakers



Heavy-Duty / Industrial

6811	6801	5253 / 5254
		
• Reentrant type horn loudspeaker in ABS material w/ IP66 protection • Up to 30W with 6 tap levels • Fitted with type 316L stainless steel fixtures	• Marine certified (ABS, DNV, and more) • Up to 6W • Aluminium front and mild steel or aluminium dome construction	• Up to 10W with 6 tap levels • ABS housing white color RAL 9010 • Self-resetting fuse to keep the audio line working in case of short circuit

Loudspeakers

Ex output - Loudspeaker products

Explosion proof xenon – bracket mount (tube type)

DB4B	DB4BM
	
• ATEX, IECEx, UL, CCC Ex, INMETRO, DNV • 8, 15, 25W – up to 124 dB • GRP enclosure, PC/ABS flare • Ex db IIC, Ex db eb IIIC / C1D2 • SIL2, short flare, line voltages (100, 70, 25V), +85°C	• ATEX, IECEx • 8, 15, 25W – up to 119 dB • Stainless steel or Marine grade alloy, PC/ABS flare • Ex db IIC, Ex tb IIIC / C1D1 • SIL2, short flare, line voltages (100, 70, 25V), +85°C

Ex output - Loudspeaker products

Loudspeakers

Explosion proof xenon – bracket mount (tube type)

DB10

- ATEX, IECEx
- 8, 15W - up to 115 dB
- GRP enclosure
- Ex d e IIB + H_2 / Ex d e IIC
- DNV

DB20

- ATEX, IECEx, CCC Ex
- 4, 8W - up to 115 dB
- GRP enclosure, ABS flare
- Ex de IIB, Ex de IIC
- Compact size

DB20C

- ATEX, IECEx
- 4W – up to 106 dB
- GRP enclosure, ABS flare/ceiling mount
- Ex de IIC

Combination Units

Convenience without compromise

Range of sounder beacons, horn strobes and combination units bring audible and visual notification together for simpler and often cheaper installation through one connection point.

Applicable to commercial, industrial, offshore and onshore applications the range includes product lines FHF and MEDC. A variety of models are available to meet your life safety and hazardous area needs.

Integrated Units

Back Plated Units

Heavy-Duty / Industrial

Sounders products


Combination Units


Integrated Units

CU1

- ATEX / IECEx / INMETRO
- 27 tones, user selectable (dual tone option - dc voltage)
- Max volume approx. 116dB(A)
- GRP corrosion-free flame path


Back Plated Units

MEDC Combi

- Wider range of certifications
- Fully configurable


Intrinsically Safe Sounders

AXL04 / AXL05 / AXL08

- High SPL of up to 120dB(A)
- Low current (AC & DC)
- Strobe light 3.5 or 2 Joule
- Robust and reliable in ABS

Ex output - Combination unit products

Combination Units

Explosion proof combination units

CU1

- ATEX, IECEx, INMETRO, CCC Ex
- Up to 116 dB / 5, 10J
- GRP enclosure
- Ex de IIB
- Std or high temp version

DB3B/XB15

- ATEX, IECEx, UL, CCC Ex, INMETRO
- Up to 122 dB / 5, 10,15J
- GRP enclosures on stainless steel backplate
- Ex db IIC, Ex tb IIIC
- Pre-interconnected, use the beacon as JB

DB3BM/SM87HXB

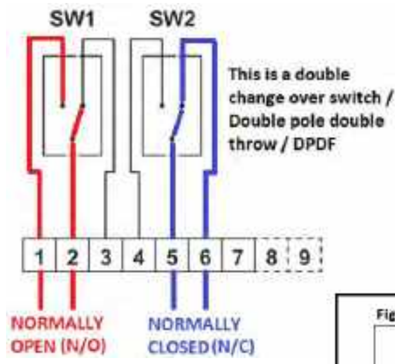
- ATEX, IECEx, UL
- Up to 116 dB / 5J
- Stainless steel or Marine grade alloy, stainless steel backplate
- Ex db IIC, Ex tb IIIC
- Pre-interconnected, use the beacon as JB

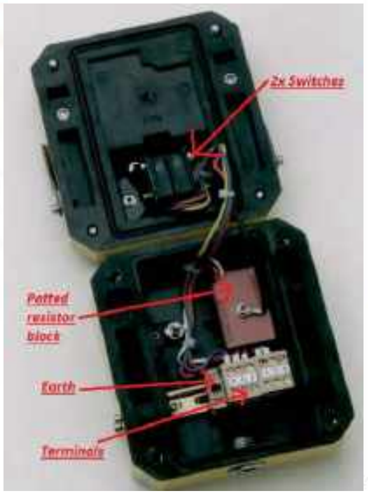
Ex input - Call points

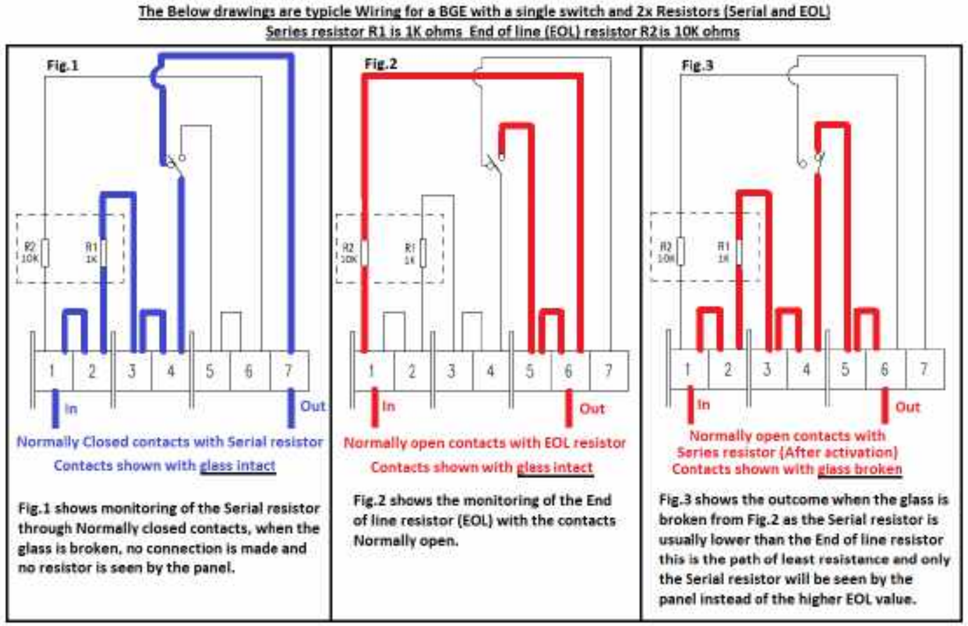
Ex input - Call points

Call points

Manual alarm call points are designed for the purpose of raising an alarm manually once verification of a fire or emergency condition exists, by operating the push button or break glass the alarm signal can be raised.







Link to Products : https://www.eaton.com/gb/en-gb/products/safety-security-emergency-communications/alarms-and-signaling-devices.html

ISA Delhi Petroleum & Power Automation Meet.

26th & 27th April 2024.

Eros Hotel New Delhi.

Title

MULTIPHASE LEVEL DETECTION FOR DESALTERS:

By,

Level Measurement Solutions

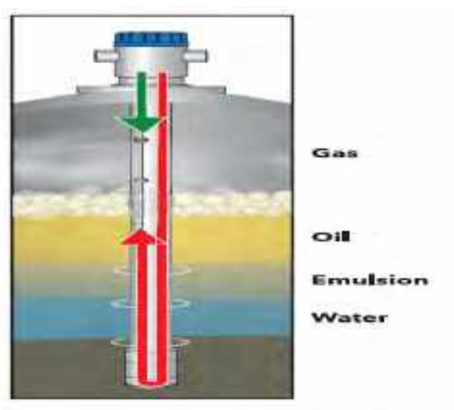
Tejas Trivedi,

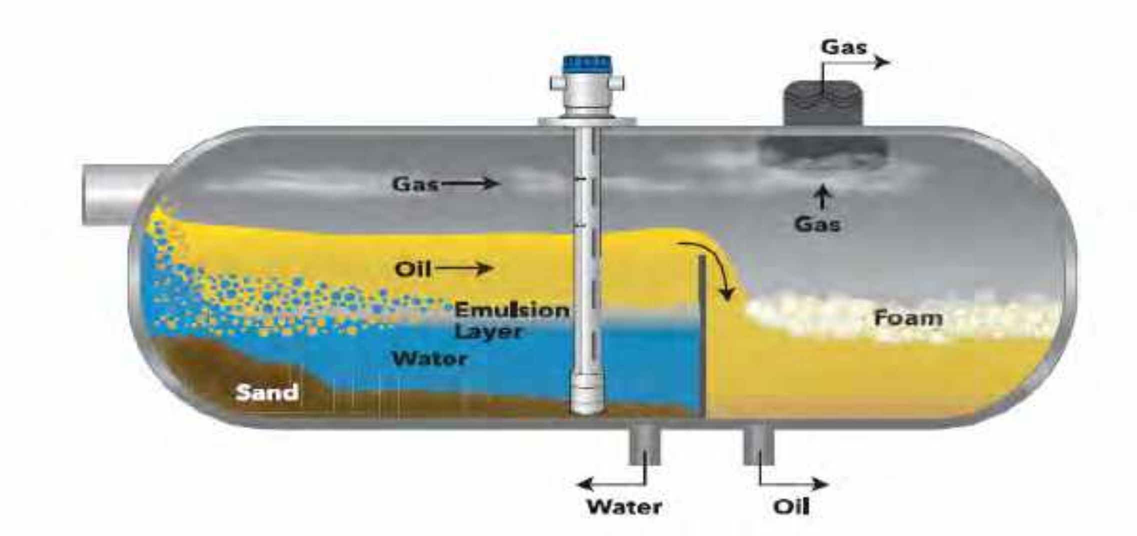
Regional Sales Manager, India & Africa

In refineries the first stage of refining process is done by the process vessels called Desalters. Oil directly from exploration sites come into this vessel in which the water is separated from oil and the clear oil is sent for further processing in the plant. But in the desalters due to the presence of the immiscible liquids oil and water get mixed and create the emulsion layer which is dynamic and keep shifting up and down in the desalter. Due to the presence of the emulsion layer the measurement of the water level becomes difficult for the conventional level measurement technologies and reliability of the operation gets affected.

GENESIS has been designed by AMETEK MAGNETROL specifically to do the measurement of emulsion present in the desalters and improve the reliability of the desalter operation by providing the exact level of water. GENESIS uses unique TDR technology which makes it possible for the measurement of all the four levels inside the desalter and provide the mA output for the top oil level, top of emulsion, water level and sediment level.

Development of GENESIS will help in the improvement of the plant reliability by providing the exact location of the emulsion inside the desalter and will help in taking out "water free oil" for the further processing and "oil free water" from desalters to be disposed accordingly.





<u>Points to be discussed during the presentation:</u>

1) Desalter application explanation and brief about the emulsion inside the desalters.
2) Brief about the benefits of the precise measurement of the level inside desalters.
3) Technology details about the GENESIS and operational details.
4) Features and benefits of GENESIS for the desalter and other Interface applications.
5) Global Installation details and third-party testing results.
6) Specifications and certifications details available for GENESIS.

Functional Safety Plan! Do I really need one?

Amit K Aglave, Partha S Mondal, Eunice Christine Soledad Padlan

Fluor Corporation.

ABSTRACT

The process industry takes pride in adoption of International Standards IEC61508 and IEC61511 for achieving functional safety. Having laid the framework for implementation of functional safety covering the entire life-cycle of the safety instrumented system (SIS), these standards are good guides to carry most of the life-cycle activities. Typical SIS safety life-cycle phases and functional safety assessment stages are illustrated in Figure-7 of IEC61511-1.

It is observed that during the design and engineering of the SIS, more focus is given to achieving the required risk reduction for the safety instrumented functions (SIF). However, it is important to understand that all framework activities of the standards are important. One of the important requirements in the journey of implementation of the SIS is to have a clear and well thought functional safety plan.

"By failing to prepare, you are preparing to fail – Benjamin Franklin".

Taking cues from this quote, this paper, "Functional Safety Plan! Do I really need one?" intends to draw attention to understanding how to have a good 'Safety Plan' in place for achieving a properly engineered and compliant SIS. The standards provide guidance for the development of a safety plan. However, it is imperative for the functional safety team to ensure that it is aligned with the project under consideration. This means establishing goals and concepts early in the project schedule. The plan would then be updated as more details are known and hence be more effectively deployed during each phase of the safety life-cycle.

KEYWORDS

Functional Safety, HAZOP, Safety Lifecycle, Safety Instrumented System, IEC61508, IEC61511.

INTRODUCTION

When the subject of functional safety is discussed, it's often observed that more focus is provided on HAZOP and then on SIL assessment and verification activities. In doing so, the functional safety engineer misses on other activities mentioned in the safety life-cycle. One such miss is either on preparation or implementation of the SIS as per Functional Safety Plan. Figure-7 of IEC61511-1, box 9 indicates the requirement of having 'safety life-cycle structure and planning'. So, it is pertinent to ask, 'Functional Safety Plan, Do I really Need One'?

Late Dr. Trevor Kletz in an interview to US Chemical Safety Board quoted; 'How can we improve the design so this (accident) can't happen, how we can remove the opportunity for errors' [4].

A review of past incidences in the process industry for understanding what went wrong can further help us understating the nature of errors which happen in development and maintenance of SIS.

- Allocation of Safety Functions to Protection Layers:
  - The CSB report for refinery fire and explosion in Texas city in 2005 indicates:
    - There was no safety interlock for high level on the raffinate splitter column.
- Design and Engineering of the SIS:
  - The investigation report for fire in multiple tanks in 2009 at one of the oil terminals in India mentions that one of the critical factors was "*Shortcomings in design and engineering specifications of facilities and equipment*".
  - The CSB report for one of the catastrophic ruptures of heat exchanger in 2010 at a refinery indicates insufficient process instrumentation on two out of six heat exchangers.
- Modification:
  - The CSB report for reboiler rupture in one of the olefins plants mentions one of the key lessons as requirement of robust management of change procedures to review and analyze the hazards in entire process due to the proposed change.

Taking cues from the thought of late Dr. Trevor Kletz and above incidences, the approach to reduce or remove the opportunity of errors is by having a proper plan and implementation of the SIS as per this plan. This will be a guiding document in achieving the objectives of functional safety.

The intent of this paper is to draw attention to understand below aspects with respect to functional safety plan:

- the objectives of having one,
- timings – when to develop,
- understand who develops and owns it,
- what should be its structure and what are the important parameters it should cover,
- impact of not having one.

OBJECTIVES OF SAFETY PLAN

IEC 61511 [2] necessitates that the management of functional safety should include safety planning to be done for all phases of the safety life-cycle. The safety planning shall be done with an objective to define the activities that are to be performed by persons, departments, organizations that are associated with the design, engineering, and maintenance of the SIS. Once the plan is in place, the plan can also be updated as necessary throughout the entire SIS safety life-cycle. The planning should be done to the detailed activity level for every phase and sub-activities if any within a phase.

The safety plan objectives as a minimum should cover the below aspects:

- Identify the activities to be carried out related to functional safety (e.g. prototype design, SIL assessment, verification etc.),
- Identify the criteria the SIS design should meet (e.g. maximum 300 msec scan time of the logic solver, redundancies, voting),
- Identify the techniques, measures, and procedures for carrying out the identified activities and which phases it is applicable,
- Identify the persons, departments or organizations who would execute the identified activities and
- Ensure that planning exists or is developed to ensure that the SIS meets the safety requirements.

The safety plan developed with the above attributes helps to ensure that the safety life-cycle activities proceed in a correct sequence, help define the required inputs before starting a phase and help define the expected outcome of each activity.

TIMING TO DEVELOP THE SAFETY PLAN

The next aspect to understand is when should be the safety plan developed? Further, it is important to understand whether it should be one plan or a plan for each phase? Figure 1 below from IEC 61511-1 [2] provides information of the SIS safety life-cycle phases and functional safety assessment stages. As box 9 is for all phases, it can be inferred that the planning should be in place for each phase. This phase wise plan shall be approved by all stakeholders before beginning the execution of that phase.

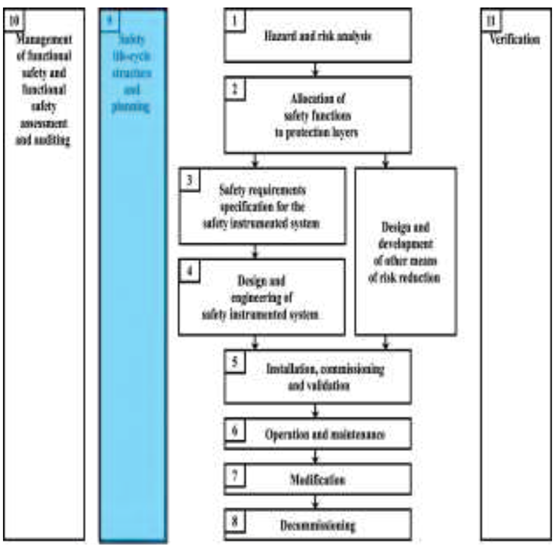


Figure 1. SIS safety life-cycle phases and FSA stages

SAFETY LIFE-CYCLE PHASES AND OWNERS (SAFETY PLAN RESPONSIBILITY)

During initiation of the project, suitable functional safety engineer shall be identified for development of the safety plan. This shall be to establish a framework plan which shall be used throughout the execution of each life-cycle phase as a guide to develop or update the plan. Any critical interfaces which are likely shall be identified early and included in the plan for being addressed at an appropriate time.

As the SIS activities progress, the ownership of execution undergoes a change in each phase with respect to the activities, persons, departments, and organization. The safety plan shall address this and responsibilities in each phase shall be clearly defined. Figure 2 shows which organisation will be responsible for carrying out the work related to a particular life-cycle phase. Within each responsible organization, the plan shall indicate responsible departments and people who will carry out the activities.

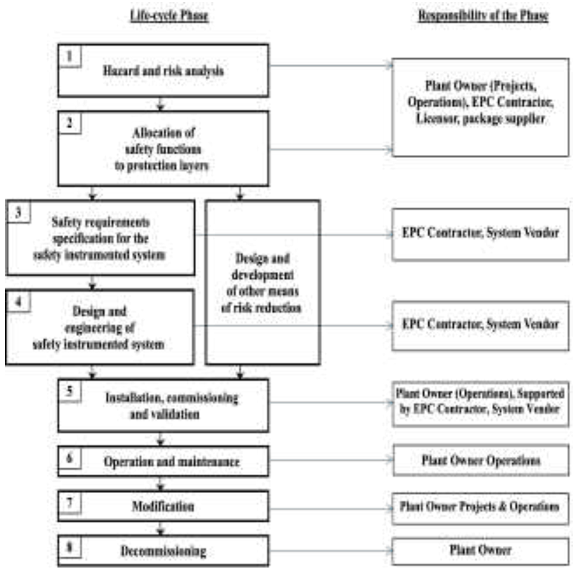


Figure 2. SIS safety life-cycle phases – Responsible Organizations

IEC 61511 [2] specifies that the periodic update or review of the safety plan should take place. However, the responsibility of making the update or undertaking review is not specified. Due to the lack of clarity on the ownership, a project often progresses without a safety plan in place. Hence it is important that the framework plan does address the requirements to update the plan.

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STRUCTURE OF THE SAFETY PLAN

IEC 61511 [2] does not specify any structure to be followed for the safety plan. The standard provides the flexibility of incorporating the safety plan as:

- part of quality plan; or
- a separate document titled 'SIS Safety Life-cycle Plan' or
- several documents which may include company procedures and practices.

The challenge, however, to take any of the above-mentioned approaches is that it doesn't address the overall responsibility and responsibilities in progressive phases. The main concerns are:

- If safety plan is part of quality plan, its challenging to define the person accountable for drafting it as the requirements of quality and functional safety are quite different. Further, it cannot be ascertained that the relevant stakeholder will be able trace the availability of such plan for use.
- If safety plan is a single dedicated document, when the phase is over, how the ownership is transferred to the next phase owner can become a complex scenario.
- If safety plan is part of several documents and part of company procedures and practices, it leads to same scenario as for quality plan?

To mitigate the above scenario and to have a robust method to have proper plan in place for each phase, a suggested approach can be to have an overall safety plan as well as phase wise safety plan.

Development of the overall safety plan shall be taken up by the owner company functional safety engineer / lead. It should cover the minimum requirements in line with company policy requirements as well as regulatory requirements as per the plant location. The overall safety plan can address non-SIS technologies which may be used for risk reduction.

Development of phase wise safety plan shall be taken up by the respective phase owners and shall align with the overall safety plan. The phase wise safety plan content shall be limited only to the phase. If more than one owner is involved in a phase, they should limit the content to their scope and address any interfaces which are required for completion of the phase. For example, the owners of execution as per box 3 and box 4 of IEC 61511 [2] safety life-cycle phase would be the engineering contractor as well as system vendor supplying SIS. The engineering contractor and system vendor shall develop their own plans for scope executed by them.
The owner company should be responsible for ensuring that the individual phase plans are aligned to the overall safety plan.

STRUCTURE AND CONTENT OF THE SAFETY PLAN

The structure and content of the overall and phase wise safety plans can cover the points as outlined below:

- **To identify the activities to be carried out related to Functional Safety.**
  Overall Safety Plan – Identify all phases which need to be carried out and requirements related to these phases which need to be considered in the safety plan. Depending on the type of the project. i.e. greenfield or brownfield or modification, applicable phases/activities will vary. The plan should also include Non-SIS based risk reduction technologies design and criteria for considering those in the overall safety strategy. The overall safety plan should also set the target dates for each life-cycle phase by which activities of each phase should be completed.

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Safety Plan per phase – For each phase, define the objectives, inputs to the activities and the intended outputs of each phase. Further, it should also define whether a particular phase requires design review to be conducted and whether verification of the output needs to be done. It is also important to ensure that the members of the team executing the phase are competent for their specific roles and when required, independent from the project team.

- **To identify the criteria the design should meet.**
  Overall Safety Plan – Identify the documents which are required to be prepared which will specify design criteria for meeting functional and integrity requirements for the SIS. Examples include safeguarding Narratives, C&E, Functional Requirements, SIL assignment report and SRS – Integrity Requirements.

  Safety Plan per phase – Identify the engineering activities for design of the SIF including its sub-systems based on the SRS. This includes the design of the sensors and initiators, logic solver and final elements. It also includes requirements for design reviews which should be conducted after completion of each important activity by system vendor such as hardware design, software prototypes and application software. This is also applicable to other package vendors. Planning should also include requirements for SIL verification, hardware testing, software prototype testing and application software testing.

- **To identify the techniques, measures, and procedures for carrying out the identified activities.**
  Overall Safety Plan – Identify the techniques, measures, and procedures to be applied for each phase to conform the design against specified requirements.

  For example:
  - Specifying one of the technique for hazard analysis to be applied (e.g., safety reviews, HAZOP, FMEA etc),
  - Specifying which SIL assignment method will be used (e.g., Risk Matrix, Risk Graph, LOPA, etc.),
  - Specifying the techniques for avoiding random hardware failures, such as use of redundancy.
  - Specifying the techniques and measures for traceability and management of changes.

  These aspects becomes important in a multi-EPC project so that all EPCs follow same methodology and criteria for consistent results.

  Safety Plan per phase – This includes the plan for implementing the techniques and measure which are identified in the overall safety plan. This should include the availability of tools and resources, the personnel who should be involved, and the detailed procedures which would be applied for carrying the work. Examples include testing of software function blocks to verify the design is as per the specification, verification activities at the end of phase to ensure that the design intent is met.

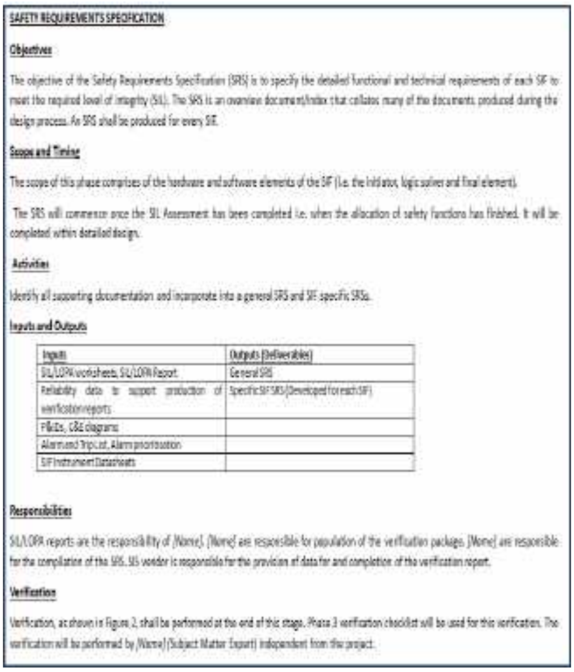
- **To identify the persons, departments or organizations who would execute the identified activities.**
  Overall Safety Plan – Identify the requirements of personnel and the competence requirements to carry out each phase. This includes criteria for designers / engineers from the owner organization, EPC contractor, system vendor, package vendors, third party consultants and assessing agencies.

For example:

- Participation from different disciplines (process, instrumentation, HSE, operations) for hazard analysis and SIL assignment.
- Assigning a competent resource for carrying out SIL verification and design implementation.
- Identification of the assessor to perform the FSA Stages.

Safety Plan per phase – For each phase, implementation plan for each phase, roles (e.g. design review, testing, inspection etc) and responsibilities (e.g. HAZOP chairman / facilitator, scribe, application developer) of involved personnel, the requirements for their independence (e.g. the design review will be conducted by independent person within organization).

Figure 3 below indicates the sample template of the phase wise safety plan for the Safety Requirements Specification (SRS) to be developed by an engineering contractor.



SAFETY REQUIREMENTS SPECIFICATION

Objectives

The objective of the Safety Requirements Specification (SRS) is to specify the detailed functional and technical requirements of each SIF to meet the required level of integrity (SIL). The SRS is an overview document/index that collates many of the documents produced during the design process. An SRS shall be produced for every SIF.

Scope and Timing

The scope of this phase comprises of the hardware and software elements of the SIF (i.e. the initiator, logic solver and final element).

The SRS will commence once the SIL Assessment has been completed i.e. when the allocation of safety functions has finished. It will be completed within detailed design.

Activities

Identify all supporting documentation and incorporate into a general SRS and SIF specific SRSs.

Inputs and Outputs

Inputs	Outputs (Deliverables)
SIL/LOPA worksheets, SIL/LOPA Report	General SRS
Reliability data to support production of verification reports	Specific SIF SRS (Developed for each SIF)
P&IDs, C&E diagrams	
Alarm and Trip List, Alarm prioritisation	
SIF Instrument Datasheets	

Responsibilities

SIL/LOPA reports are the responsibility of [Name]. [Name] are responsible for population of the verification packages. [Name] are responsible for the compilation of the SRS. SIS vendor is responsible for the provision of data for and completion of the verification report.

Verification

Verification, as shown in Figure 2, shall be performed at the end of this stage. Phase 3 verification checklist will be used for this verification. The verification will be performed by [Name] (Subject Matter Expert) independent from the project.

Figure 3. Sample template for the phase wise safety plan - SRS

IMPACT OF NOT HAVING A SAFETY PLAN OR NOT FOLLOWING THE SAFETY PLAN

In functional safety, each safety life-cycle phase has unique requirements and expected outcome. The output of one phase becomes inputs of the next one as the SIS design progresses. To have successful implementation, it is important to have a plan considering the aspects mentioned in the previous section. Every plant has varied requirements based on its geographic location, manufacturing capacity, physical and chemical nature of process and the feed it uses, owner requirements and risk tolerance criteria, regulatory requirements etc. Hence, the plan should be specifically developed for the plant and should not be a generic plan.

What happens if the safety life-cycle activities progress without having a safety plan in place or not following the safety plan? The following section helps us to understand the importance of implementation as per the safety plan.

- **Hazard and Risk Assessment.**
  - Incomplete / Incorrect assessment of hazards.
  - Inflated / Underrated risk definitions.
  - Safety critical elements not properly identified. This means the system design may have insufficient safeguards.
  - Next phase of SIL assignment cannot progress or progresses with insufficient data.
  - Risk to cost and schedule if the hazards surfaces in later stage of engineering.

- **Allocation of Safety Functions to Protection Layers**
  - Unidentified SIFs.
  - Missed / Incorrect credit of IPLs.

- Inflated / Underrated SIL targets.
- May delay the procurement of the SIF components impacting the cost and schedule.

- **Safety Requirements Specification for the SIS**
  - Key functional requirement and technical parameters may not be available for the design and engineering phase. For example, if the SIF wise process safety time is not available, the closing time of the valve cannot be determined and results in delay of procurement of the valve.
  - Incomplete SRS may result into failures of the SIS during the operational phase due to systematic faults / errors in design. Based upon the study by the UK Health & Safety Executive on 'Out of Control – Why Control Systems Go Wrong and How to Prevent Failures' [3] the main contributor to the failures is incorrect specification. It contributes to 44% of failures. The components 'Inadequate Functional Requirement Specifications' and 'Inadequate Safety Integrity Requirement Specifications' are 12% and 32% respectively. The result of the failures may be devastating for the plant safety.

    Further, if the failures reveal a systematic fault during operation phase, it may mean costly repair for modification of the SIS and probable stoppage to the operations.
  - Inputs for the logic solver design may not be complete resulting in delays of the design. For example, if the trip override philosophy is not defined, it would mean change in application software at a late stage in the project.
  - Important parameters for the SIL verification activity may not be adequately captured. This will result into the delays in completing the SIL verification. For e.g. definitions of β common cause failure factor, coverage criteria for proof tests.
  - Non-SIS related requirements may be missed. For example, the operator response to BPCS alarm is taken credit for in SIL assignment. However, if the requirements are not stated in SRS, it may be missed from the BPCS configuration.

- **Design and Engineering of the SIS**
  - SIF design may not completely meet the requirements of SRS.
  - The SIL verification may not be completed and there might be hold points on important aspects such as voting, proof testing etc. For example, if the voting requirements change resulting in increase of the final elements, it not only changes the design of SIS, but also impacts other disciplines such as piping, civil.
  - The procedures for SIF commissioning, maintenance, operations, and proof testing may have deficiencies resulting in challenges during those phases. For example, if the proof testing time for meeting the SIL of the SIF is based on the testing at certain frequency, delays in testing means operations with degraded SIL.

- **Installation, Commissioning and Validation**

- Incorrect sequence of installation may result in delayed commissioning.
- Improper coordination of the agencies responsible for installation activities of SIF components such as field instruments, logic solver cabinets, field wiring and loop checks. This may also result in rework / retest.
- The non-compliances against design requirements are recorded as punch items during FAT or SAT. Some of these punch items may remain unaddressed due to the commissioning schedule pressures. Continuing commissioning with such open items means not having complete safeguarding in place. Further, the validation of the SIS after installation at site cannot be completed.
- Safety plan is a mandatory requirement from the standard IEC 61511 [2] and regulatory boards requires this plan. Failure to comply may prevent the start-up of the plant.

- **Operation and Maintenance**
  - Before the ownership of the system is transferred from the project to owner operator, key document, such as SRS, should be revised and up-to-date. If this activity is not explicitly included in the overall safety plan, this step may not be completed. This may delay important operation and maintenance safety function activities from being completed.
  - If the maintenance activities like partial stroke tests or proof test activities are delayed or not performed, the integrity of the SIF may be degraded.
  - If the results of the findings are not compared against the criteria mentioned in SRS, defects/errors in the intended design cannot be ascertained.
  - Possible ignorance to the diagnostics messages generated by SIS means SIS repair is not done in time and may lead to increased spurious trips or no trips on demand.

- **Modification**
  - The SIS modification proceeds without an updated functional safety plan and SRS. This means the scope of the modification is not defined. This might result not only into incorrect execution of the modification but may also induce newer hazards into the SIS / process.
  - Risk of not having updated documents will affect the operations and maintenance or any future upgrades or modifications.

- **Decommissioning**
  - Improper decommissioning without complete analysis and effect may introduce new hazards or impact the safeguards for operational units and its SIS.
  - Risk of not having updated documents which affects the operations and maintenance of operational units and any future upgrades / modifications.

Other activities which are conducted in the safety life-cycle which also has impact of not having a safety plan / not following the safety plan are reviewed below:

- **Verification** – A plan for verification of outcome of each phase or important milestones within a phase should be prepared. This plan is necessary to ensure that verification activities are performed to demonstrate that the intended outcome of the activity or phase meets the objectives of the phase. This will also help to ensure that the subsequent phase has the sufficient required information. The verification plan should address the requirements for completing the task in terms of:

- Required Checklists
- Personnel who should carry the verification and independence required.
- How the records of verification will be maintained and who will be responsible for carrying out actions on the findings.

- **Functional Safety Assessment** – The overall functional safety plan should include the requirements for completing Functional Safety Assessment (FSA). The FSA is performed to investigate and arrive at a judgement based on evidence on functionally safety achieved by one or more SIS and protection layers. The requirements of FSA should include:
  - Scope of FSA
  - Skills, responsibilities, and authorities of FSA team
  - Personnel who should carry the FSA and independence required.
  - Resources required and
  - Methods for revalidation post modifications.

- **Competence of personnel** – Though part of management of functional safety, a plan should be in place for ensuring the requirements of competence. The requirements of competence apply to persons, departments and organizations associated with execution of one or more phases of the safety life-cycle.

CONCLUSION

Failures in implementation and maintenance of SIS can be devastating. Proper planning can help achieve the intended results along with the other safety life-cycle activities. Past incidents in the process industry have demonstrated that the deficiencies in the design can remain undetected for years and can jeopardize operations, lead to lost revenues apart from denting the operating owner company's image.

Functional safety plan is a tool that helps to ensure the required activities are taken into consideration and resources allocated in timely manner for carrying out all life-cycle activities.

The approach of having an overall safety plan with a mandate of having phase wise safety plan for all stakeholders can ensure that activities are planned and executed as per the plan. Not having a safety plan or not executing as per the safety plan means 'Plan to fail'. But to ensure safe operations and to do justice to the investment in functional safety, one of the key deciding factors is to execute all phases as per a properly developed safety plan. This approach would then mean a 'Plan to succeed'; succeed in the goal of achieving the objectives of functional safety.

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BIOGRAPHY

Amit is a graduate in Instrumentation engineering. He has 27+ years of experience in the process industry and specializes in the design and engineering of Safety Instrumented Systems (SIS) according to the functional safety standards of International Electrotechnical Commission (IEC) 61508/IEC 61511.

He is working with **Fluor Daniel India Private limited** for over ten years and previously worked with Honeywell Automation India Limited for fourteen years. He has extensively worked on Safety System projects in different roles which involved activities such as Design and Detailed Engineering, HAZOP, SIL assignment and verification, Commissioning, Project cost estimation, Front End Engineering and Design (FEED) and Consultancy. Apart from India, he has worked on various projects across globe at locations like South Korea, Norway, UK, UAE, Netherlands, USA and Australia.
He is a certified Functional Safety Expert and certified Industry 4.0 Assessor.

Partha is a graduate in Instrumentation & Electronics engineering and has a master’s degree in cyber security. He has 15+ years of experience in the process industry and specializes in the design and engineering of Safety Instrumented Systems (SIS) according to the functional safety standards of International Electrotechnical Commission (IEC) 61508/IEC 61511.

He is working with **FluorDaniel India Private limited** for over fifteen years. He has extensively worked on Safety System projects in different roles which involved activities such as Design and Detailed Engineering, HAZOP, SIL assignment and verification, Front End Engineering and Design (FEED). He is a certified Functional Safety Expert(CFSE 210810 001).

Eunice is a graduate of Bachelor of Science in Instrumentation and Control Engineering. She has 12+ years of experience in the process industry and specializes in the design and engineering of Safety Instrumented Systems (SIS) according to the functional safety standards of International Electrotechnical Commission (IEC) 61508/IEC 61511.

She is working as a Control Systems Engineer with **Fluor in the Philippines** for over twelve years. She has worked on various projects and has been involved on the Functional Safety roles from Front End Engineering and Design (FEED) and Detailed Engineering phase including activities such as Functional Management Plan, Safety Requirement Specification and SIL verification. She also has experience with construction and commissioning and had supported Stage 1 to Stage 3 Functional Safety Assessment.

She is a Certified Functional Safety Expert certified by Exida.

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IMPLEMENTING PRE-START UP ACTIVITY AS A SAFEGUARD IN LOPA

M. Ulaganathan

Abstract

This article recommends considering Pre-start up activity as an Independent Protection layer while performing LOPA study as part of PHA methods. Such activities involve safety checks that are required for plant, equipment, machinery prior to being started or used on daily basis. Also it identifies Safety deficiencies, maintenance problems or damage before equipment is used. Always taking credit on involvement of Human operations is still a challenging task, it is better to recommend to implement such activity as IPL, so that Operator shall aware and understand on all vulnerable scenarios and monitor failure rate of equipment, so that preventive action shall be executed. Hence this paper specifies that such activities has all vital features to be considered as Safeguard in LOPA analysis and it also adds pros of implementing such methods.

Keywords

Pre-start up activity, Functional Safety, Safety Instrumented System, Independent Protection Layer, Layer of Protection Analysis.

INTRODUCTION

Startup of new or modified equipment is a particularly vulnerable time for safety incidents and other unplanned events which can cause significant loss, damage to human life and health. Implementing the number of elements of good process safety management includes measures to reduce risk of loss on startup. The main objective of Process Hazard Analysis (PHA) is the Systematic evaluation of Process Hazards with the purpose of ensuring that sufficient safeguards are in place to manage the inherent risk. Such Safeguards shall be a device, system or action that is capable of preventing a scenario from proceeding to the undesired consequences without being adversely affected by the initiating event or by the action of any other protection layer associated with the scenario. One such PHA method is LOPA, where the primary purpose of LOPA is a risk assessment tool used to identify a system features and action that can lead to, or prevent an incident. Hence by implementing effective PSSR, can prevent major incidents and consequences from occurring during plant operations and thereby improves the reliability of the equipment. This paper highlights that by having efficient PSSR activities especially during non-operational conditions such as transient, startup, maintenance condition will reduce the frequency of Initiating events by identifying the hidden faults and in turn helps to consider PSSR of Human action as preventative IPL.

PSSR

Pre-Start up Safety Review is a formal review of a manufacturing process to verify that critical areas of the affected process have been assessed and addressed prior to using the process. This is accomplished by verifying that the equipment is installed in a manner consistent with the design intent and that process safety management is in place.

Hence in-adequate PSSR is often identified as significant contributory cause. It is recommended that PSSR been carried out as intended will avoid the hazardous scenarios from arising.

When to perform a PSSR

PSSR "*event*" typically presents after construction completion and required at multiple phases. For example a PSSR before commissioning (RFC), between commissioning and start up and between startup and full handover.

It is recommended that PSSR be carried out prior to commissioning or re-start step in following cases.

- Capital projects
- Modified equipment
- New valves or valve operation
- New or modified control system
- Startup after a Turnaround
- Startup after a ESD
- Significant process changes
- Changes in Regulations

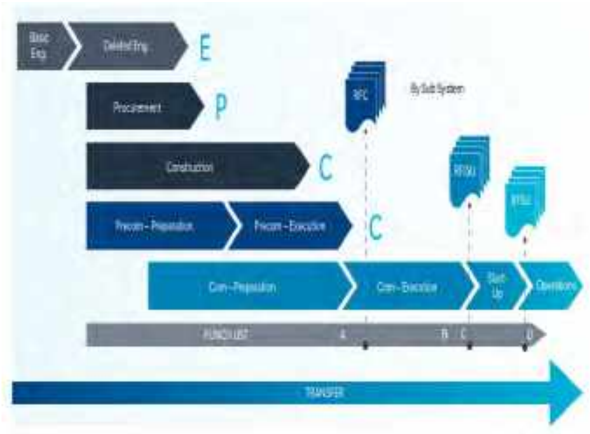

Image -1

A well-defined PSSR program will fit within a facility's existing process safety and risk management program as well as any other performance enhancement effort. Since PSSR is the verification step that MoC, PHA and other processes were carried out as prescribed and recommendation from all such activities have been completed.

Relationship of PSSR with Process Safety Elements

Excellent practices such as PHA, MoC, Construction checklist, punch list and operating procedures do not compromise PSSR, but as stated in above reference Image-1, they will contribute as inputs to PSSR. As per above image PSSR is performed only after obtaining 80-90% of completion of PHA studies as inputs. However still PSSR requires a Risk based approach which will use the performance-based aspect of the PSSR regulations and industry guidelines to more efficiently and effectively design changes or trigger event's PSSR activities based upon the likelihood and consequences. The goal is to make the best use of organizational resources based upon the risk attributed to trigger event for the process.

TABLE 1-1
How PSSR Typically Interfaces with Other PSM Elements

PSM Element	*Potential Interface*
Employee Participation	• Employees from various departments can have input into the PSSR program as developers, team leaders, team members, or interviewees during the reviews. • The PSSR procedure and PSSR checklist documentation provides clear evidence of how your organization encourages employee participation.
Process Safety Information	• PSSR assists in verifying that process safety information (PSI) for equipment, material hazards, and technology is updated in a timely fashion.
Process Hazard Analysis (PHA)	• PSSR assists in verifying any PHA action items required have been or will be addressed.
Operating Procedures	• PSSR provides a second check on whether the operating procedures affected by the change have been written or revised to properly reflect the change.
Operator Training	• PSSR checks to verify any changes to training related to the trigger event have been made and that training on the affected procedures has occurred as needed.
Mechanical Integrity	• PSSR verifies maintenance task procedures are in place and workers have been trained on the tasks and applicable safe work practices. • PSSR verifies equipment has been reviewed for placement in the mechanical integrity program and that it was designed and installed according to codes, standards, and manufacturers' recommendations.
Contractors	• PSSR can identify when certain contract job tasks require special training in response to a change and when contractors need to be trained or informed on aspects of a change.
Hot Work Permit (and other safe work practices)	• PSSR verifies new safe work practices (SWPs) required for the trigger event are in place and designed and implemented for the targeted workers.
Management of Change (MOC)	• PSSR is a check of every MOC-related activity and its documentation; it is a second level of protection to ensure MOC is working to keep workers and the public safer. • The complexity of the PSSR is determined based upon information in the initial MOC request and associated documentation. • PSSR can confirm that a proper management of change effort was performed.
Incident Investigation	• PSSR documentation may provide support to investigation teams. • Investigation recommendations may impact future PSSR activities. • Lessons learned are powerful tools for improvement.
Emergency Planning and Response	• A well-designed PSSR verifies that applicable emergency response plan changes are included in the review and affected workers are trained.
Compliance Audits	• The PSSR program will be audited on a regular basis and those audit results can help improve the PSSR program and a facility's overall PSM performance.
Trade Secrets	• A well-designed PSSR can verify that applicable trade secrets are addressed properly.

Image 2: Ref: CCPS – Guidelines for performing Effective Startup

Following points are key aspects that need to distinguish a Simple PSSR with respect to Complex PSSR. Some of the specific aspects may be examined in detail for selecting PSSR suitable for a given event.

• Are there changes to equipment or trigger events in a process that involves especially hazardous materials regarding health, reactivity, and flammability or explosively (for example, NFPA level 3 and above)?
• Are there new control systems or modifications that affect safety controls or interlocks (both safety & non-safety)?
• What is the project cost? For example, a facility may require the use of detailed PSSR for all affected projects over $10,000 - or any appropriate dollar amount for a specific facility.
• Does the change or trigger event involve a new type of equipment? For example, the first of its kind at the site or substantially different from older, similarly purposed equipment at the site.
• Are there multiple tie-in points to other systems or units? For example, one company chooses to use "three or more tie-in points" for a change or modification that affects the process safety information to indicate that a complex/long form PSSR approach will be used.
• If the process involved fails during or after startup, is it likely to result in a reportable health, safety, or environmental incident?
• Does the change or trigger event involve new or modified fire protection systems?
• Does the change or trigger event involve other new or modified life safety systems?
• Does the change or trigger event result from corrective actions taken due to a significant incident?

Managing Human Performance

Managing Human performance is important to prevent errors that can initiate LOPA scenarios and adversely affect the reliability of IPLs. Human error depends on number of factors that should be considered. These factors include.

1. *Procedure accuracy and procedure clarity:* Operators has to do procedures have a high level of accuracy, art of communicating the information, and convenience to use.
2. *Training Knowledge and Skills:* New Operators has been established with efficient selection criteria on the duties that need to be performed. Effective, demonstration - based initial and refresher training can be used to develop and maintain the skill level.

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3. *Fitness for duty:* Factors such as fatigue, stress, illness and substances abuse been managed during all phases of operation. It is important that Operators be physically capable of completing the task required.
4. *Workload Management:* Operator has been optimized with workload during all phases of operation, including normal, start-up and emergency shutdown modes. If the workload is too low, Operators may become bored resulting in decreased vigilance. If an Operator's workload is too high, human error will tends to increase as a result of task overload.
5. *Communication:* Management Systems and protocols for proper communication radios and during shift changes have been implemented. Miscommunication is a frequent cause of human error in work place; effective communication strategies can reduce human error due to miscommunication.
6. *Work environment:* Factors such as lighting, noise, temperature, humidity, ventilation and distractions have been managed to minimize their contribution to human errors.
7. *Human – machine interface:* HMI interface facilitate the Operator's interaction with the process. The layout of the equipment, displays and controls strongly affects the human performance. Abnormal conditions needs to be clearly annunciated and alarm management is important to prevent nuisance alarms or alarm overload.
8. *Work Complexity:* Work has been assessed to ensure the task is not overly complex, making human errors more likely to occur. The complexity of an activity is proportional to several factors, including the number of steps, the level of difficulty of the procedure and degree to which judgment is required.

Steps for Effective IPL

There are seven key attributes that are the basic characteristics of an effective IPL. The core attributes are

1. Independence
2. Functionality
3. Integrity
4. Reliability
5. Auditability
6. Access security
7. Management Of Change

When human interact with the process, the design and management of alarms, interfaces, bypass, capabilities, isolation valves and manual shutdown systems should be assessed to understand how human factors, access security and MOC are addressed. When same personnel, procedures and testing schedules are used to maintain multiple instruments, there is great potential for human error to adversely impact multiple layers of protection. To address this issues, the effective process safety management system are in place to ensure that the equipment is well designed, installed and maintained and that factors influencing human error are well controlled.

Common scenarios where risk of Common Cause failure may be higher than expected:

1. Redundant instruments are serviced with the same person performing the calibrations (e.g. a person could mis-calibrate both instruments) or using the same calibration instruments. (Faults calibration instruments can cause both field instruments to be mis-calibrated).
2. The same type of valve sensors, or other device is used in multiple systems. (In this case, a specification error or functional deficiency in the supplied devices can cause simultaneous failures of different systems).

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Human action as an IPL

Considering the above factors, a Human (or group of Humans that routinely work together) is used only once in a scenario (either as part of IE or as part of IPL).

In situations where it is desired to take credit for the action of multiple layers relying on humans, it is important to determine if the humans are relying on independent information and are expected to take action independently. Generally operators working as a team are not considered as independent of each other. If the humans are not fully independent, then use of a Human Reliability Analysis or other similar methodology may be needed to substantiate the credit being claimed.

Hence when considering Operator IPLs, the Operating procedure and the information or data that the operator will rely upon to trigger action should be assessed to ensure that they are sufficiently independent of the IE to support the IPL claim.

For an IPL to be effective, it needs to function in a way that prevents or mitigates the consequences of the scenario being studied. Hence IPL is valid for the mode of operation being analyzed (start-up, shutdown, normal batch, etc.). When Operator response is part of IPL, there is well-written procedure and an effective training program to ensure that operators understand the hazards and how to respond to the initiating event, an alarm annunciation or emergency situation.

Recommendation of PSSR as IPL

Considering the above aspects, PSSR performs final checks, validates and meets all the requirements of IPLs in protecting major of the incidents that are being occurring due to latent failures.

However following are the key functionality that needs to be consider while crediting PSSR as an IPL

- Regularly evaluating industry process safety related incident reports and how PSSR was potentially involved in the situation.

- The PSM manager or coordinator at the site should research and share the experiences of other chemical processing facilities whenever it might apply to their facility.

- Using electronic databases for capturing past PSSR documentation. This allows PSSR teams to use search engines or other file indexing tools to evaluate similar past PSSRs. This encourages and enables taking advantage of the company's collective knowledge and lessons learned.

- Performing PSSR on selected critical maintenance activities even when the PSSR step may not be required by regulatory standards.

- This practice provides a double check on key performance issues.

- Involving many different workers in the PSSR process. This promotes reinforcement of the process safety program at the facility and provides documented employee participation.

- Selecting a PSSR team leader who is somewhat removed from the specific project involving the change. This helps remove the possibility that project schedule pressures and pride of ownership will negatively influence the review.

- Showing open management support for the importance of PSSR.

By seeing facility management personnel occasionally delay a planned startup to ensure the final details required by the PSSR team are fulfilled before authorization for startup, all employees realize the critical nature of the review.

In case of any changes or modifications in Process Safety Information, the reason of changes needs to be detailed.

Is the change is due to changes pertaining to regulated substances used or produced by the Process or due to new technology or due to equipment in the process.

In general PSSR compliance should consider following aspects

1. Construction and equipment meets the design specification
2. A PHA has been performed for new facilities or that the site management of change process has been followed.
3. Training of each employee involved in Operating process is complete.

CHECKLIST

It is recommended to maintain all key items for PSSR in a checklist to validate the necessary activities has been included, but not limited to

- All completions such as mechanical completion and punch lists have been completed and signed off.
- A punch list for items for completion before or for consideration for completion after startup.
- Completion of operator training.
- Standard operating procedures have been revised if required.
- Emergency operating procedures have been revised if required.
- Commissioning procedure for first start-up including consideration of withdrawal of non-essential personnel, and additional personnel to be available, staffing of adjacent areas.
- Process hazards analysis including HAZOPs available, and requisite actions taken on the recommendations made in the PHA.
- Any regulatory issues such as flaring notified to the regulator accordingly.

It is recommended that the checklist items consist of items which it is reasonable for the PSSR team to verify. Checklist items such as “are all pressure relief valves adequately sized” or “has the consequences of backflow been considered” are to be avoided. PSSR team can check that there are Relief valve design calculations and they can check Process Hazard Analysis and all recommendations have been addressed.

CONCLUSION

The objective of this paper is not to set new standards for the processing industry on risk based analysis approach, but to encourage end users and safety practitioners to apply existing standards and operational discipline necessary to establish their own internal requirements for Pre-start up safety review that supports Safety integrity of the process equipment. The guidelines provided in this paper help End-users to perform Systematic approach to managing their PSSR program and implement applicable portions of Responsible care, Process Safety practices and other industry guidance while meeting external and internal Health, Safety, Environmental and Quality requirements.

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ACRONYMS

IPL Independent Protection Layer
LOPA Layer Of Protection Analysis
MoC Management Of Change
PHA Process Hazard Analysis
PSSR Pre-Startup Safety Review
SIL Safety Integrity Level
SIS Safety Instrumented System

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BIOGRAPHIES

M. Ulaganathan was born in Tamilnadu and graduated in Anna University having more than 12 years of experience in Functional Safety related to oil and gas processing facilities.

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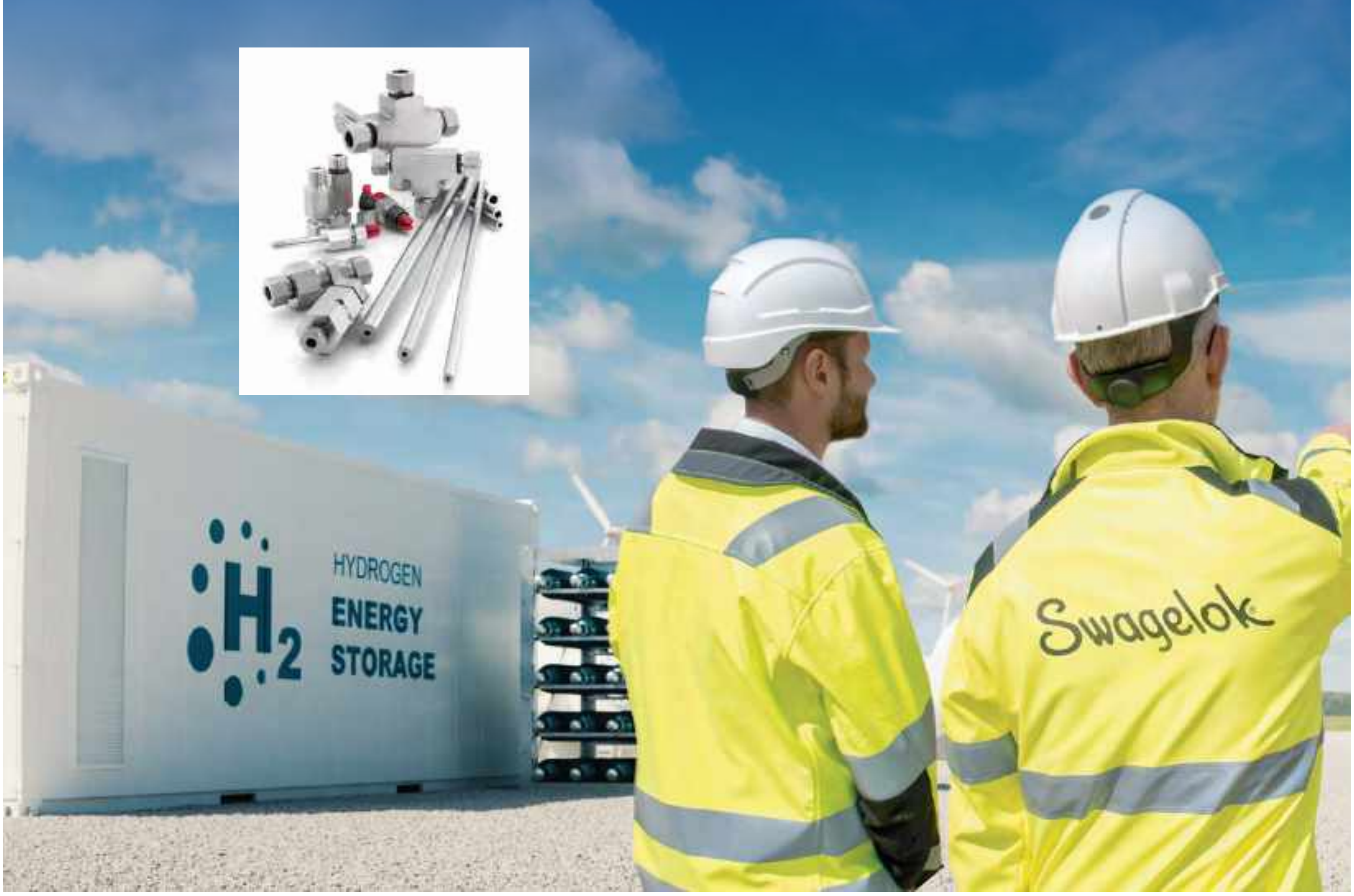

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Butterfly Valve - Concentric Integrally Moulded Liner Design	50 - 1200 mm (2" - 48")	PN 10, PN 16, PN 20, & ASME # 150	API 609 Category A, BS EN593, IS 13095, **UL 1091**	All kinds of Water/Chemicals/ Air/Oil/ Gases (up-to 204°C / 400°F including Vaccum services)
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Butterfly Valve - Double Eccentric (Offset) High Performance	80-3000 mm (3" - 120")	Upto ASME 150	API 609 B, BS EN 593, IS 13095, AWWA C504/516	All Services up-to 200°C / 392°F
Actuated Butterfly including MOVs, On-off Remote Shut-off Valves	50 – 3000mm (2" – 120")	Pn10, Pn16, ASME # 150, 300, 600, 900, 1500	API 609, **SIL 3**	With Electric, Pneumatic, Electro Hydraulic, Complete Hydraulic, Actuators & Instrumentation
Balancing Valve	25 – 1200 mm (1" – 48")	Upto PN 25	DIN 3202 / BS 7350/ BS EN 593 Face to face as per ISO 5752 Table 8	Water, Glycol, Brine solution

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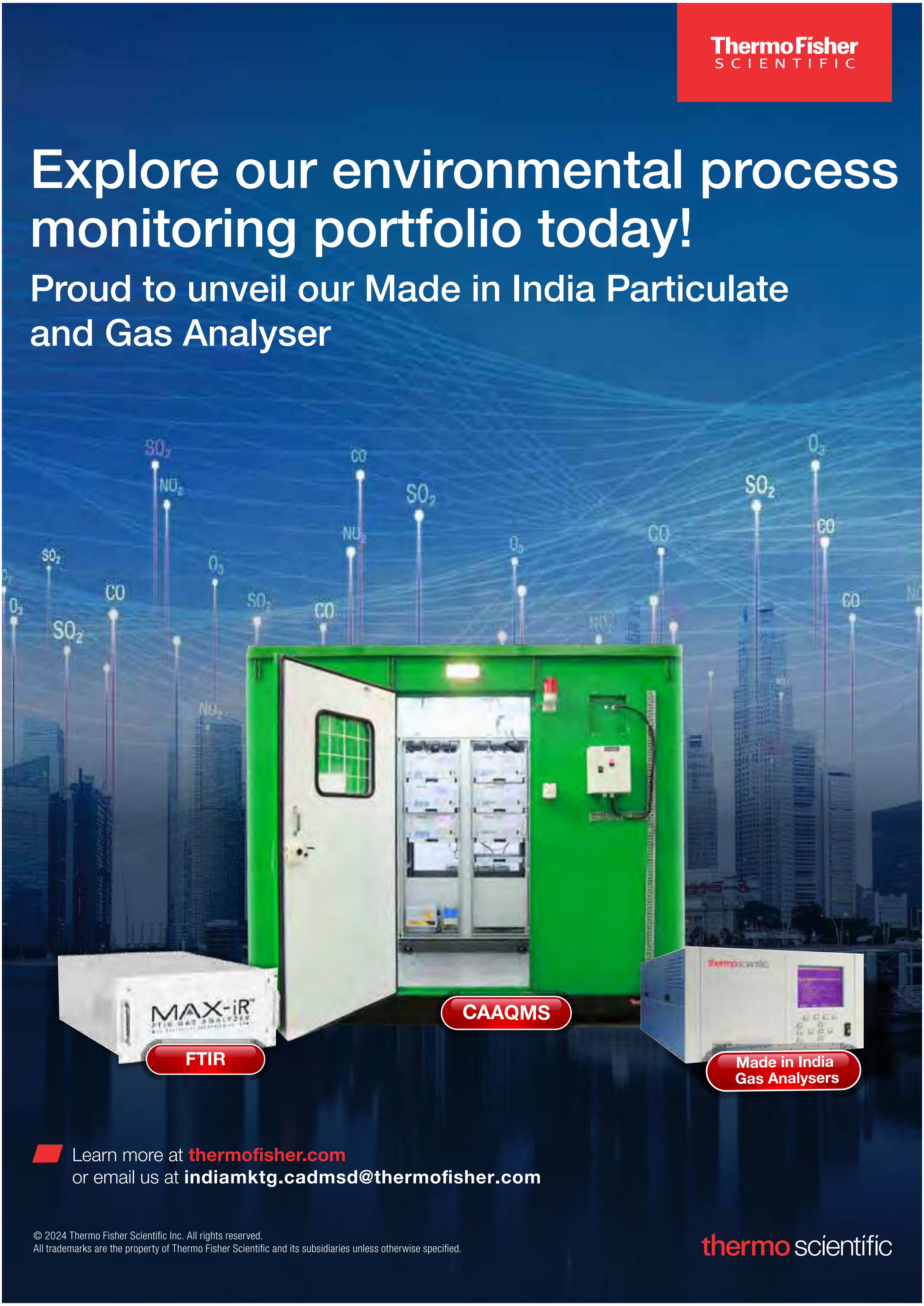
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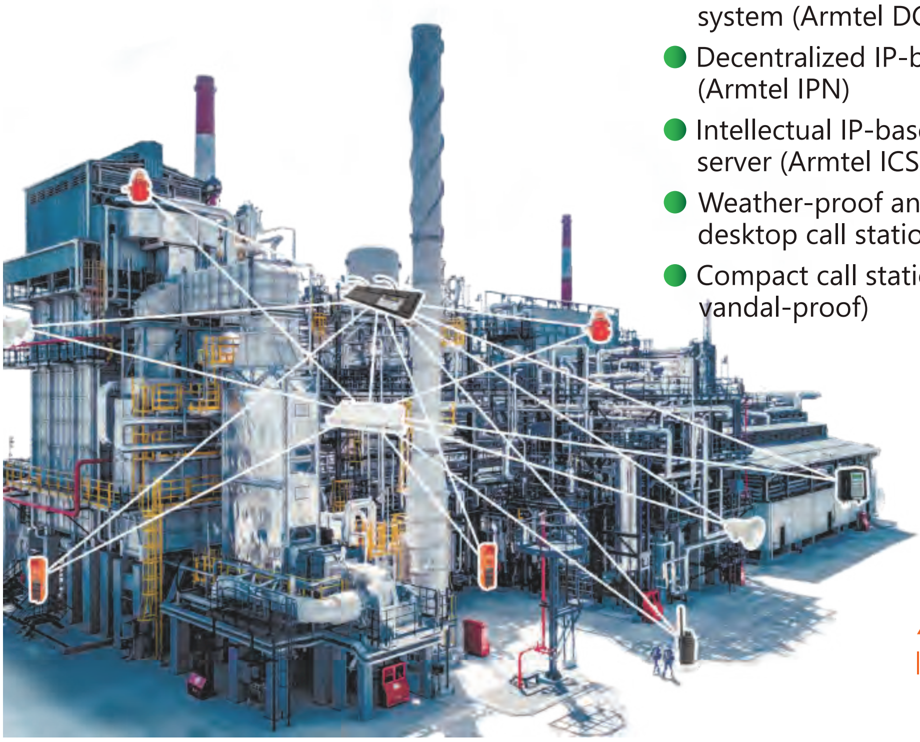

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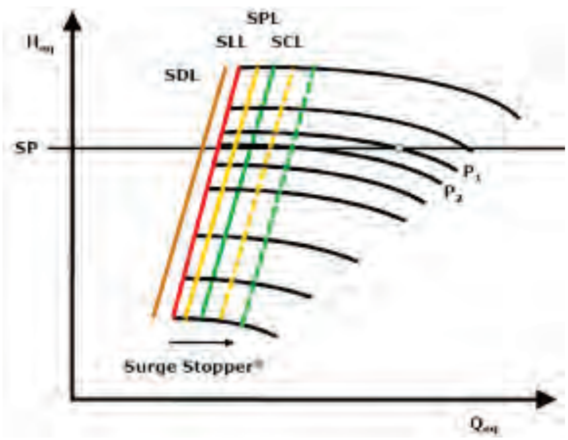

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50% smaller than industry standard

30% higher channel count compared to industry standard

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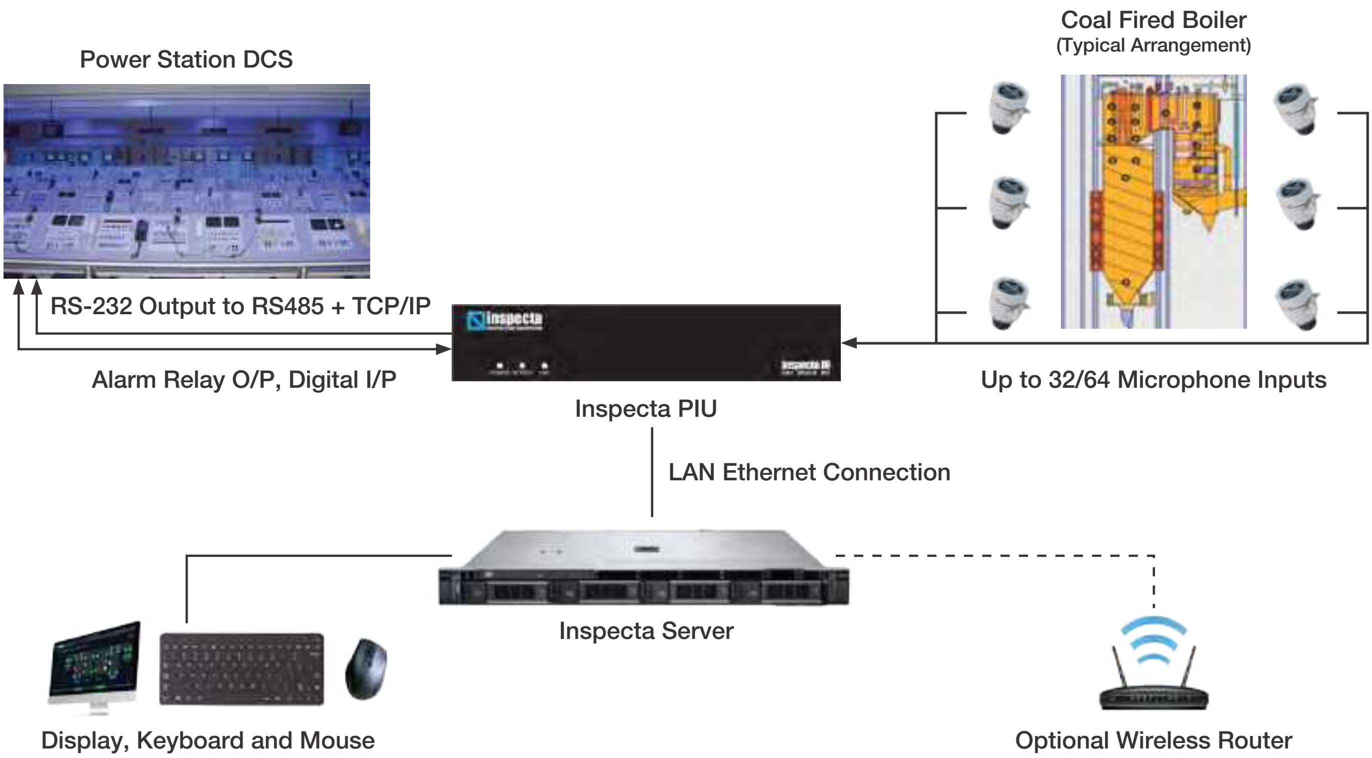

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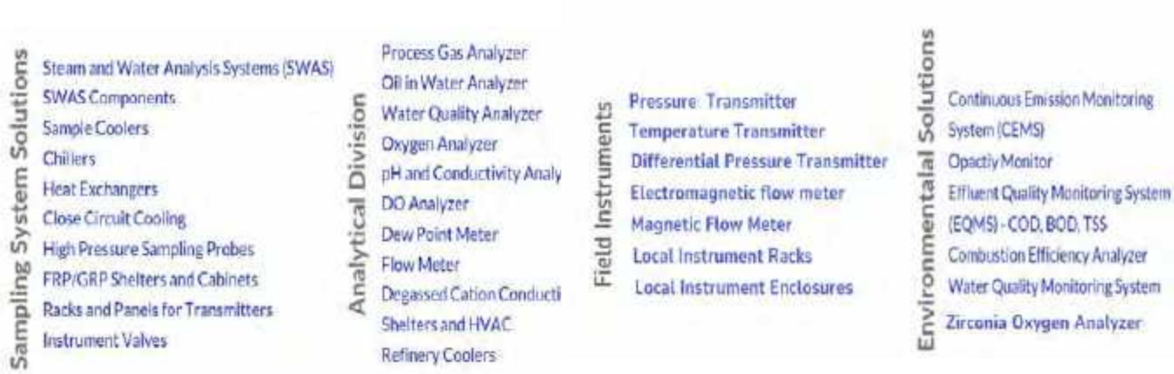

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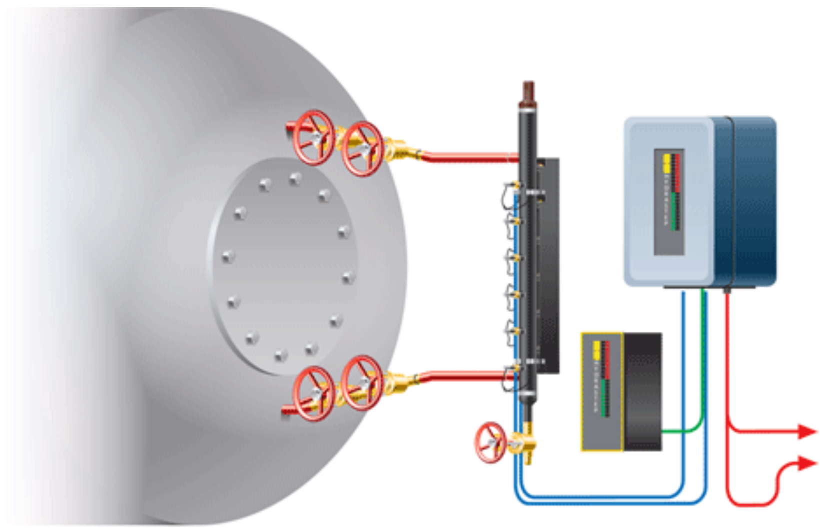

V. AUTOMAT & INSTRUMENTS (P) LTD.

AUTOMAT HOUSE, F-61, Okhla Industrial Area, Phase-I, New Delhi - 110 020, INDIA

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The versatile and robust design of Securaseal C-series metal-seated ball valves exceeds the capabilities of other valve types in high-pressure, high-velocity applications with erosive and possible corrosive media.

- Tight shut-off
- Lower operating torque
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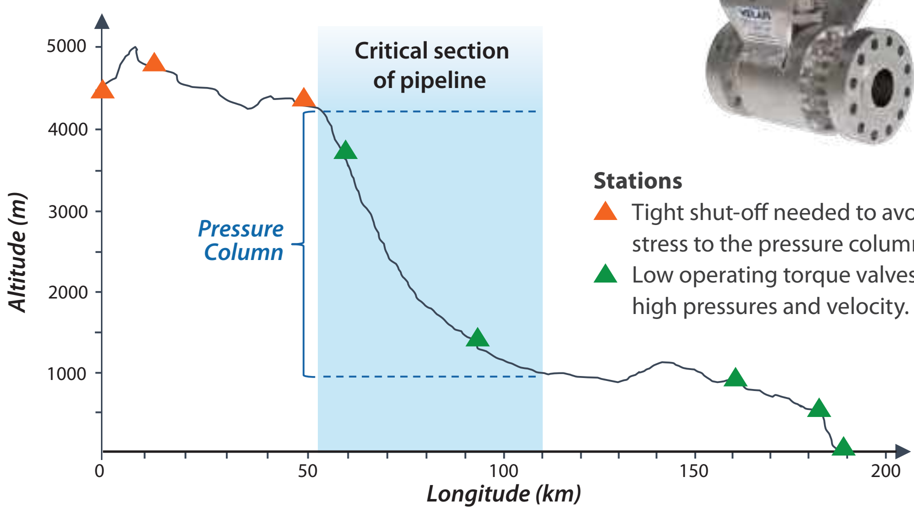
PIPELINE TOPOGRAPHY

The Securaseal C-series versatile and robust design meets all conditions required along the pipeline.



Stations

- ▲ Tight shut-off needed to avoid adding stress to the pressure column.
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QuickTrip

ELECTRO-HYDRAULIC TRIP BLOCK ASSEMBLY FOR INDUSTRIAL STEAM TURBINES

WOODWARD | INDUSTRIAL TURBOMACHINERY SYSTEMS

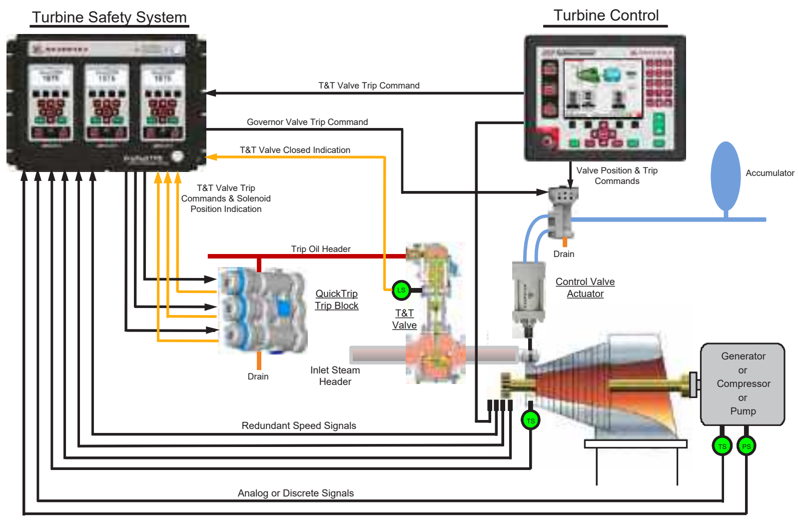
The QuickTrip trip block assembly is designed for use in steam, gas, and hydro turbine shutdown systems for quick and reliable dumping of the turbine's trip oil header. This integrated trip block assembly is intended for use on mechanical-drive or generator-drive steam turbines that use low pressure (5–25 bar / 73–363 psi) hydraulic trip oil headers.

The QuickTrip's fault tolerant design makes it ideal for critical steam turbine applications, where turbine up-time and availability are essential. This trip block assembly's 2-out-of-3 voting design provides users with a very high level of system reliability as well as compliance with industry standard API-670.

The QuickTrip is certified for use in IEC61508 based turbine safety systems, and when paired with the Woodward ProTechTPS, can be applied into systems that require a "Safety Integrity Level – 3" rating or below.

PRODUCT FEATURES

- Dirt-tolerant design (25lb rotary chip shear force)
- Self-cleaning valve design (rotary solenoids)
- Fast trip times (< 50 ms solenoid action)
- Increased reliability (2-out-of-3 voting design)
- Repairable online
- Testable on-line
- Safety certified for use in IEC61508 SIL-3 systems
- API-670 Compliant
- Local & remote position indications
- Compact size
- Certified for hazardous locations



Executive Committee Members(2023-24)

S.No	Position	Name	E-mail Address	Mobile No.
1	President	Mr. M K Srivastava	mksrivastava01@ntpc.co.in	9650991053
2	Vice President	Mr. N Vinod	nvinod@indianoil.in	9466702974
3	Secretary	Mr. Sachin Kr. Agrawal	sachin.agrawal@eil.co.in	9958092991
4	Treasurer	Mr. Sandeep Gupta	totalsolutionsco@yahoo.co.in	9868255848
5	Society Delegate	Mr. Sachin Joshi	sachin.joshi@eil.co.in	9650011669
6	Alt. Delegate	Mr. Arun Gupta	arung@indure.com	9818102784
7	Program Chair	Mr. Some Nath Kundu	somenathkundu@gmail.com	9650997664
8	Program Chair	Mr. Manish Kumar	manish.kumar@eil.co.in	9810890933
9	Education Chair	Mr. Anil Choudhary	anil@noclesys.com	9310016949
10	Education Chair	Ms. Ritu Agarwal	rituagarwal@pdilin.com	9717104054
11	Membership Chair	Mr. Anupam Srivastava	anupam.srivastava@emerson.com	9873079003
12	Membership Chair	Mr. Surinder Paul Tandon	tandonsp@indianoil.in	9937012734
13	Membership Chair	Mr. Sanjay Kumar	ersanjay1996@gmail.com	9891271003
14	Newsletter Editor	Mr. T R Jegdeesh	tr.jegdeesh@eil.co.in	9971866131
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17	Exhibit Chair	Mr. Rajat Goyal	rajatgoyal06@gmail.com	9818953473
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23	Honors & Awards	Mr. Parag Tyagi	paraag@wissenautomation.com	9310295951

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S.No	Position	Name	E-mail Address	Mobile No.
24	Historian	Mr. Aman Sagar	aman_sagar44@yahoo.com	9910555211
25	Student Section Liaision	Mr. Pankaj Gupta	pankajinst@yahoo.com	8506066604
26	Student Section Liaision	Ms. Anuja Thukral	anuja.thukral@gmail.com	9310221033
27	Section Division Liasion	Mr. S Mahesh Kumar	s.mahesh.kumar@eil.co.in	9868105971
28	Standards & Practices	Mr. Gaurav Mittal	mittalg@indianoil.in	9996644332
29	Standards & Practices	Mr. Arupjyoti Saikia	arupjyoti.saikia@eil.co.in	9910066741
30	Past President	Mr.Rajiv Gupta	rajivra1212@gmail.com	9818341262
31	Chief Patron	Mr. Rohit Bhardwaj	rohit_iocl@yahoo.co.in	9873149991
32	Patron	Mr. S K Dhawan	sk.dhawan28@gmail.com	9818686181
33	Patron	Mr. Prasenjit Pal	prasenjit@ntpc.co.in	9650991122
34	Patron	Mr. S K Bardhan	bardhansk@yahoo.co.in	7838000016
35	Sr. Advisor	Mr. R K Bassi	rkbassi@yahoo.com	9810005826
36	Sr. Advisor	Ms. R Priyamvada	r.priyamvada@yahoo.com	9312229961
37	Sr. Advisor	Mr. Sushil Kumar	sushil@gail.co.in	9871004983
38	Sr. Advisor	Mr. Sanjay Raijada	raizadas@indianoil.in	9416500180
39	Sr. Advisor	Mr. Alok Agarwal	alok.agarwal@mcdermott.com	9911998292
40	Sr. Advisor	Mr. S K Tripathi	sanjaykrtripathi@pdilin.com	9868358859
41	Sr. Advisor	Mr. Dharmender Singhal	dhsi@topsoe.in	9999387604
42	Sr. Advisor	Mr. Raja Sekhar Gudipaty	rs.gudipaty@gmail.com	7206055509
43	Sr. Advisor	Mr. Atish Chakraborty	atish400@gmail.com	9810629360
44	Sr. Advisor	Mr. Ashish Dev	dev3408@gmail.com	9650999070
45	Sr. Advisor	Mr. R Sarangapani	rsarangapani@ntpc.co.in	9650992571
46	Sr. Advisor	Mr. Ravinder Goyal	rgoyal@eipenviroindia.com	9810181109
47	Sr. Advisor	Mr. Vivek Gupta	vivek_gupta@dcmshriram.com	9829037954

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