



**Delhi**  
Section

# ISA-D PPAM 2025

**PETROLEUM & POWER AUTOMATION MEET 2025**

**“Advanced Automation for Energy Resilience”**

# e Souvenir

**2<sup>nd</sup> & 3<sup>rd</sup> May 2025 (FRIDAY & SATURDAY)**  
**New Delhi**





Delhi  
Section



## *Message*

The rapid advancements in Measurement and Control systems technology in recent years powered by the advent of Artificial Intelligence has made these exciting times living with effects of cutting-edge technology seen all around.

With natural energy resources facing crunch in availability along with the effects of global warming palpable, it becomes all the more imperative to bring the advancements in Control and measurement technology powered by 'AI' to be implemented in the operation of Green fuels and to give impetus to the Sustainability drive worldwide.

With a view on this, ISA-D has organized this year's PPAM meet to bring the industry experts from diverse technical fields in the Instrumentation and Control System domain to put forth their ideas and innovations to meet the objective of AI driven Control operations technology in the increased implementation of the twin goals of Greener fuels and Sustainability.

Best wishes to all stakeholders, industry professionals, delegates and participants in coming together to make this ISA-D PPAM 2025 event (Advanced Automation for Energy Resilience) a grand success.

*Anindyo Ray*

Convenor – PPAM 2025



## 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.

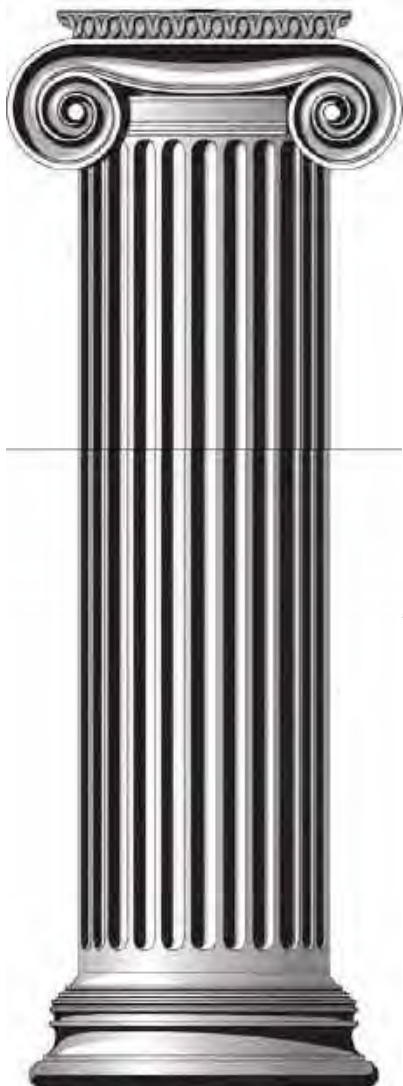


### **ISA has been involved in promoting emerging technologies across the globe by a variety of ways such as:**

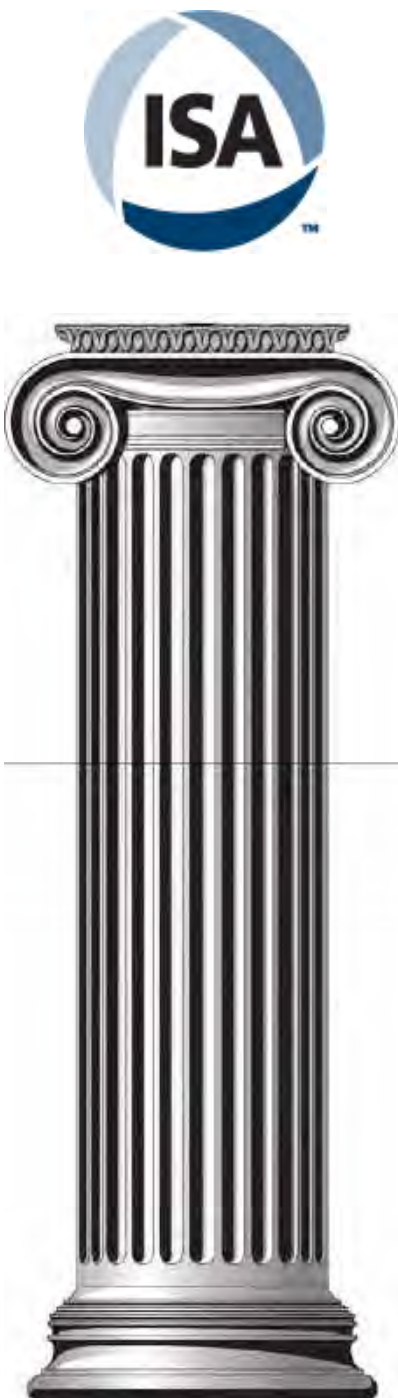
- Developing and updating standards for existing & evolving technologies in automation related fields.
- Publication of Textbooks, handbooks, journals, proceedings etc. on a wide array of automation related subjects from primary field sensors to integrated automation and management systems for various 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

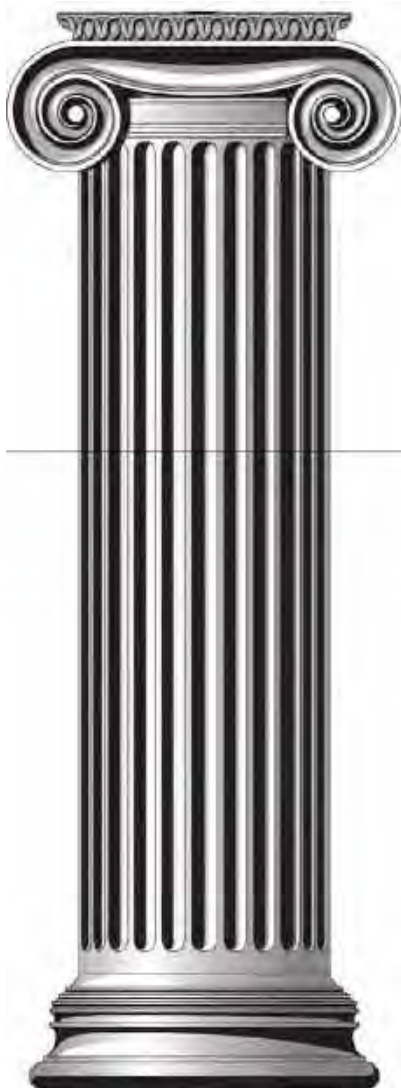


## Grow

- 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.





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**

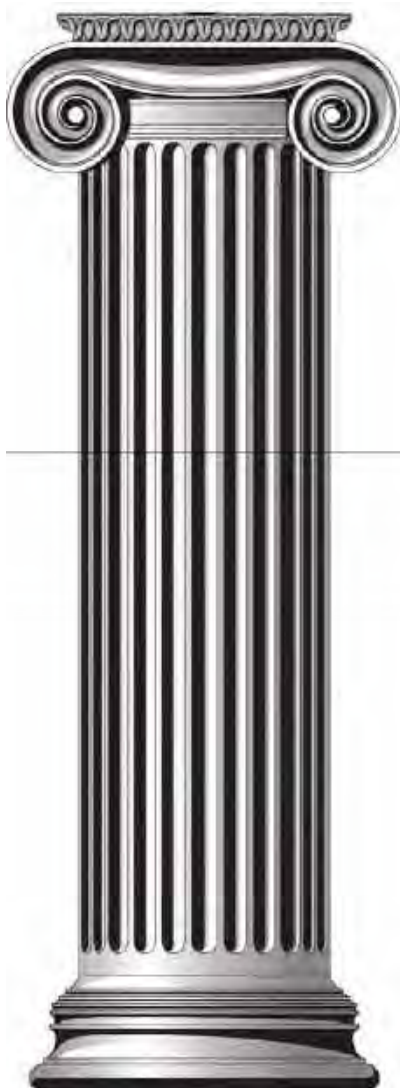
Join ISA to engage with peers and subject matter experts around the world, share and develop best practices to advance the profession, build your resume and reputation, and use this opportunity to inspire the next generation of professionals. Together, we create the future of automation, and we need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

### **Learn**

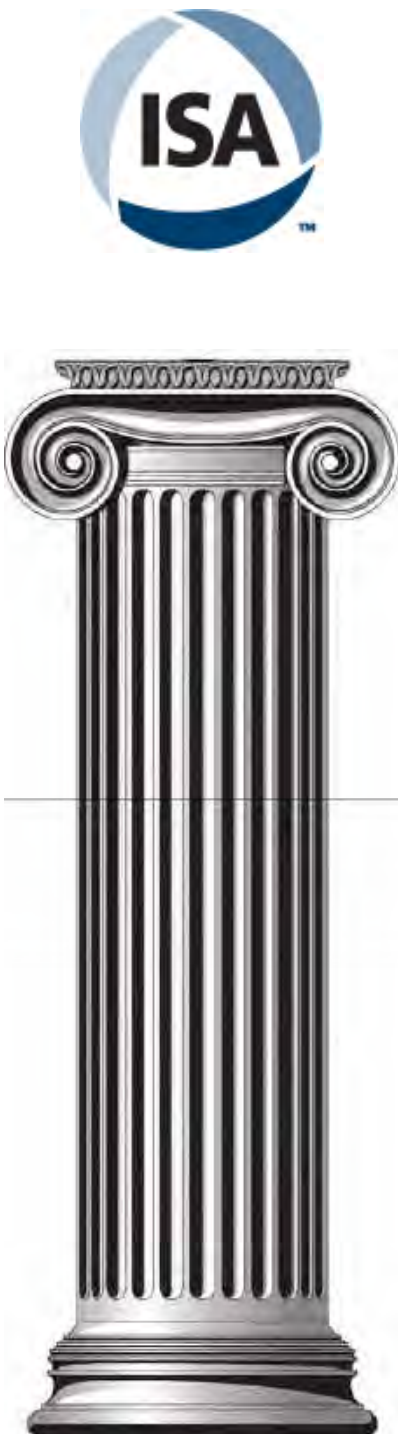
- Access over 150 standards that reflect the expertise of industry leaders in the automation industry.
- Read the latest in industry information through our online news source, Automation.com and flagship publication, InTech magazine ebook.
- Take advantage of training programs designed to increase knowledge 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.







### **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.

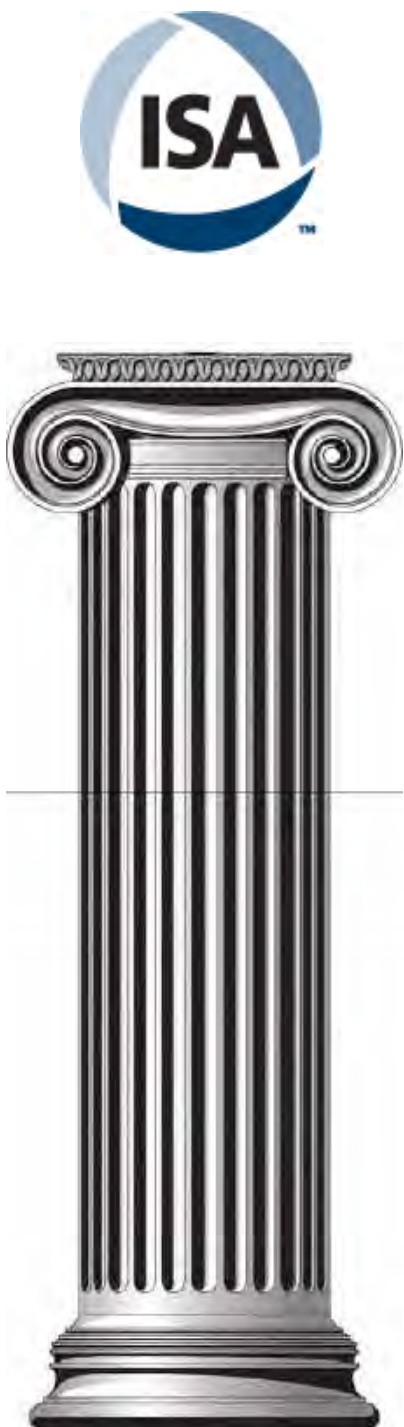
The ISA web site helps students more easily stay current on research without attending numerous expensive conventions or wading through non-automation related literature for the useful gems. Also, students can find the conferences they should attend to both gain information and networking possibilities,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





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To overcome these challenges, Forbes Marshall MachPulse delivers a cost-effective, advanced solution for real-time vibration monitoring and diagnostics. Designed to simplify machinery health management, MachPulse ensures precise detection of abnormalities, enabling proactive maintenance and enhanced operational efficiency. In addition, expert services and daily reports on abnormalities provide actionable insights and detailed analysis, empowering teams to address issues promptly and maintain machinery reliability at its best.







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- LAB (Linear Alkaline Benzene)
- TGTU Desulphurization
- Coal to Methane
- VCM (Vinyl chloride monomer)
- DHDT (Diesel Hydro-treater Unit)
- FCCU (Fluid Catalytic Cracking Unit)
- HCU (Hydro Cracker Unit)
- Green Hydrogen Application
- PVC (Poly Vinyl Chloride)

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# Orbit 60 Series

## Next-generation condition monitoring, asset protection, and data integration for all rotating machinery in any industry

The Orbit 60 Series is Bently Nevada's most advanced condition monitoring and protection system that will help you make smarter decisions faster—and accelerate your journey to digital transformation.

It collects and processes data on the edge at high speed—equipping operators with the right analytics and machine-health information needed to optimize performance and maintenance.

## Robust cybersecurity

The Orbit 60 Series is the first intrinsically cybersecure vibration monitoring system with a built-in data diode—creating a safe industrial environment for data processing. It's designed to ISA 62443 Cybersecurity Standard.

## Enhanced analytics

The system has 100x higher signal processing power than the industry standard. It offers best-in-class data resolution across all machine types, and seamlessly connects to System 1 software for advanced data analysis—delivering highly accurate machine-health information at the speed you need.

## Scalability and flexibility

The architecture can support up to 65 dynamic data channels per rack (versus industry average of 50), so you can monitor more machinery with less effort and lower capital expenditure. With scalable architecture, a modular remote I/O system, and the ability to connect to third-party systems—the Orbit 60 Series can cover a wide range of assets, from critical machinery to balance of plant—making it the ideal platform for future expansions. It's also the only turbomachinery monitoring system that can be distributed or rack-based, which maximizes your installation and operating flexibility.

The unit is exponentially more efficient: 50% smaller than industry standard, so it optimizes space and reduces associated costs for installation, operations, and maintenance—across a wide range of industries including oil and gas, power generation, renewables, and industrial.

## Continuity

The Orbit 60 Series performs high-resolution offline data storage for incidents—ensuring continued access to data even during a network interruption. It has SIL 2 Certification for confidence through redundancy measures.



1<sup>st</sup>

intrinsically cybersecure vibration monitoring system with built-in data diode

100x

processing power vs. industry standard—with variable signal processing

50%

smaller than industry standard

30%

higher channel count compared to industry standard

60+

years of expertise from Bently Nevada

## Learn more

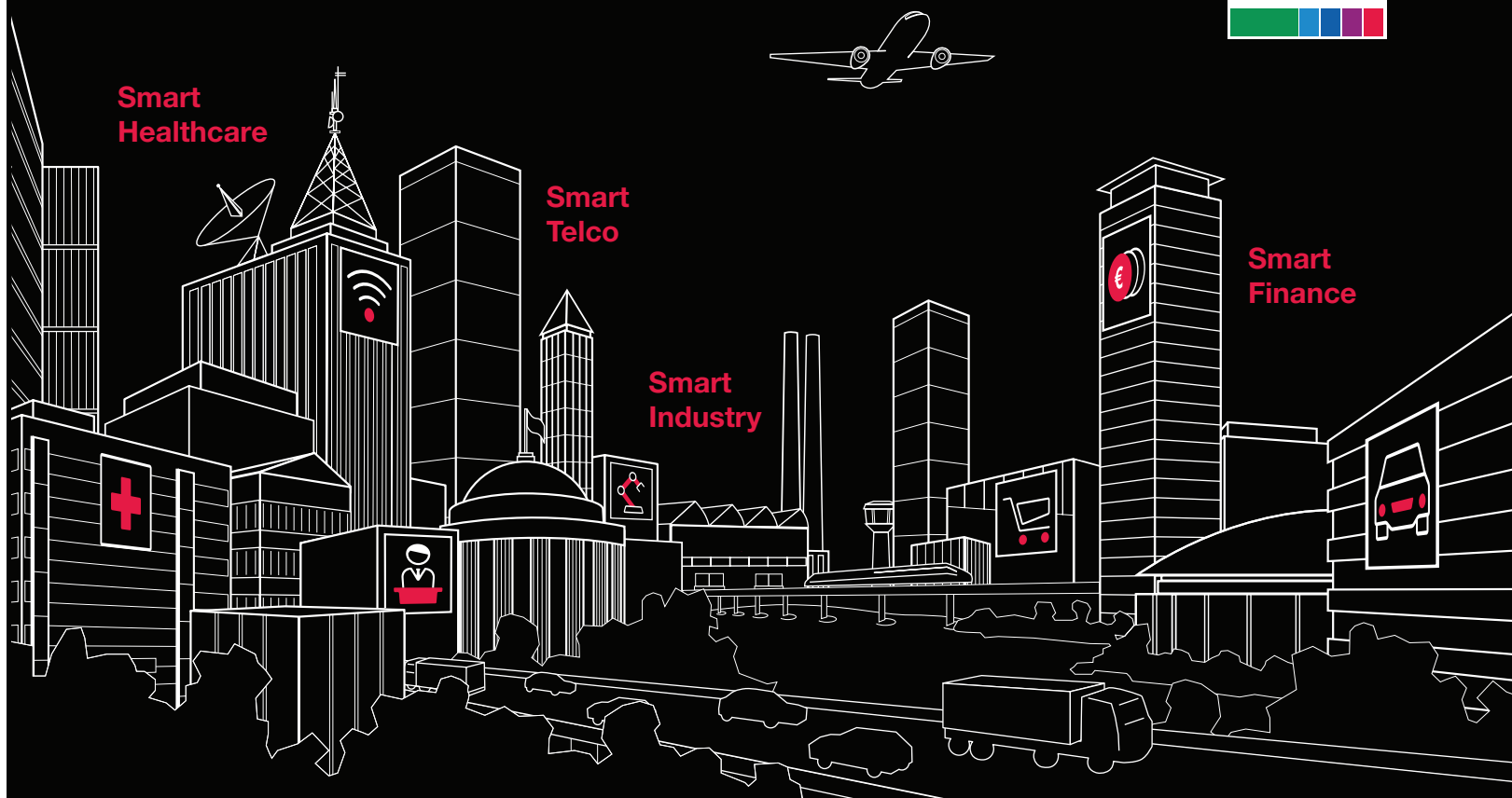
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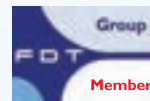
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	<b>PROGRAM DETAILS</b>				
	<b>Date-2nd &amp; 3rd May 2025</b>				
	<b>Petroleum &amp; Power Automation Meet</b>				
	<b>DAY -1</b>	<b>2nd May 2025 (Friday)</b>			
				Time	
				FROM	TO
	<b>Registration</b>			9:00 AM	9:30 AM
	<b>Inaugural Session</b>				
1	Introduction of Chief Guest and Guests of Honour			9:30 AM	9:40 AM
2	Lamp Lighting Ceremony			9:40 AM	9:45 AM
3	Welcome Address by Convenor PPAM-2025			9:45 AM	9:55 AM
4	Address By Chief Guest and Guests of Honour			10:00 AM	11:00 AM
5	Note of Gratitude - ISA (D) Secretary			11:00 AM	11:10 AM
6	Release of e-Souvenir and Inauguration of Exhibition			11:10 AM	
	<b>TEA BREAK AND STALL VISIT</b>			11:15 AM	11:30 AM
	<b>Session - 1 : (AI in Industrial Automation)</b>	<b>Organization</b>	<b>Participant</b>	1130 AM	1:30 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	Exploring Green AI in Sustainable	IOCL R&D centre Faridabad	Resmi K		
2	Application of Cutting Edge Technologies and AI in Industrial Automation across various sectors	NTPC	PK Gupta & Sumit Haldar		
3	The human factor in control room designs with Workshop respect to human factor engineering guidelines.	Pyrotech Workspace	Sunil Ladha		
4	Revolutionising Predictive maintenance with AI for rotating equipments in the plant	Forbes Marshall	Mukesh Vyas		
	<b>SMART QUIZ SESSION</b>				
	<b>NETWORKING LUNCH BREAK AND STALL VISIT</b>			1:30 PM	2:30 PM
	<b>Session - 2 : (Advanced Automation)</b>			2:30 PM	03:45 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	Achieve Sustainability Goals with Energy Management and Optimization	ABB	Mangesh Nawarange		
2	Advanced automation in greenfield energy projects	Rittal	Ajit Mistri		
3	Automated tight shut off Triple Offset Valves in High Temperature Service- Design and Performance testing	Delval	Ravindra Patil		
	<b>SMART QUIZ SESSION</b>				
	<b>TEA BREAK AND STALL VISIT</b>			03:45 PM	04:15 PM
	<b>Session - 3 : (Cutting Edge Technologies)</b>			4:15 PM	5:30 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	Journey with Open Process Automation: Insights from their OPAS Test Bed	Reliance	D Shah		
2	Advanced Integrated Gas Analyzers Solutions for Petrochemical Industry	Adage	Manoj Singh		
3	Latest trends in Control room video wall latest trends in fine pitch SMD V/s COB technology	Pyrotech Electronics	Kuldeep Singh Rathore		
	<b>SMART QUIZ SESSION</b>				
	<b>LUCKY DIP</b>			5:30 PM	5:45 PM
	<b>STALL VISIT</b>			5:45 PM	6:30 PM
	<b>NETWORKING DINNER</b>			6:30 PM	9:00 PM



	DAY-2	3rd May 2025 (Saturday)			
	Registration			9:00 AM	9:30 AM
	Session - 4 : (Automation in Renewable Energy)			09:30 AM	11:00 AM
	OPENING ADDRESS BY SESSION CHAIR				
1	Real time measurements in production of Biogas.	E&H	Hemal Desai		
2	Execution of Prefabricated substations	Flour Electrical	Namita Rawat/Sanjay Rakheja		
3	Building System Durability & Reliability by designing Smart equipment protection	nVent	Lallit Purri/Vipin Pandey		
	SMART QUIZ SESSION				
	TEA BREAK AND STALL VISIT			11:00 AM	11:30 AM
	Session - 5 :(Role of Automation in Green Energy)			11:30 AM	01: 30: PM
	OPENING ADDRESS BY SESSION CHAIR				
1	Sensors in the Hydrogen economy	Vega	Vinod Kumar		
2	HART Is now SAFE, with Enhanced Security	Fieldcomm	Harish Wadhwa		
3	Role of Automation in Green and Clean Energy Infrastructure	Topsoe	Atanu Ghoshal/Avneesh Sharma		
4	Integrated Gas Analyzer Shelters: The Role of Automation and IoT in Real-Time Monitoring	Axis Solutions Limited	Sanjeev Chakraborty		
	SMART QUIZ SESSION				
	NETWORKING LUNCH BREAK AND STALL VISIT			01:30 PM	02:30 PM
	Session - 6 : (Advanced Automation)			02:30 PM	03:45 PM
	OPENING ADDRESS BY SESSION CHAIR				
1	Qualification of I&C equipments for Nuclear Power plant	Arabelle	Pawan Kumar Garg/Niraj Mathur		
2	Smart surveillance - Enhancing premises & perimeter security with integrated cameras & Audio soultions	Toshniwal	Mohan Lal/Gunjan Agarwal		
3	Optimizing Fired Heaters using infrared sensor technology	Land Instruments-Ametek	Souvik Chowdhury		
4	Simplicity in Pressure Calibration using fully automatic & Smart Software Solution	Fluke	Kaushik /Satyajit Nath		
	SMART QUIZ SESSION				
	Session - 7 :				
1	TAKE AWAY SESSION BY DISTINGUISED GUESTS			3:45 PM	4:15 PM
2	FELICITATION TO EXHIBITORS			4:45 PM	5:00 PM
3	LUCKY DIP DRAW			5:00 PM	5:15 PM
4	NOTE OF GRATITUDE - ISA (D) PRESIDENT			5:15 PM	
	***** EVENT NEXT *****				



The background is a deep blue gradient. The upper half features a network of white hexagons and connecting lines, some of which are highlighted in a lighter blue. The lower half contains a glowing, circular digital interface with concentric rings and a central cross-like structure, resembling a radar or data visualization.

# TECHNICAL PAPERS



# **Exploring Green AI in Sustainable Energy Research**

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Research and Development Centre, Faridabad

## **ABSTRACT**

The urgent need for sustainable energy solutions has never been greater, driven by climate change, resource depletion, and the global push towards a low carbon and circular economy. This has led to the growing synergy between Artificial Intelligence (AI) and Renewable energy technologies. Green AI, an emerging technological approach, is reshaping sustainable energy research by providing innovative, data-driven solutions to optimize energy production, storage, distribution, and consumption. This paper explores how Green AI (both Green in AI and Green by AI) has become a critical tool in improving renewable energy technologies and reducing environmental impacts. Through the application of machine learning (ML) models and data-driven approaches, Green AI is reshaping the future of materials science, optimizing energy systems, and reducing carbon footprints across the lifecycle phases of renewable energy technologies. By leveraging AI models, and simulations, Green AI enables more efficient, cost-effective, and eco-friendly solutions, significantly contributing to global sustainability efforts. This paper also outlines the current applications, challenges, and potential future directions for Green AI in these domains.

## **KEYWORDS**

Artificial Intelligence in Sustainable energy, Self Driven Labs, Material research, Circular policies, Sustainable AI

## **1. INTRODUCTION**

Green AI is a broad umbrella term for a two-sided research variant of AI, namely Green by AI and Green in AI. It refers to the use of artificial intelligence (AI) and machine learning (ML) technologies to address environmental issues and promote sustainable solutions. Green by AI focuses on the development and use of AI and ML algorithms, advanced analytics and systems to improve resource efficiency and develop cleaner technologies. On the other hand, sustainable AI or Green in AI refers to the design and implementation of AI and ML algorithms and systems that are themselves environmentally sustainable. This is important to minimize carbon footprint during AI operations, and to enable the execution of AI/ML algorithms on resource limited devices or computing environments. Green AI, as an emerging technological approach, offers the potential to optimize the development of materials and energy systems while reducing energy consumption and environmental impact. AI technologies, conventionally



associated with high computational demands, can now be utilized in ways that promote efficiency and sustainability in material selection, experiment design along with manufacturing and transportation. It emphasizes energy efficiency, responsible use of resources and minimal carbon emissions aiming to ensure that AI's versatile capabilities are leveraged to benefit our planet and ecosystem. The power of AI is already being used in the entire life cycle of Energy Industry, from production, operation, asset management and maintenance, safety and risk management to supply chain and logistics. It is also used to improve the performance of renewable energy systems, facilitate smarter grid management, improve energy storage solutions, and aid in the design of sustainable buildings and cities. This report explores how Green AI is playing a transformative role in sustainable energy research lifecycle, ranging from material selection to experiment design and policy implementation.

## 2. GREEN (BY) AI IN SUSTAINABLE ENERGY RESEARCH

With the advance of Green AI, researchers are accelerating innovations in renewable energy namely Wind, Solar, Battery research, Fuel cell, electrolyzers etc. Current developments in artificial intelligence (AI) play a multi-faceted role in advancing energy materials research by accelerating the discovery and synthesis of new materials for energy generation and storage. AI techniques are also used in designing experiments and are utilized in laboratory automation to speed up synthesis, iterative testing, and refinement. The experimental data along with various models and vast data sets help in bridging the gap from laboratory-scale research to certified industrial-scale use.

### 2.1. MATERIAL DISCOVERY, SELECTION AND PERFORMANCE ANALYSIS

The discovery, design and synthesis of sustainable materials traditionally involved labor-intensive and resource-heavy trial and error processes. Machine learning and AI techniques significantly shorten this process by using advanced models and analytics to predict material properties and their performance with the help of large datasets available worldwide i.e it enables inverse design. They simulate a vast range of material combinations, helping to identify candidates with desired physio-chemical properties (e.g., thermal stability, strength, conductivity) under varying conditions, without the need for extensive physical experimentation.

For example:

- **Battery Materials:** In energy storage systems, AI models can analyze data from existing materials to predict and analyze the performance of the best combination of electrodes and electrolytes, for high-performing long lasting batteries. They can predict how different battery chemistries will behave over time, leading to innovations in energy storage systems that store more energy and are easier to recycle. This reduces the need for trial and error in material selection, speeding up the development of more sustainable battery technologies.
- **Solar Cell/ coating Materials:** Machine learning models can simulate the performance of new solar cell materials under various environmental conditions, aiding in the discovery of more efficient and cost-effective photovoltaic cells/ thermal coatings with better light/ heat absorption, reflection and stability.



- **Wind Turbine Design:** Generative design techniques can help design wind turbine blades that are both more efficient and durable, reducing material costs and energy loss.
- **Hydrogen storage and fuel cells:** AI models can be used for establishing a relationship between the catalytic performance and structure, composition, and surface area of various materials and is an efficient screening tool for identifying potential catalytic materials before the actual synthesis and testing.
- **Bio- energy, Carbon Capture and Storage Technologies:** AI is being applied in bioenergy systems, namely in the areas of detection (prediction of biomass yield using, satellite weather and soil data), production/process (prediction of chemical properties of feed , estimation of the energy recovery parameters etc), supply chain, transportation and energy usage (to optimize feedstock transportation/inventory, energy planning and site selection for biogas plants). Properly trained AI models can also predict novel materials that can adsorb CO<sub>2</sub> effectively.

## 2.2. AI FOR EXPERIMENT DESIGN & OPTIMIZATION- “*SELF-DRIVEN LABS*”

AI along with high end robotics is used to design experimental plans, predict outcomes, analyze results and adapt next steps; all of these in real-time. This forms a closed-loop system where experiments and methodologies are continuously refined based on results, leading to faster discovery, increased reproducibility, improved safety and enhanced analysis and insights.

For example,

- *The Berkeley A-Lab where robots operate instruments, and AI make decisions to find new materials. A-lab can process hundreds of times as many samples as a human every day and use AI to pursue promising finds in the areas of solar cells, fuel cells, thermoelectrics.*
- *HCLTech- Smart Labs for Pharma uses AI to automate lab processes, predict outcomes and optimize experimental design.*
- *Open Catalyst Project (Collaborative research effort of Meta AI + Carnegie Mellon): Use AI to model and discover new catalysts for converting renewable energy to easily storable fuels.*

## 2.3. LIFECYCLE ASSESSMENT AND ENVIRONMENTAL IMPACT

AI tools can also be utilized in environment impact assessment of materials throughout their lifecycle—from extraction and production to usage and disposal. They can quantify the environmental factors such as energy consumption, carbon footprint, and recyclability of materials which enable manufacturers and researchers to work on materials that align with sustainability goals. AI also helps optimize the usage of raw materials by recommending production processes that reduce waste, enhance material usage, and increase the recyclability of materials. AI models can also contribute to reducing carbon footprint of supply chain by recommending more energy-efficient or sustainable transportation and manufacturing practices.



## 2.4. AI-ENABLED CIRCULAR ECONOMY POLICIES

Some of the major applications of AI in circular economy are designing renewable energy technologies based on circularity (reuse, repair, and recycling), personalized energy management solutions (based on renewable energy availability and consumer's personal habits) and Intelligent recycling systems, where AI-powered robotics and machine learning can help sort, recycle and reuse valuable materials from decommissioned renewable energy systems. In addition to this, AI can model and monitor the impact of circular economy policies to achieve sustainability goals of energy production, consumption, and waste management.

**Predictive Modeling, Monitoring and Dynamic adjustment:** AI can simulate the impacts of different policy scenarios (eg: taxes on carbon emissions, subsidies for renewable energy systems, reuse or recycling mandates) to predict their long-term outcomes and help regulatory bodies to understand the potential impacts on resource consumption, economic performance, and environmental sustainability. AI can also effectively track, monitor and enforce compliances with sustainability regulations and ensure the goals are met. Using real time data analytics and continuous feedback, AI can help adjust and recommend policy shifts that align with changing sustainability goals to optimize outcomes based on new technologies and change in economic conditions.

## 3. GREEN (IN) AI OR SUSTAINABLE AI

Traditional AI & ML algorithms typically require large amounts of data, computational power and advance hardware resulting in significant energy consumption, water consumption (to refrigerate data centers) and increased greenhouse gas (GHG) emissions. Sustainable or Green (in) AI is characterized by a low carbon footprint, small models, low computational complexity, and better-quality data. Below are the most promising approaches aimed at reducing environmental impacts of AI itself.

### 3.1. ALGORITHMIC OPTIMIZATION, HARDWARE OPTIMIZATION FOR ENERGY-EFFICIENT AI

The development of energy-efficient AI models or “*Green Algorithms*” is a growing field that require fewer computational resources, use less power, and are designed to be sustainable while still delivering high-performance results. Limiting the number of times an algorithm is run, especially those that are computationally expensive is another step towards energy efficiency and Green AI. Choosing more computationally efficient hardware like Specific GPUs, TPUs, parallel processors and utilizing edge computing where computation is performed at the locations of data collection or use, reduces the need to transmit the data to a data center or to the cloud thus leading to energy efficient AI.

### 3.2. SUSTAINABILITY, REGULATIONS AND DATA CENTER OPTIMIZATION

The carbon footprint of a data center is directly linked to its efficiency and the carbon intensity of its location. So appropriate sizing and location of data centers to meet actual market needs is



very important towards sustainability. It is also encouraged that policies and standards should be set regionally with mandates to partly or wholly power data centers using renewable energy sources. To optimize data center use, algorithms and frameworks are already in place that can dynamically manage server loads, adjust and customize cooling systems, and optimize resource allocation. AI training can be done separately and does not require immediate results, which allows it to be conducted in locations based on abundant and unconstrained availability of resources such as renewable electricity and water. This flexibility enables optimization of renewable resources but also minimizes the environmental impact of AI training activities thus moving towards sustainable practices.

### 3.3. ENERGY CONSUMPTION CALCULATION TOOLS

Considerable efforts are being made in creating standardized methods for calculating the carbon emissions associated with training models, resulting in several tools like *Carbontracker*, *Code carbon*, *Power top*, *Green algorithms* etc. for tracking and managing the carbon emissions generated by their software and codebase. They are also used to identify power hungry processes, devices, and components in computer systems, making it a valuable tool for optimizing energy consumption and extending battery life of hardware.

## 4. CHALLENGES IN IMPLEMENTING GREEN AI

Despite its significant potential, the integration of Green AI into sustainable materials and energy systems faces several challenges:

- **Data Availability and Quality:** High-quality, unbiased, comprehensive datasets are necessary for the development of effective Green AI models and their accurate predictions. Insufficient, proprietary or inconsistent data across regions are major hurdles in this way.
- **Bias and Trust: Ethical and Social Impacts:** AI “black-box” models are still met with concerns in critical infrastructure application. Also, AI-based systems must be designed to ensure fairness, equity, and accountability in energy access and decision-making across regions.
- **Computational Demand and Energy Costs.:** Although Green AI aims to reduce energy consumption, the training and deployment of large-scale AI models can still be energy intensive. They can offset sustainability gains if not sourced renewably.
- **Interdisciplinary Collaboration:** Implementing Green AI in materials science and energy systems requires collaboration, cross-disciplinary communication, and knowledge transfer between AI researchers, material scientists, energy engineers and policy makers.

## 5. FUTURE DIRECTIONS

The future of Green AI in sustainable materials and energy systems design is promising, with several exciting areas of development:



- **Explainable AI (XAI)** - As AI systems are increasingly utilized in environmental, sustainability and critical infrastructure related decision-making processes, it is crucial to understand and interpret the reasoning behind AI-generated recommendations to ensure transparency. XAI helps to identify potential biases in the models and provides insights into the data and factors influencing their decisions ensuring responsible AI development.
- **Eco-friendly AI hardware or Energy-harvesting AI devices-** Innovation in hardware design is focused on creating powerful and ecofriendly AI devices that can execute algorithms and models with minimal energy consumption. Energy harvesting or self-sufficient AI devices can harvest energy from the surrounding environment to power AI systems e.g., from ambient light, vibrations, and heat, contributing to their sustainable deployment.
- **AI-Driven Climate Modeling-** AI can help identify, explain and predict extreme climate events more effectively, improving disaster response and communication. Future applications include the development of standards specific to extreme events and their integration for better model training, and the creation of robust, scalable and dynamic AI systems.

The AI landscape is continually evolving and there is a high probability that researchers, engineers, and environmentalists shall discover novel ways to integrate AI into diverse realms of sustainability, addressing challenges and creating new opportunities.

## 6. CONCLUSION

Artificial Intelligence represents a powerful catalyst and tool for sustainable energy research. Green AI in sustainable energy research helps reduce energy consumption, lower emissions, and improve the integration of renewable energy, while simultaneously working to make AI itself more energy efficient. This dual focus is crucial for achieving long-term sustainability and combating climate change. By leveraging AI for material discovery, energy optimization, and sustainability assessments, Green AI can significantly contribute to the global transition toward more sustainable practices. Despite technical, ethical, and regulatory challenges, the future of Green AI in sustainability looks promising. With strategic investment and inclusive governance, AI can help drive a sustainable energy future. The utilization of AI in enabling innovation in renewable energy field can unveil countless applications that could significantly contribute to a more sustainable and eco-friendly future.



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## BIOGRAPHIES



Mrs. Resmi K (Research Manager at IOCL R&D Centre) is an IIT Roorkee Alumnus and has more than 13 years of experience in Instrumentation engineering supporting R&D Projects across Petrochemical, Lube Technology, Solar, Battery Research & Nanotechnology. She was also involved in Project planning and execution for setting up of R&D – II (New campus) and is currently part of Biotechnology and Sustainability group.



Dr. Umish Srivastva (Executive Director of Technology Promotion & Forecasting at Indian Oil Corporation Limited (IOCL), leads strategic initiatives to drive innovation, technology foresight, and future-readiness within India's energy sector. A respected leader in the energy innovation landscape. Dr. Srivastva is known for his visionary approach and contributions to national-level programs in technology forecasting and strategic planning. With extensive experience in research management, technology strategy and industrial innovation, Dr. Srivastva plays a key role in identifying emerging technologies and aligning them with Indian Oil's long-term growth and sustainability goals. His work bridges the gap between cutting-edge research and industrial application, fostering collaborations across academia, startups, and global partners.





**Delhi**  
**Section**

*Setting the Standard for Automation™*

# Application of Cutting Edge Technologies and AI in Industrial Automation across various sectors

**By Sh. P.K Gupta**

**Sh. Sumit Kumar Haldar**

ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)

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# Industrial Automation

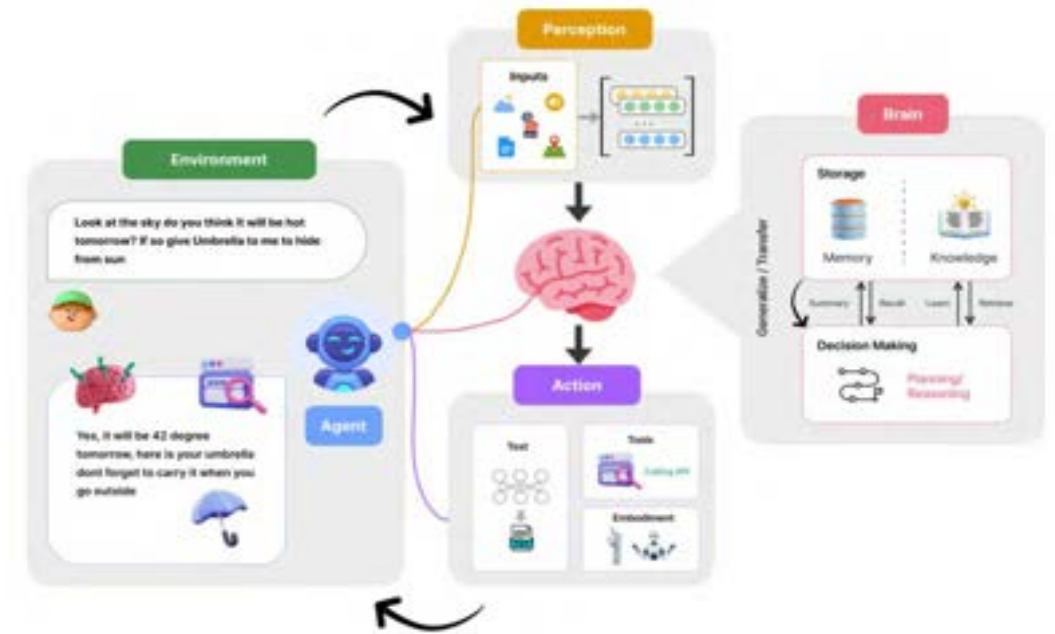
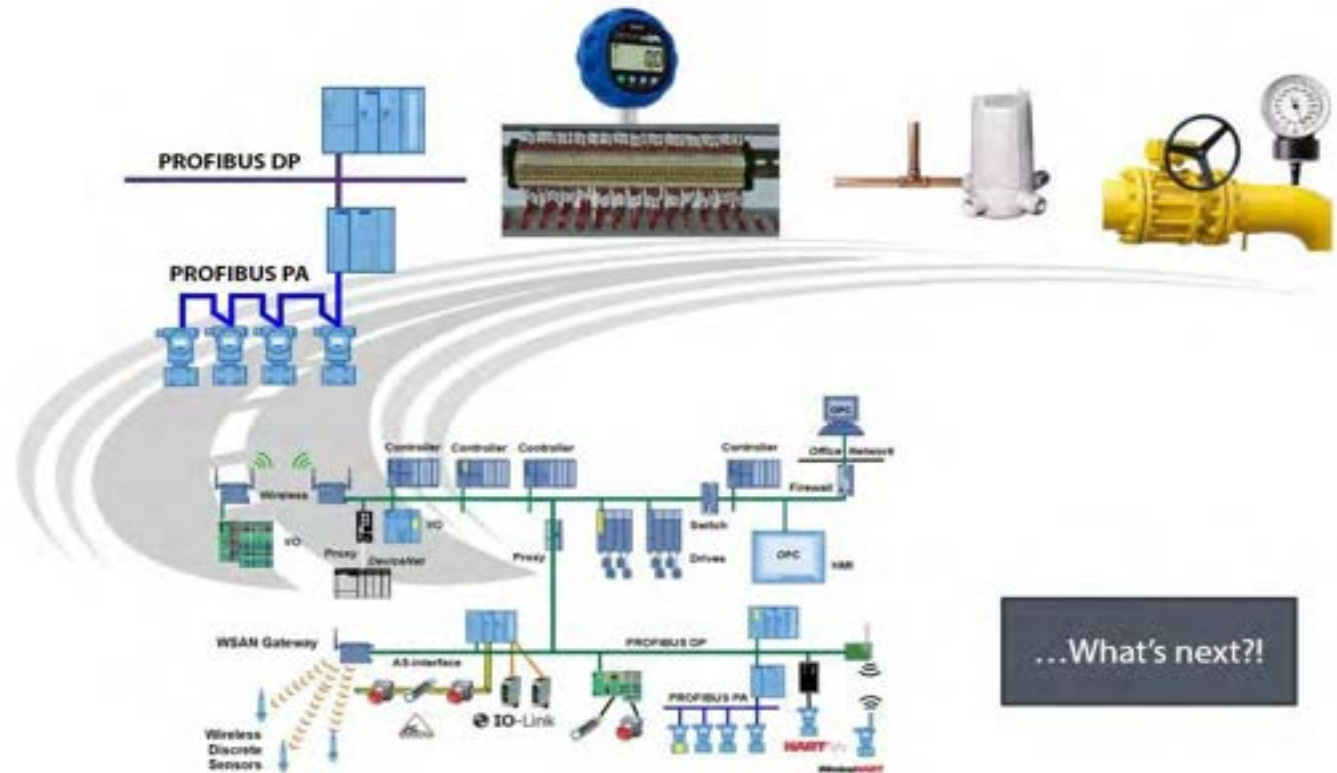
## Evolution Timeline

1950s-1960s: Early automation with relay-controlled systems

1970s-1980s: Introduction of PLCs and computer numerical control

1990s-2000s: Integration of software systems and networks

2010s-Present: Industry 4.0 and AI-driven automation





# Evolution of Automation: From Manual to Agentic AI

## Manual Era

Labor-intensive manufacturing with minimal tooling and high human involvement



## Industry 4.0

Connected systems and basic AI AI implementation with human oversight

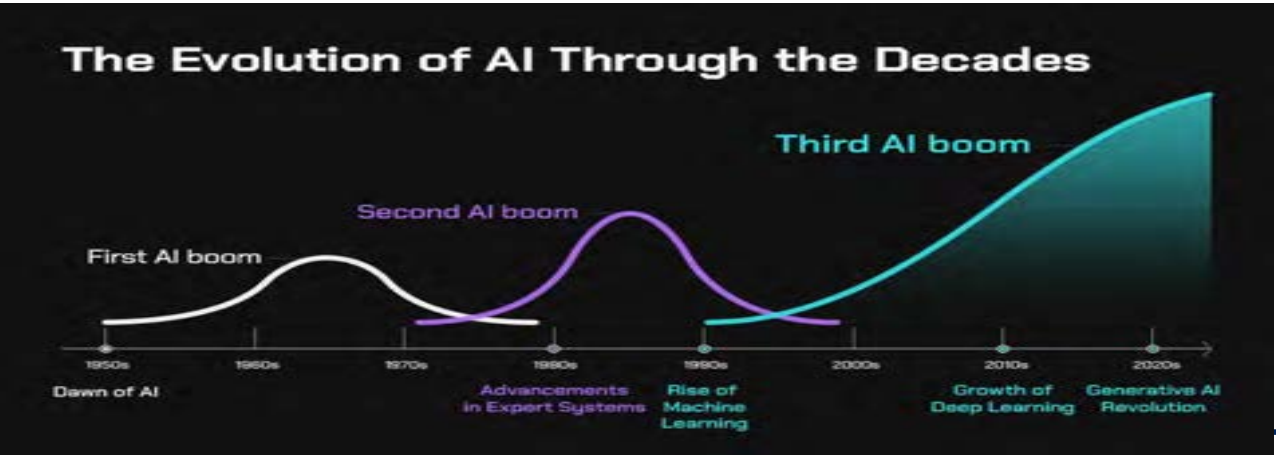
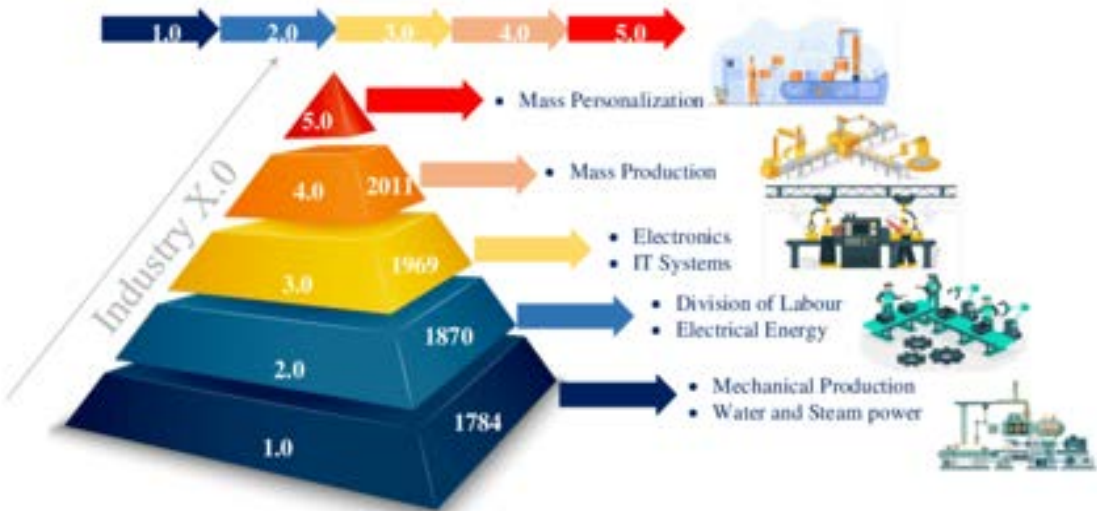


## Mechanical Automation

Assembly lines and mechanized mechanized processes with fixed fixed programming

## Agentic AI

Fully autonomous systems capable of self-learning and independent decision-making





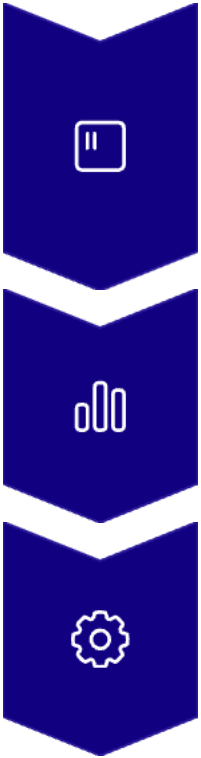
# AI-Driven Predictive Maintenance in Manufacturing



Increase of **Availability & Reliability**



Reduction of yearly **OPEX**



## Collect Data

IoT sensors monitor vibration, temperature, and performance metrics.

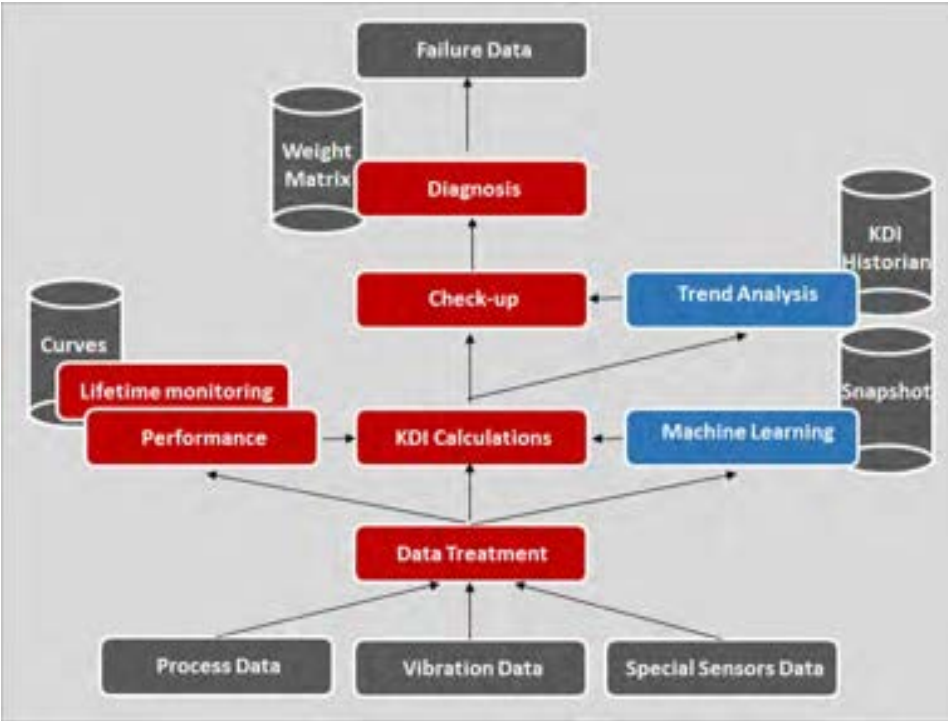
## Analyze Patterns

AI identifies abnormal patterns before visible issues appear.

## Schedule Maintenance

System automatically schedules optimal repair windows.

ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)





# Key Technologies Transforming Industrial Automation



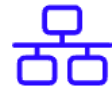
## AI/ML Integration

Machine learning algorithms optimize production flows and quality control.



## Edge Computing

Processing data at the source reduces latency for critical operations.



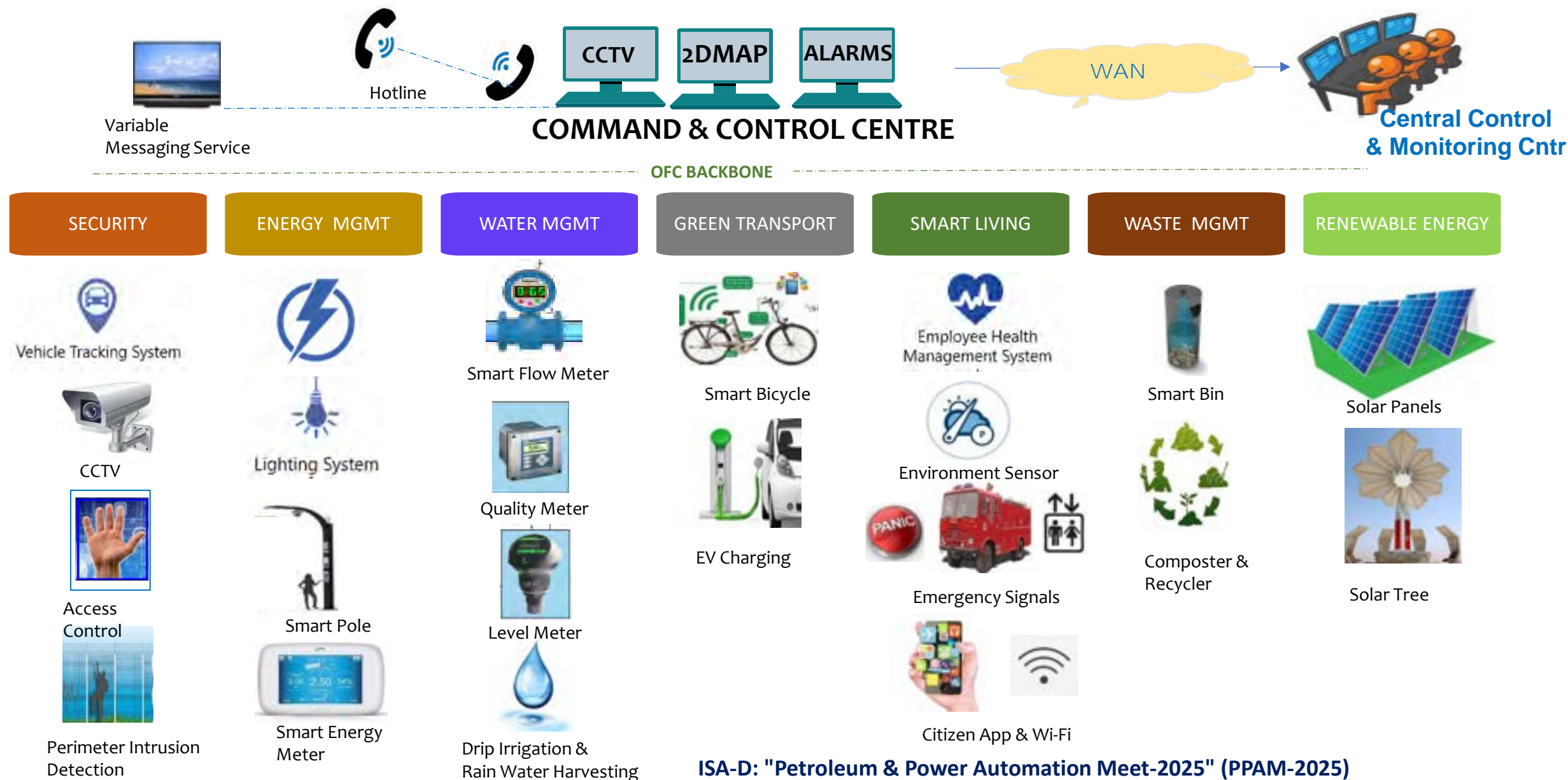
## 5G Connectivity

Ultra-fast wireless enables real-time coordination of factory systems.





# General System Architecture of an IIoT based System

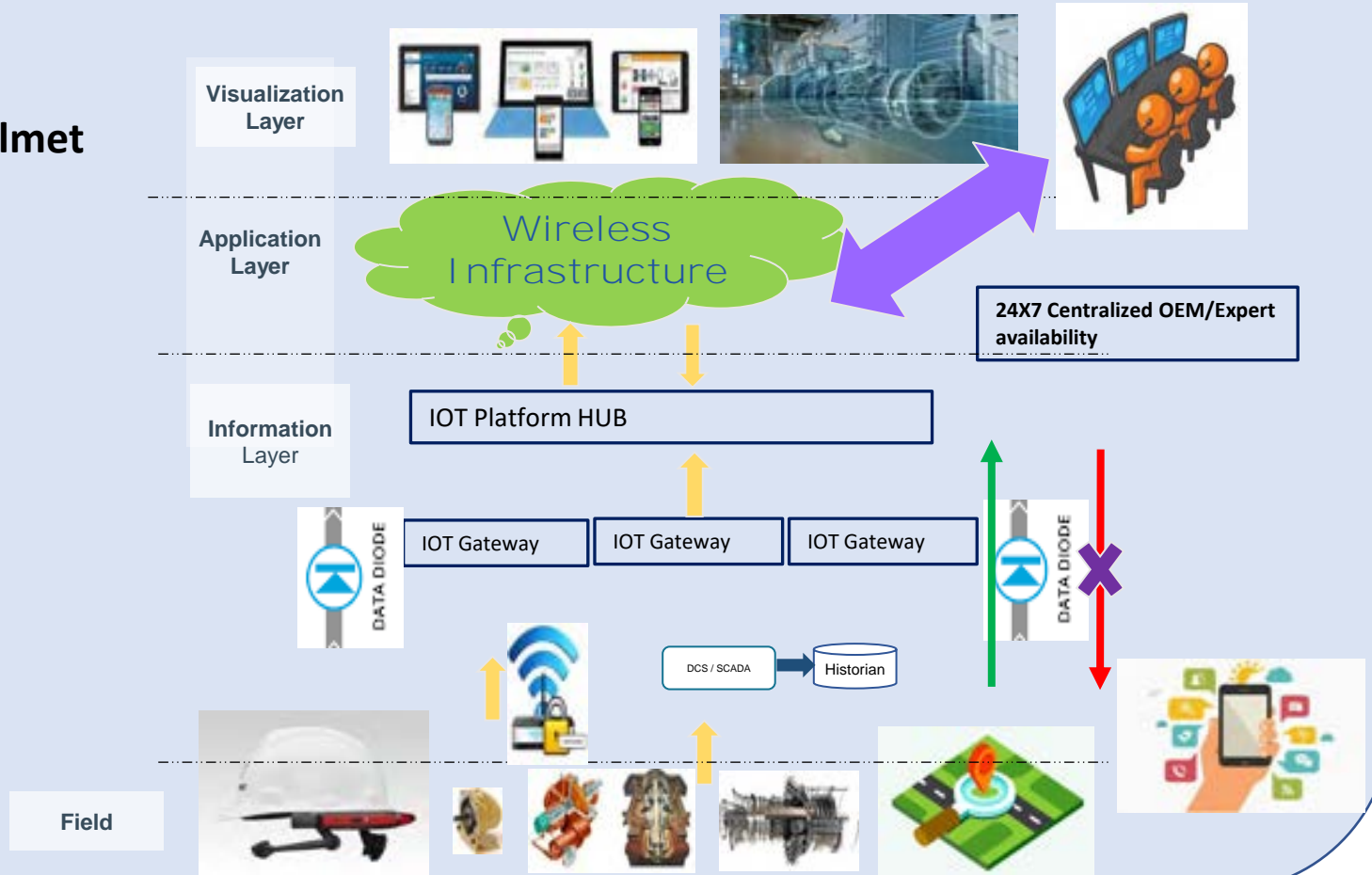




# IIoT with Edge / Cloud Computing for Asset Management

## Technology: IIoT, RCM, 3D Modelling, Smart Documentation

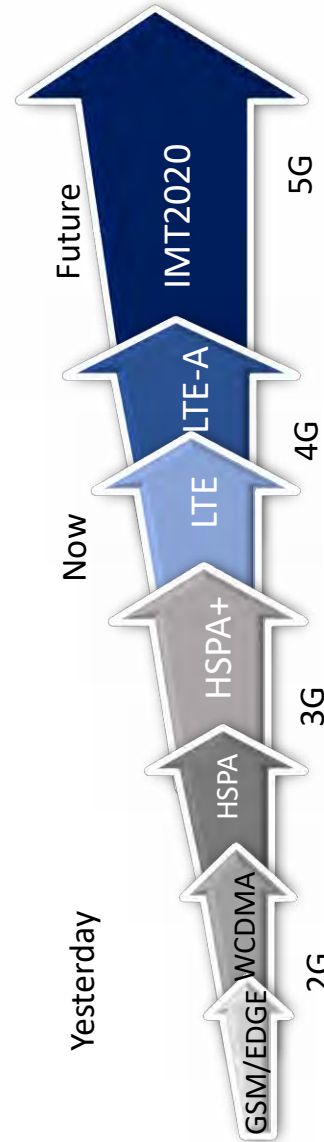
1. IIoT Solutions for: asset monitoring.
2. Digital Worker: Realwear based Digital Helmet /Connected Digital Worker-Skill Centre.
3. Mobility application – Mobile Apps
4. Real time location tracking system (RTLS).
5. Asset Information Management.
6. Asset Performance Management (RCM) Software.
7. Analytics & Dashboard Platform.





# WANs Beyond Wires for Digital Transformation

- Cloud services, IoT devices, and greater mobility are pushing businesses beyond the architectural constraints of wired networks. Each of these are driving demand for broader reach, increased diversity, and better operational flexibility to serve new used cases that drive competitive advantage.
- Together they are putting a strain on wired network capabilities and having a powerful impact on wide-area network (WAN) architectures. Wireless WANs, based on the capabilities of 4G LTE and more powerful 5G technology, are becoming an essential part of any organisation's digital transformation.



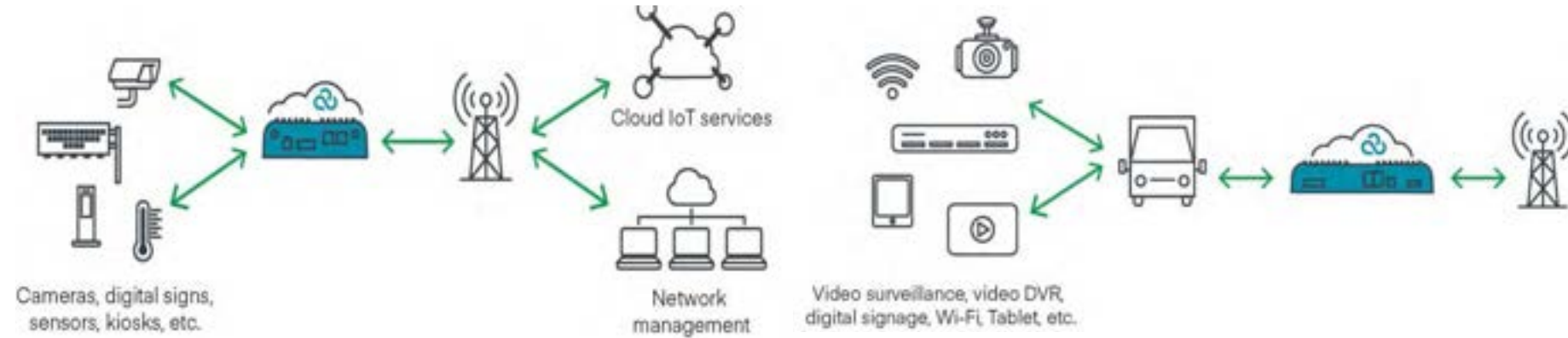
- SD WAN – 1<sup>st</sup> Step in WAN Transformation
- Wireless WANs – 2<sup>nd</sup> Step
- From 4G LTE to 5G
  - 5G services offer even greater performance and opportunity for new services.
  - More than just increased bandwidth, 5G technology delivers a wide range of new capabilities and use cases.
  - 5G is designed to deliver ultra-low latency, enabling new applications that require faster response times.
  - Enhanced antenna and transmission techniques massively increase the number of devices and conversations that each 5G station can handle, making wireless support for IoT networks and other high-density applications a reality.
  - With Gigabit-Class LTE widely available now, and 5G services rolling out from most major carriers, it is becoming much easier to pull a network out of the air, whenever and wherever the business needs it.



# WANs Beyond Wires for Digital Transformation

## Five Strategies for Wireless WANs:

Wireless WANs solve multiple problems for business networks, create new opportunities, and lay the foundation for further transformation and innovation.



**No. 1**

**Enhancing network failover**



**No. 2**

**Augmenting network bandwidth**



**No. 3**

**Making wireless the primary link**



**No. 4**

**Expanding IoT capabilities**

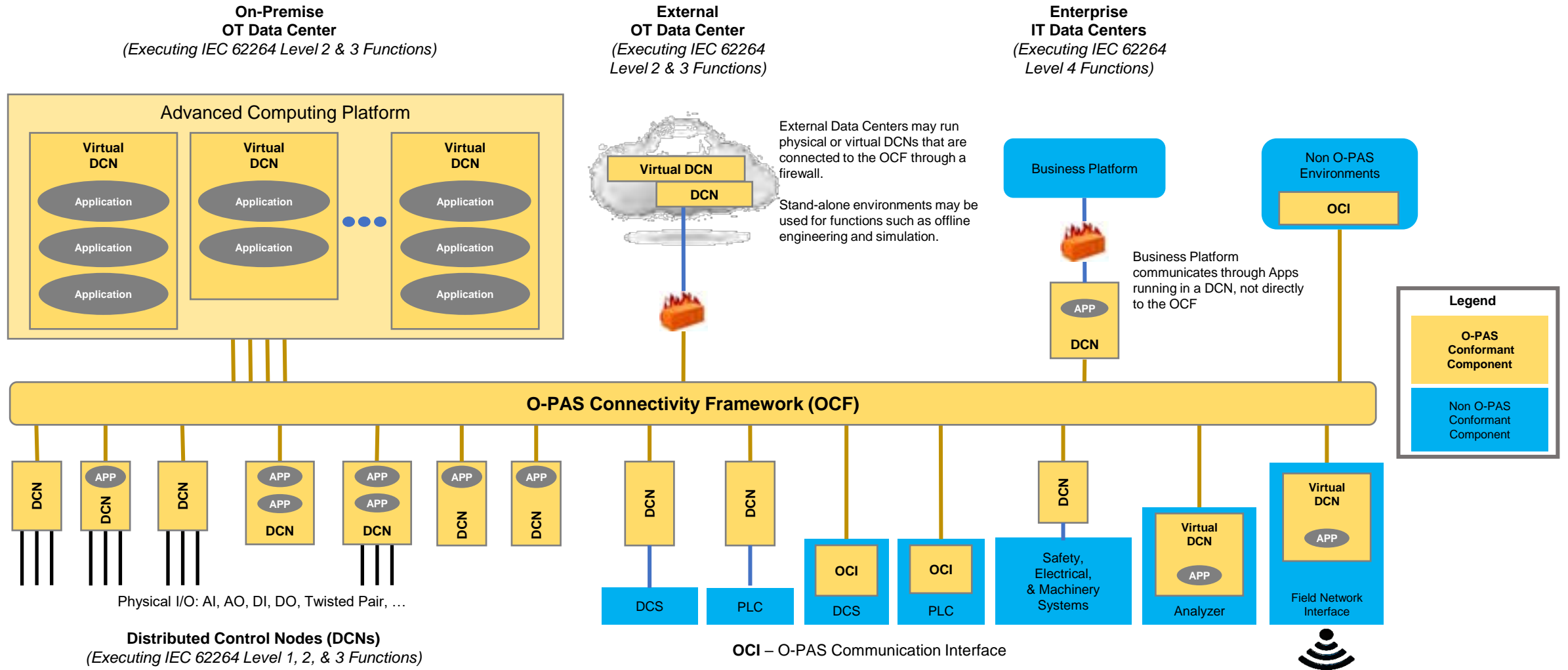


**No. 5**

**Boosting business mobility**



# Open Process Automation System





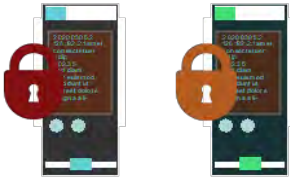
# Key Motivation Behind Adopting OPAS

Operations costs  
=  
Competitiveness



- Imperative to lower capital + lifecycle costs
- Pressure to increase profitability from operations

Systems are  
closed



- Costly to integrate new capabilities
- Data not readily accessible
- High operational costs for maintenance and upgrades

Security was  
an afterthought



- Security is often bolted on, not designed into architecture

OPAF – The Forum  
O-PAS™ – The Standard

Improved  
Operations



- Easy migration and upgrade path
- Certified software and hardware component interfaces

Open  
Systems



- Multi-vendor interoperability
- Future proof

Pervasive  
Security



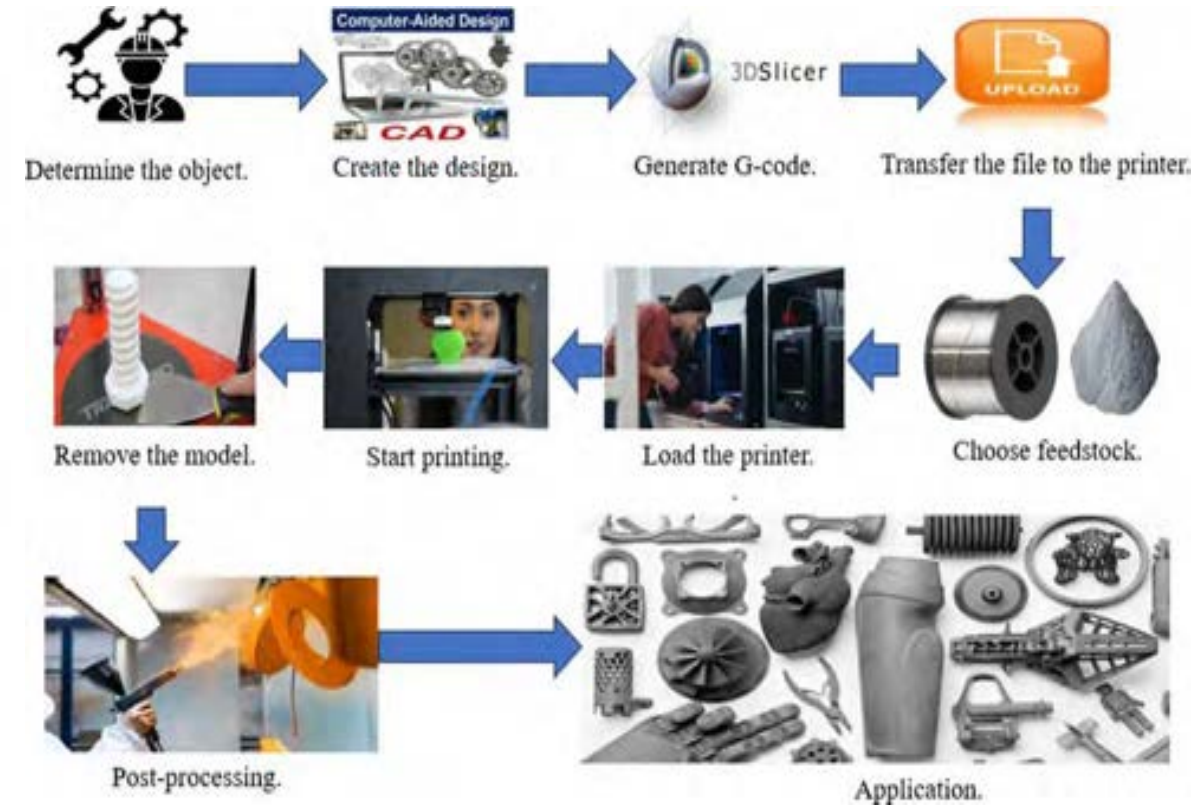
- Holistic security framework
- Designed and integrated from the beginning

OPAF Motivation to Change

O-PAS™ Benefits



# Additive Manufacturing (3D Printing)







# Smart Robotics



Fig. 10: KUKA KR 3 RS40 Industrial robot.

## Assembly

Robots perform precise welding and component placement.

## Process Improvement

Data analytics identify bottlenecks and optimization opportunities.



## Quality Control

AI vision systems inspect for defects with 99.9% accuracy.

## Human Collaboration

Cobots work alongside humans for complex complex tasks.







# Process Optimization in Food & Beverage



## Raw Materials

AI-powered sorting systems identify quality issues.



## Processing

Digital twins simulate recipe changes before implementation.



## Packaging

Automated systems adjust to different package types instantly.

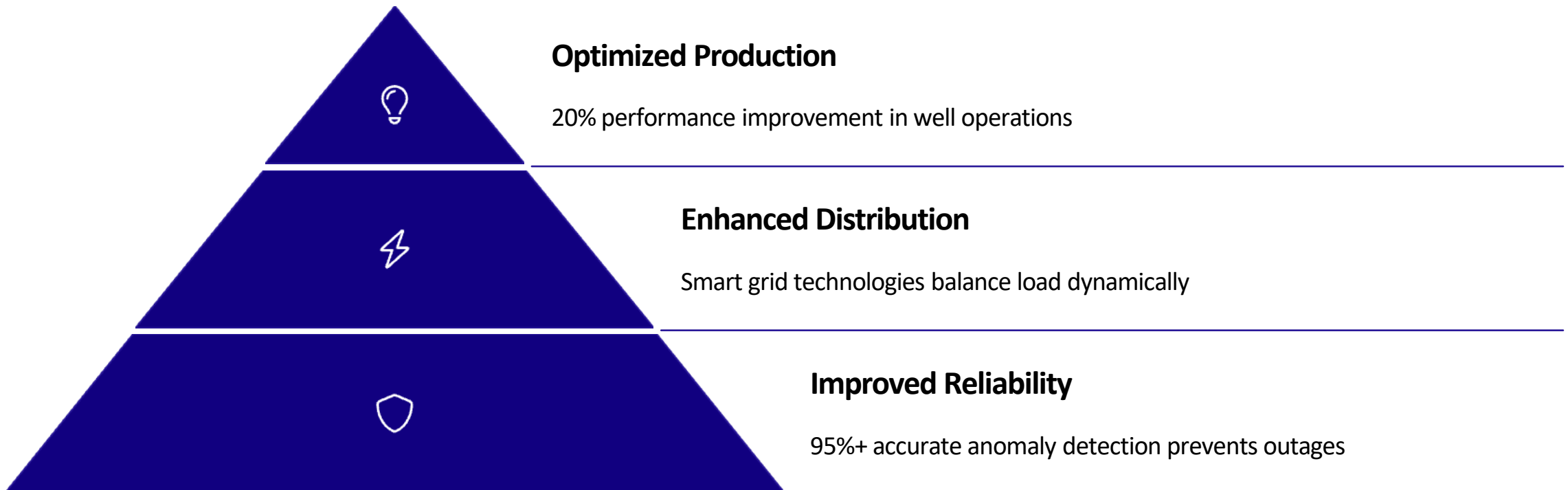


## Distribution

IoT-enabled tracking ensures optimal conditions throughout delivery.



# AI and IoT in Energy & Utilities





# Evolution of Generative AI

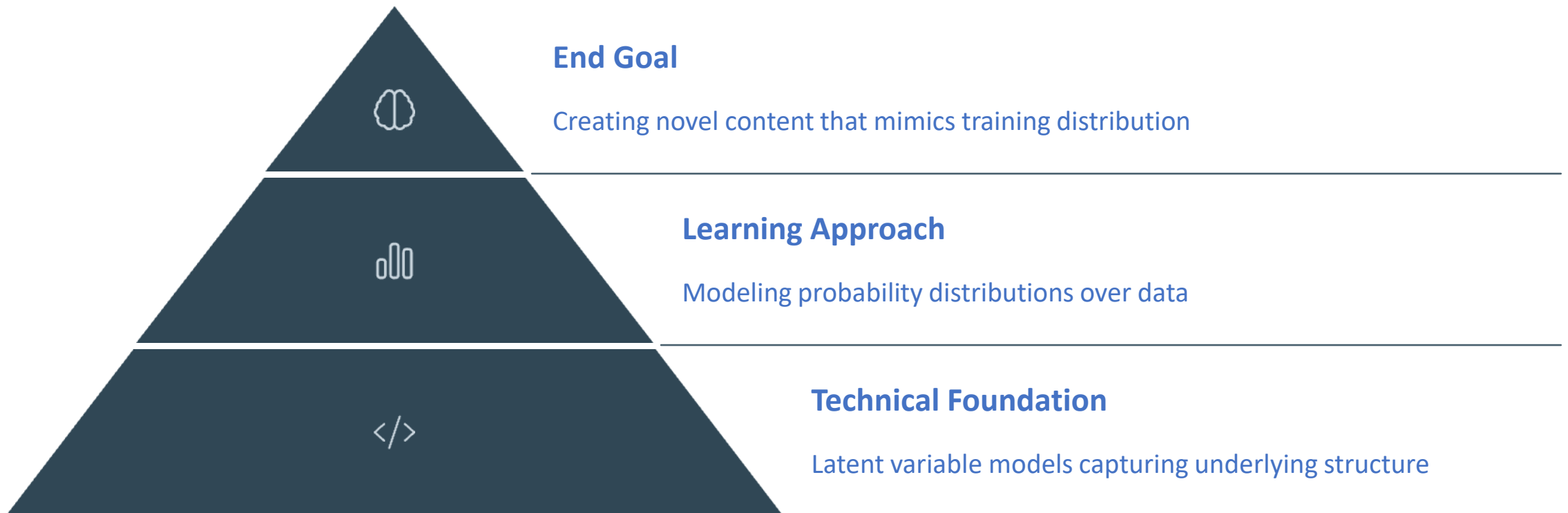
Generative AI represents a revolutionary shift in machine learning. Unlike discriminative models, these systems create novel content rather than classifying existing data.

This technology is transforming industries from healthcare to creative arts through its ability to generate realistic text, images, code, and more.



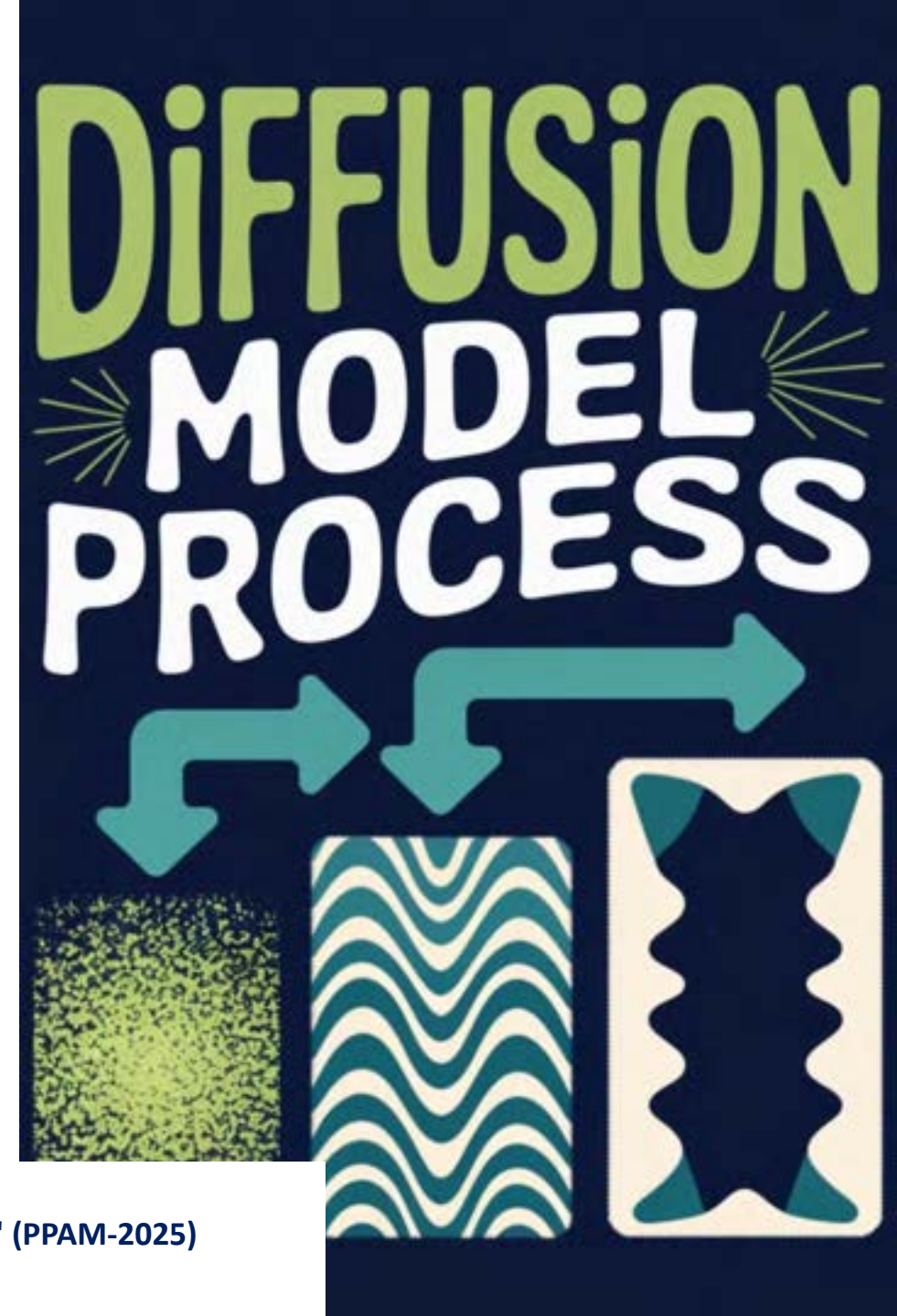
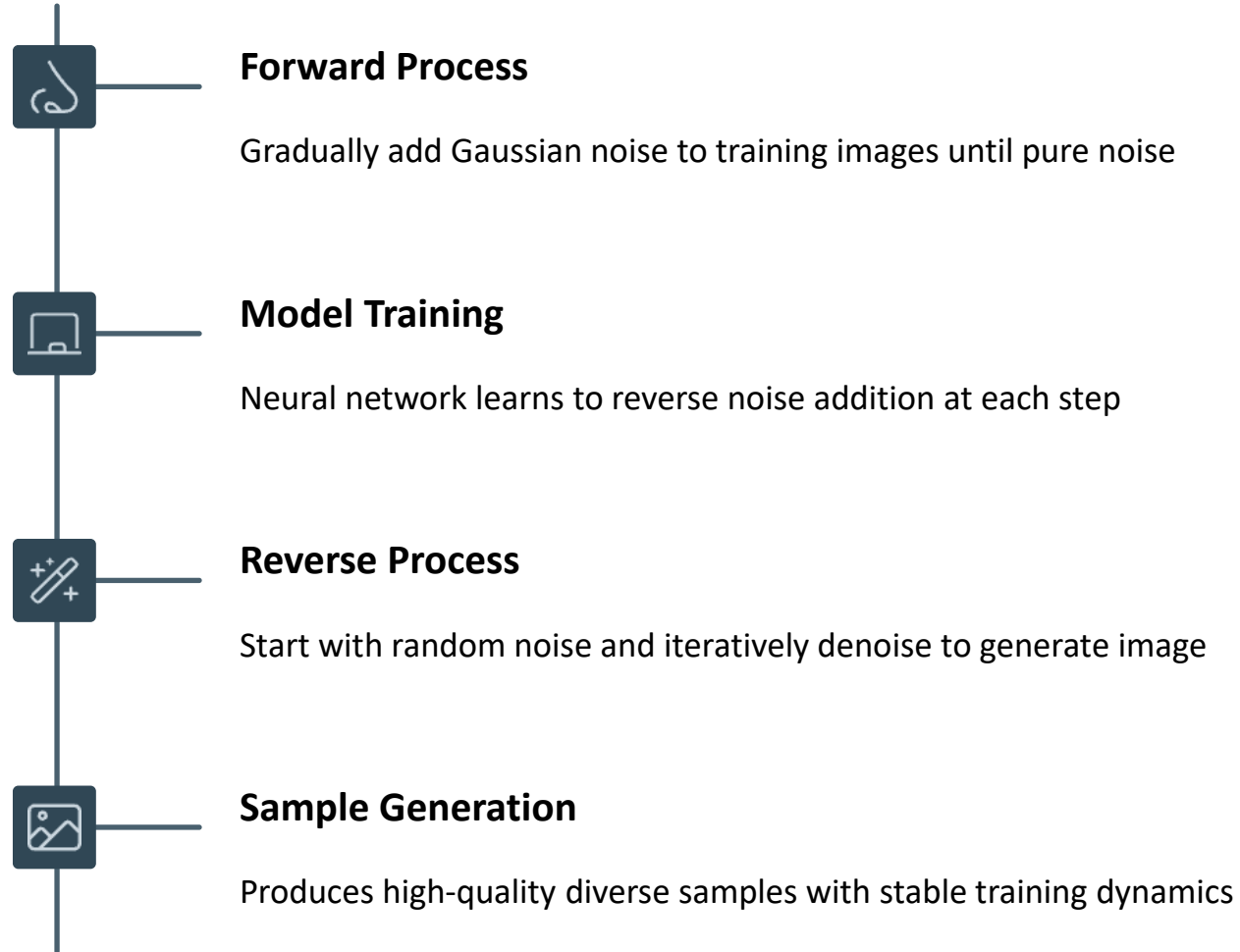


# Core Concepts in Generative AI

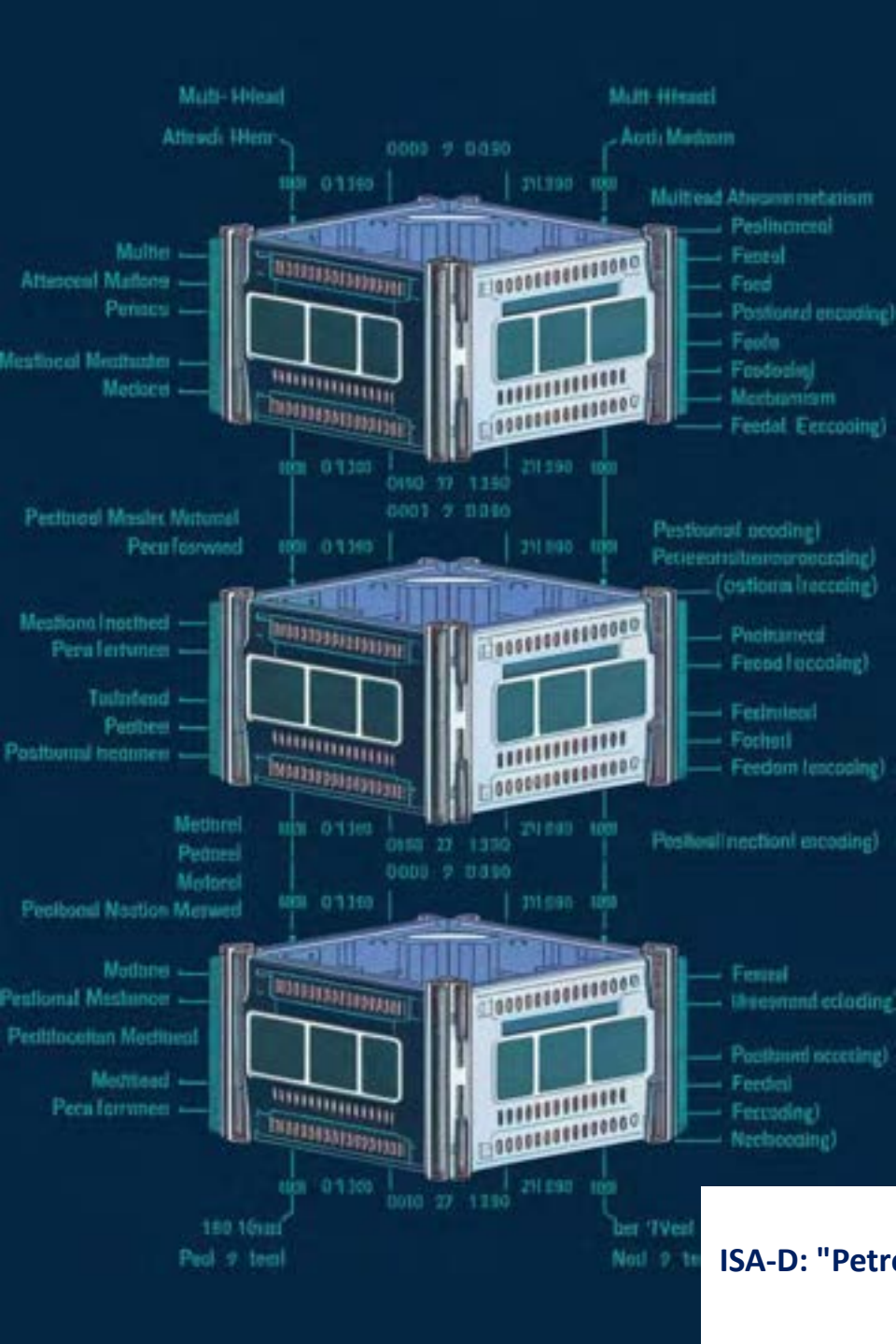




# Diffusion Models







# Transformer-Based Language Language Models



## Self-Attention

Computes relationships between all tokens in sequence. Enables parallel processing. Captures long-range dependencies.



## Transformer Blocks

Combines attention with feed-forward networks. Employs residual connections. Uses layer normalization.



## Scaling Laws

Performance improves predictably with size. More parameters yield better results. Requires massive training data.



# Multimodal Generative AI



## Vision-Language Models

CLIP creates joint embedding space for images and text. It enables zero-shot learning across modalities.



## Text-to-Image Systems

DALL-E and Stable Diffusion convert text to images. They use diffusion models with text conditioning.



## Unified Architectures

Flamingo and Gemini process multiple modalities simultaneously. They share parameters across different data types.



# Training Generative Models



## Data Preparation

Massive datasets with careful cleaning and preprocessing



## Infrastructure Setup

Distributed training across thousands of GPUs/TPUs



## Training Techniques

Curriculum learning and self-supervised objectives



## Evaluation & Refinement

Continuous benchmarking and hyperparameter tuning





# Inference and Decoding Strategies

Method	Quality	Diversity	Speed
Greedy Decoding	Medium	Low	Fast
Beam Search	High	Low	Medium
Top-K Sampling	Medium	Medium	Medium
Nucleus Sampling	High	High	Slow



# Fine-tuning and Adaptation

## Parameter-Efficient Fine-Tuning

LoRA adds small trainable matrices to frozen weights. Adapters insert compact modules between layers. QLoRA uses quantization to reduce memory needs.

## Reinforcement Learning with Human Feedback

Models are trained on human preferences. A reward model ranks outputs. Policy optimization maximizes human-preferred generations.

## Instruction-Tuning

Models learn task-specific formats through examples. They follow instructions in natural language. This enables flexible zero-shot capabilities.



# Generative and Agentic AI?

## Traditional AI

Reactive responses to specific inputs



Fixed functionality within narrow domains



Limited context awareness



## Agentic AI

Autonomously pursues objectives

Plans and executes multi-step tasks

Reflects on performance and adapts

## Generative AI

Creates content and solutions from existing data



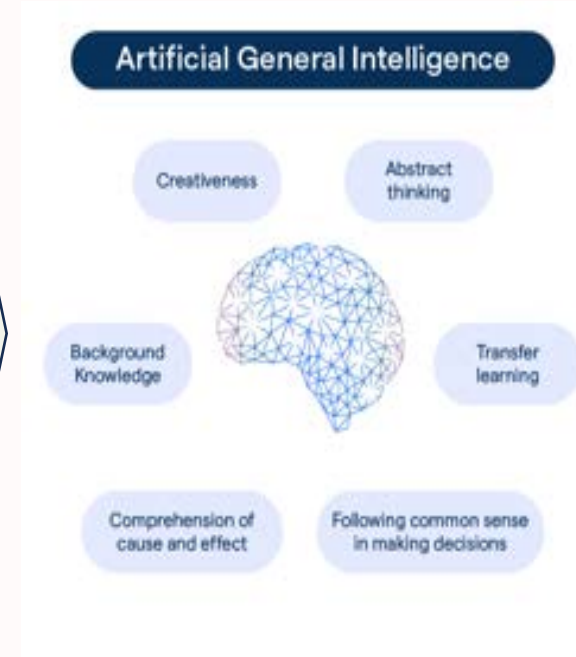
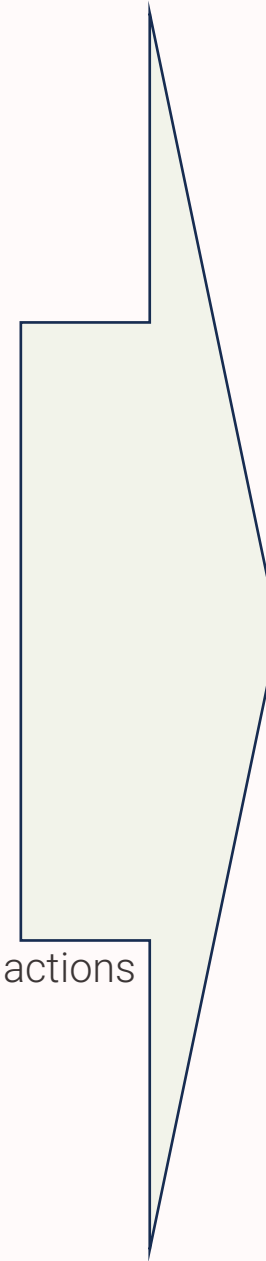
## Agentic AI

Makes decisions and takes autonomous actions

- Text generation
- Design creation
- Code production



- Closes the feedback loop
- Executes in real-world scenarios
- Adapts to changing conditions





# Agentic AI Workflow

## Understanding agentic AI workflow



## Underlying technology components





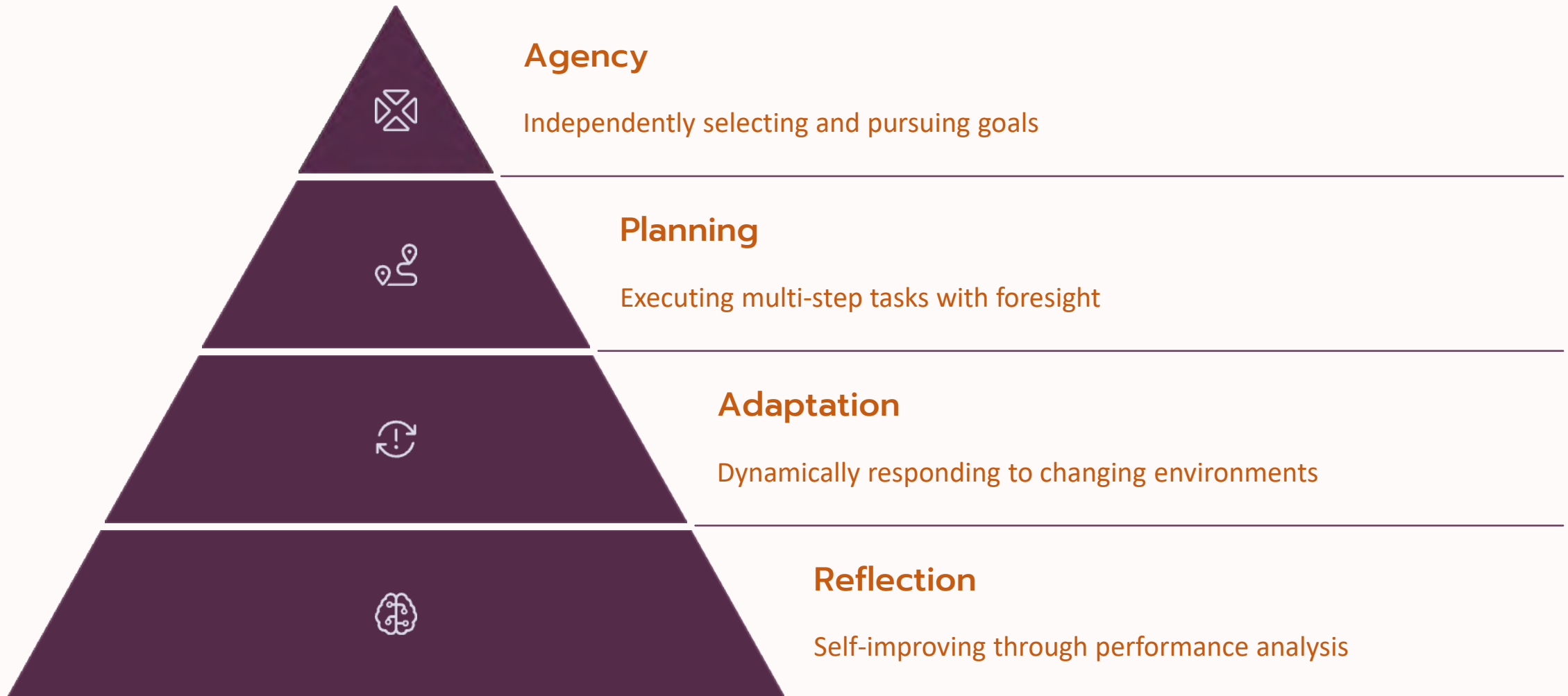


# Historical Context & Evolution





# Core Principles of Agentic AI







# Agent Architectures: Technical Components

## Perception

Environment sensors and state modeling components that interpret input data

- Sensory processing modules
- Environment representation

## Reasoning

Cognitive modules for logic, inference, and decision-making

- Inference engines
- Uncertainty handling

## Action

Execution frameworks that interact with target systems

- API controllers
- Output generators

## Memory

Persistent storage for experiences and knowledge

- Working memory
- Long-term storage



# Systems Integration: Tool Use & APIs

## Tool Discovery

Agents identify relevant tools from available options based on task needs

## API Integration

Programmatic interfaces allow agents to access external data and services

## Orchestration

Agents coordinate multiple tools in sequence to achieve complex goals

## Feedback Loop

Results from tool use inform subsequent actions and decisions







# Planning Algorithms

Algorithm	Strengths	Limitations	Efficiency
Hierarchical Task Networks Networks (HTN)	Excellent for decomposing complex goals	Requires domain knowledge	High
Monte Carlo Tree Search	Handles uncertainty well	Computationally intensive	Medium
LLM-driven planning	Flexible across domains	Potential for hallucination	Variable



# Reflection and Self-Improvement



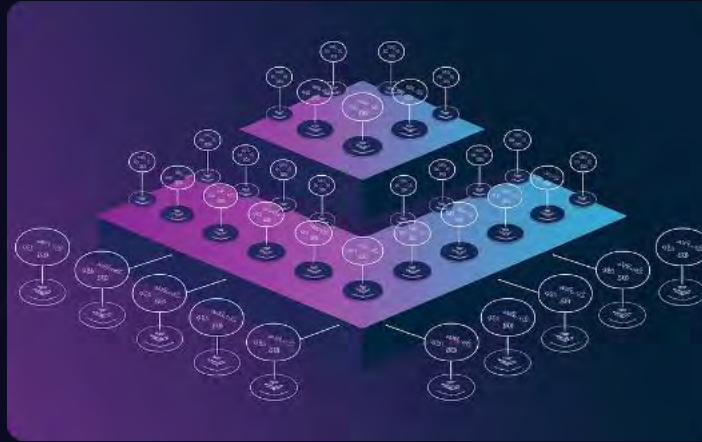


# Multi-Agent Systems and Collaboration



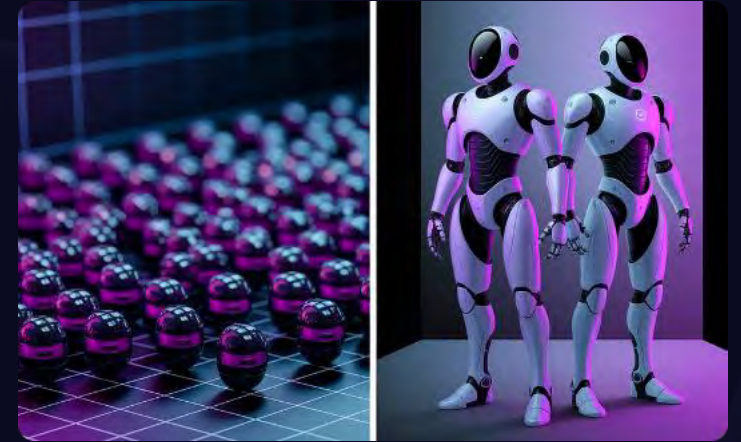
## Communication Protocols

Standardized message formats enable agent interactions. Coordination requires shared ontologies.



## Goal Decomposition

Complex problems split into manageable subtasks. Specialized agents tackle different aspects simultaneously.



## Collaboration Models

Swarm intelligence uses many similar agents. Specialized teams assign different roles to each agent.



# Advanced Memory and Context Handling



## Episodic Memory

Stores specific experiences and interactions from the agent's history



## Semantic Memory

Maintains general knowledge and facts independent of specific experiences



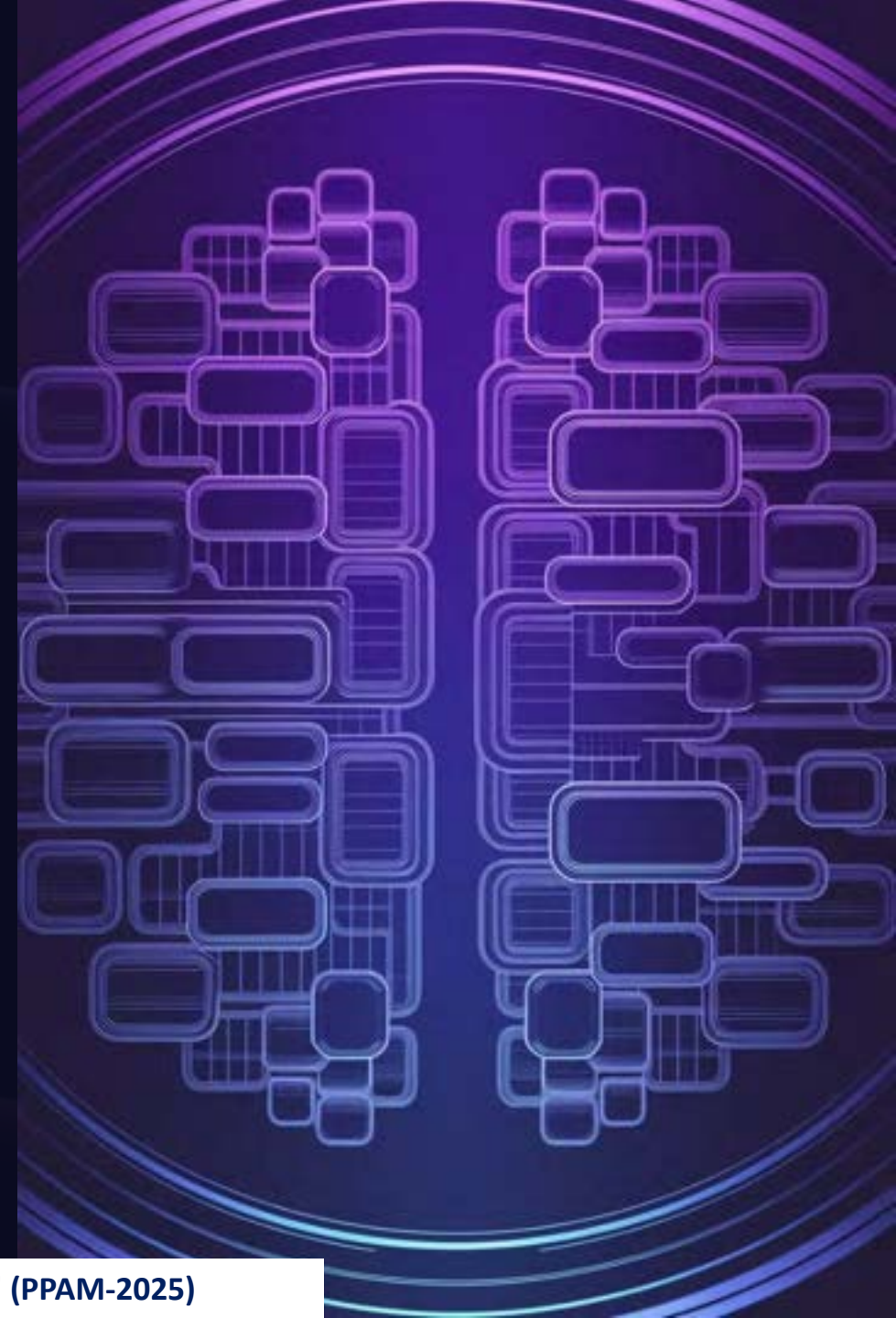
## Vector Storage

Encodes information as embeddings for similarity-based retrieval



## Retrieval-Augmented Generation

Enhances reasoning by accessing relevant stored information





# Safety, Control, and Alignment



## Sandbox Execution

Isolate agent actions in controlled environments

---



## Goal Alignment

Ensure objectives remain aligned with human intent

---



## Monitoring Systems

Detect problematic behaviors or goal drift

---



## Red Teaming

Proactively probe for vulnerabilities





# Real-World Applications



## Research Assistants

Automated literature review and hypothesis testing systems like Devin



## Data Pipeline Orchestration

AutoML agents that configure and optimize complete machine learning workflows



## Autonomous Trading

Fintech agents that analyze markets and execute trading strategies



## Software Development

Coding agents that design, implement, and test software systems



# Sector 1: Manufacturing



## Predictive Maintenance

Siemens and GE Predix platforms predict failures before they happen.



## Defect Detection

BMW uses generative visual models to spot flaws in vehicles.



## Adaptive Assembly

Fanuc AI robots autonomously adjust to production changes.



## Business Impact

15% reduction in downtime and 20% higher yield (McKinsey, 2024).





# Sector 2: Energy & Utilities



## Grid Optimization

Google DeepMind agents reduce energy usage by 15%.



## Facility Design

Shell uses Autodesk AI for energy-efficient facilities.



## Renewable Analytics

Wind farms use generative time series models for predictions.

ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)







## Sector 3: Automotive & Mobility

### Autonomous Vehicles

Waymo and Tesla deploy agentic AI for self-driving fleets. Systems make real-time decisions based on environmental inputs.

### Design Optimization

Toyota implements generative CAD workflows. Engineers specify parameters while AI creates optimal designs.

### Supply Chain Intelligence

Volkswagen Industrial Cloud uses AI agents for logistics. Companies report up to 10% cost savings (Bain, 2024).



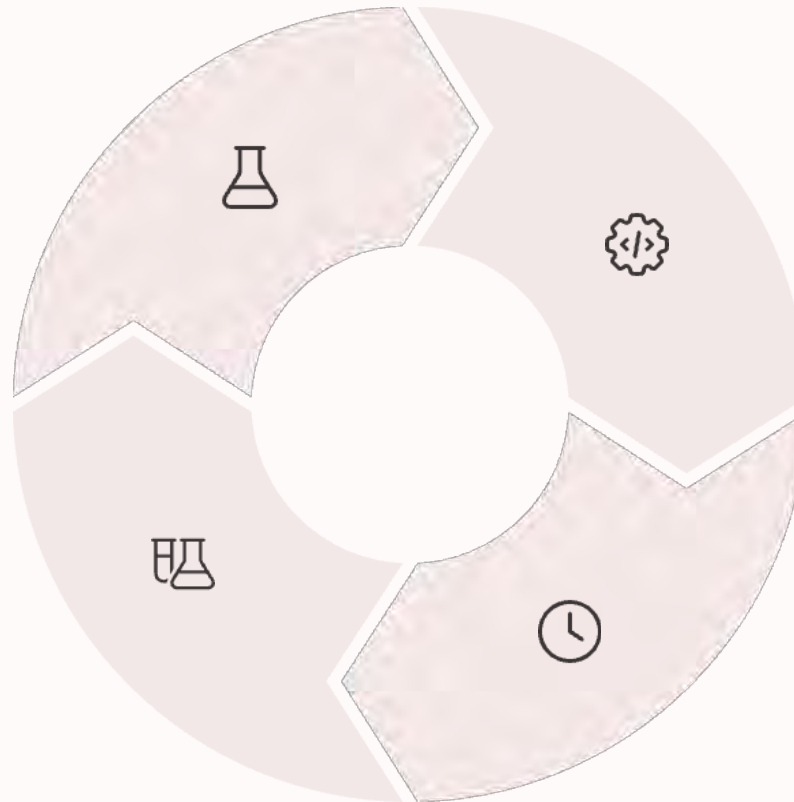
# Sector 4: Pharmaceuticals & Chemicals

## Molecule Discovery

Insilico and Atomwise use generative models for drug discovery.

## Testing Automation

AI accelerates trial phases through simulation and optimization.



## Process Controls

Pfizer and BASF deploy agentic systems in batch manufacturing.

## Time Efficiency

Industry sees 30% reduction in time-to-market (Deloitte 2023).



# Future Outlook & Key Takeaways

\$500B

Economic Impact

Projected value by 2030 (BCG)

60%

Industry Adoption

Industrial firms piloting AI agents  
(Capgemini 2024)

2x

Productivity Gain

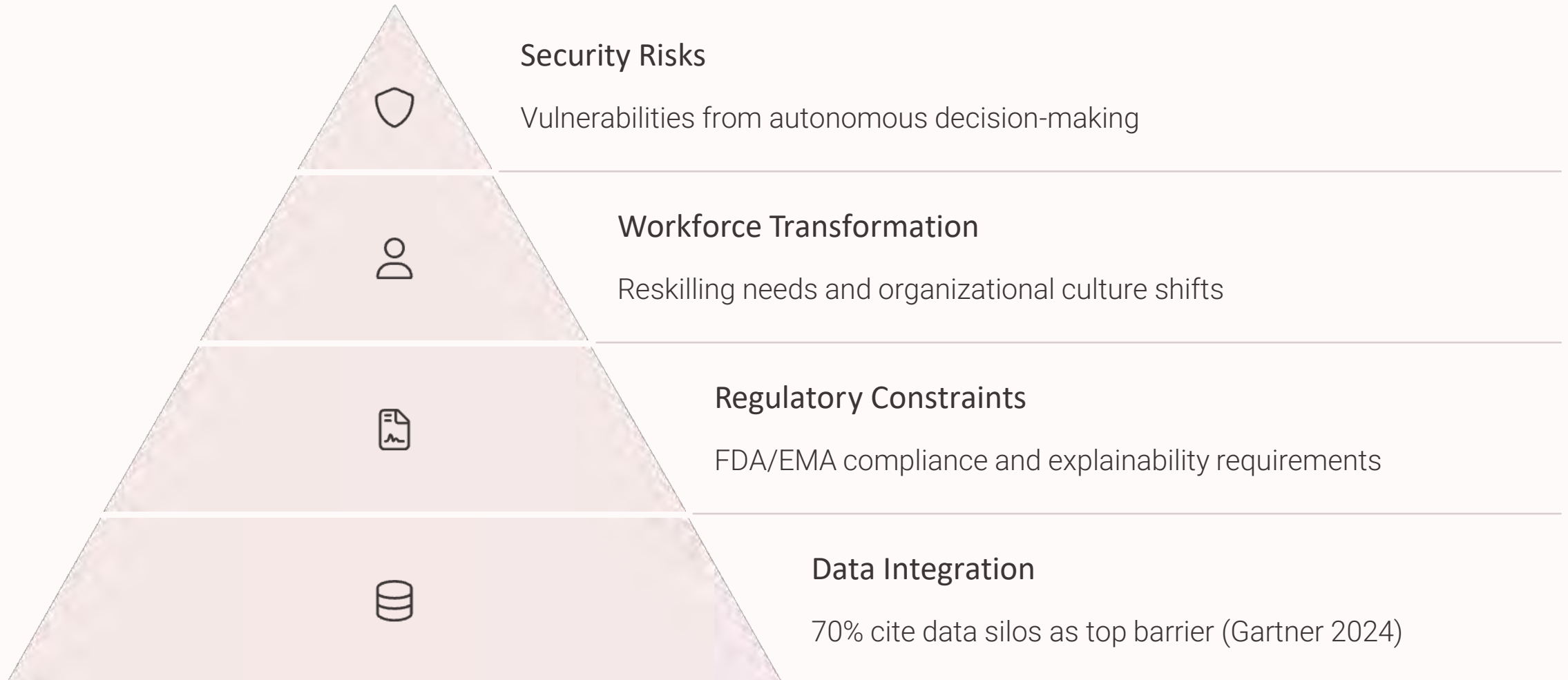
Potential efficiency improvement in  
targeted processes

Strategic investment and workforce enablement are critical success factors. Early adopters will gain significant competitive advantages.





# Implementation Challenges of Agentic AI





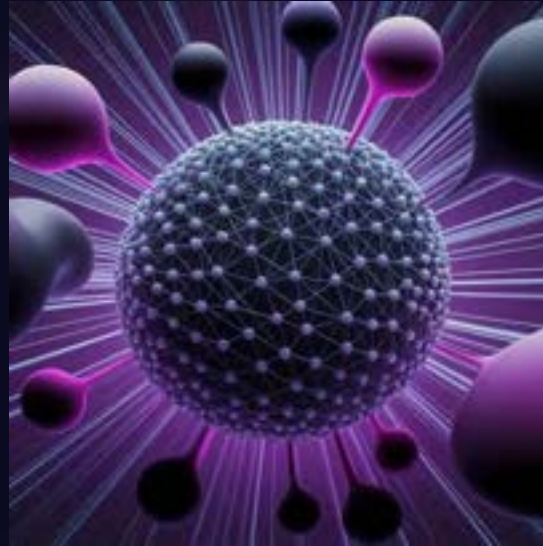
# Technical Challenges and Open Problems



$10^6x$

Scale Gap

Required improvement in planning horizon  
length



60%

Emergent Behaviors

Actions that weren't explicitly programmed  
programmed



42%

Benchmarks

New evaluation frameworks needed



# The Future of Agentic AI (IA2IA)



## Scale

Larger memory, longer planning horizons, more complex goals



## Human Oversight

Improved feedback mechanisms and human-in-the-loop systems



## Hybrid Systems

Combining symbolic reasoning with neural capabilities



## Agent Societies

Complex organizations of specialized autonomous systems







## Challenges and Future Opportunities with Cutting Edge Technologies

### Cybersecurity Concerns

Connected systems increase attack surface. Advanced security protocols are essential.

### Interoperability Issues

Legacy equipment often struggles to integrate. Standards development is crucial.

### Workforce Transformation

Training for high-skilled jobs must accelerate. Digital literacy is non-negotiable.

### Ethical AI Development

Responsible automation requires governance. Transparency builds trust.



# Secure by Design – Adaptive Cybersecurity Frameworks for Resilient Infrastructure



01

## Dynamic Threat Response

Adaptive cybersecurity frameworks leverage AI and machine learning for dynamic threat response and real-time security incident management.

02

## Resilient Infrastructure

Cyber-physical security measures ensure the resilience of critical infrastructure against evolving cyber threats and vulnerabilities.

03

## Opportunities

Adaptive cybersecurity frameworks present opportunities for proactive threat mitigation, secure digital transformation, and resilient operational cybersecurity for power plants, driving innovation in cybersecurity practices.



# Repurposing of Thermal Power Plant

## Coal Power Plant

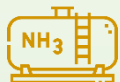
### Possible Options



**100% Torrefied Biomass Firing**



**Methanol Co-firing**



**Ammonia Co-firing**



**Nuclear (SMR)/Thermal Storage Integration**



**Grid Services (Synchronous Condenser)**

### Actions Taken

- 20% co-firing demonstrated at Tanda
- 50% co-firing planned at Unchahar
- MoU with GEIPL

- MoU with GEIPL for 30% Cofiring
- FR approved

- MoU with GEIPL - cofiring
- FR by JICA-Cofiring

- Feasibility study completed for SMR and TESS Integration

- Feasibility study for conversion to SynCon completed

## Gas Power Plant

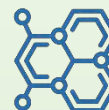
### Possible Options



**Methanol Co-firing**



**Hydrogen Co-firing**



**Ammonia, Syngas Firing**



**Grid Services (Synchronous Condenser)**

### Actions Taken

- Feasibility study completed
- Demonstration planned at Kayamkulam (civil works completed)

- Feasibility study completed for 5-10% co-firing with various OEM

- Possibility being explored

- Possibility being explored for provision of clutch



# New Horizons in Automation for NTPC



**The Fifth Industrial Revolution** will emerge when its three major elements — Intelligent devices, Intelligent systems, and Intelligent automation fully merge with the physical world in co-operation with human intelligence.

- Cyber Security
- Collaborative Robotics
- Autonomously Controlled Processes
- Autonomous 3D printing

## Human Machine Interaction Technologies



- Advanced Asset Management
- Structural Health Monitoring
- Advanced Fieldbus
- Advanced Physical Layer

## Asset Management



- AI Strategy for sustainability
- Deep Learning Applications
- Big Data Analytics
- Cloud Native Technologies
- Quantum Computing

## AI & ML & Related Technologies



- Operator + VR
- Operator + wearables
- Operator + Intelligent assistant
- Operator + Big Data Analytics
- Generative AI based autonomous RL agents

## Operator 4.0+



- Digital Twin
- AR / VR / XR
- IoB
- RPA / Discovery bots
- Robotics & Drone Tech.

## Hyper Automation



- Nano / Bio / FO Sensors
- Advanced Control Strategies
- Advanced Nox – Sox monitoring & Control

## Advanced Sensors & Controls





# Conclusion: Towards a Fully Automated Future

## Implement Pilot Projects

Start with high-impact, low-risk areas. Measure ROI carefully.

## Scale Successful Solutions

Expand proven technologies across operations. Leverage early wins.

## Develop AI Strategy

Align automation with business goals. Focus on competitive differentiation.  
differentiation.

## Foster Continuous Innovation

Build culture of technological advancement. Stay ahead of industry  
industry trends.







THANK YOU





*Setting the Standard for Automation™*

## Advanced Automation in Greenfield Energy Projects by Rittal



# AJIT MESTRI



## Rittal

2002 – Present

### IT Infrastructure Solutions

- Sales (2002-2010)
- Application Engineering (Data center Solution Architect) (2011-2015)
- **Marketing Technical Support - International** (2016 –Current)



## Greaves Cotton & Co Ltd

1993- 2002

Production / Sales / Technical Support

India's leading and well-diversified engineering company manufactures of a wide range of industrial products like Diesel / Petrol Engines, Gensets , Pumpsets, Fluid wheels, Process industry products, etc.

Mumbai, India



Phone: **+91 8971662238**

WA : **+91 9324804605**

Email: **ajit@rittal-india.com**

Web : **www.rittal.com**



## A Strong Family

The Friedhelm Loh Group – a successful business



**11,600**

employees worldwide

**2,000**

patents



**58**

international subsidiaries

**>3 bn.**

euros turnover



# Advanced Automation in Greenfield Energy Projects

## Industry 4.0 and Challenges



- Growing populations and expanding energy needs
- Disaster recovery and redundancy
- High-density data demand
- Dealing with Digital Twins Technology



**Instead of Big Data,  
let's call it *Smart Data***



# Advanced Automation in Greenfield Energy Projects

## Infrastructure Modular Concept



Power Distribution

Security Solutions



Enclosures



Cooling



Remote Monitoring



# Advanced Automation in Greenfield Energy Projects

## Enclosures for Digital Equipment Housing



### TS8 Enclosures

*16x folded rolled hollow frame section punched in 25mm DIN pitch pattern*

*Load Capacity : upto 1400Kgs*



### VX25 Enclosures

The VX IT frame is more torsionally rigid compared to the TS IT frame. The load capacity for static and dynamic applications is more.

*Load Capacities : upto 1800Kgs*



### Compartmental Enclosures

Available in TS8 and VX25 versions.



### Wallmounts



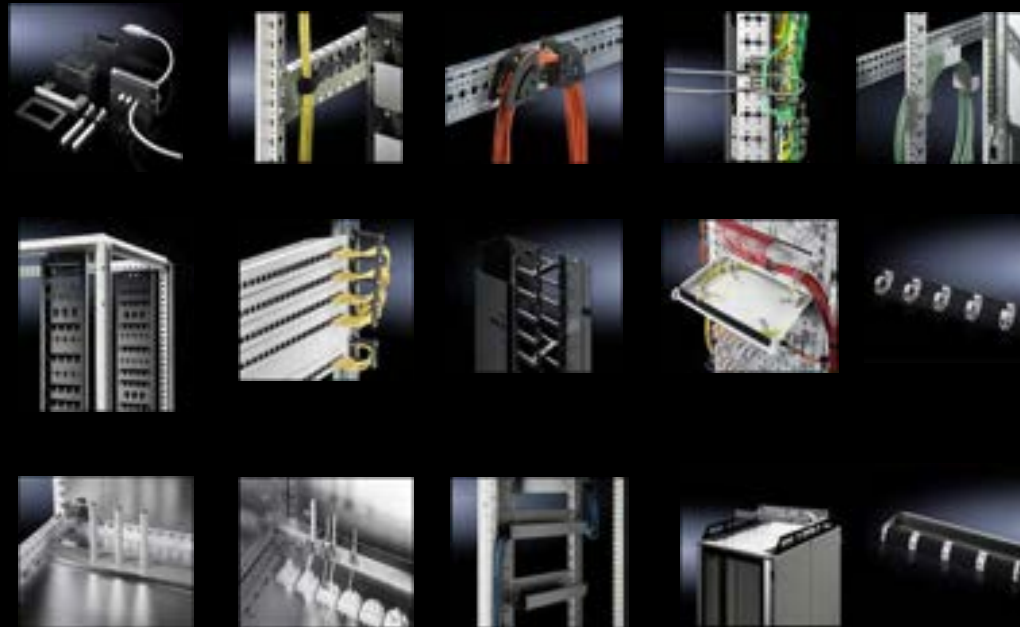


# Advanced Automation in Greenfield Energy Projects

## Cable Management for Digital Equipment Housing



Source: YT



Cable Management Accessories





# Advanced Automation in Greenfield Energy Projects

## Outdoor Cabinets for Digital Equipment Housing



Network connectivity



Signaling systems



Traffic surveillance

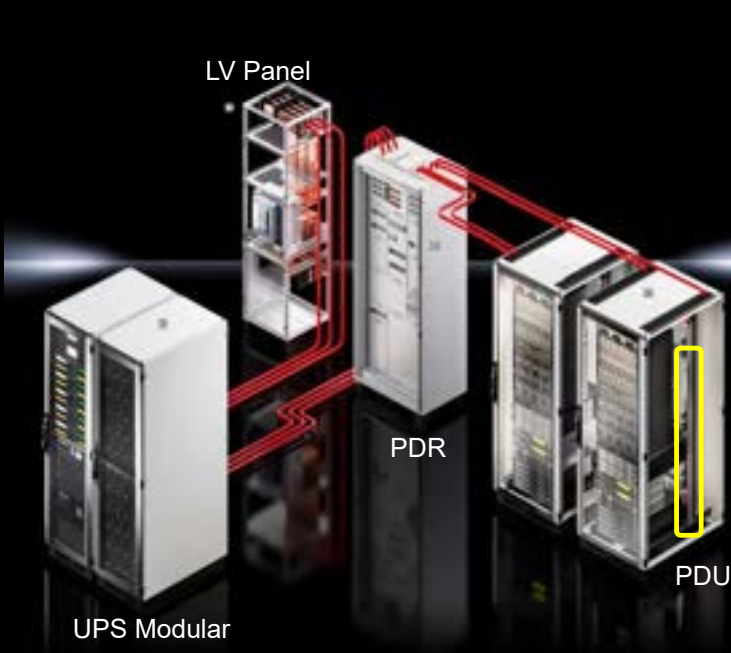


CCTV surveillance



# Advanced Automation in Greenfield Energy Projects

## Power Infrastructure for Digital Equipments



Metered	Measurement per phase
Metered Plus	Measurement per output slot
Switched	Measurement per phase, switching output slot
Managed	Measurement & switching per output slot



# Advanced Automation in Greenfield Energy Projects

## Power Infrastructure for Digital Equipments



Metered	Measurement per phase
Metered Plus	Measurement per output slot
Switched	Measurement per phase, switching output slot
Managed	Measurement & switching per output slot

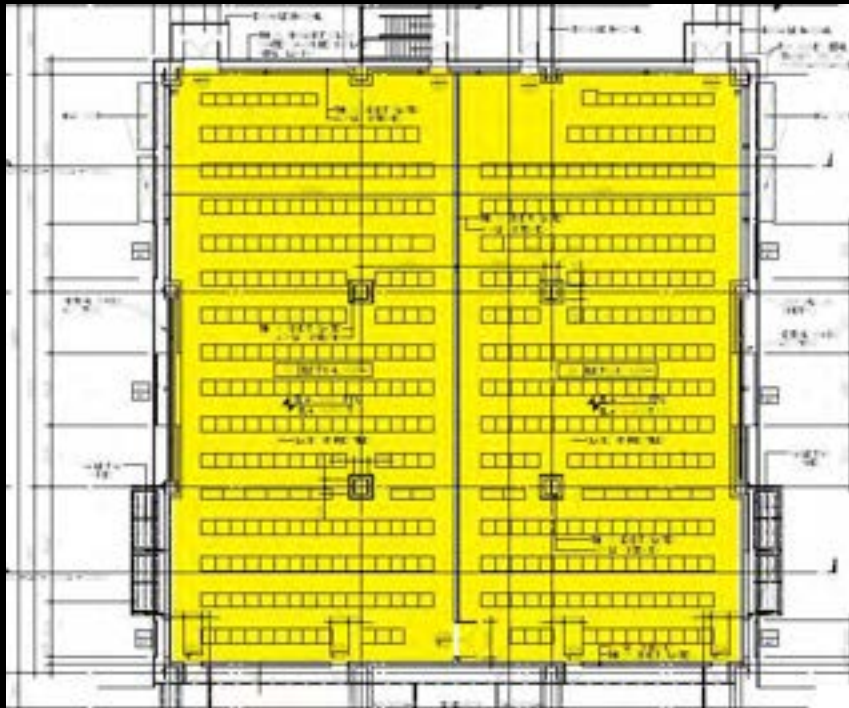


# Advanced Automation in Greenfield Energy Projects

## Challenges: Cooling System for IT and Digital Equipments



Source: YT

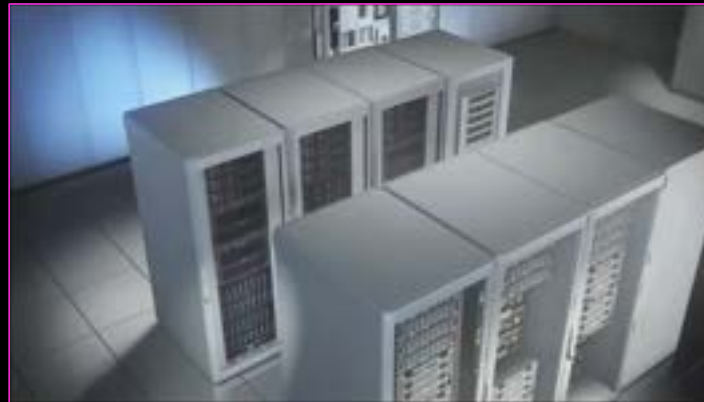
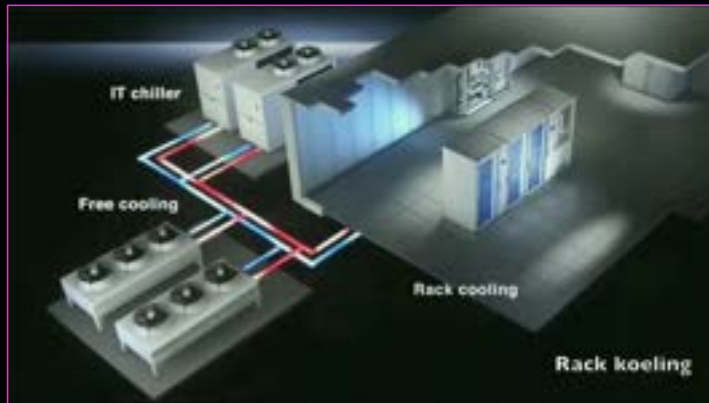


- Non-uniform Cooling
- Dust accumulation
- Noise Pollution
- High Energy consumption
- Improper space management
- Reduced Component Service Life



# Advanced Automation in Greenfield Energy Projects

## Energy Efficient Cooling System for IT and Digital Equipments



- High-performance cooling scalable up to 30 kW, 53kW / rack
- High energy efficiency
- Best option for achieving better and reliable PUE
- **Raised floor not required**
- **Cooling medium Options:**
  - Chiller Water (CW)
  - Refrigerant (Dx)

### Integrated In-Rack Cooling

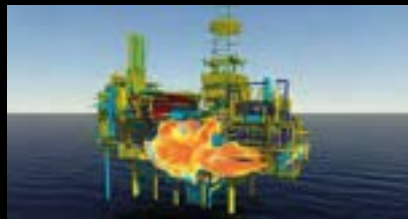


# Advanced Automation in Greenfield Energy Projects

## Physical Protection for Digital Automation Enclosures

### Micro Centers (MDC)

Protection against:  
**Hazardous  
Environment**



### Control Room / SCADA Center




### Security Rooms







# Advanced Automation in Greenfield Energy Projects

## Remote Monitoring for Automation Systems



- IT sector:
  - SNMPv1/2c, SNMPv3
- Industry sector:
  - OPC-UA, Modbus/TCP
- Protocols parallel usable
- RS232



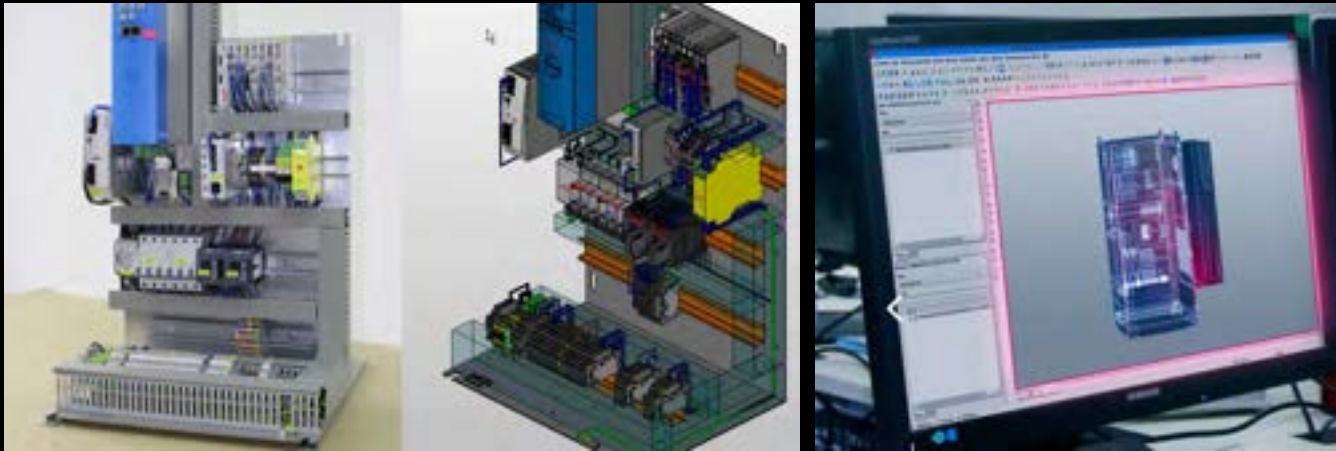






# Advanced Automation in Greenfield Energy Projects

## Digital Twins



### Edge Data Centers





# Advanced Automation in Greenfield Energy Projects

## Standards, Approvals, Certifications and PCF



**Rittal - The System.**  
Faster - better - everywhere.

Products ▾ Software ▾ Solutions ▾ Configuration Services ▾ Company ▾ References

Product category for Rittal SKC	SKC
Protection category NEMA	NEMA 1 NEMA 12
Type rating to UL 94E	Type 1 Type 12
UL Code	R150
Number of doors	1
Basic material	Sheet metal
Packs of	1 pack
Net weight	120.7 kg
Gross weight	125.9 kg
PCF per pack (cradle-to-gate)	209.8 kg CO <sub>2</sub> -eq (Cat B)

ENCLOSURES POWER DISTRIBUTION CLIMATE CONTROL IT INFRASTRUCTURE SOFTWARE & SERVICES

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# Thank You !

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8971662238





**Delhi**  
**Section**

*Setting the Standard for Automation™*

# RIL OPAS Test Bed

Insights of RIL Test Bed

- Divyang Shah  
Reliance Industries Limited

ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)

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- **A Fortune 500 Company** and **India's Largest and Most Valuable Corporate**
  1. *US\$ 240 Bn+ Market Capitalization*
  2. *US\$ 100 Bn+ Revenue*
  3. *US\$ 20 Bn+ EBITDA*
- **Unprecedented shareholder value creation** – 32%+ annualized return over 45 years
- Constantly leading India's capital creation – **Over US\$ 75 billion capex in last 5 years**
- **Significant transition from B2B to B2C in last 10 years** – established new Market Leading Platforms in Telecom, Retail, Media and Financial Services (now demerged)
- **Rated above India's Sovereign Credit Rating** – Two notches by S&P and one notch by Moody's

**We are India's most reputed and trusted Company**



# Growth Platforms Across Energy, Consumer, Technology Businesses

## Digital Services

- **Largest** digital services provider in **India** – **489.7 mn subscribers** in just over 7 years
- Completed **pan-India 5G rollout** – **fastest ever globally, largest operator world-wide** in terms of **data traffic**

## Retail

- **India's largest and most profitable retailer** - among the **fastest growing retailers globally**
- **18,918 retail stores, 81.3 mn sq. ft. of retail space**, Leading O2O platform with digital commerce

## O2C

- **Deep integration, competitive cost position, wide product portfolio** reduces earnings volatility
- **Among world's largest O2C player** - operates world's largest single site refinery at Jamnagar

## New Energy










- Investment of ~**\$10bn** in new energy business – building world-class **integrated renewable energy ecosystem**
- Developing enabling ecosystem to **rollout 100 GW new solar capacity by 2030**

**Reliance is the best proxy for New India's Consumption, Tech-driven Growth Story**



# Strong Foundation for Creating Future Value

The first Indian company to achieve the following milestones during FY24:

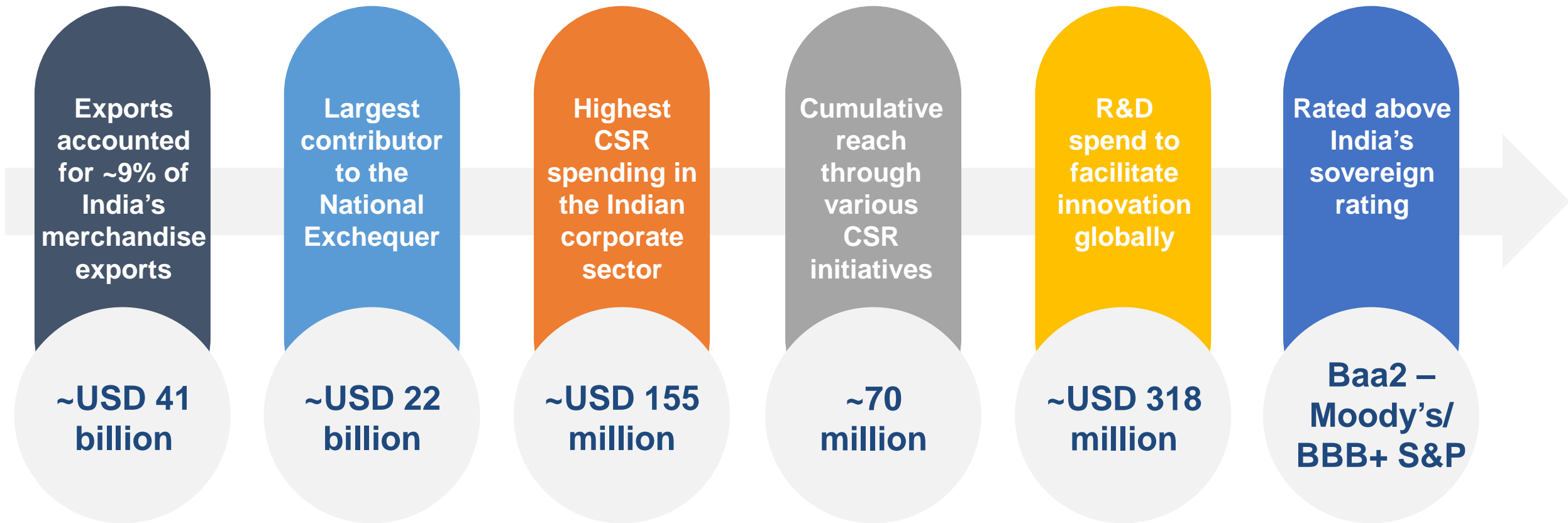
	<u><b>RIL</b></u> Consolidated EBITDA crossed ₹175,000 crore mark		<u><b>RIL</b></u> Consolidated PBT crossed ₹100,000 crore mark		<u><b>RIL</b></u> Market Cap crossed ₹20,00,000 crore mark
	<u><b>JPL</b></u> Revenue crossed ₹100,000 crore mark		<u><b>JPL</b></u> Net Profit crossed ₹20,000 crore mark		<u><b>Digital Services</b></u> Completion of world's fastest 5G rollout
	<u><b>RRVL</b></u> Revenue crossed ₹300,000 crore mark		<u><b>RRVL</b></u> Net Profit crossed ₹10,000 crore mark		<u><b>Retail</b></u> Store footprint crossed 80 mn sq.ft. mark

Net Profits of JPL and RRVL rank them among India's Top 20 and 30 companies respectively

© Reliance Industries Ltd., 2025



# Pre-eminent Position in India



**Maintained leadership position among Indian corporates for nearly three decades**

© Reliance Industries Ltd., 2025



# Empowering the Society Through Consistent Value Creation

As on 31<sup>st</sup> Mar'23...



## Rural Transformation

**17.66 mn+**

people impacted



## Health

**8.56 mn+**

people reached



## Disaster Management

**20 mn+**

people impacted



## Education

**0.65 mn+**

people supported



## Sports For Development

**22 mn+**

people reached



## Supporting Entrepreneurship

**177**

start-ups supported



## Employees

**29.5 mn+**

person hours of training provided *in FY23*

Following an integrated approach to social wellbeing of all segments



# O2C Business: World Class Assets of Global Scale



**1.4MMBPD Crude Refining Capacity**  
Largest single site refinery complex globally



**67.8 MMT of Production meant for Sale**  
(FY24)



**1,730** Fuel Retail Outlets | **4,750+** EV Charging Points  
in 51:49 JV with BP



**Among Top 5**  
Largest Producers of PTA & PP Globally



**21.1**  
Complexity Index<sup>1</sup>



**3<sup>rd</sup>**  
Largest Producer of PX Globally



**1.5%**  
of Global Crude produced at Jamnagar Complex



**14**  
Manufacturing facilities in India (11) and Malaysia (3)

**Pioneered vertical integration and conceived oil-to-chemicals concept well ahead of industry**

© Reliance Industries Ltd., 2025



# Growth Engines for Sustainable Value Creation



Operational excellence demonstrating robust strategy and execution capabilities



EBITDA nearly doubled over 5-year period; Consumer business EBITDA up ~4x in the same period



Robust balance sheet, prudent capital allocation and risk management framework underpin future growth



Strong commitment to ESG; Target to be net carbon zero by 2035



Energy businesses – enabling a sustainable future through greener fuels and products

- Next phase of O2C growth to be led by India centric capacity expansion, customer centricity and circularity
- Green energy investments and RTC power to deliver lower and predictable energy costs and new revenue streams
- KG D6 to provide valuable transition fuel for the economy



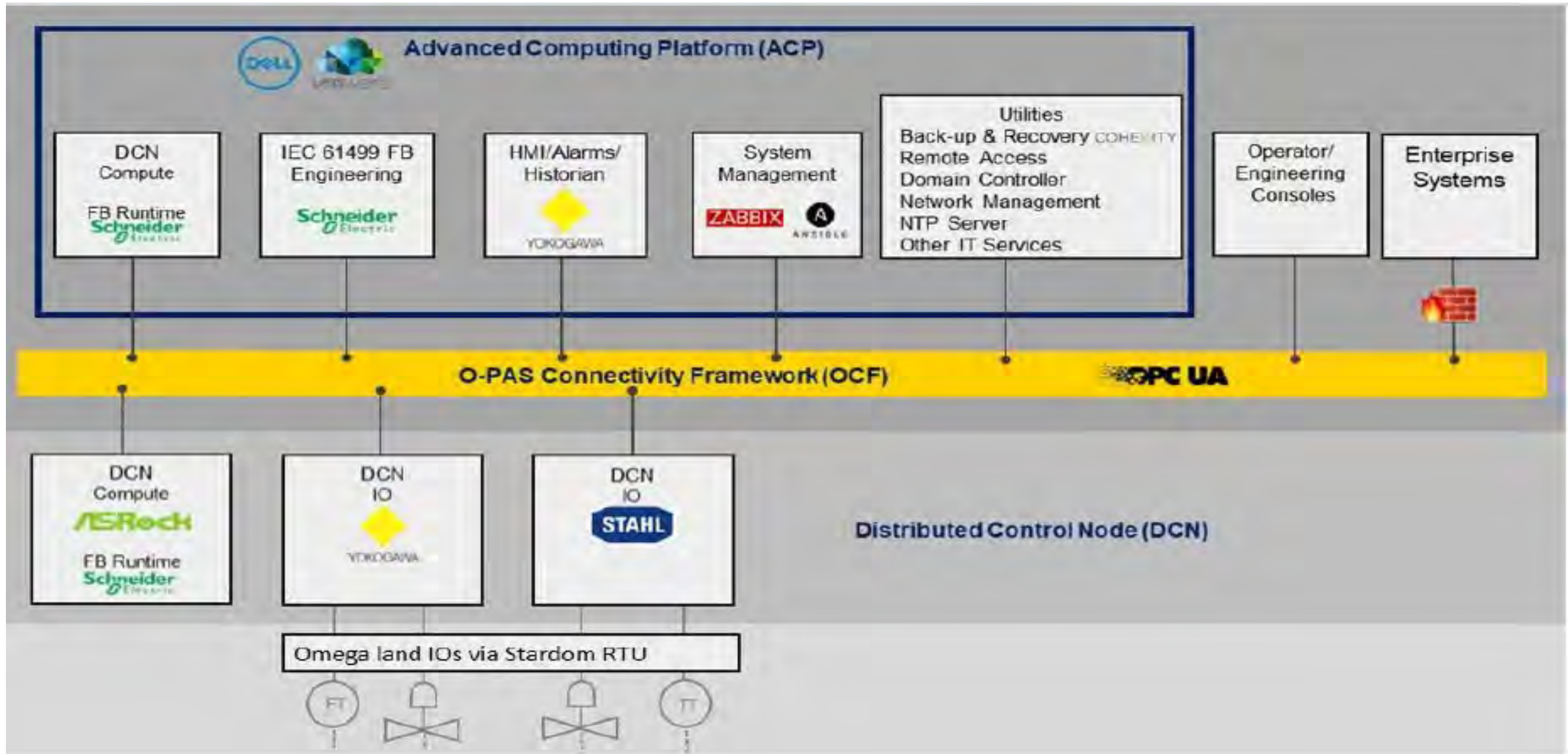
Consumer businesses - unparalleled access to Indian consumers with multiple growth drivers

- Jio – Executing identified strategies for Individuals, Homes, Enterprise and Digital Platforms
- Retail – Expanding omni-channel offerings, strengthening logistics, product development and premiumization

**Poised to benefit from structural growth in India industrial and consumption demand**

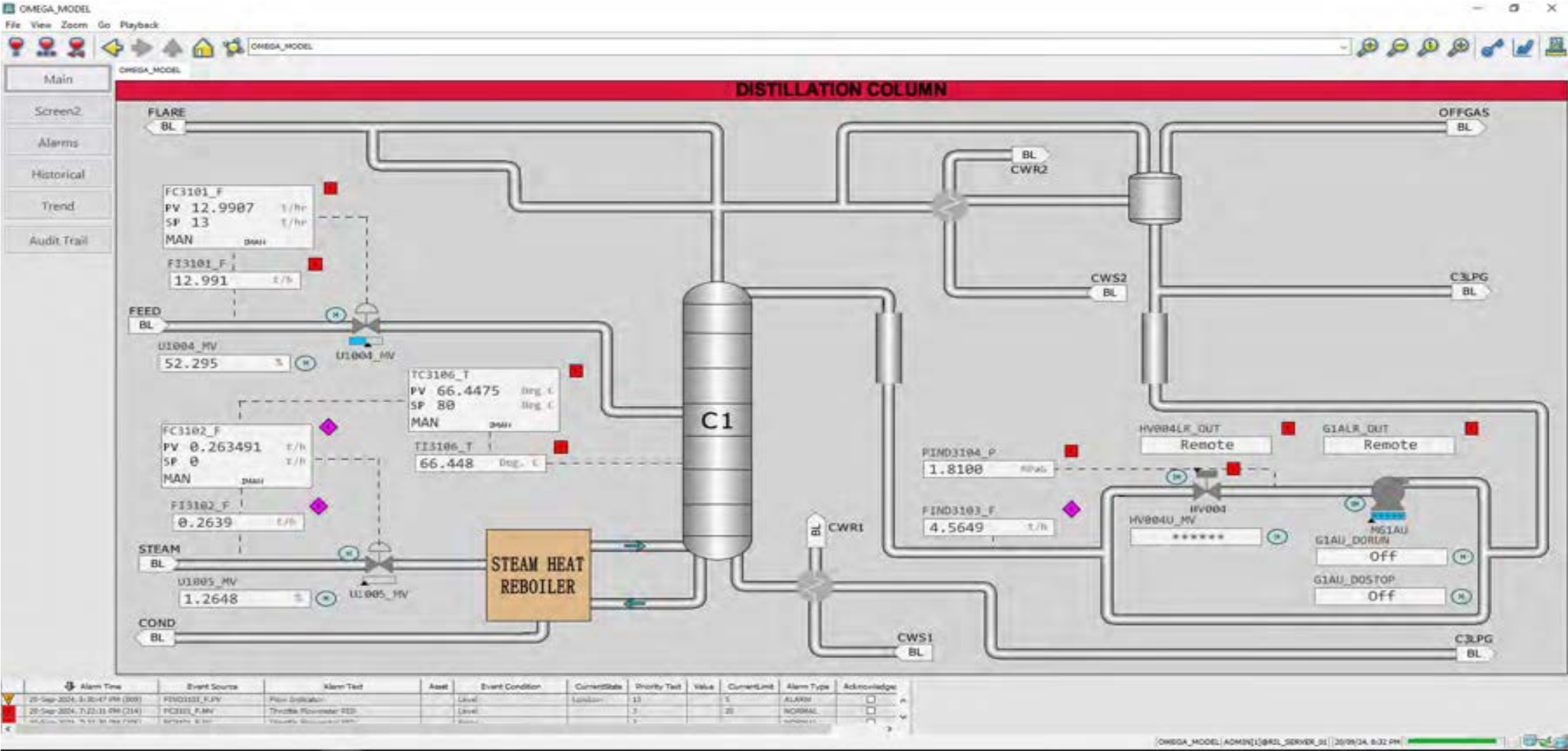


# OPA Test Bed Architecture



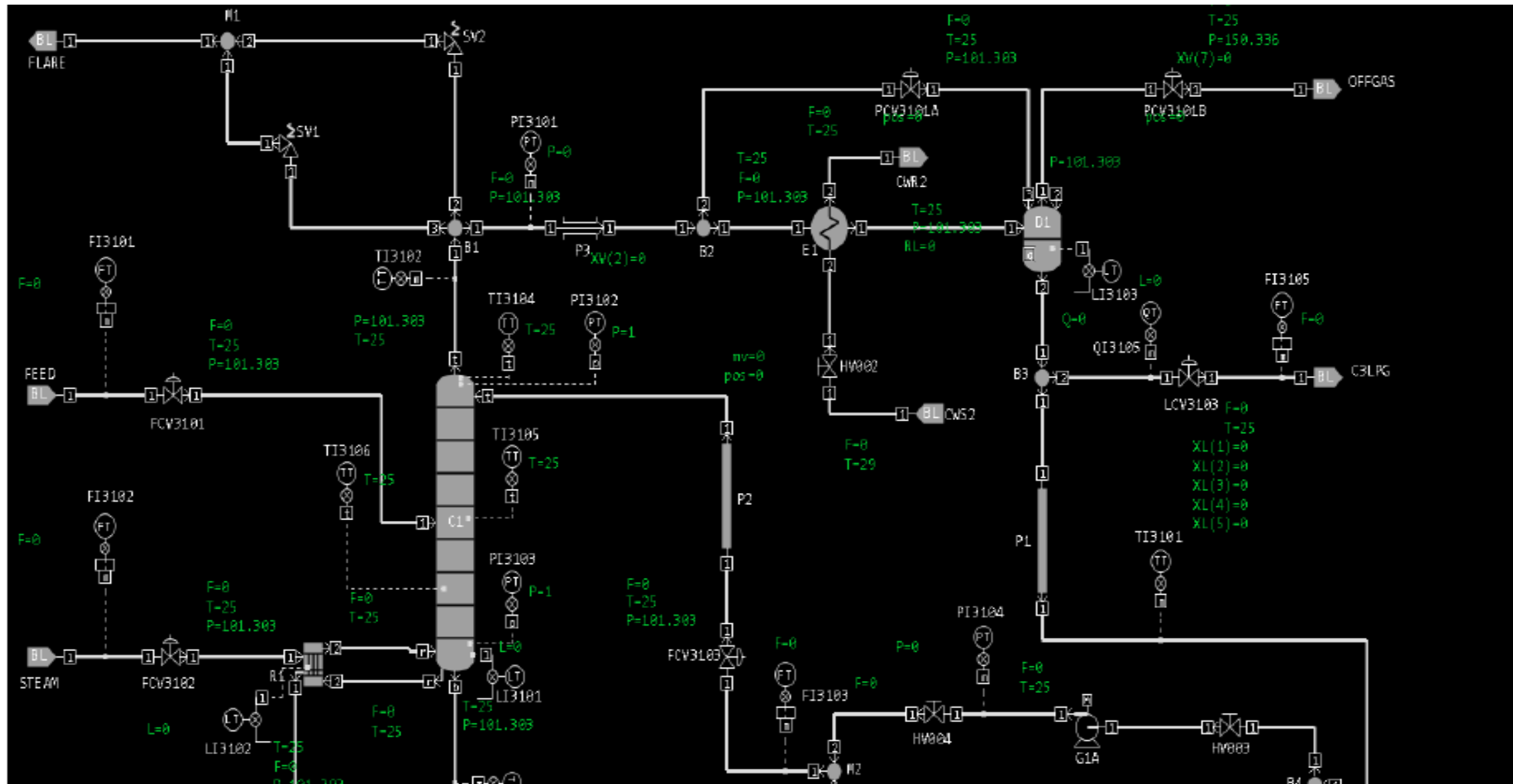


# Simulated Process – Column Controls



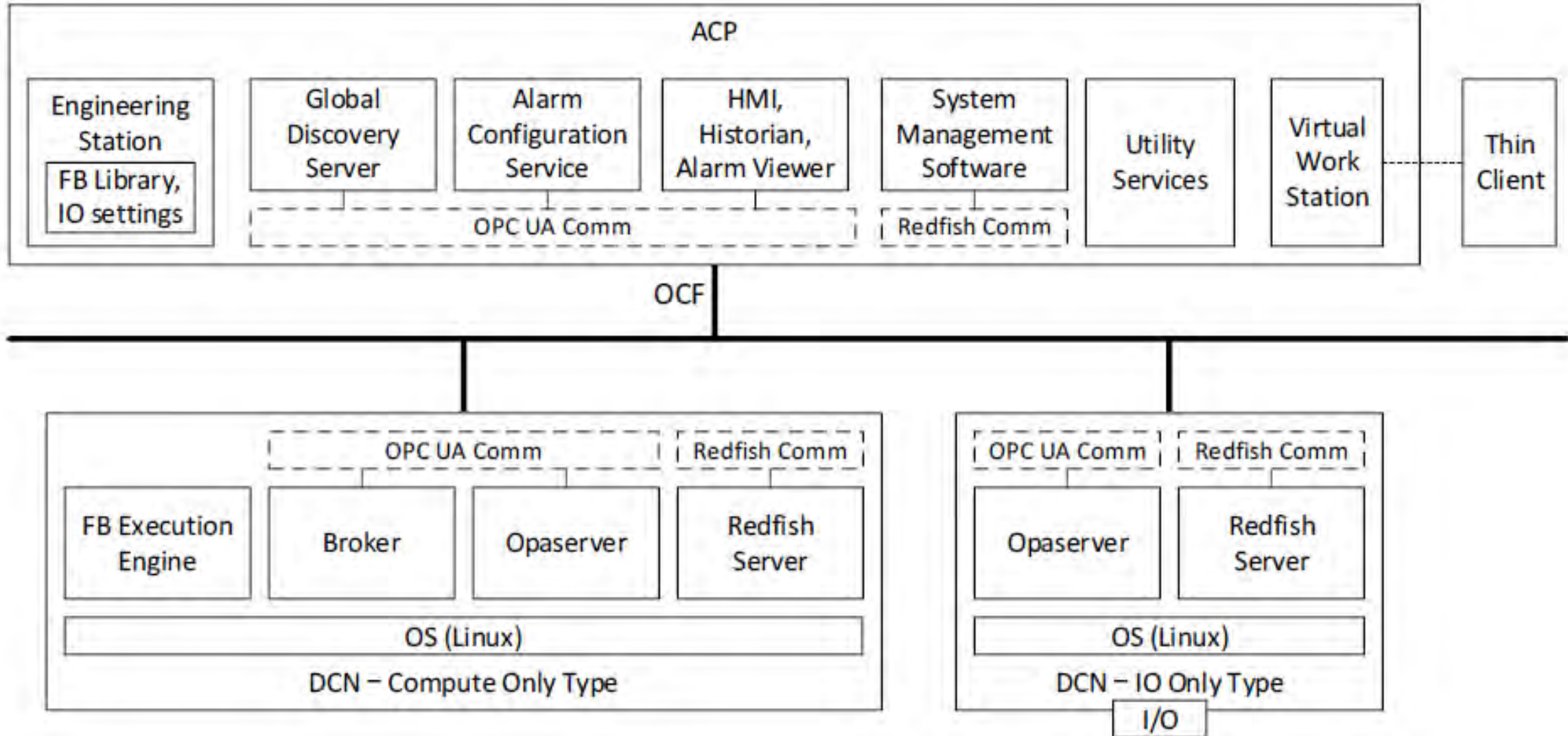


# Simulated Process – Configuration of Omega Land





Approx 20 VMs in Single ACP





- Secure by Design
  - Use of AD for OS, Applications, Firewalls, Switch
  - Logs monitoring
  - Certificate Management, Secure On boarding
  - OPC UA used with security features
- Extensive use of Open Source Software – Zabbix, Ubuntu, Cohesity, Apt-Mirror ...
- Delinking of Controller and I/O Functions
- Use of Common Engineering Tool – EAE – For configuration of logics across different make of DCNs.
- Use of OPC UA for control backbone.
- Use of Dockers and Containers.
- Training of End users for use of these software, automation.



- Zabbix Monitoring
  - ACP / HMI clients covered
    - CPU, Memory, HDD Utilization
    - Power, Temp monitoring
  - Software applications covered
  - Network devices covered



# Further Checking planned at Factory

All type of FBs, Sequences, Logics used in RIL existing installations. Checking of Different Control Strategies used in existing installations.

Interoperability, Interchangeability and Portability of DCNs

OT side – Failure mode identification and resolution to make system Reliable

Zabbix Optimization – Criticality Segregation, Scan time setting according to response time required.

Integration with IT and Other Applications like APC. IT/OT integration checks.

Total cost of Ownership calculation

Scan time taken from Omega Land to CI server is approx. 3 -5 seconds. Need further checks.



# Improvements desired in Standard / Products as applicable

Use of Single Software for Configuration of DCNs – To build logic, IO configuration, Config alarms

Each OEM for DCN supplying OPA Server, Redfish system management, Secure deployment, Orchestration scripts in place of system integrator providing it

Redundancy requirement at ACP, DCN levels

OPC UA Pub-sub implementation.

SI competency at Local level

Differentiation between Under range & Open Circuit



# Improvements desired in Standard / Products as applicable

EAE Audit trail facility

EAE and ACS (Alarm Configuration Service)/ AET (Alarm Engineering Tool) synchronizing.

Outputs holding predefined value on communication failure



# Thank You





# Advanced Integrated Gas Analyzers Solutions for Petrochemical Industry

## PPPA Meet 2025 Conference

Presented by : Manoj Singh

President Sales and Marketing ( SBU 2)



# Head Office and World-Class Analytical Integration Facility in Goa: Your Premier Destination for Gas Analyzer Solutions. :



**Head office & SBU -1 (Cement ,steel and Power)**



**SBU -2 (Refinery, Petrochemical , Oil & Gas )**



**Sales Team**



**We have delivered more than 50 shelters for various petrochemical and Refinery applications .**



**At a time we can integrate 20 shelters in our facility.**



# We are ISO 9001:2015, 45001 : 2018 and ISO 14000:2015 certified .



Adage have an integrated quality process into its entire operations. We are approved vendors of EIL,Exxon Singapore and getting approved with Sabic



# Customized Analyzer Solutions



## Process Control

Higher process automation  
Less consumed resources  
Increased productivity



## Quality Control

Assure and improve  
product quality



## Safety Monitoring

Plant protection,  
Personal safety



## Environmental Protection

Regulatory  
compliance



## Fiscal

Analyze to determine  
the selling value  
of a chemical product



# Our Technology Partners with back to back service arrangement.

ADAGE



On line Gas  
Chromatograph

SIEMENS

- Continuous Gas Analyzers Sox, Nox, CO, CO<sub>2</sub>, CH<sub>4</sub>, SF<sub>6</sub>, O<sub>2</sub>
- ASM, PEMS and Softsensor
- TDLAS for NH<sub>3</sub>, HF, O<sub>2</sub>, HCL

AMETEK®

- Sulphur Analysers
- Tail Gas Analyser
- O<sub>2</sub> and combustible Analysers
- H<sub>2</sub>O Analyzers,
- CL<sub>2</sub> Analysers

SK

- Thermo FID Analyser

icon

- Flash Point
- Pour Point
- RVP
- Distillation Analyser

PAC

- Low range Sulphur Analyser

Process  
Insights  
Premium Insights Into Process

- Mass Spectrometer
- NIR ( Guided Wave)
- LAR ( oil in Water)
- Wobbie Index

H2scan  
ADVANCED HYDROGEN SENSING

- In line H<sub>2</sub> Process monitor

±um  
union  
INSTRUMENTS | COMPETENCE  
IN GAS  
MONITORING

- Gas Calorimeter for basic industries

envea

- Ambient Air Quality monitoring applications

AIR OPTIC™

- TDLS analyzers for CO, CO<sub>2</sub>, O<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>O, NH<sub>3</sub>, H<sub>2</sub>





# Maxum Edition II - Unique features makes technically advanced GC



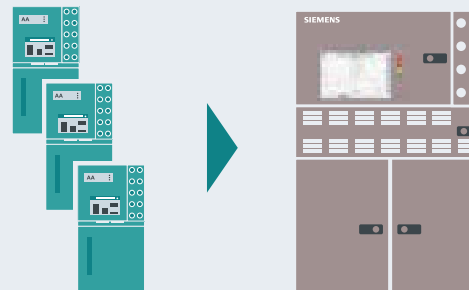
Valmet



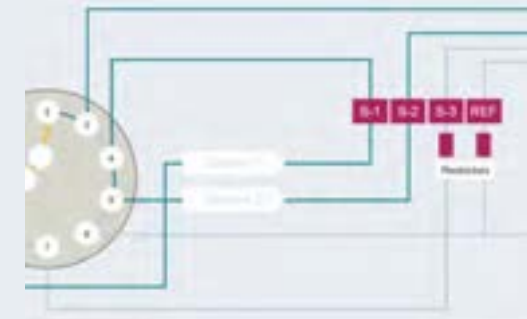
Multiple oven configuration



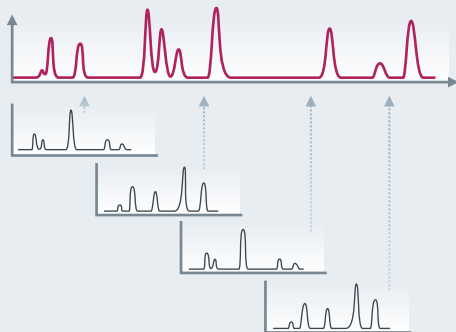
Multi-Sense TCD



Densification



Inter column detector



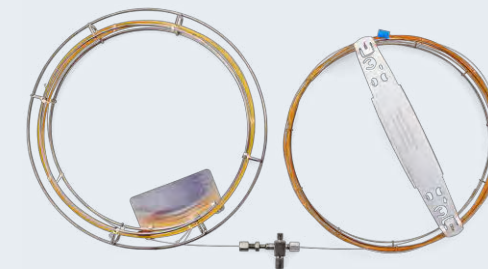
Parallel Chromatography



Electronic Pressure Controller



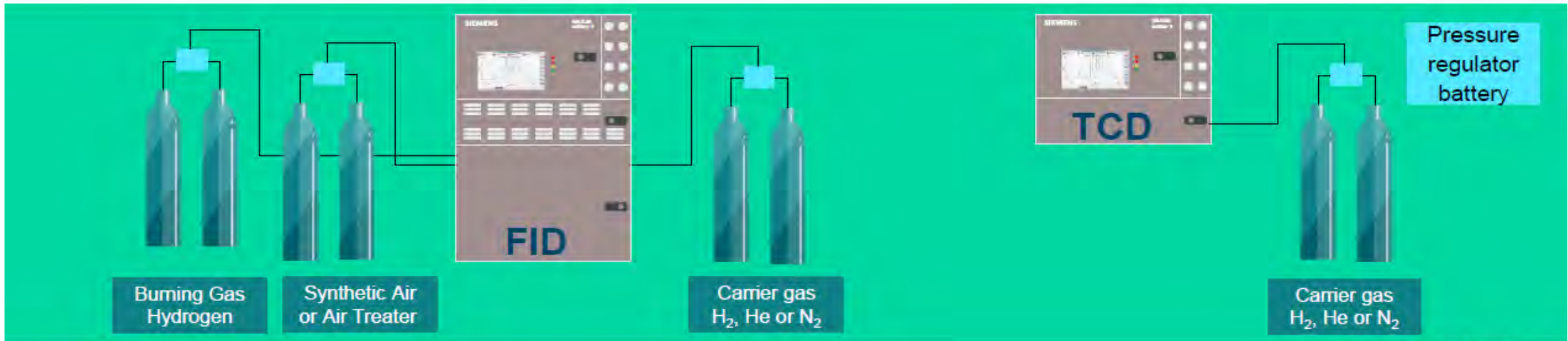
Model 50 valve



Live switching



## TCD fits trace analysis and reduces CAPEX and OPEX Required equipment for TCD vs FID



		TCD savings
<b>Detector HW</b>	TCD instead of FID, less pressure regulators	++
<b>Gas Supply</b>	Gas supply batteries: qty 2-3 for FID, qty 1 for TCD configuration or additional Air Treater	++
<b>Consumables</b>	FID: approx 20 bottles/Y for synthetic air, approx. 2 bottles/ Y for burning gas <b>in addition</b> .	+
<b>Maintenance</b>	FID: more service expenses compared to TCD for bottle change	+

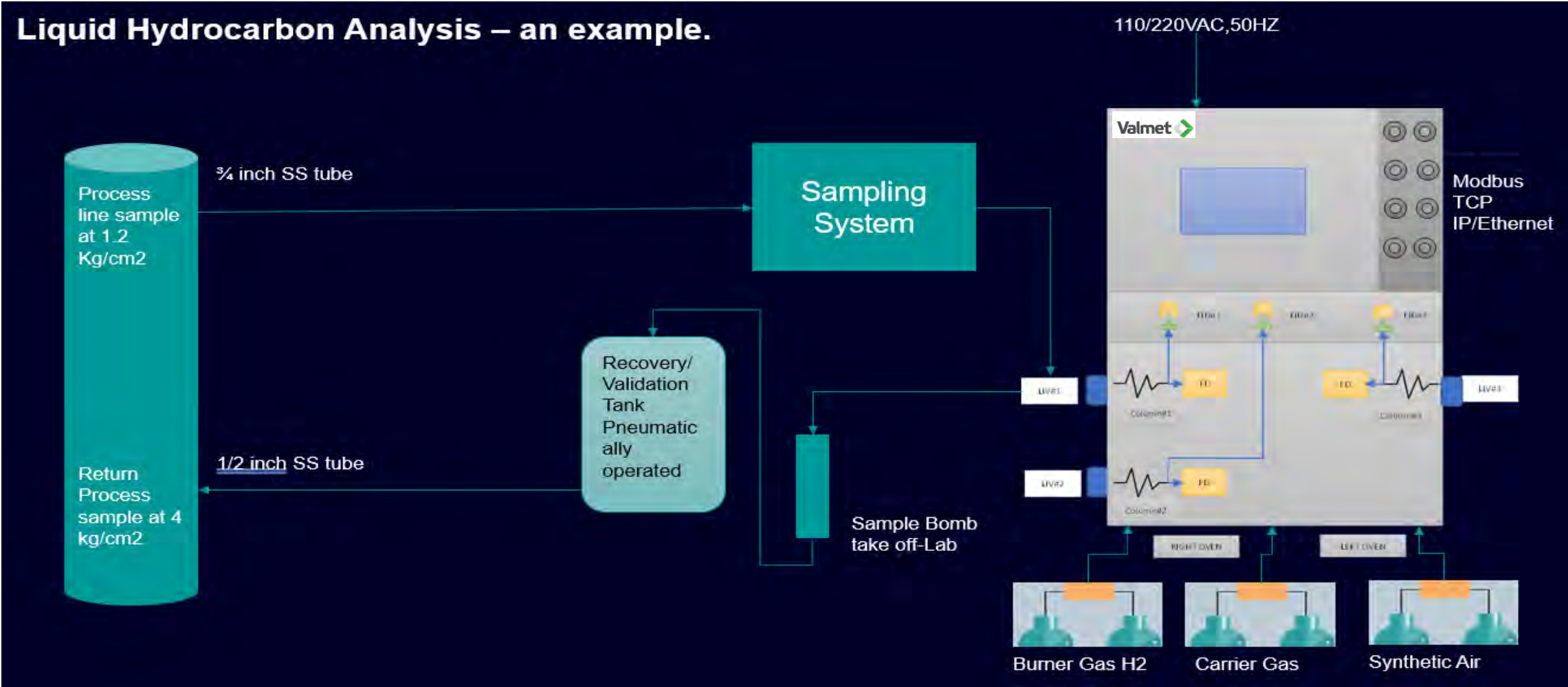


**License based online GCs specifies Maxum as one of the options.**  
 Grace – Univation PP (formerly DOW)

Analyzer Point	Sample Stream	Measuring Components	Cycle Time	Siemens Appl. Reference
ASP-40-01A & ARP-40-01B	Reactor C-4001 Cycle Gas	H <sub>2</sub> , N <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>8</sub> (CO on request but not in this analyzer)	2 min or less	MSA-072
ASP-43-01A & ARP-43-01B	Reactor C-4301 Cycle Gas	H <sub>2</sub> , N <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>8</sub> (CO on request but not in this analyzer)	2 min or less	MSA-072
AP-10-01A & B	Ethylene Supply or Purification	CO, CO <sub>2</sub> , CH <sub>3</sub> OH	6 min or less	MSA-070
AP-12-01	H <sub>2</sub> Supply	CO, CO <sub>2</sub>	6 min or less	MSA-070
AP-20-01a thru -01E	Propylene Purification	CO <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> (CO, C <sub>2</sub> H <sub>2</sub> , CH <sub>3</sub> OH, Methyl Acetylene upon request)	6 min or less	MSA-071
AP-052-01 thru -07	Vent Recovery System	H <sub>2</sub> , N <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>8</sub>	6 min or less	MSA-073



3 stream simultaneous Liquid Hydrocarbon Analysis ( Butanol  
Purity measurement )





Flare gas measurement for Petrochemical and Refinery applications to meet environmental norms and drive sustainability.

ADAGE

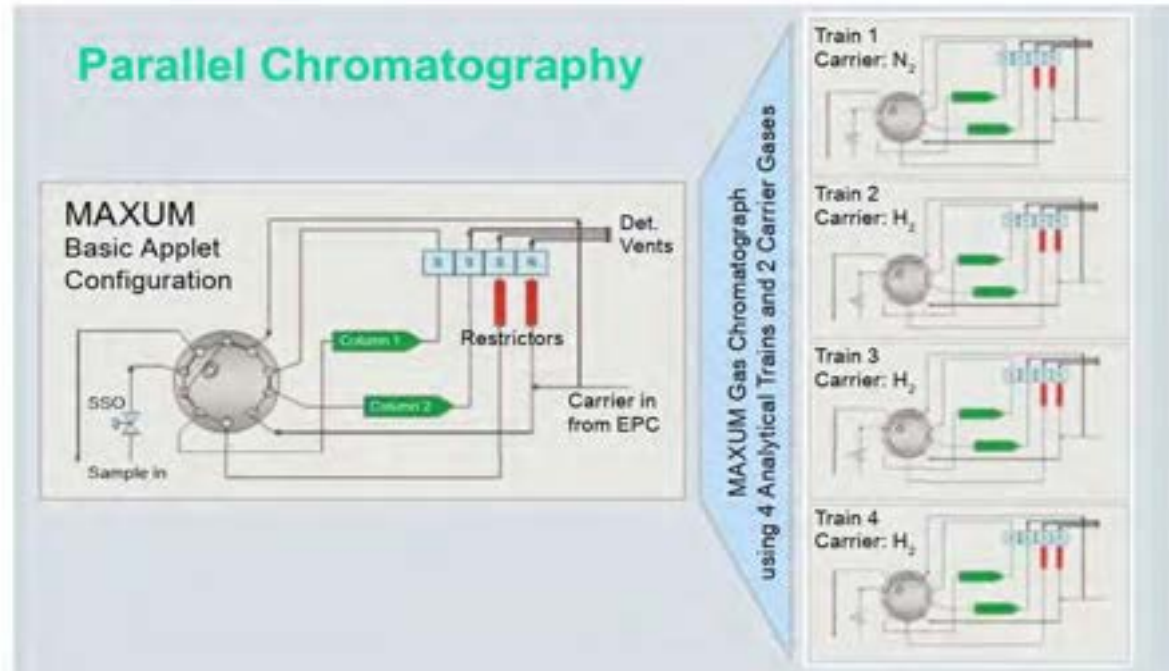
Component	Conc. Range Mol %	MDL Mol %	Repeatability +/- %
Hydrogen	0-100	0.5	1
Oxygen & Argon	0-100	0.02	1
Nitrogen	0-100	0.02	1
Methane	0-100	0.02	1
Carbon Monoxide	0-100	0.02	1
Carbon Dioxide	0-100	0.02	1
Ethylene	0-100	0.02	1
Ethane	0-100	0.02	1
Acetylene	0-100	0.02	1
Propane	0-100	0.02	1
Propylene	0-100	0.02	1
iso-Butane	0-100	0.02	1
n-Butane	0-100	0.02	1
iso & 1-Butene	0-100	0.02	1
trans-Butene-2	0-100	0.02	1
cis-Butene-2	0-100	0.02	1
1,3-Butadiene	0-100	0.02	1
iso-Pentane Plus	0-100	0.02	1

- As few as 7 components
- As many as 19 components
- Possibly from 0 to 100%





# GC configuration widely used for flare gas Compositional Analysis



Configuration using 4 analytical trains based on standardized “applet” configurations



# PAC- Process Solutions – Online Analyzers



Oil in Water measurement for HC  
in produced water, cooling water  
and dewatering application



Physical properties analysers –  
vapour pressure, flash point,  
freeze point, viscometer, colour...



Accurate Total sulfur and/or  
nitrogen measurement for quality  
control and regulatory compliance



Accurate boiling point in less  
than 10 minutes, to get closer  
to ideal operating ranges



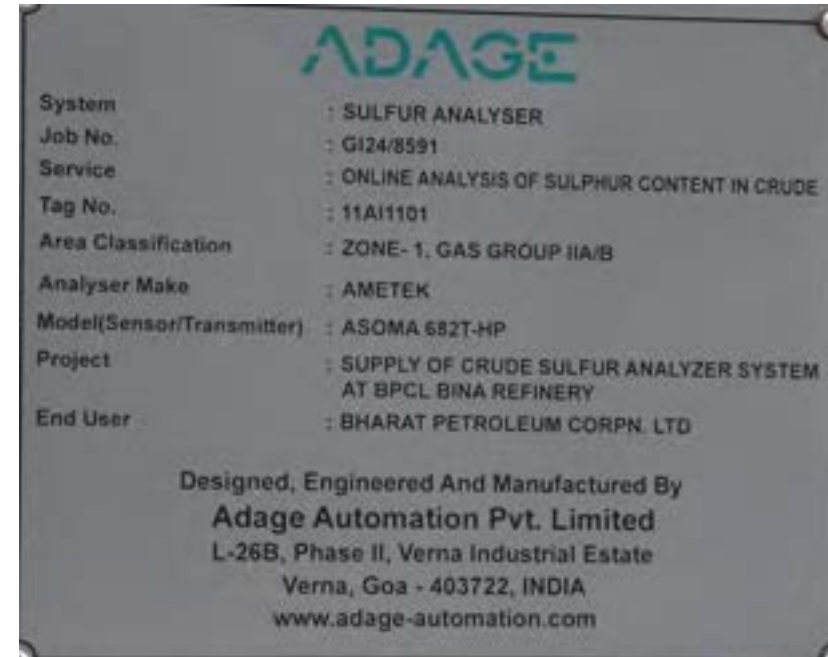


# Flash point Analyzer System for High-speed diesel

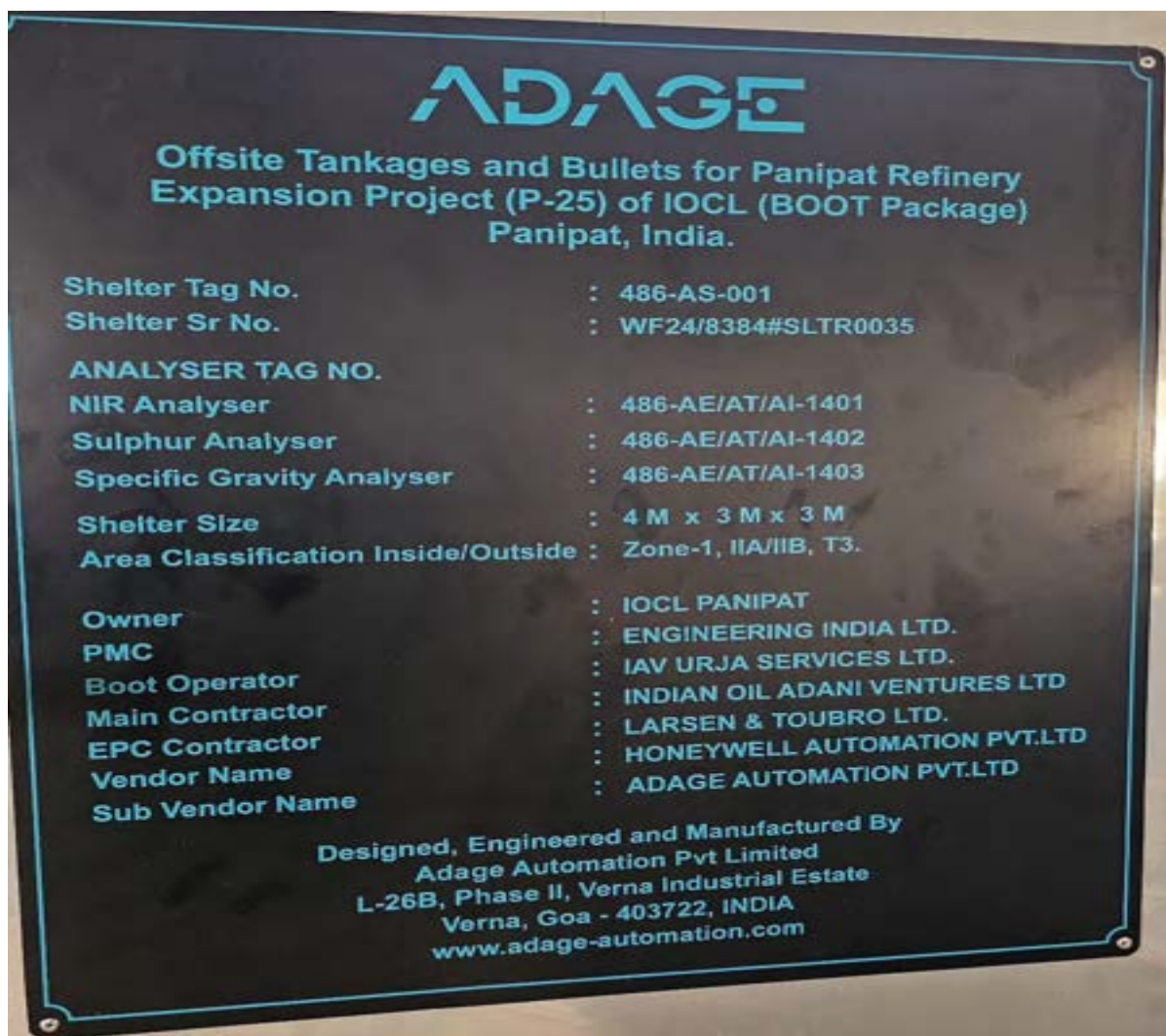
PROCESS PARAMETER	
TAG NO.	AT-5003C
QUANTITY	1
SERVICE	HIGH SPEED DIESEL
AREA CLASSIFICATION	ZONE 1, GAS GROUP IIB+H2, T8
RELATIVE HUMIDITY	95%RH(MAX), 5%RH (MIN)
STREAM / FLUID STATE	HIGH SPEED DIESEL / LIQUID
FLASH POINT	30°C / 35-45°C / 90°C
TEMPERATURE (Min/ Norm /Max)	31°C / 55°C / 80°C
PRESSURE (Min/ Norm /Max)	2 / 4 /14.9 Kg/cm <sup>2</sup> g
MEASURING RANGE	30°C - 90°C
VISCOSITY	-
DENSITY	-





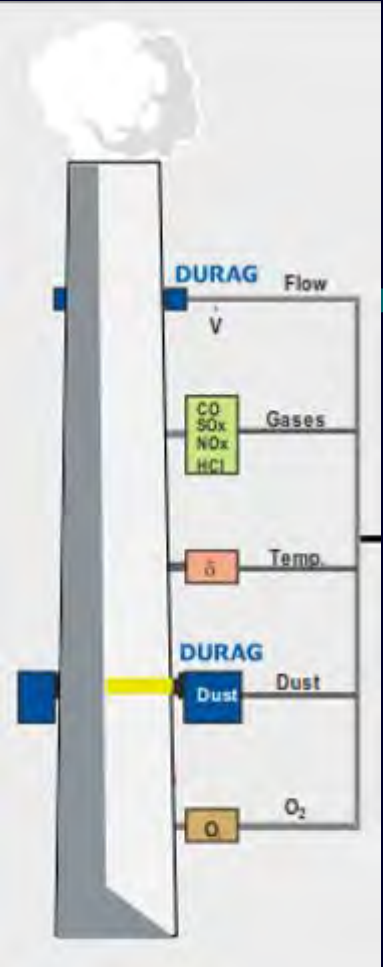






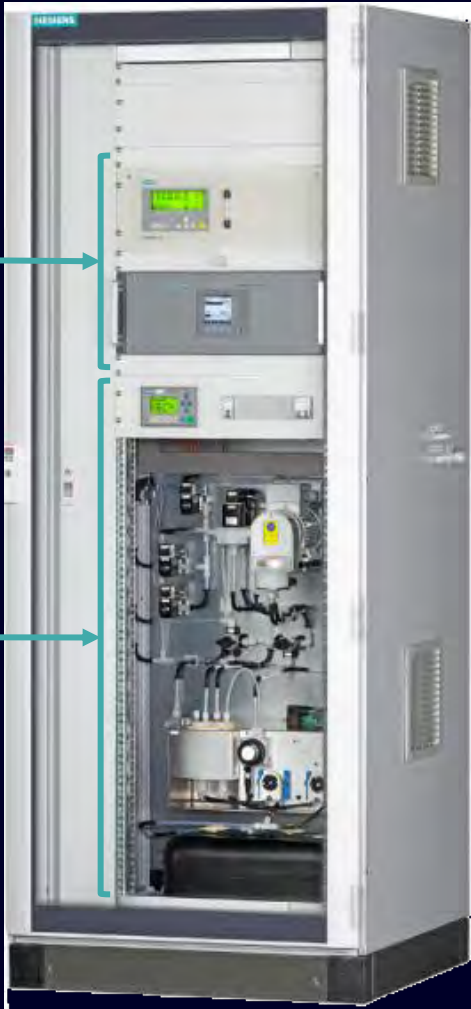


# CPCB Certified CEMS for Process Industries with Cloud connectivity and remote maintenance capability



Up to three continuous gas analyzers measuring CO, NO, SO<sub>2</sub>, NO<sub>2</sub> and O<sub>2</sub> (modular package to individually satisfy customer requirements)

Sample conditioning system entire system from one supplier (incl. SIMATIC control & communication elements)



**Certificates**  
certified and proven continuous emission monitoring system (QAL1 according to EN15267-3) TÜV/UBA



Released



## Analyzer System Manager (ASM)

### ASM feature scope

#### Analyzer System Manager

Continuous monitoring of  
of all analysis data

Predictive maintenance  
for analyzers

Advanced process control

Automation of validation

Statistical quality control

Maintenance organization

KPI reporting for all devices



**ASM supports the user in analysis-related tasks, automates a wide range of tasks and is the digitalization approach to optimize the performance of the entire installed base!**



# Our esteemed Customers: Include End users,EPCs ,LSTKs





# Our esteemed Customers: Include End users,EPCs ,LSTKs





# Summary



**“Complete Process Gas Analyser ecosystems, designed for critical industrial applications and powered by cutting-edge technology.”**



# Thank you



## **Contact Coordinates**

President Sales & Marketing -SBU2

Mobile : +91 9820783479;

Mail ID: [manoj@adage-automation.com](mailto:manoj@adage-automation.com)

## **Adage Automation Pvt Ltd**

L-26B, Phase II, Verna Industrial Area;Verna, Goa – 403722,  
INDIA;CIN No: U 74900 MH 2001 PTC133206; [www.adage-automation.com](http://www.adage-automation.com)





**Imagine. Ideate. Innovate.**

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**Delhi  
Section**

*Setting the Standard for Automation™*

# Execution of prefabricated substations

NAMITA RAWAT & SANJAY RAKHEJA

FLUOR DANIEL INDIA PVT LTD

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# Type of Substation Buildings

Reinforced  
Cement Concrete  
(RCC) Buildings

Pre-engineered  
Buildings

Prefabricated  
Buildings

Prefabricated  
Substation  
Buildings



# Type of Substation Buildings

## Reinforced Cement Concrete (RCC Buildings)

- Concrete building built at site in line with contractual requirement.
- Most economical
- Construction span of civil building is longer and this shall match with project schedule
- No size restriction

## Pre-engineered Buildings

- Pre-engineered substation buildings are prefabricated steel structure building assembled and installed at site.
- In the remote area where concrete work is not economical and very difficult then pre-engineered substation building is better option.
- No shipping restriction
- Better delivery and quality.
- Reduced Coordination effort



# Type of Substation Buildings

## Prefabricated Buildings

- Only substation building is prefabricated with all utilities like lighting, fire fighting
- Any equipment's are not integrated or prefabricated

## Prefabricated substation Buildings

- This includes substation building with all the electrical components and systems integrated within the substation



# Applicable Codes

- **IEC 62271-202** High-voltage switchgear and controlgear - Part 202: High-voltage/low voltage prefabricated substation.
- **Article 545 of the National Electrical Code (NEC)** which covers requirements for manufactured buildings and relocatable structures.
- Other than the above there are **local codes including building codes and statutory requirements**.

For e.g. in **India the NBC ( National Building Code)**, published by the **Bureau of Indian Standards (BIS)**, provides comprehensive guidelines for building construction, including prefabricated structures. It includes requirements for structural safety, fire safety, electrical installations, and plumbing systems .



# Prefabricated Substations



Prefabricated Substation is a prefabricated, pre-tested and pre commissioned electrical room. It is complete with Lighting and small power system, Fire alarm and fire fighting system, HVAC and Telecom system at site.



It can be transported and can be lifted from top or bottom with all equipment installed.



Where the complete prefabricated substation exceeds the maximum allowable transportation dimensions it will consist of sub modules, which will require a mechanical and electrical reconnection on site.





# Prefabricated Substations

There are **two options** for scope of supply of electrical equipment in prefabricated buildings;

- **Lump sum basis** on single vendor as prefabricated package along with all electrical panels
- **Prefabricated Building along with building related facilities**, eg., lighting, small power, HVAC etc. in fabricators scope, where as other major Electrical items, eg., switchgear, VFD, UPS, lighting transformer, instrument & telecom panels, etc., maybe issued by the Company and/or Contractor as free issue material.



# Business Drivers- Merits & Demerits

## Merits

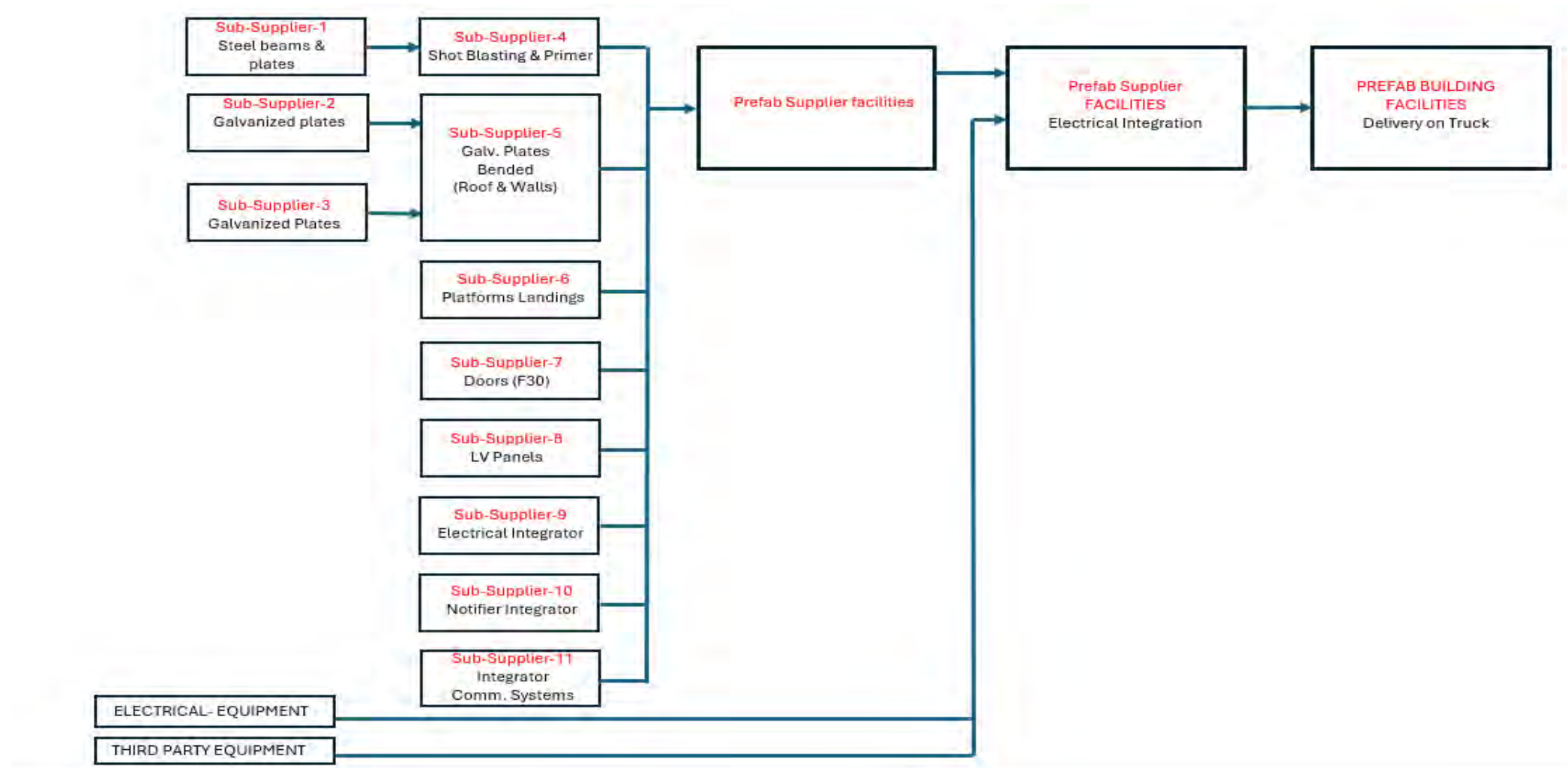
- Utilize the available set-up at fabrication yard for testing & commissioning
- Minimize site construction costs including construction power
- Reduce number of site-based contractors and personnel and hence reduces construction time and cost
- Derisk project schedule
- Less site query / problems.
- Remote Location, lack of existing structures and low electrical capability

## Demerits

- It may be costly in comparison to other options upon project specifics.
- Transportation limitation for e.g. in Africa based project, shipping envelop limitation was 4.5 m (W) x 15m (L) x 4 m (H).
- High transportation cost and Transportation risk since equipment inside substation are transported along with the Building.
- Change management is difficult.
- Close Coordination required with sub vendors & sub suppliers.



# Typical Workflow- Coordination Between Sub-vendors





# Few Challenges During Execution w.r.t Concurrent Engineering

## 1. Finalize equipment layout of the buildings even when

- ✓ Detail Engineering may not be completed.
- ✓ Final inputs from other disciplines (Inst. / Telecom / Mech. Package etc.) may not be fully received
- ✓ Purchase order may not be placed / vendor not known / dimension not available

## 2. Finalize cable route even when

- ✓ Load Schedule may not be final
- ✓ Cable Schedule may not in good shape

## 3. Limited space

- ✓ As the cost of prefabricated substation building is high in comparison to other buildings, optimized layout keeping limited extra spaces are preferred. Height of the buildings may also be optimized to minimize cost and facilitate sea transport.

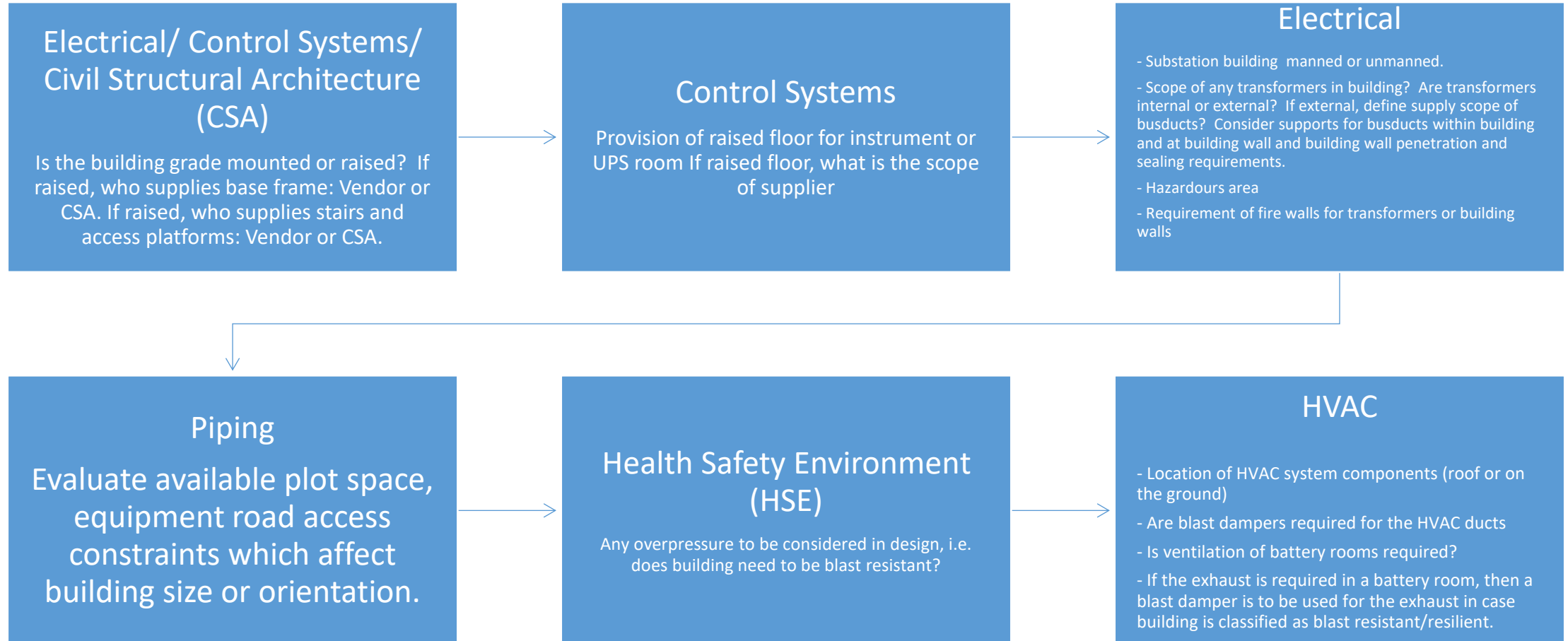
## 4. Future growth

- ✓ Accommodating future growth due to increase of scope, additional inputs from other discipline at later date, receipt of final vendor drawing etc.



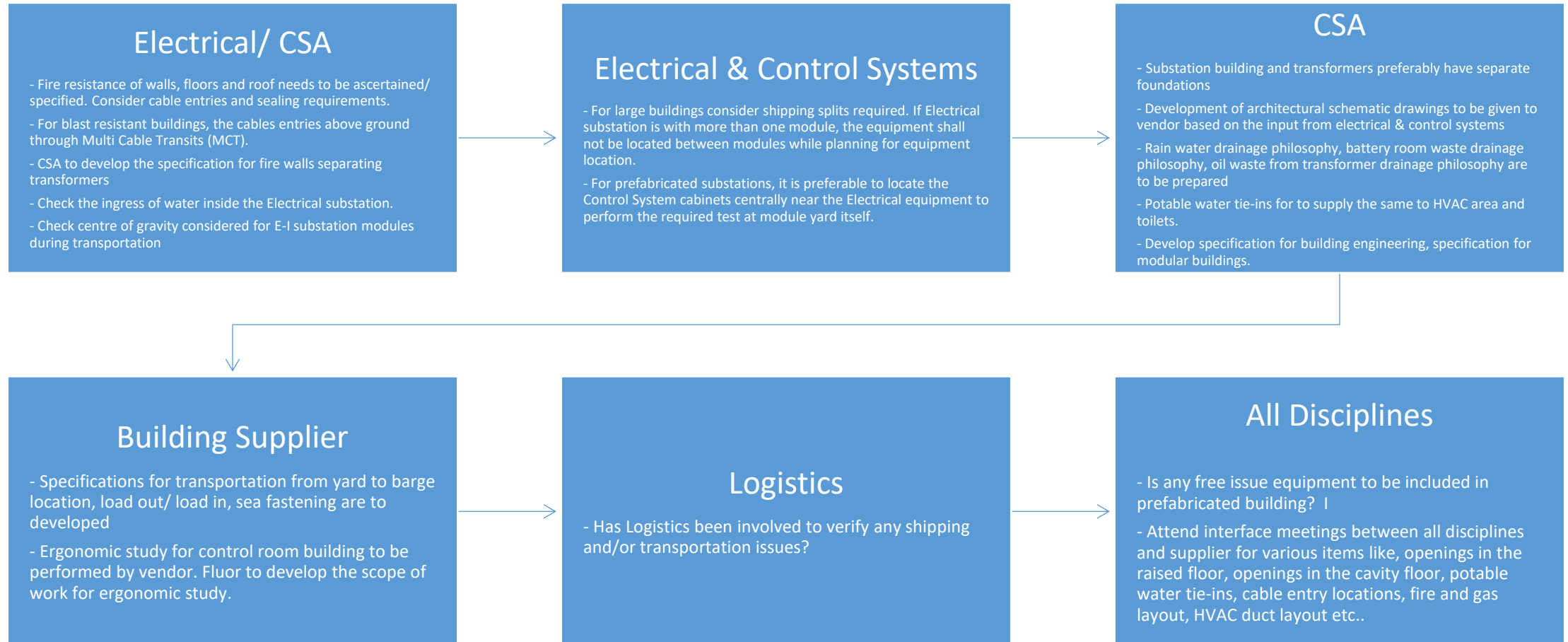
# Discipline Interfaces- Special Attention

Main responsibility for the supply and correctness of the technical specification and design data is with the Lead Electrical Engineer.





# Discipline Interfaces- Special Attention





# Design Considerations

1. One centralized substation for each unit
2. Environmental conditions
3. Structural analysis
4. Logistics and transportation
5. Battery banks in prefab
6. Cable tray sizing in Cable cellers
7. Floor/ wall penetrations & fire rating
8. Elevation and under structure
9. LV , MV switchgear
10. Equipment clearances
11. Ship loose items



# Design Considerations

## 1. Environment Conditions

Building to be designed for the most severe environment conditions expected during design life

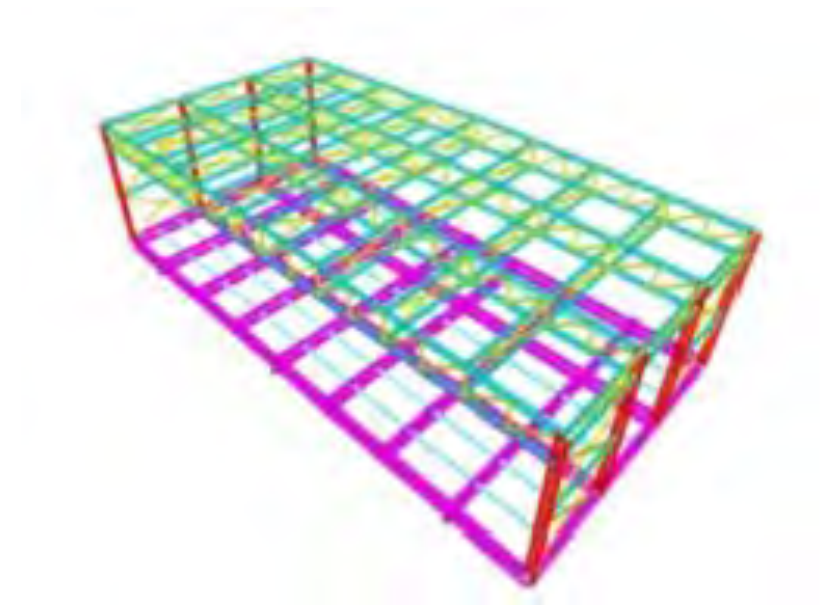
- Ambient temp and humidity
- Corrosion from atmospheric conditions
- Sandstorms
- Extreme wind velocities
- Seismic events
- Blast/ overpressure events
- Fire protection
- IP66



# Design Considerations

## 2. Structural Analysis

- Structural analysis is also done but by vendor.
- They take care of dead load- static load, lifting & transport deflection
- Live load which includes wind load, ice load, seismic load, blast overpressure





# Design Considerations

## 3. Logistics and transportation

- Limiting factors in design & manufacturing of prefab buildings are:-
  - ✓ Transportable max weight and dimensions (by road, rail, ship) from manufacturing yard to site
  - ✓ Site access (roads, offloading & lifting access)
  - ✓ Manufacturing restrictions of the fabricator facilities
- Max weight & dimensions of the building/ section will be different for each project
- Single piece building to be utilized wherever possible





# Design Considerations

## 4. Battery banks - Battery technology defines design requirements

Valve regulated battery do not require any separate rooms. They work on oxygen recombination principle and do not emit gas under normal conditions

Lithium batteries are also used depending on capacities

Parameter	NiCad batteries	VRLA Batteries
Temperature tolerant	Yes	No
Life Span	25-years	7-10 years
Hydrogen emissions	High	Very Low
Separate room required	Yes	No (unless very big)
Room ATEX rating	Zone 2 Ex'e' IIC T5	N/A
Ventilation / HVAC	ATEX Ventilation	HVAC (temp critical)
Acid spill hazard	Yes	No
Price	High	Low





# Design Considerations

## 5. Floor/ Wall penetrations

- Floor and wall penetrations- careful planning is essential at design stage
- Fire Rating- Wide range of insulating materials are available
- For raised buildings cable entry is from below but side and top entry are possible too with careful sealing

Cable entries possible by

- ✓ Gland plates
- ✓ Multi cable transits

Internal cabling can be

- ✓ Under floor
- ✓ overhead ladder





# Design Considerations





# Design Considerations

## 6. Elevation and Under structure

- Understructure is possible with concrete or steel legs
- Min elevation is kept approx. 1.8 m to allow easy access for cable management and bending radius
- Stairs and access platforms must be provided for personal access/ equipment access

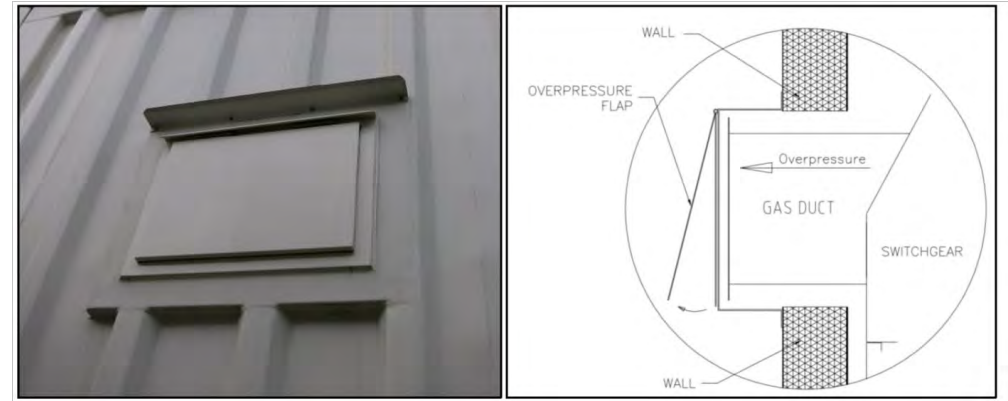




# Design Considerations

## 7. LV/ MV Switchgear

- Efficient layout/ Splitting system, clearances
- Future expansion/ Spare space provision
- Cable entry- top versus bottom, front versus rear
- Bus duct interfaces
- HV Gas ducts- Special attention will be taken if personal walkways cross the blow out openings of the gas ducts.





# Courtesies & References

- Project execution experience of different geographies including North, South America, Africa, Europe, Australia
- Project site experience and supplier interactions



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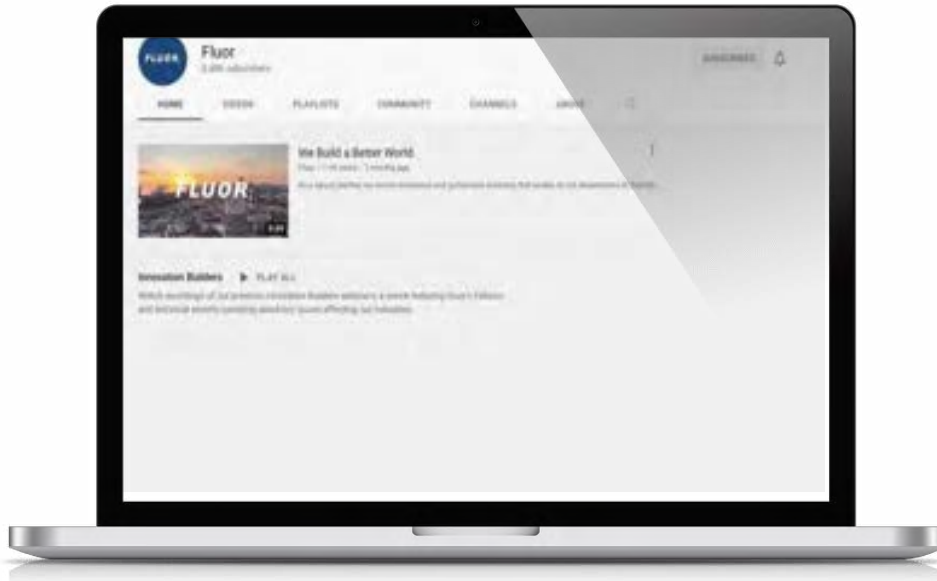
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# Building System Durability & Reliability by Designing Smart Equipment Protection

Enhancing reliability through effective equipment strategies

Lallit Puri / Vipin Pandey

May-2025





# Equipment Protection Selection Process



## Onjectives

- Understand Different Type of Enclosure Material Available
- Understand How to specify the best Enclosure Material
- Understand different factors to dertmine enclosure mateial





## Industrial Enclosure Material Types

	Material	Ratings	Indoor / Outdoor	Typical applications
Metals	Mild steel	TYPES 1, 12, 3R, 4 IP20/30/54/55	Indoor Outdoor non-corrosive	Industrial & commercial applications
	304 stainless steel	TYPE 4X IP66/69K	Indoor/Outdoor	Food & Beverage
	316L stainless steel	TYPE 4X IP66/69K	Indoor/Outdoor	Oil & gas, especially offshore oil platforms
	Aluminum	TYPE 4X IP66	Outdoor	Telecommunications
Non-metallics	Poly-carbonate	TYPE 4X IP66	Indoor/Outdoor	Electronics & instrumentation
	ABS	NEMA 4X (non-UL) IP66	Indoor/Outdoor	Electronics & instrumentation
	Polyester	TYPE 4X IP66	Outdoor	Water treatment facilities
	Fiberglass	TYPE 4X IP66	Outdoor	Oil & gas

**Different Material affect Enclosure Performance**



## Factors Determining Enclosure Materials

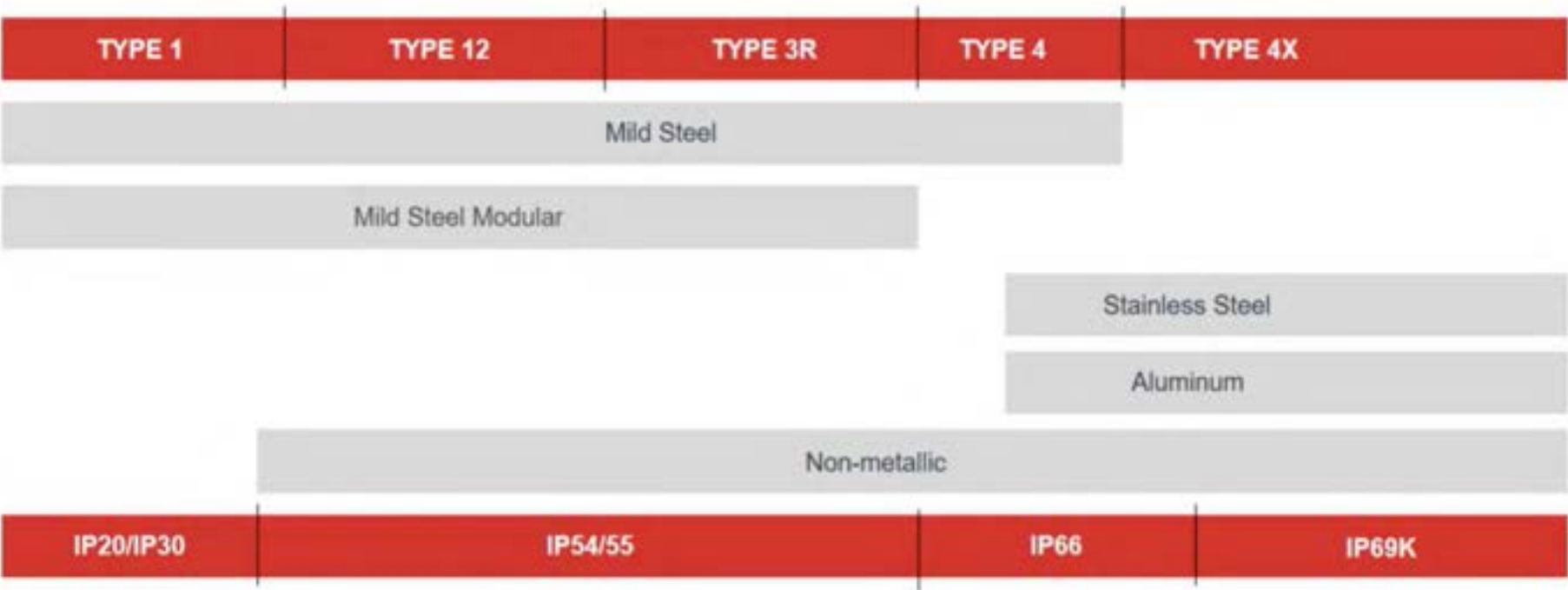
- Environmental considerations
- Chemical resistance
- Heat absorption & dissipation
- Flexibility & ability to modify
- Impact resistance & material strength
- Weight considerations
- Aesthetics
- Purchase price



**Many Factors to consider**



# Environmental Considerations



Environmental ratings a primary factor in material selection



# Chemical Resistance

	Solvents	Alkalis	Acids
Recommended	304 stainless steel 316 stainless steel Fiberglass Aluminum Polyester	304 stainless steel ABS Polyester	304 stainless steel 316 stainless steel ABS Polyester Polycarbonate
Satisfactory	Mild steel (painted) Polycarbonate ABS	316 stainless steel Polycarbonate Fiberglass	Fiberglass
Limited use		Mild steel (painted) Aluminum	Mild steel (painted) Aluminum

Hoffman has tested these materials extensively





## Heat Absorption & Dissipation



**Louvers, Solar Shields or Active Cooling components can be added**



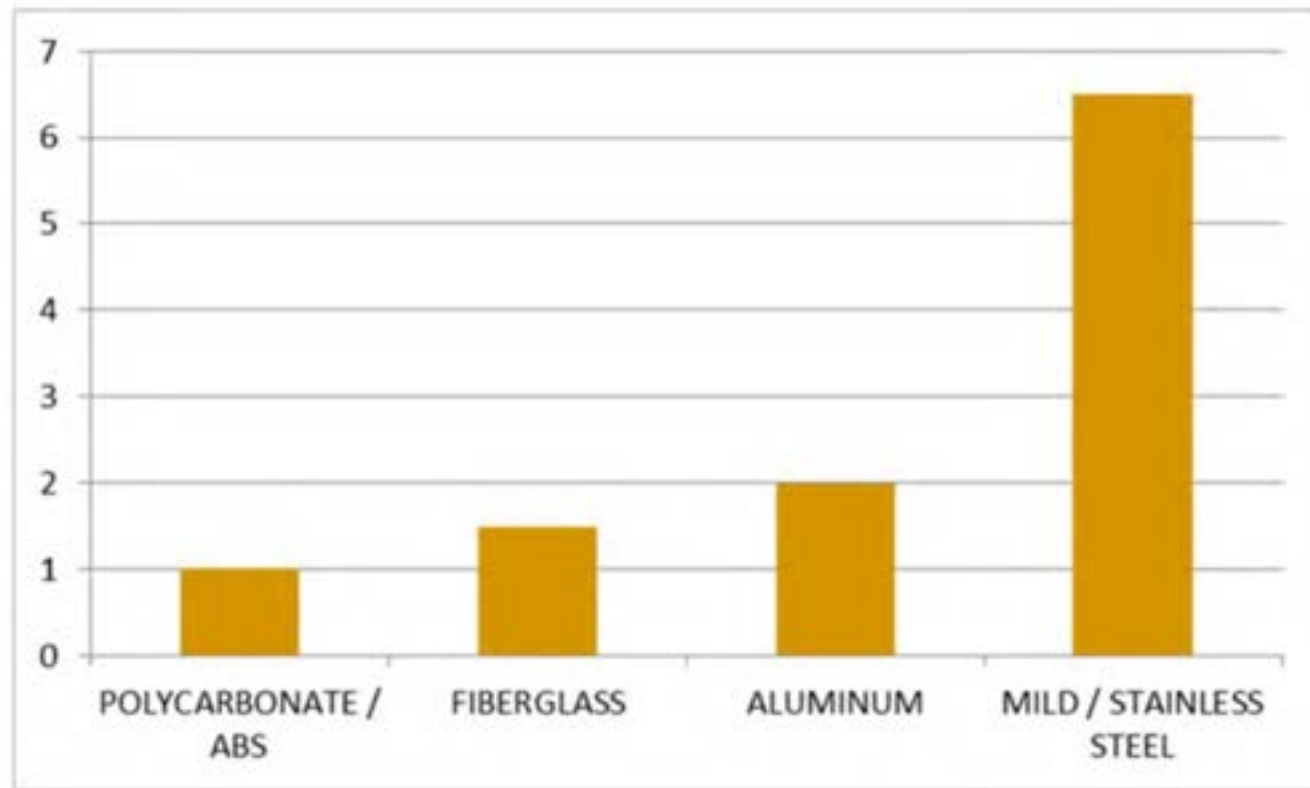
## Sizing Flexibility & Ability to Modify



**Hoffman can provide Modified Features from Factory**



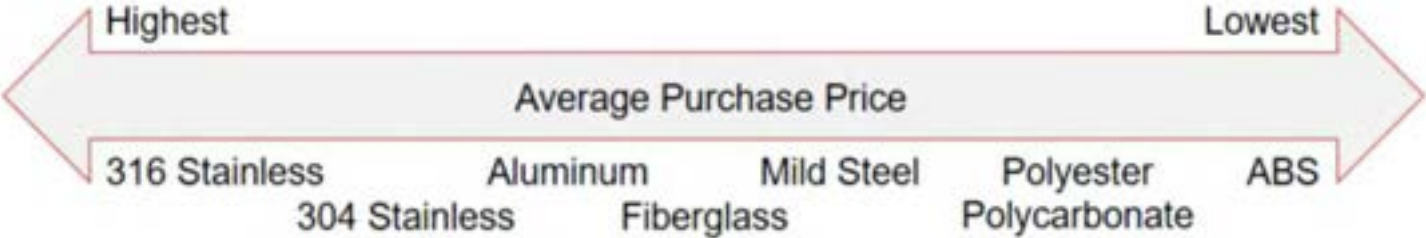
## Weight Considerations



**Must take into account Weight of the Enclosed Equipment**



# Purchase Price





# Hazardous Area

---

## CASE 1





# WHAT ARE HAZARDOUS LOCATIONS?

## DEFINITION:

Areas where flammable liquids, gases, vapors or dusts are present creating risks for fires and explosions.

## SO WHAT?

Equipment used in these areas must be specifically designed and installed to prevent explosions.



OIL & GAS



PETROCHEMICAL



POWER GENERATION

Other industries include waste water treatment, chemical, grain elevators, pharmaceutical, food processing, flour silos and mills

**Hazardous locations are present in many industries and plants**

### DEFINITION:

Areas where flammable liquids, gases, vapors or dusts are present creating risks for fires and explosions.



# PROPERTIES OF EXPLOSIONS

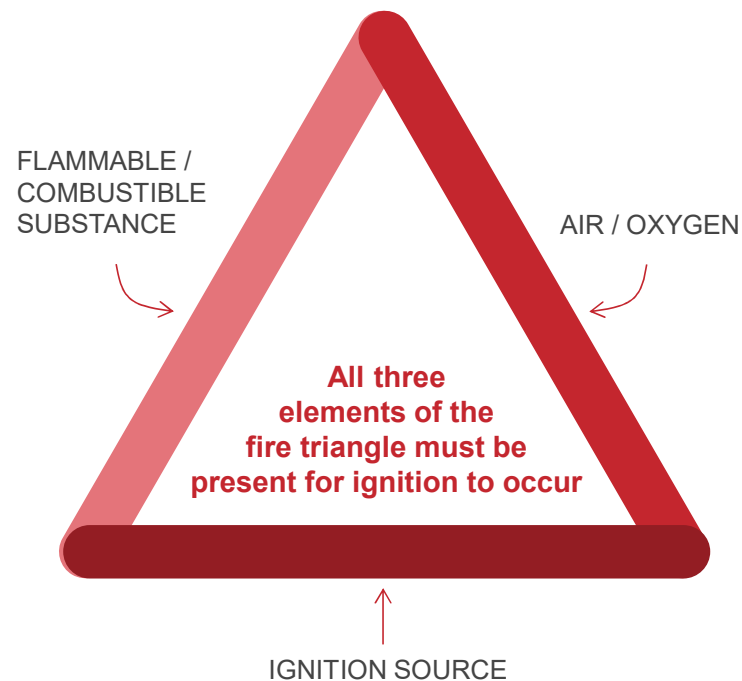
## FLAMMABLE SUBSTANCES

- Gases such as acetylene, hydrogen, ethylene and propane
- Metal powder dusts such as aluminum or magnesium
- Agricultural dusts such as grain, flour and sugars

## IGNITION SOURCE

- Sparks or high heat from electrical equipment

## FIRE TRIANGLE



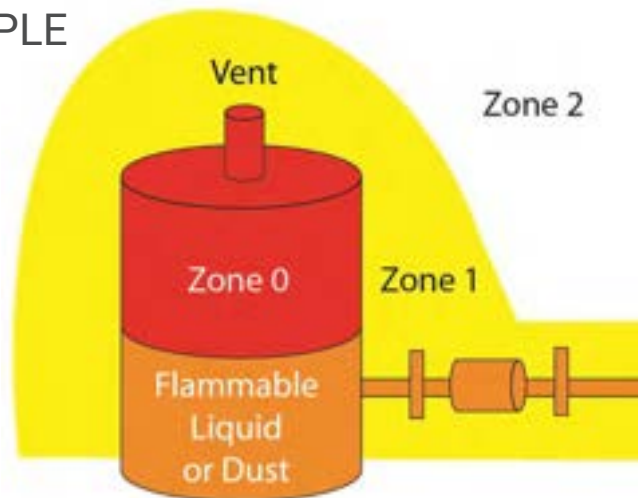
**Proper Equipment is Vital to Preventing Explosions**



# ATEX / IECEx Use Zone Classification



LIQUID, GAS OR  
VAPOR EXAMPLE

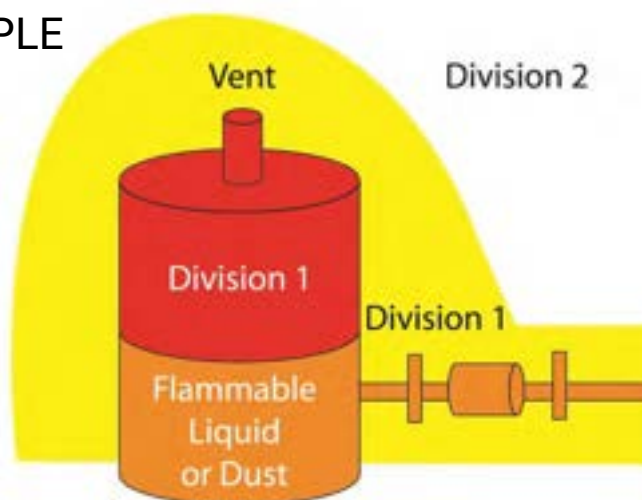


FREQUENCY	GAS, LIQUID, VAPOR	DUST, FIBERS, FLYINGS
Continuously	Zone 0	Zone 20
Intermittent / Periodic	Zone 1	Zone 21
Abnormal Condition	Zone 2	Zone 22



## NEC Class & Divisions Classification

LIQUID, GAS OR  
VAPOR EXAMPLE



FREQUENCY	GAS, LIQUID, VAPOR	DUST	FIBERS, FLYINGS
Continuously	Class I, Division 1	Class II, Division 1	Class III, Division 1
Intermittent / Periodic	Class I, Division 1	Class II, Division 1	Class III, Division 1
Abnormal Condition	Class I, Division 2	Class II, Division 2	Class III, Division 2



# Critical Elements

Hazardous Area  
Corrosivity Category (Environmental)  
What needs to housed inside  
Protection Concept Chosen  
Type of Accessories required

Zone-1/2/Zone-20/21/22  
Solvents/Alkalie/**Acids**  
Arc Flashing comments  
Exd/Exp/**Exe**/Exia etc  
Window Kits, Breather Drains, Lights, Door  
Switch, Heater, Cooling Unit etc

Solution:  
Exe Enclosure in SS316L Material with  
Window Kit and Heater





# Case-2 Marine Application





## Critical Elements

Highly Corrosivity Environment  
Tea Staining  
AirTight and Water tight Enclosures  
Type of Accessories required

C5M Powder Coated SS316L  
IP66/Nema Type 4x Enclosure  
Window Kits, Breather Drains, Lights,  
Door Switch, Heater, Cooling Unit etc

Solution:  
An IP66/Nema4x Enclosure with C5M  
coated





## Environmental Specification Requirements - Corrosive Environment



### Corrosive Marine Environments

Marine applications are frequently exposed to corrosive environments, particularly due to saltwater, which can damage equipment.



### Equipment Design Considerations

To prevent premature failure, equipment must be specially designed to withstand harsh marine conditions, ensuring durability.



### Preventing Premature Failure

Special coatings and materials are often necessary to prevent corrosion and extend the lifespan of marine equipment.



## Design Principles: Certification Requirements



### Durability Standards

Marine equipment must adhere to strict durability standards to withstand harsh environmental challenges, ensuring reliable performance.



### Environmental Challenges

Moisture and corrosion are significant challenges for marine equipment, requiring certification for prolonged function and safety.



### Certification Requirements

Specific certification requirements ensure that marine equipment meets the necessary standards for durability and safety in marine environments.





# Critical Elements - Material Selection, Powder Coating, Selection of Right Accessories

## **Corrosion-Resistant Materials**

Choosing materials that resist corrosion is vital in marine applications to ensure longevity and reliability.

## **Powder Coating Benefits**

Applying powder coating provides an additional layer of protection against harsh marine environments, enhancing durability.

## **Selecting Accessories**

Choosing the right accessories is crucial for ensuring the functionality and protection of marine equipment.



# Practical Case Study





## Lessons Learned and Best Practices

### Key Lessons Learned

The case studies highlight important lessons that can improve equipment protection and enhance system reliability in various sectors.

### Best Practices

Adopting best practices in equipment protection design can lead to increased efficiency and reduced downtime in operations.

### Industry Application

The insights gained can be applied to multiple industries, ensuring robust equipment protection and operational success.



# Conclusion

## Importance of Equipment Protection

Smart equipment protection is essential for ensuring the durability and reliability of systems across various applications.

## Selection Process

Understanding the selection process for protective equipment involves assessing various factors for optimal performance and safety.

## Hazardous Area Requirements

Hazardous area requirements must be considered to ensure equipment operates safely in challenging environments.

## Learning from Case Studies

Analyzing case studies offers valuable insights that can inform better practices in equipment protection and safety.



# APPENDIX

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# Global Certification Map

## MANY REGIONAL STANDARDS EXIST

NEPSI – China

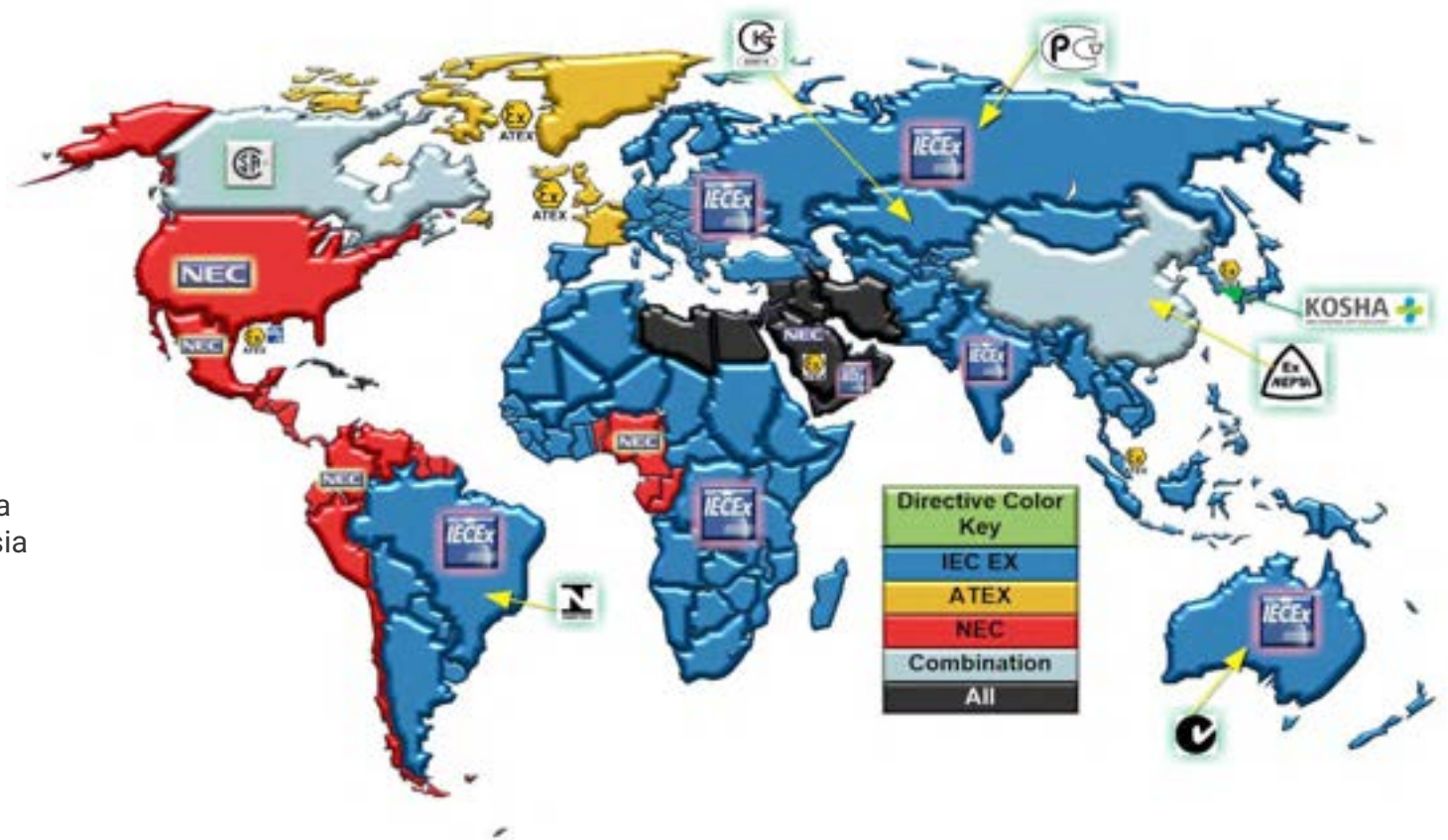
INMETRO – Brazil

ANZ – Australia

KOSHA – Korea

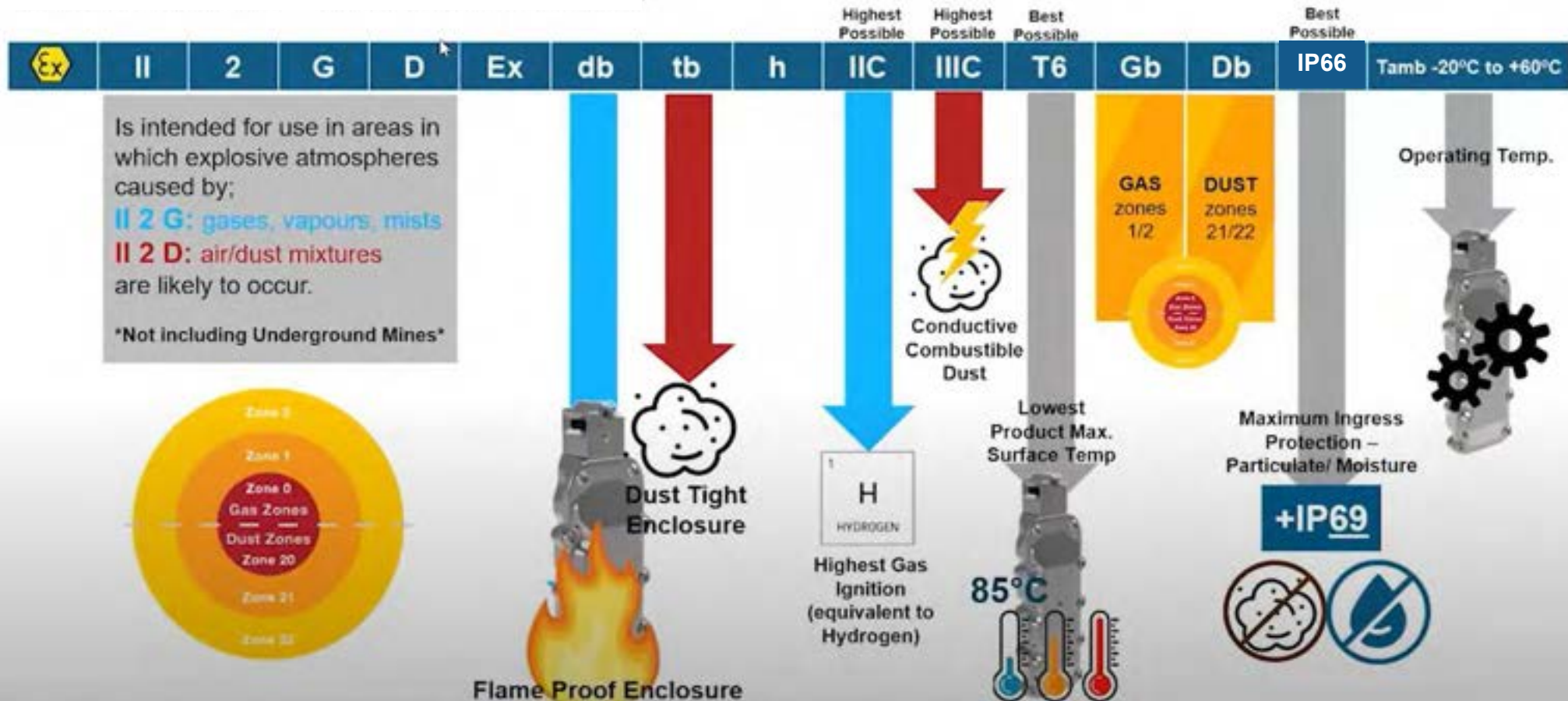
GOST-R – Russia

PESO – India





# Typical Example and Interpretation of Ex marking





# Protection Concept Used in Enclosures

---





# Protection Concept Exd

**Standard:** IEC 60079-1

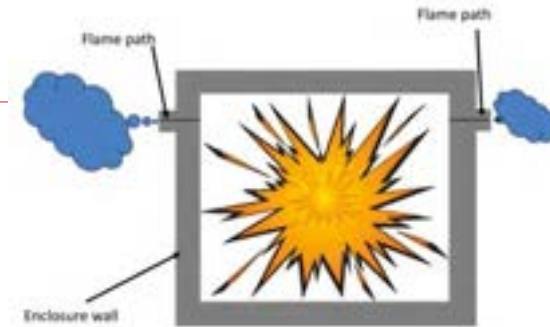
**Basis of Protection:** Parts which can ignite an explosive atmosphere are enclosed in an enclosure, that withstands explosion pressure in its inside and prevents the transfer of explosion to the environment.

## Pros

- Exd protection can be applied to various types of electrical equipment, including motors, switches, control panels, and lighting fixtures. This versatility allows for the use of a wide range of equipment in hazardous areas.
- Exd protection has been used for many years and has a track record of success in preventing explosions in hazardous environments.

## Cons

- Potentially higher initial cost compared to alternative protection methods. The construction of explosion-proof enclosures with specialized materials and design features can increase the overall expense of the equipment
- Explosion-proof enclosures are often heavier and bulkier than their non-explosion-proof counterparts. This increased weight and size can be a limitation in applications where space and weight are critical factors.





# Protection Concept Exp

**Standard:** IEC 60079-2

**Basis of Protection:** Keeping the flammable substance and Oxygen away from the source of ignition by Over Pressure.

## Pros

- Can be used in Few limitations on the nature of the equipment that may be placed in the enclosure
- No limits on the size of the enclosure
- Several enclosures can be connected
- All flammable gases or dusts of all groups may be involved

## Cons

- Enclosures and ducting may leak
- Energy costs required to supply and maintain air or inert gas may be prohibitive
- The operational delay while purging takes place
- Items inside the enclosure must be arranged in order to avoid air pockets or hazardous gases being trapped and therefore not adequately purged





# Protection Concept Exe

**Standard:** IEC 60079-7

**Basis of Protection:** Elimination of source of Ignition

- Arcs, sparks, and hot surfaces are avoided
- Creepage and clearance between the bare conductive parts must meet the requirements of the Standards.

## Pros

- Exe equipment is often considered more cost-effective compared to Exd alternatives.
- No limits on the size of the enclosure
- Exe equipment may be easier to maintain compared to explosion-proof alternatives.
- Retrofitting existing installations with Exe equipment may be more feasible than retrofitting with explosion-proof alternatives.

## Cons

- Relays, Switches, Circuit Breakers or any Type of Make/Break Components can't be installed.
- Evaluation of the whole system is required





# Temperature Class and Auto Ignition Temp

---





# Temperature Class Vs Auto-Ignition Temperature of the Explosive Gases in Hazardous Area

## Temperature Classes

Defines max surface temperature

T-Class	°C
T1	450 °C
T2	300 °C
T3	200 °C
T4	135 °C
T5	100 °C
T6	85 °C

## Auto Ignition of Gas

(Temp at which mixture Air/Gas will Spontaneously ignite with any additional source of Energy)

GAS	AUTO-IGNITION TEMP °C
HYDROGEN	560 °C
ETHYLENE	425 °C
DIESEL	200 °C
DIETHYETHER	135 °C
CARBON DISULPHINE	95 °C

**The Temp Class must always be lower Auto Ignition Temp of the Gas present**



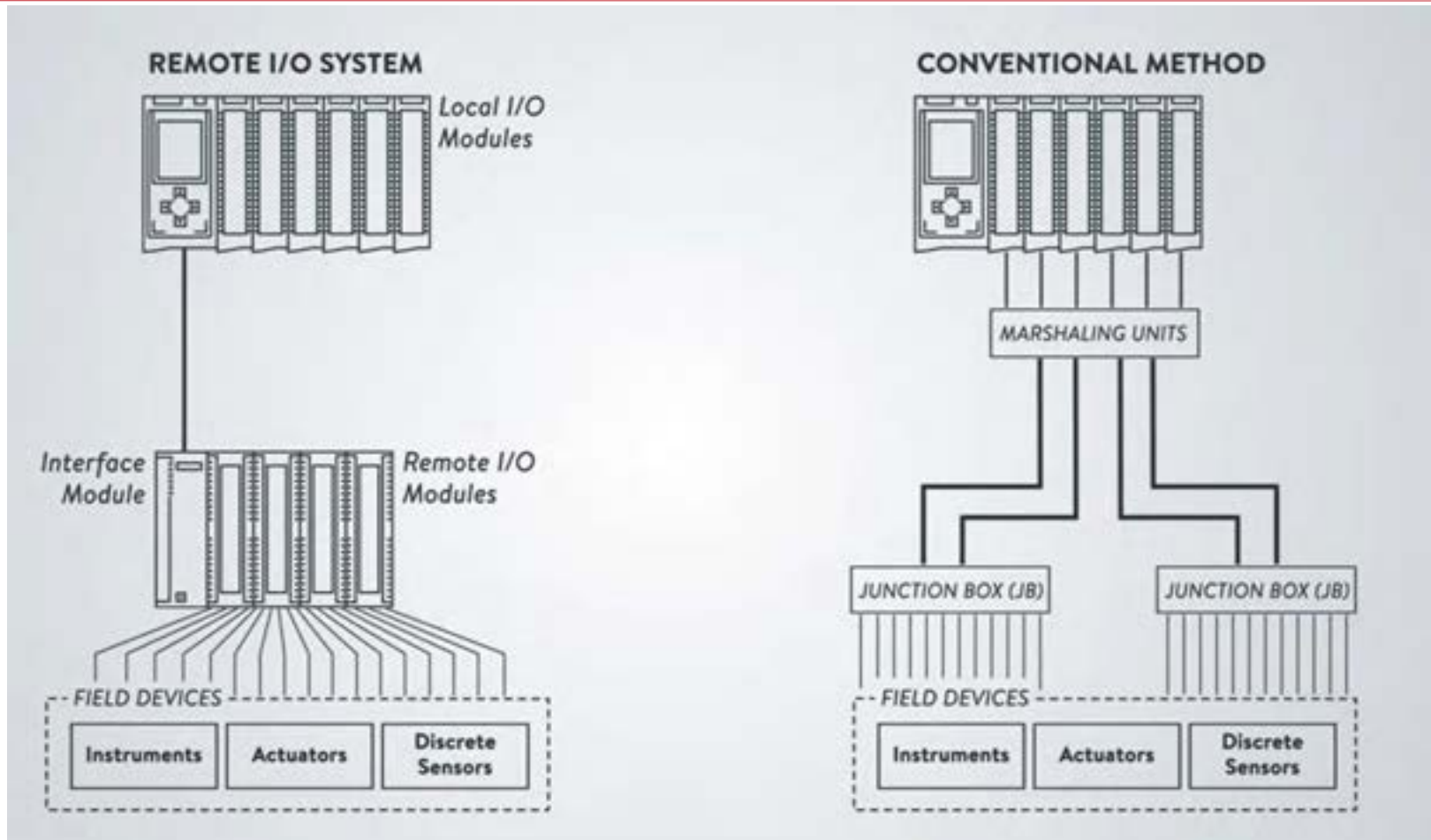
# Remote IOs for Zone-1 & Zone-2 Hazardous Location Areas

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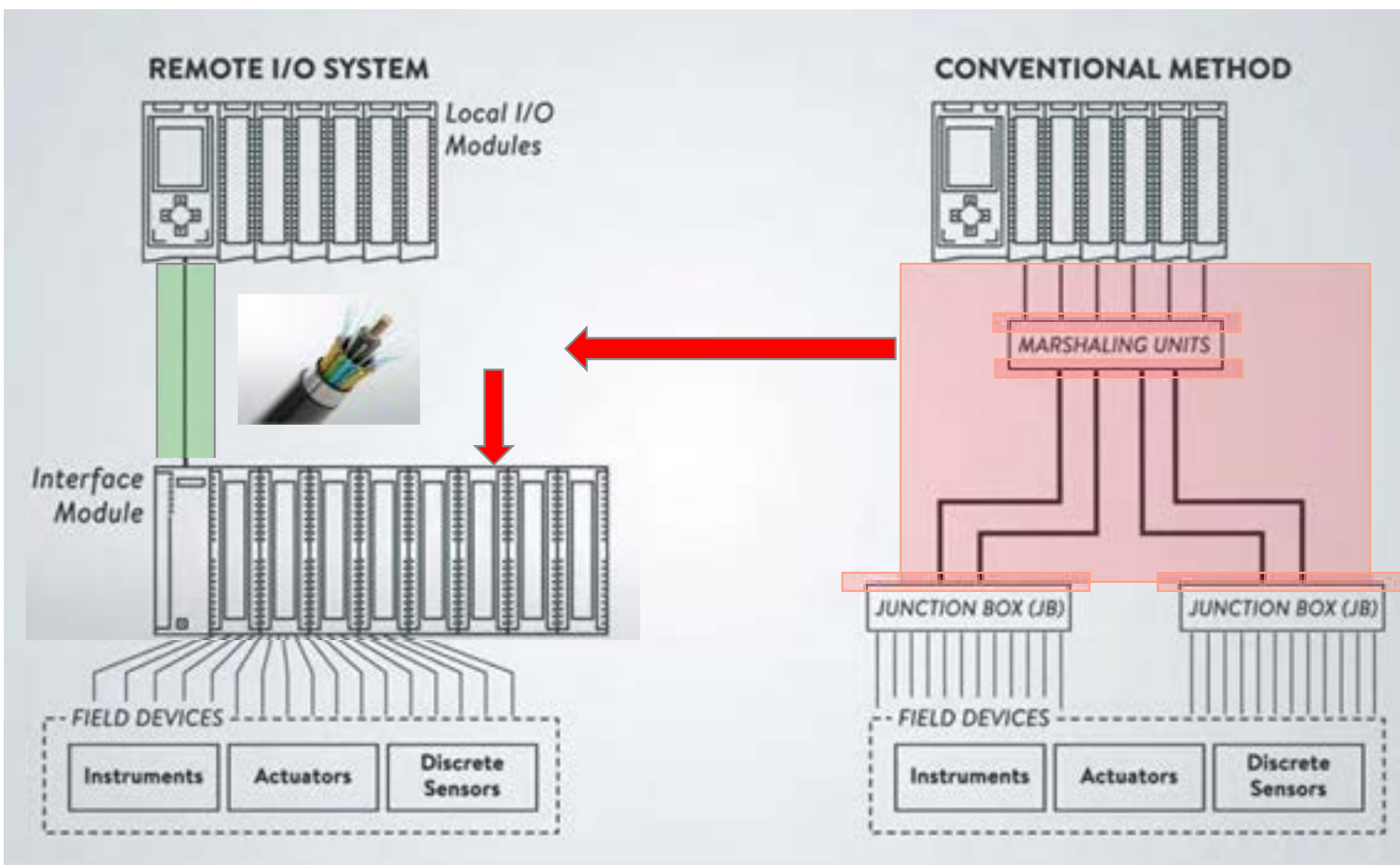


## Remote I/O system V/s Conventional System





## Remote I/O system Benefits



- Using Remote Input and Output Systems reduces the amount of cable, conduits and time spent on cabling works and result in spending much less money.
- Furthermore, it almost halves the No of termination points which also saves lots of time. It is also major decrease in points of failure as a result it makes our lives easier in trouble shooting.
- This method also eases the expanding phases of the project
- With use of Fiber Optics Technology and using some Convertors we can bring the data which from Kilometers away to main control panels



# Enclosures and Accessories for Hazardous Locations

---





# Zonex Enclosure Overview



Non Metallic Enclosure



Screw Cover Enclosure



Hinge Cover Enclosure

## ACCESSORIES



Window Kit



BREATHER DRAIN



Hole Seals



Thermal Management



Purging and Pressurization



# ZONEX ENCLOSURES – Stainless Steel



- Increased Safety (Ex e)
- Zone 1, 2, 21 and 22

## EASY INSTALLATION



**Welded, full-width, top and bottom wall-mounting brackets**

## CORROSION RESISTANCE FOR LONG SERVICE LIFE



**Corrosion resistant 316 stainless steel construction**

## SECURE SEALING TO PROTECT EQUIPMENT



**Continuous one-piece polyurethane gasket seal** (optional silicone for high-temperature)



- Increased Safety (Ex e)
- Zone 1, 2, 21 and 22

## EASY INSTALLATION



**Wall mounting brackets** heavy-duty 2.5-mm (12 gauge) welded-on brackets on top and bottom

## EASY ACCESSIBILITY



**316 stainless steel slotted 1/4-turn door latch**

## SECURE SEALING TO PROTECT EQUIPMENT



**Polyurethane gasket seal** for protection against water and dust ingress (optional silicone for high-temperature applications)



- Increased Safety (Ex e)
- Zone 1, 2, 21 and 22

## EASY INSTALLATION



**Heavy-duty horizontal wall mounting brackets** for single-person installation

## EASY ACCESSIBILITY



**180-degree opening door** easily removed by lift-off hinge

## SECURE SEALING TO PROTECT EQUIPMENT



**Silicone gasket seal** protects against water and dust ingress in high-temperature applications



## Customized ATEX & IECEx Enclosures

- Product certification covers configurations beyond standard offering
- Freestanding enclosure often used for OEM applications
  - Distributed control systems
  - SCADA & RTU panels
  - Compressor control panels
  - Blow out prevention systems
- Other applicable modifications
  - Materials: SS304
  - Modified gland plates
  - Holes, cutouts, paint
  - Custom plinth bases
  - Super durable paint options



HEIGHTS  
100-2289  
MM

WIDTHS  
100-1000  
MM

DEPTHS  
76-1000  
MM

**MultiDoor Option also Available**

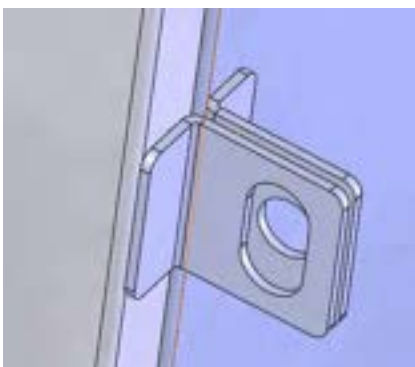


**No One Can Replicate or Exceed Our High Quality Design!!!**



## Padlocking Option

### Welded Brackets



- Cheapest Option
- Can be used with all ATEX/IECex/Aex Applications

### Wing Knob (PTWPSS)



- Can be used with all ATEX/IECex/Aex Applications
- Ideal for Wall Mount applications

### PadLocking Latch Kit (WSLPL)



- Can be used with all ATEX/IECex/Aex Applications
- Ideal for Wall Mount applications

### PadLocking Handle (WSHPL)



- Can be used with all ATEX/IECex Applications
- Ideal for Free Standing Applications

**Choose from a Wide Selection of Padlocking Option & Now we can also offer the Compression Locks**



# Thank you



# Timeline for Hazardous Location Standard







**Delhi**  
**Section**

*Setting the Standard for Automation™*

# VEGA Solutions in Green Hydrogen

# **VEGA**

ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)

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# THIS IS HOW IT LOOKS AT **VEGA**

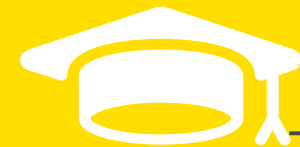


Headquarters in *Schiltach*,  
Germany

1,200



Employees  
in Schiltach



80

Trainees

WORLDWIDE  
2,400 EMPLOYEES



**supfina**

***grieshaber***  
PRECISION





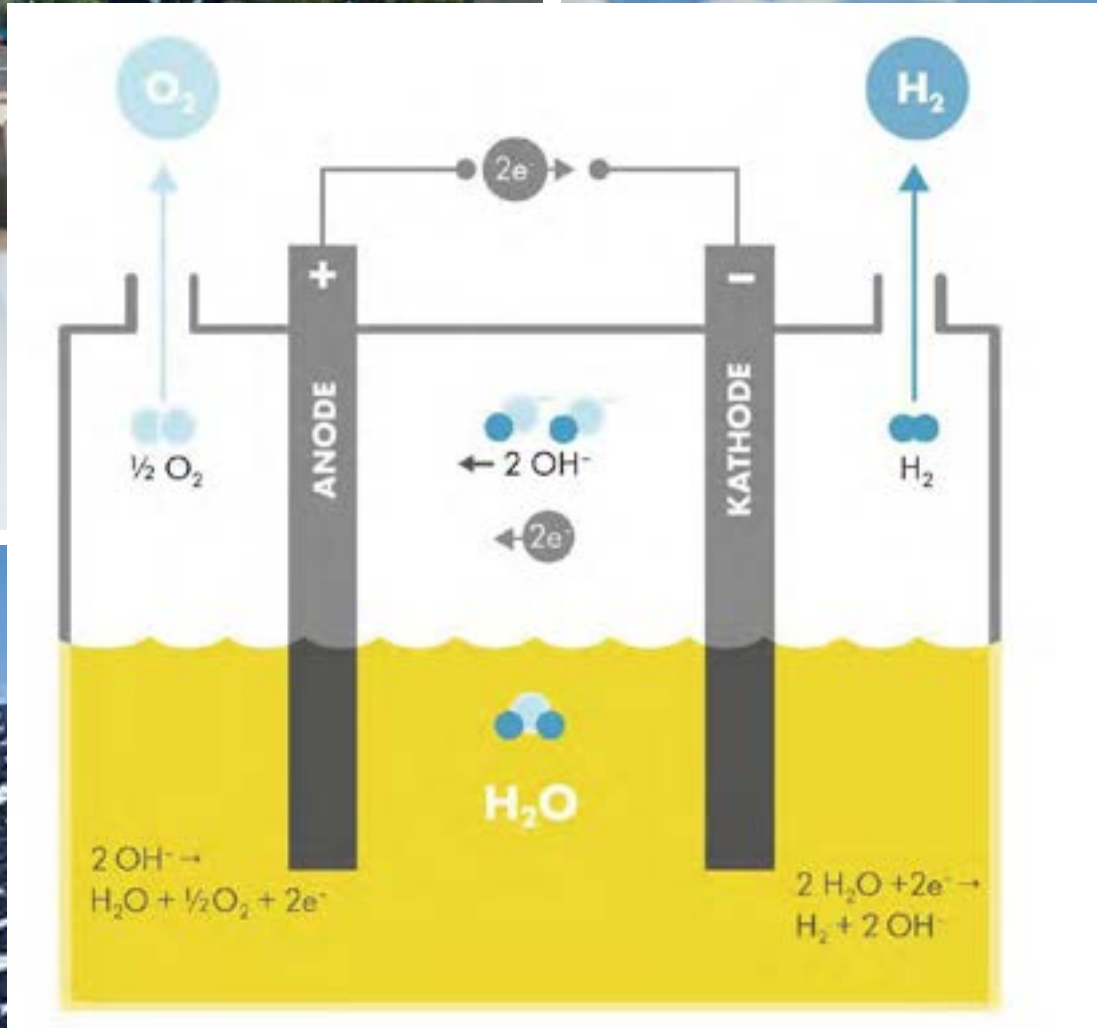
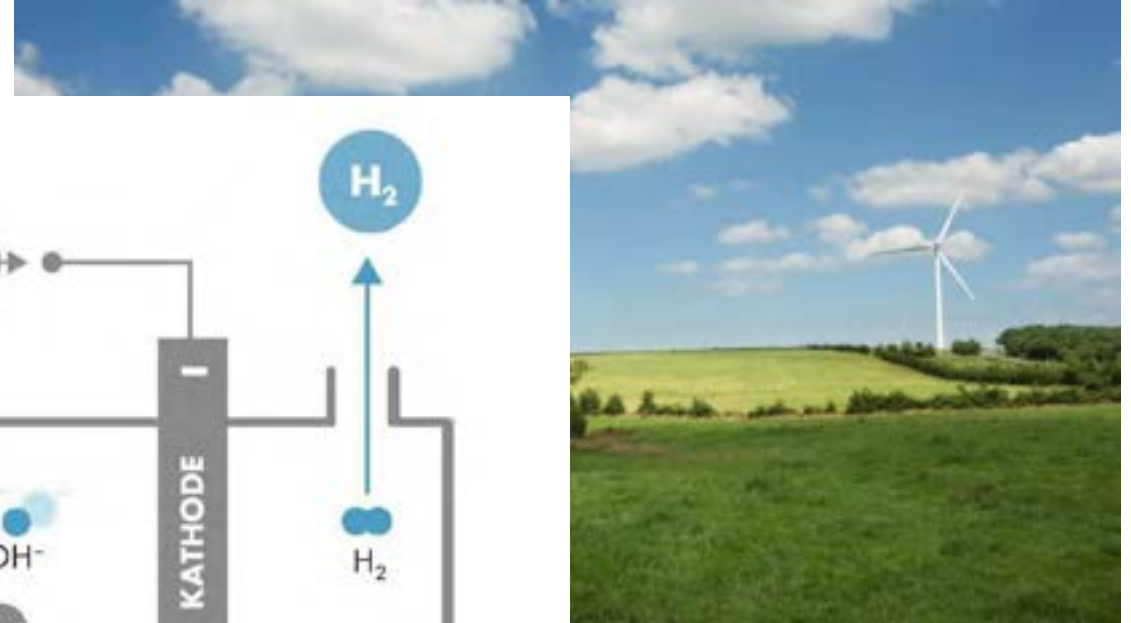
Industry information

# Green Hydrogen Applications

**ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)**



# Green Hydrogen





# Alkaline Electrolyzer



ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)



# Alkaline Electrolyzer



VE stacks



# Alkaline Electrolyzer – H<sub>2</sub> & O<sub>2</sub> Separators



**Application : KOH + Water + H<sub>2</sub> traces**  
**Temperature : 100 to 120degC**  
**Pressure : Atm**

## **VEGA Solutions**

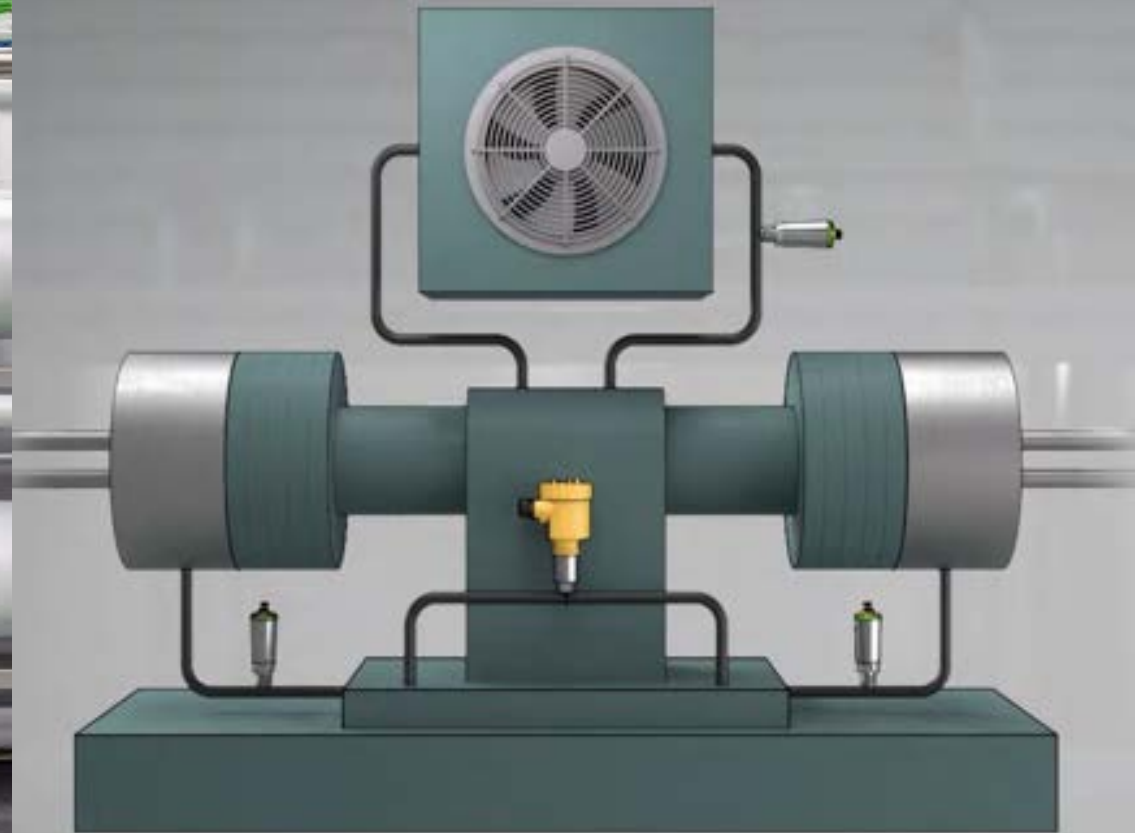
- 1) Guided Wave RADAR sensor**
- 2) Differential Pressure Transmitters**



# Hydrogen Compressor



Application : H<sub>2</sub> gas  
Pressure range : 350 to 750bar  
VEGA Solution : VEGABAR 83 with Dry measuring system





# Hydrogen pipeline



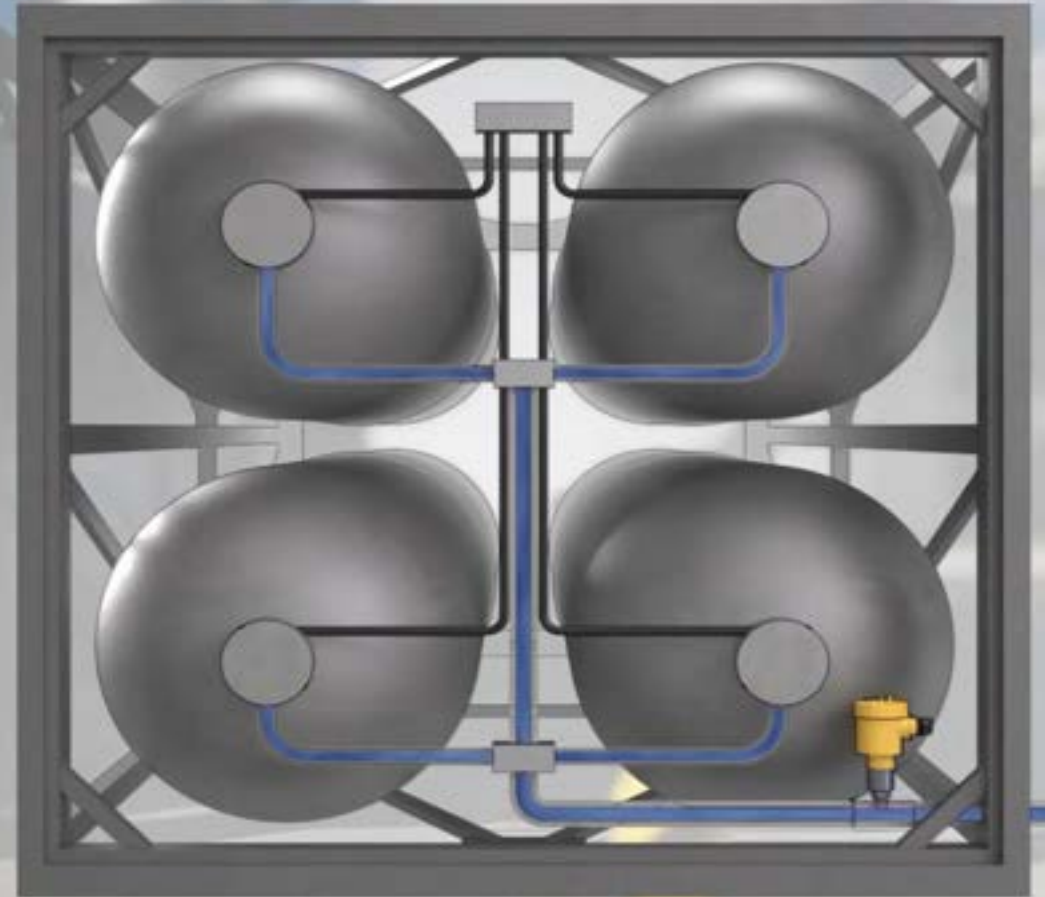
**Application : H<sub>2</sub> gas**  
**Pressure range : 350 to 750bar**  
**VEGA Solution : VEGABAR 83 with strain gauge**



# Hydrogen Storage tank



Application : H<sub>2</sub> gas  
Pressure range : 350 to 750bar  
VEGA Solution : VEGABAR 83 with Dry measuring system







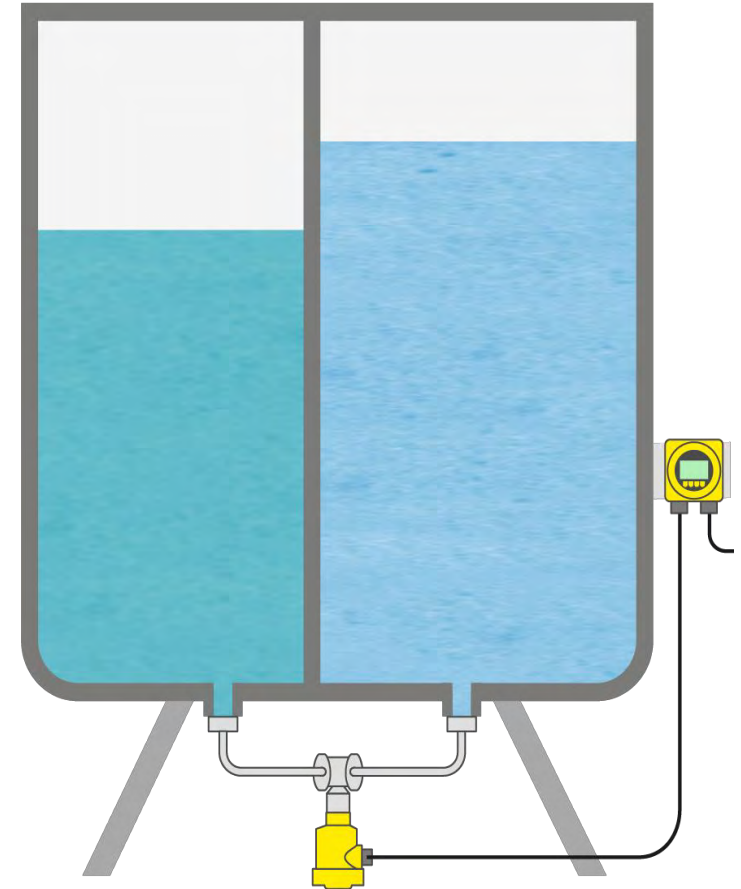


# Osmosis filter

- Drinking water supply



## Differential pressure measurement



### VEGA Solution

- 1) VEGADIF 85
- 2) VEGABAR 28 with Ceramic diaphragm & PVDF fitting



## PEM electrolyser



© NEUMAN & ESSER, NEA | HYTRON PEM, 2023

Application : Water + H<sub>2</sub> traces

Temperature : 120degC

Pressure : 35bar

VEGA solution : Non-Contact RADAR





# Hydrogen

- ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)



1	[1.00784, 1.00811]	atomic weight
H		acid-base prop of higher-valenc
1s <sup>1</sup>		crystal structure
hydrogen		physical state at 20 °C (68 °F)

Other nonmetals      Gas

Hexagonal      Equal relative strength

Britannica, Inc.





# Thank you

---

- ISA-D: "Petroleum & Power Automation Meet-2025" (PPAM-2025)

# HOME OF VALUES

VEGA



# AUTOMATION FOR POWER-TO-X

ROLE OF AUTOMATION IN GREEN AND CLEAN  
ENERGY INFRASTRUCTURE

TOPSOE



*Setting the Standard for Automation™*

By-

Atanu Ghoshal- Principal Engineer (Instrumentation)

Avneesh Sharma – Group Manager (Electrical)






# AGENDA

1. TOPSOE – EREACT™ TECHNOLOGY PLATFORM
2. EREACT™ POWER SUPPLY UNIT & AUTOMATION
3. EREACT™ TECHNOLOGY DEVELOPMENT
4. FIELD INSTRUMENTS FOR GREEN TECHNOLOGY UNITS.
5. FINAL CONTROL ELEMENT FOR GREEN TECHNOLOGY UNITS.
6. GAS ANALYZERS FOR GREEN TECHNOLOGY UNITS.
7. CAPACITY CONTROL FOR GREEN H<sub>2</sub> & GREEN NH<sub>3</sub> LOOP.
8. REMOTE IO (RIO) FOR DCS, ESD & FGS FOR MODULAR GREEN H<sub>2</sub> & GREEN NH<sub>3</sub> PLANTS.
9. QUESTIONS???

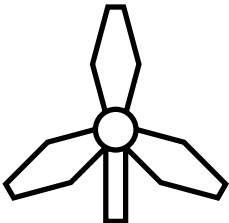


WHY eREACT™?

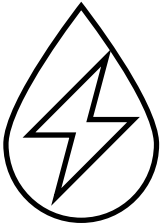
A GOOD FIT TO ENERGY TRANSITION AND FUEL DIVERFICATION



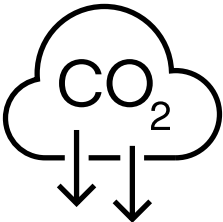
Demand for GHG emission reduction



Improved cost of renewable energy

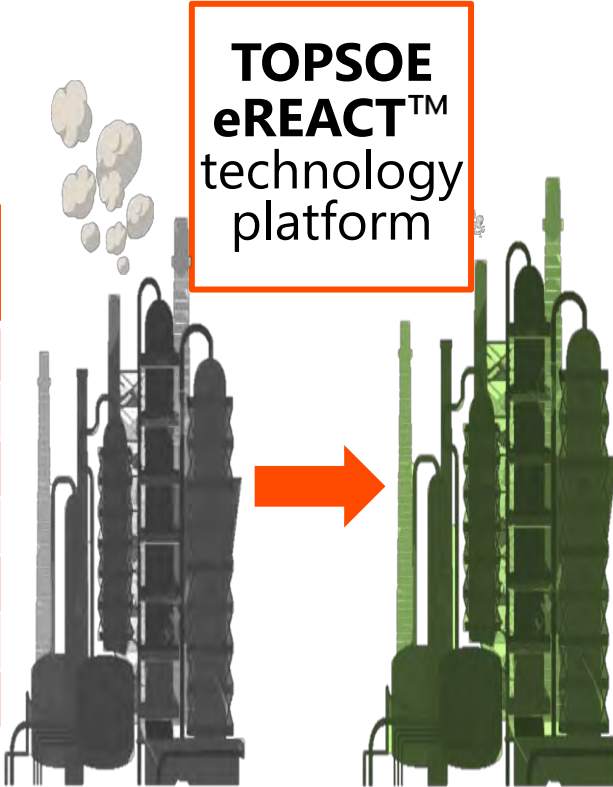


Increased focus on Power-2-X



Solutions for both blue and green chemicals and fuels

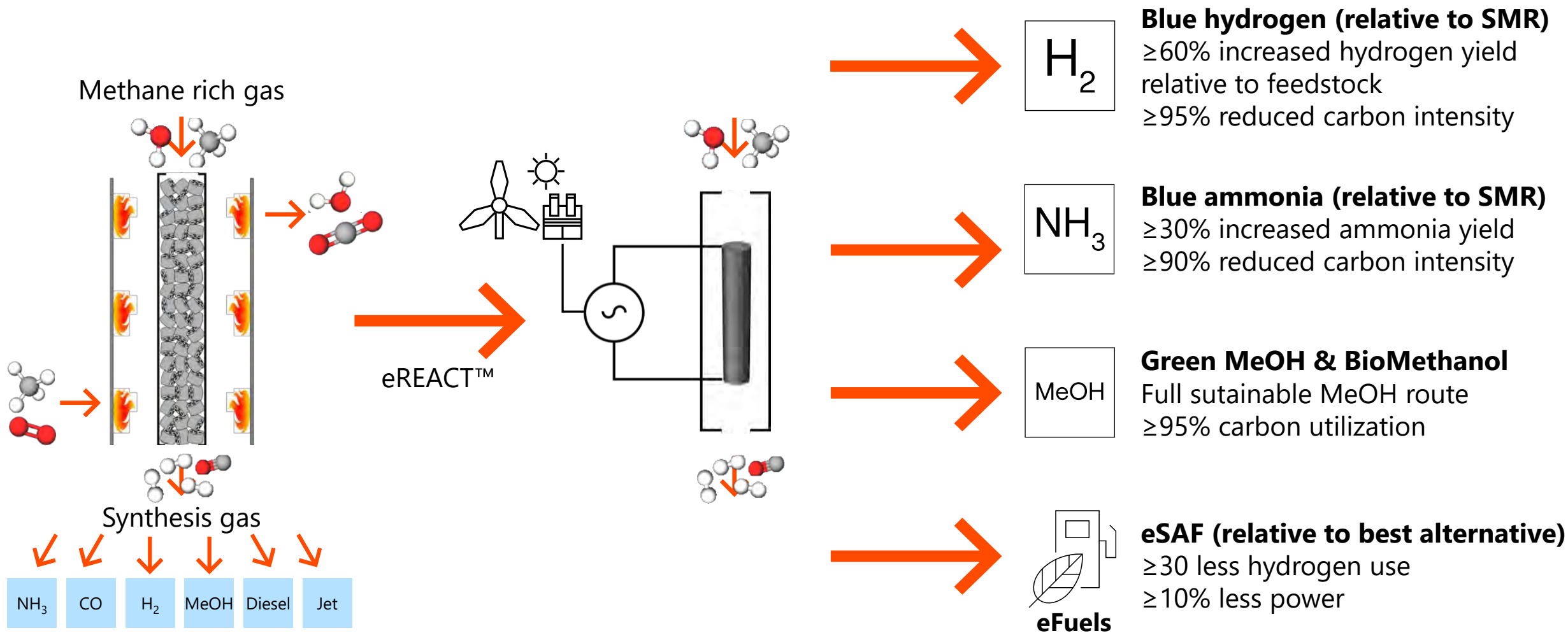
+	-
eSMR	Tubular reformer
PSU	Furnace
Preheater(s)	WHS
	Air blower
	Air preheater
	Fuel preheater
	Stack





# CHEMICAL SOLUTIONS BY EREACT™ TECHNOLOGY

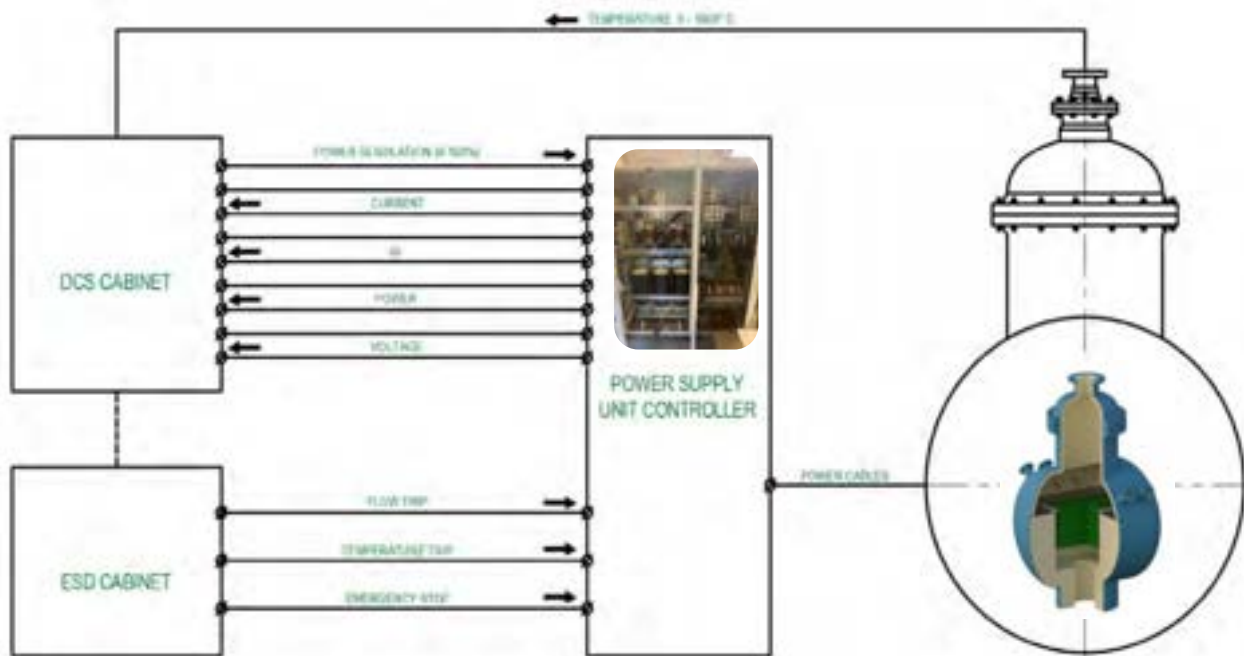
## THE NEW PLATFORM





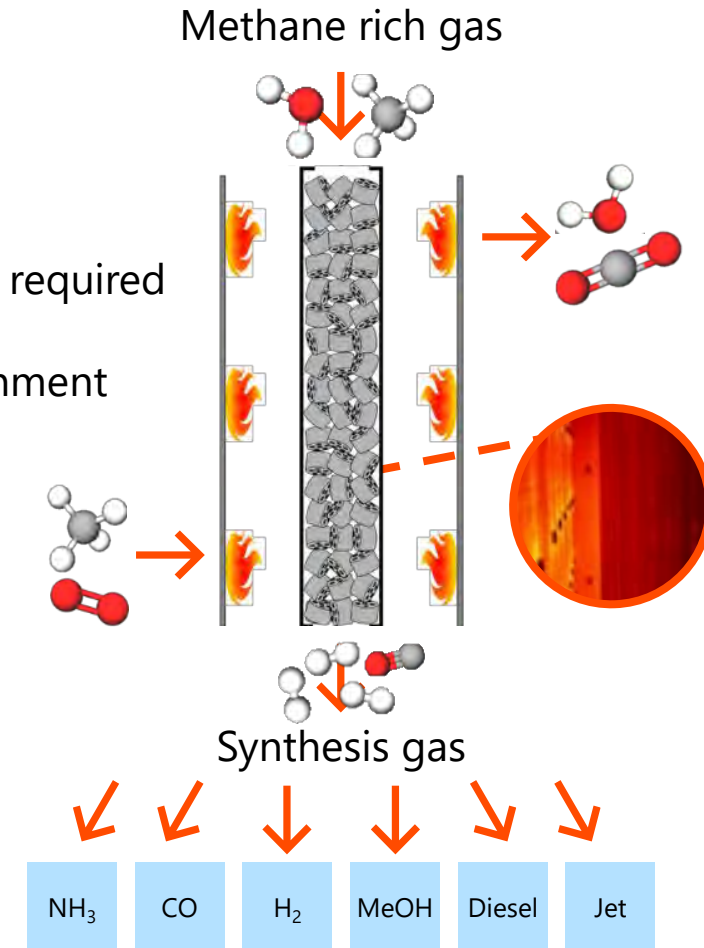
## eREACT PSU & AUTOMATION

- Smooth temperature control (0-100%)
- NO flame = NO combustible environment
- Modular in operation
- Simple start /stop procedure
- NO burners = NO adjustment by throttling air , fuel and feed lines
- Direct temperature/firing control



TOPSOE

- Flame monitoring
- Symmetrical pattern required for firing
- Combustible environment
- Complex algorithms





# PILOT SITE FOULUM

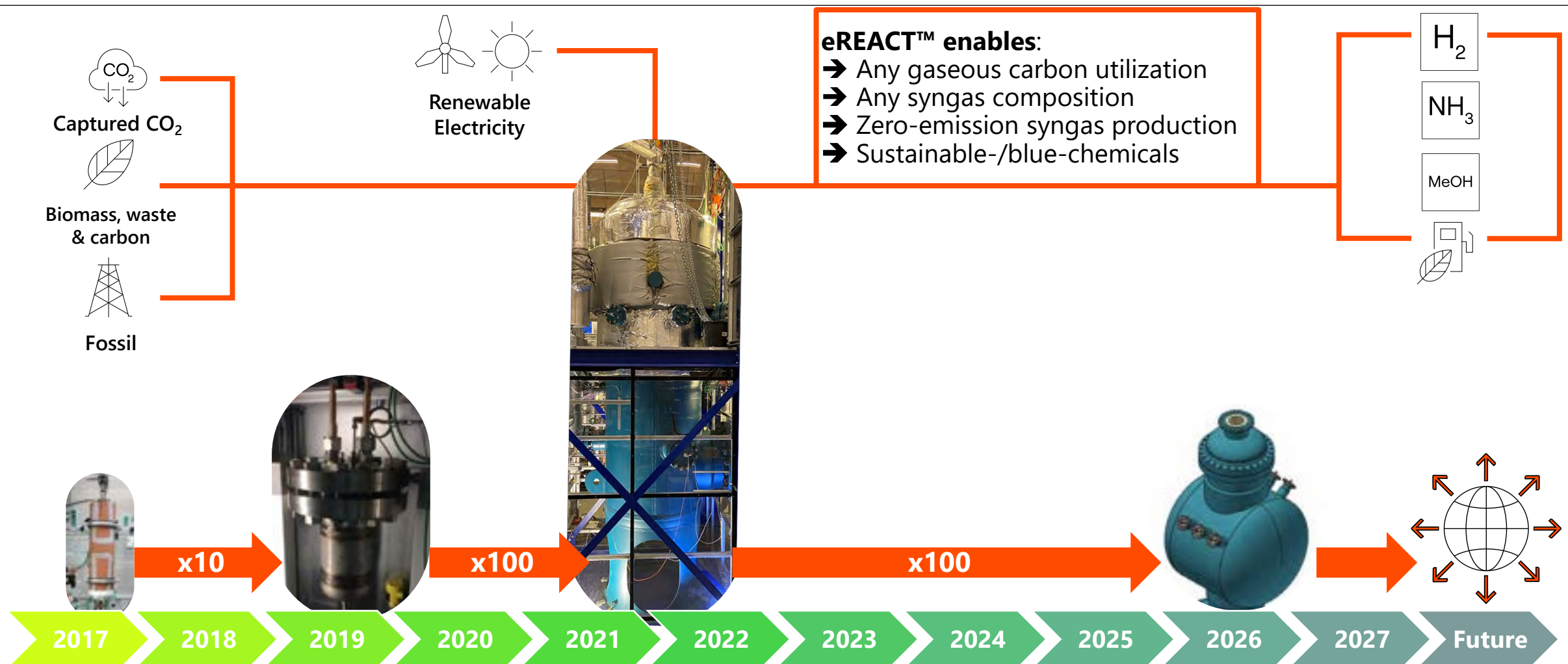
CENTRAL JUTLAND- DENMARK





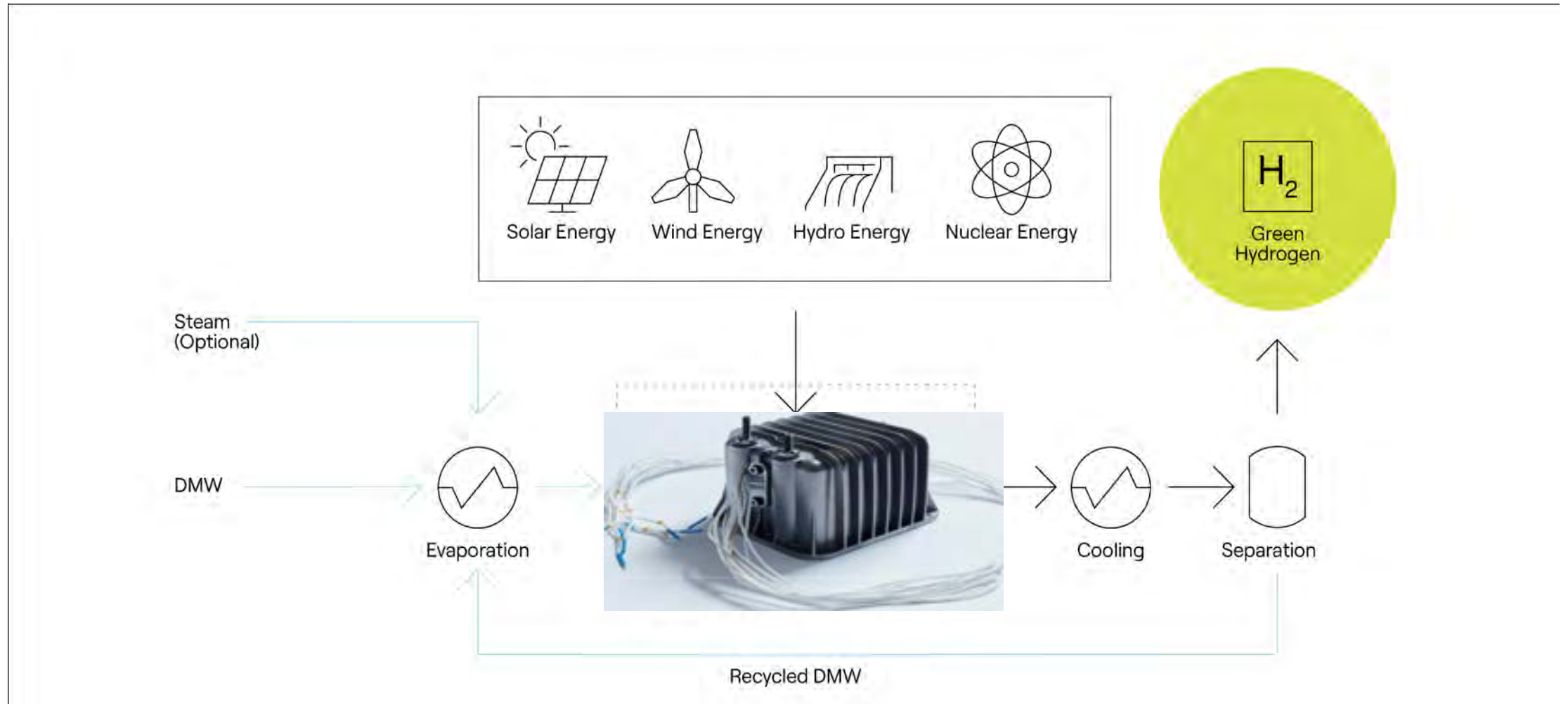
# EReACT™ TECHNOLOGY DEVELOPMENT

## SCALING UP FOR INDUSTRIAL APPLICATION





# GREEN H2 PRODUCTION FLOW CHART





# FLOW MEASUREMENT

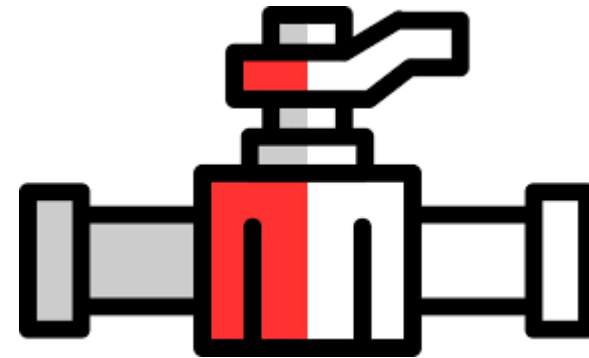
- Mostly in-line flow meters like Vortex, Coriolis, Ultrasonic, Magnetic & Thermal Mass flow meters are used to measure 10% turndown case flow instead of Flow Orifice and other DP Flow Meters.
- Pressure drop at 10% turndown were major challenges with in-line flow meters.
- Ultrasonic flow meters in gas application didn't have SIL certification except for clamp-on types.
- For flow meter in syngas loop few vendors could meet process specification of high H<sub>2</sub> concentration at 190 bar g pressure.





# CONTROL VALVE

- Special control valve trims had to be selected to meet 10% turndown as well as high velocity in some of the applications.
- High rangeability with very low DP in hydrogen service was a challenge because of very low MW of H<sub>2</sub>.
- Safe and reliable operation under hot conditions and temperature control with varying plant capacity.





## GAS ANALYZERS –VERY FAST RESPONSE TIME

- Laser based optical analyzers used instead of conventional analyzers to achieve fast response time as they eliminate long sample lines from measurement point to analyzer shelter.
- Thermal Conductivity Gas analyzers  $T_{90} \leq 2$  sec have been considered for Green H2 Unit.
- Tunable Diode Laser(TDL) analyzers are required for measuring traces of O2 in N2 coming from Air Separation Unit.

PPAM: 2025



## CAPACITY CONTROL FOR GREEN H2 & GREEN NH3 UNITS

- 10 – 100% Capacity Control of eSMR™ Unit & SOEC Unit.
- Thyristor Driven Electrical Heaters used for Temperature Control & Steam Generation.
- Electrical Heater as Start-up Heater of NH3 Converter.
- Green H2 operation shall be combination of sequential control of SOEC through PLC and continuous control implemented in DCS.
- Green H2 plant capacity max ramping rate can be +/-6%/min with switching On & Off SOEC cells. However, in combination with Green NH3 Loop it will be +/-3%/min to match Green NH3 Loop ramping rate.
- Green NH3 Loop Capacity Control 10 – 100% in synchronization with Capacity Control of Green H2 Unit.





## REMOTE IOS(RIOS) FOR DCS, ESD & FGS FOR MODULAR PLANTS

- Remote IOs(RIOs) units for DCS, ESD & F&S system Installed on modules.
- Only few pairs of fiber optic cables running from RIO cabinets to control rooms & rack rooms.
- No voltage induction issues with fiber optic cables.
- No temperature transmitters required. Thermocouples & RTDs directly connected to RIO modules.
- No Analyzer shelter for modular plant and with analyzers located as close as possible to measurement point & sampling handling station reducing response time.
- Significant reduction in cables, cable trays & detail engineering man hours.
- Significant reduction in size of control rooms & rack rooms.
- Significant reduction in commissioning & start-up time with modular plants.





# QUESTIONS?

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**TOPSOE**

PPAM: 2025



The background of the slide is a composite image. On the left, there is an aerial view of a large concrete dam with a reservoir. On the right, there is an aerial view of an industrial facility with complex piping and structures. A large, semi-transparent yellow diagonal band runs from the bottom left towards the top right, partially covering the industrial facility image.

# Secure. Improve. Protect.

Actionable insights  
from video.

CRITICAL INFRASTRUCTURE AND INDUSTRIAL SITES





# Contents

- ▲ Who is Axis?
- ▲ Solutions for securing sites
- ▲ Solutions for improving productivity
- ▲ Solutions for protecting people
- ▲ The Axis advantage



## **Who is Axis?**



# Who is Axis?

## **We offer:**

- ▲ Network cameras
- ▲ Other IP devices — audio, thermal technology, and more
- ▲ Intelligent analytics
- ▲ Compatibility with all major VMS
- ▲ Option of end-to-end management software

## **We pride ourselves on:**

- ▲ Quality, reliability, and performance
- ▲ Powerful processing capabilities
- ▲ Open systems and easy integration
- ▲ The highest levels of cybersecurity
- ▲ Visionary approach and innovative technology





# **The potential of network video**



# The potential of network video

Protecting your production means minimizing disruption. How?



## Secure your site

Intrusion protection



## Improve productivity

Operational efficiency



## Protect people

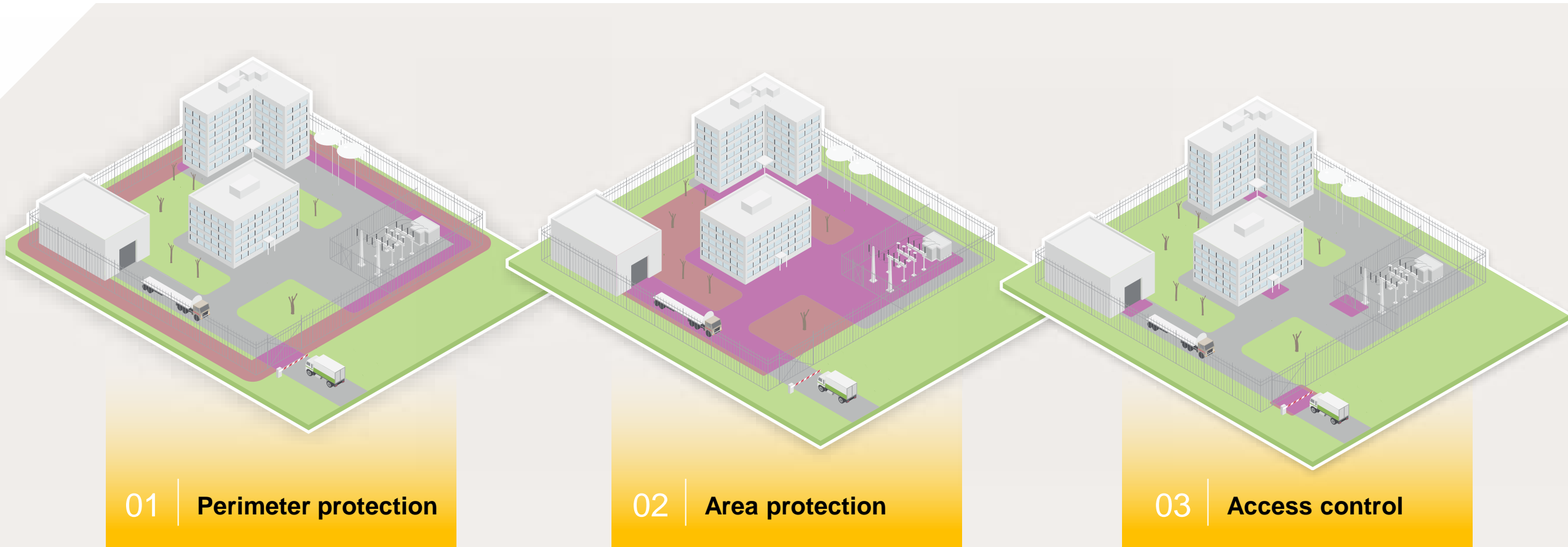
Health, safety, and environment



## **Solutions for securing sites**



# Secure your site: Layers of protection





# Layer 1: Perimeter protection



**Buffer zone**



**Fence line**



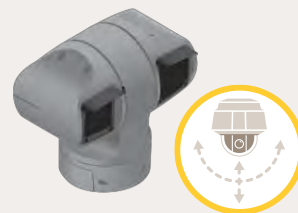
# Perimeter protection – buffer zone

Detect and deter before potential intruder gets too close



## Detection of presence

A radar pointing outwards detects people and vehicles outside the perimeter.



## Alarm is triggered

An alarm event is triggered and sent to an operator, while other devices such as a PTZ camera tracks the object.

## Physical intervention

Operator initiates physical intervention.

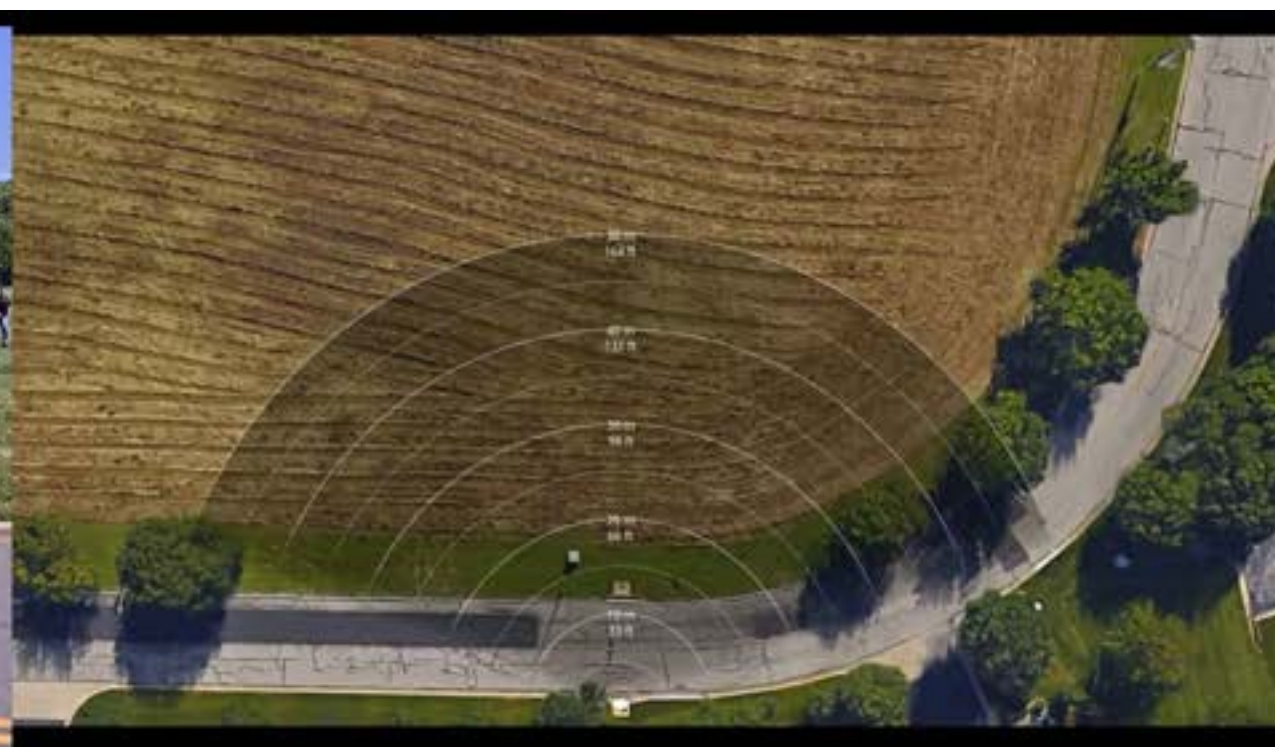




# Layer 1: Perimeter protection

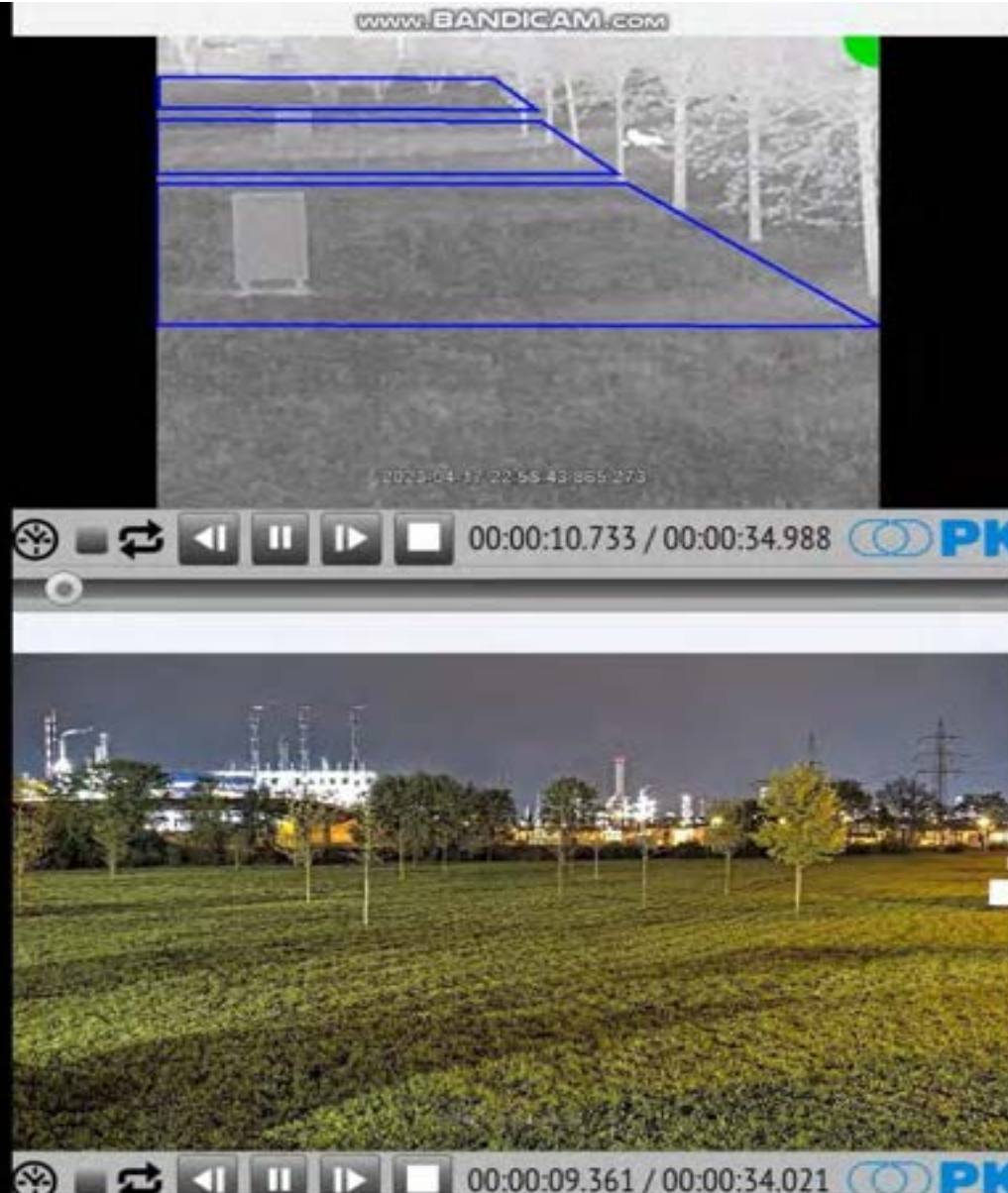


Buffer zone





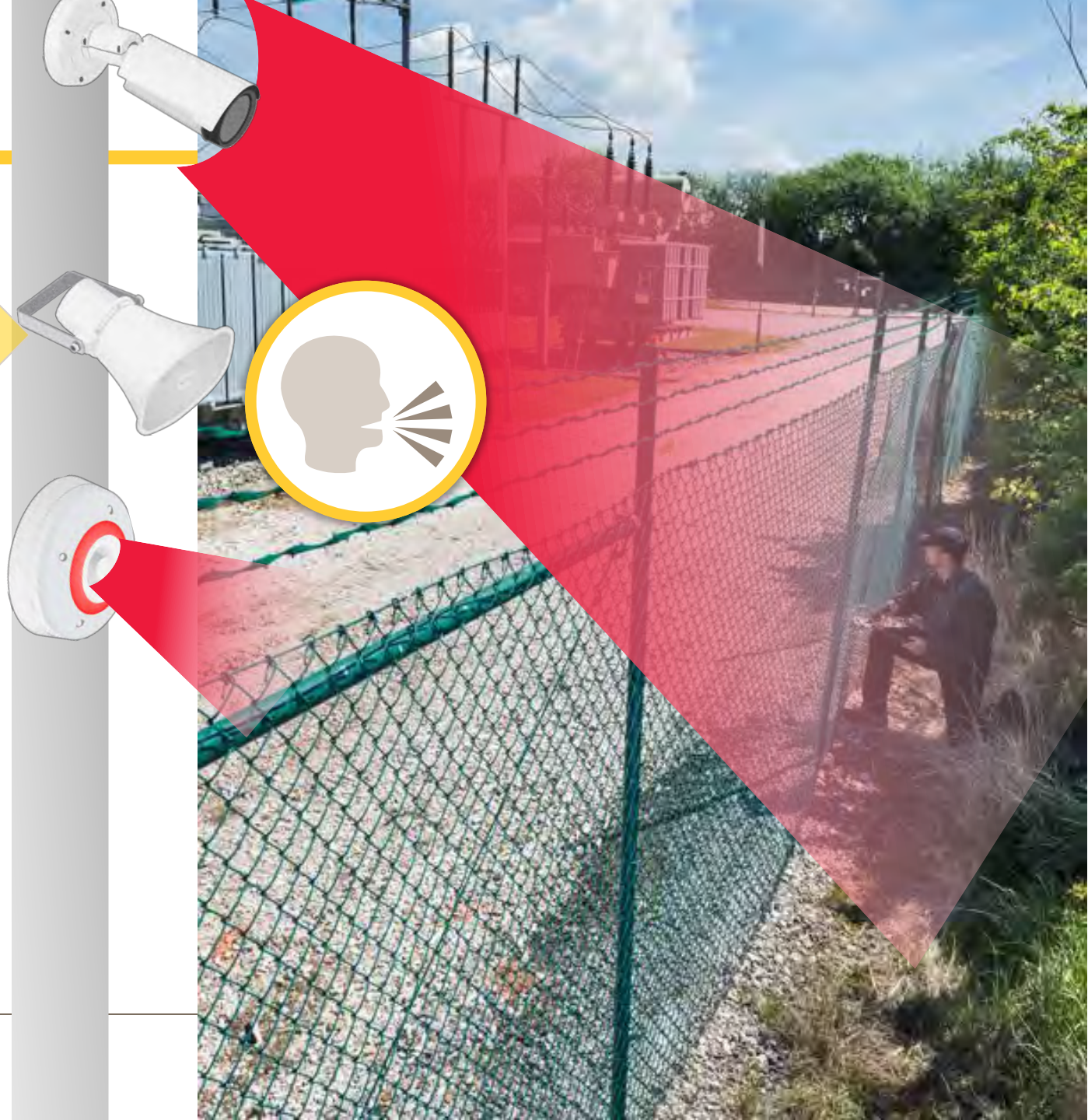
# Layer 1: Perimeter protection







## Intrusion deterrence by Pre-recorded and live spoken message





## Layer 2: Area protection



**Protection inside  
the perimeter**



**Document incidents  
on patrol**



# Area protection and general surveillance

Provide situational awareness for improved risk response



## Monitor activity sitewide

A radar or a camera provides wide area coverage of your site, allowing greater situational awareness.



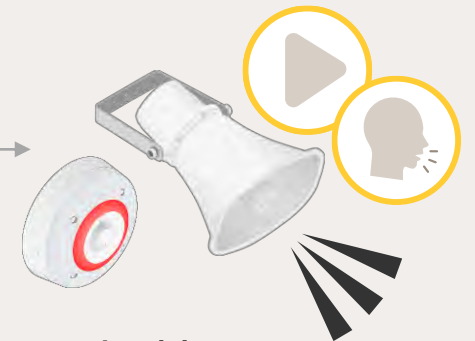
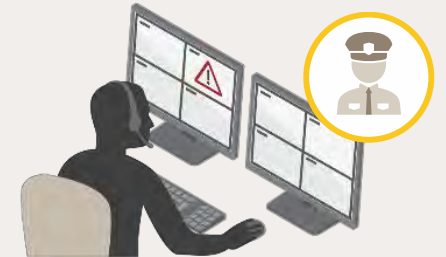
## Better situational awareness

In the event of unwanted activity the object can be tracked around the site.



## Physical intervention

Operator initiates physical intervention.



## Deter unwanted activity

Manually or automatically trigger pre-recorded or live audio messages or siren, with or without light signals.



# Document incidents on patrol

## Document and deter unwanted activity on premises



### Documentation and deterrence

A body worn camera worn by a security guard records both audio and visual view of the surroundings.

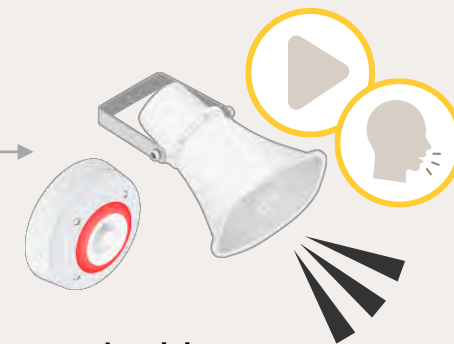
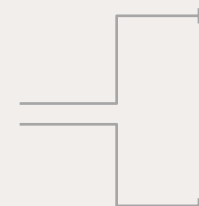


### Situational awareness

In a situation where a guard might need help, live streaming from the camera to a colleague in the control room means real-time visibility of what's happening.

### Physical intervention

Operator initiates physical intervention and sends more guards to the scene.

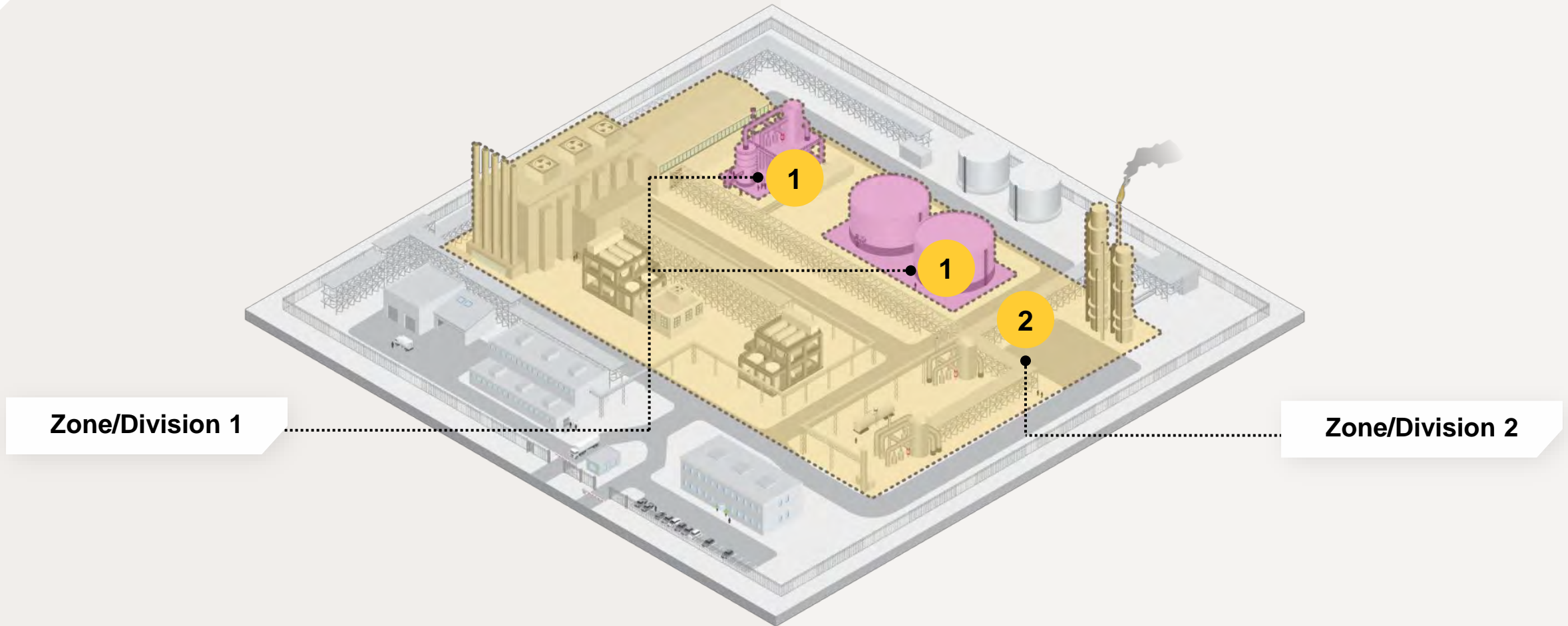


### Deter unwanted activity

Manually or automatically trigger pre-recorded or live audio messages or siren, with or without light signals.



# Critical Area :Zone/Division 1 & 2





## ...types of protection in what zone/division

### Zone/Division 1



AXIS XC1311/ Zone/Division1

**Ex d** – explosion-protected  
(flameproof) enclosure

### Zone/Division 2



**Ex e** – increased safety



### Conclusion

A lighter, more compact and cost-efficient camera.



## Layer 3: Access control



**Access control  
for people**



**Vehicle  
access control**



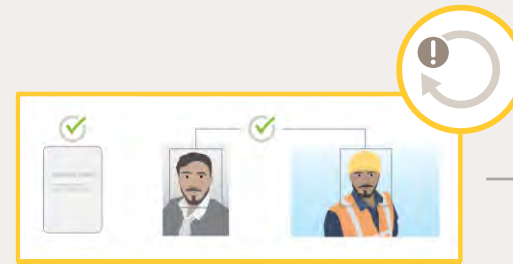
# Access control

Secure sites, buildings and offices from unwanted visitors



## Card or code for entry

Staff or visitors use cards, keycodes or QR codes to enter site or buildings.



## Check if user is registered

System checks the database to see if the user is registered and permitted in the specific location.



## Access is granted or denied

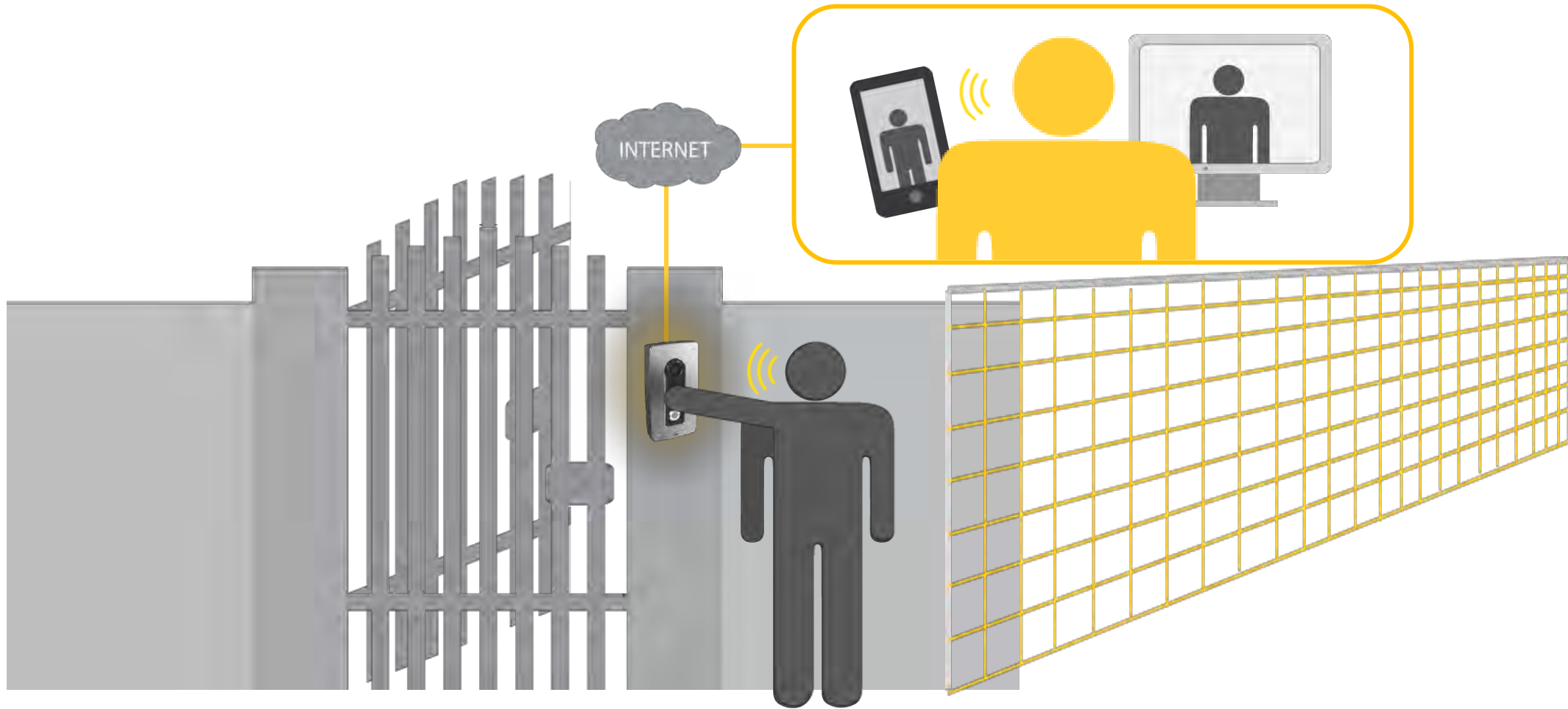
Depending on privileges access is either permitted or denied.

## Documentation of visitors

Access control has the added benefit of documenting all site visits with video evidence.



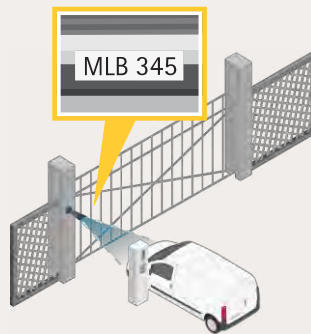
# Audiovisual entry control into video surveillance





# Vehicle access control

Automate access control to site for greater efficiency



## Detect vehicle and read license plate

Car approaches gate and camera with embedded analytic reads license plate.

REG NR	TYPE
XXX XXX	Allowed
XXX XXX	Allowed
XXX XXX	Allowed
XXX XXX	Allowed
XXX XXX	Blocked
XXX XXX	Allowed
XXX XXX	Allowed
XXX XXX	Allowed
MLB 345	Allowed
XXX XXX	Blocked
XXX XXX	Allowed
XXX XXX	Allowed
XXX XXX	Allowed

## Analyze license plate data

Plate data is analyzed and the result is compared to a list of allowed vehicles.



## Control access manually

In the event the visitor is unknown the site administrator can either deny or allow access.

## Automatic entry

If the vehicle is known the gate opens automatically for them.

## Documentation of visitors

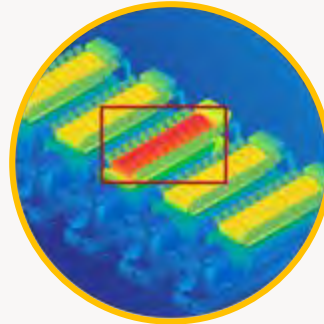
Vehicle access control has the added benefit of documenting all site visits with license plates and video evidence.



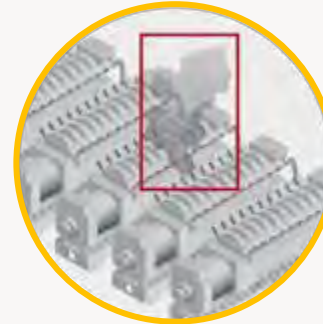
## **Solutions for improving productivity**



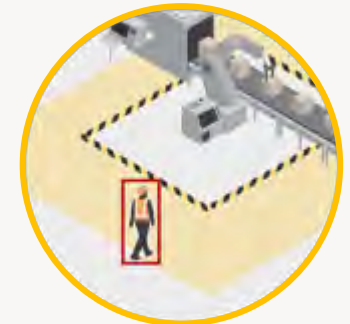
# Improve productivity: Minimize downtime



**Overheating equipment**



**Early fire prevention**



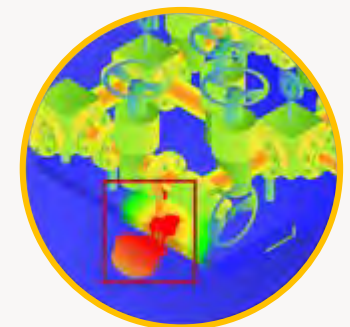
**Keep restricted areas clear**



**Visual verification**



**Maintenance verification**

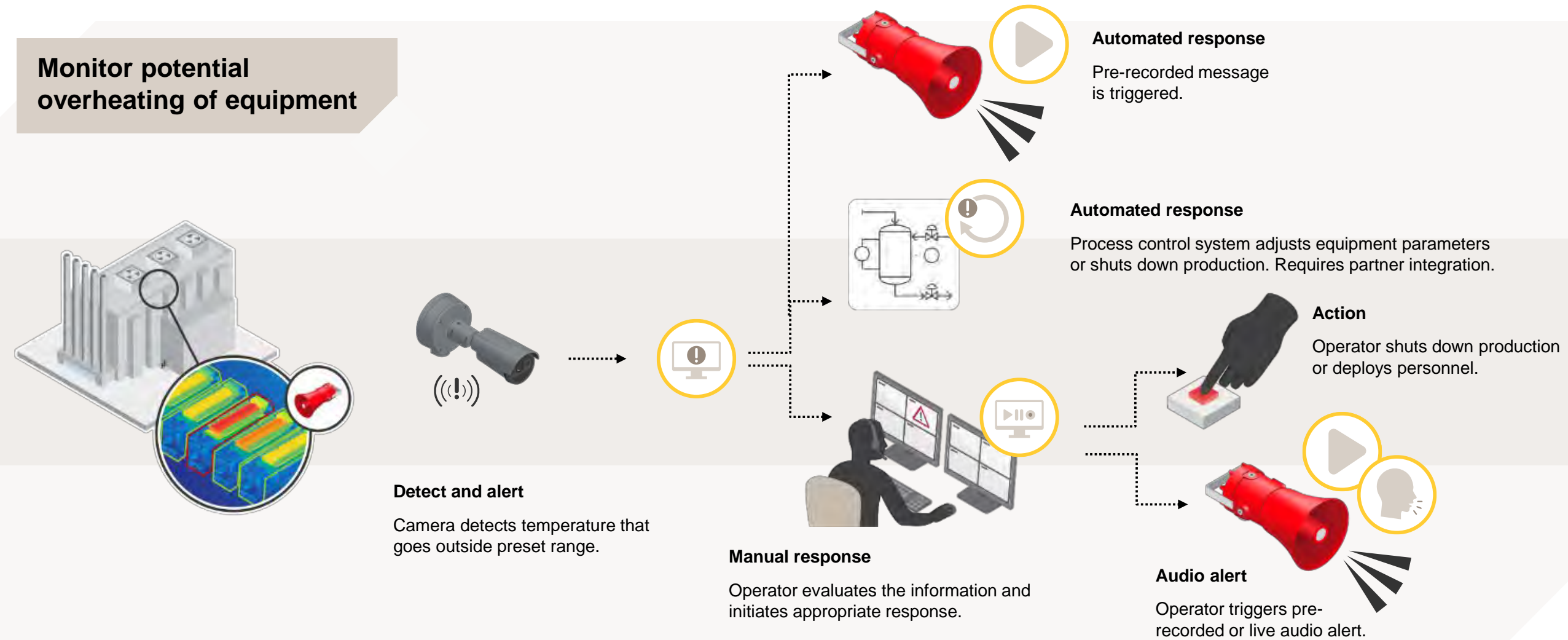


**Leak detection**



# Temperature monitoring

Monitor potential  
overheating of equipment



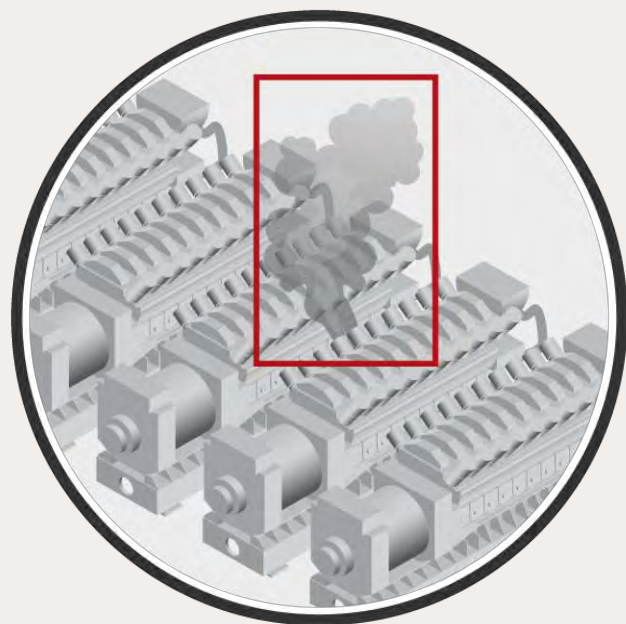






# Early fire prevention

Prevent fire with early recognition of smoke



**Monitor a site for smoke**  
Camera with embedded analytic is trained to recognize smoke.

## Alarm raised

In the event of smoke an alarm is raised and sent to an operator or an automated alarm.



## Manual response

Operator evaluates the information and initiates appropriate response.

## Emergency response

Operator shuts down production and notifies fire department.



## Audio alert

Operator triggers pre-recorded or live audio alert.







## **Solutions for protecting people**



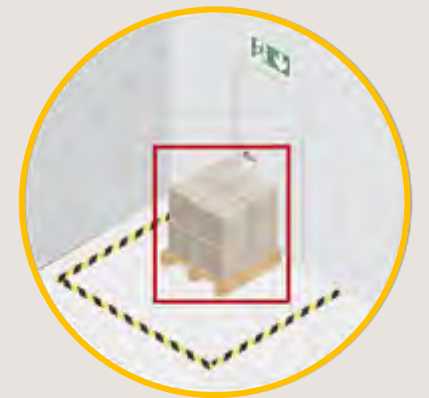
# Near-future risk reduction



**PPE detection**



**Keep restricted  
areas clear**



**Blocked exit  
notification**

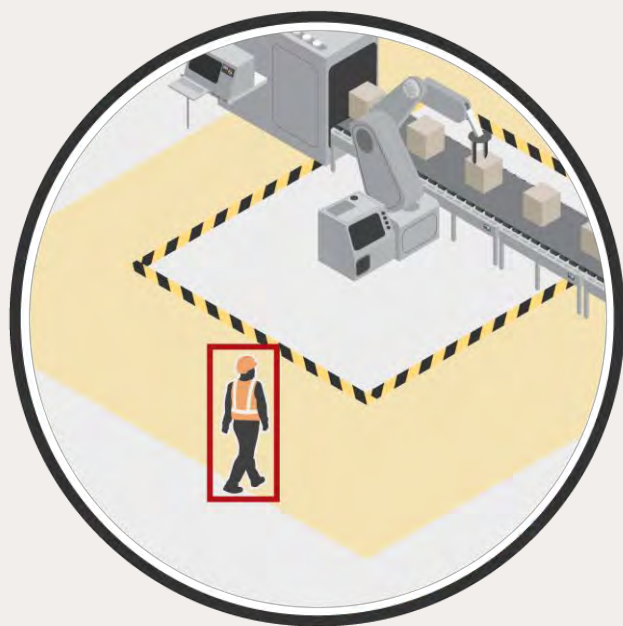






# Keep restricted areas clear

Minimize risks of people causing automatic shutdowns of production

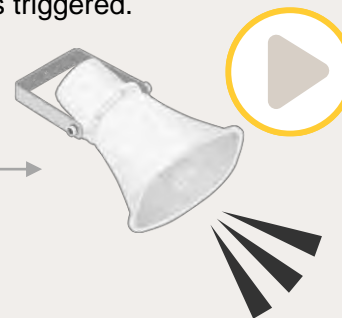


## Detect and alert

Camera with embedded analytic supports detection of humans in the scene.

## Automated response

Pre-recorded message is triggered.



## Manual response

Operator evaluates the information and initiates appropriate response.



## Audio alert

Operator triggers pre-recorded or live audio alert.





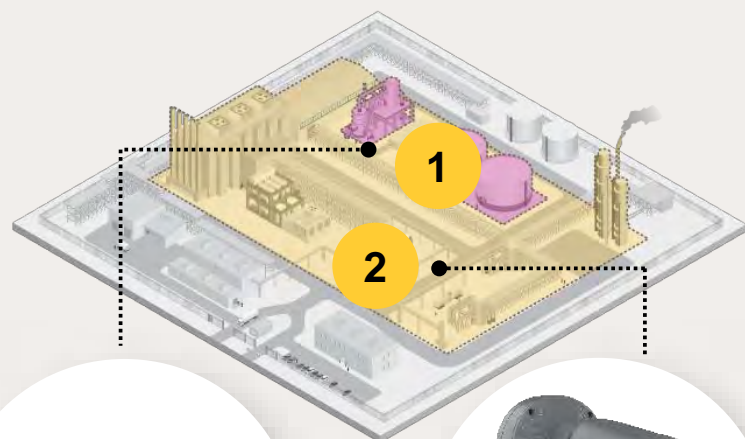


## Key takeaways



# Key take aways

Zone 1 and Zone 2

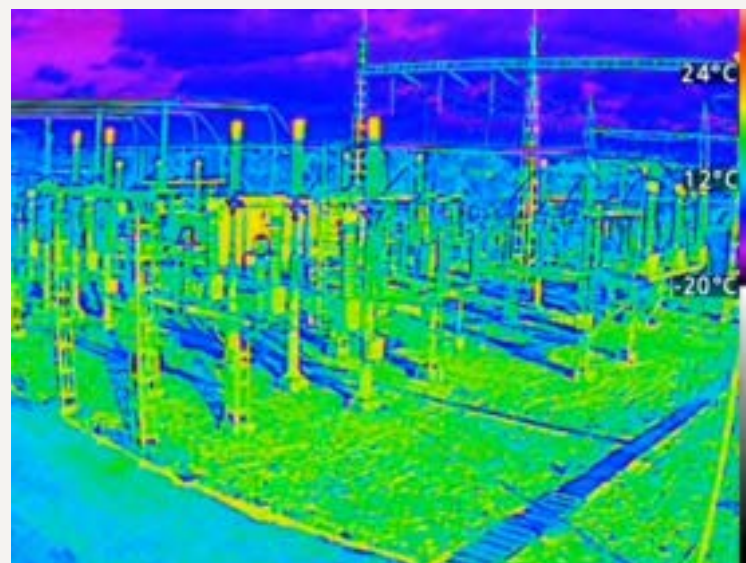


Zone/Div 1



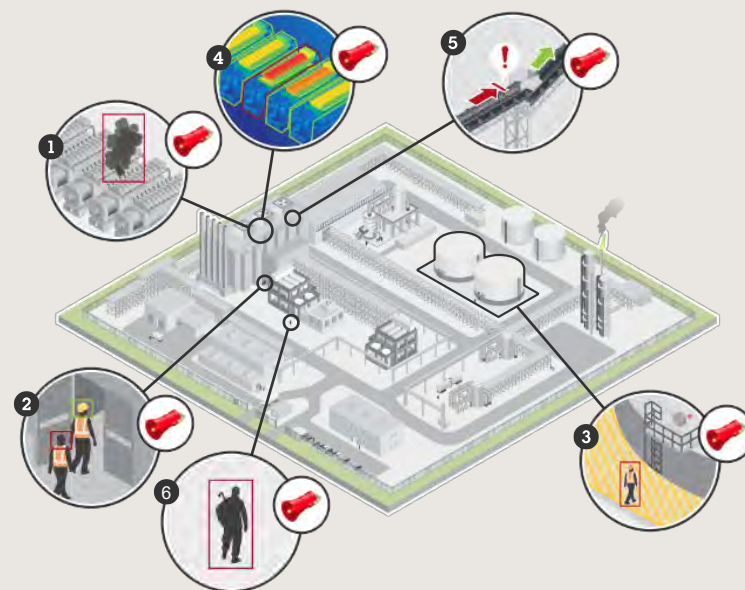
Zone/Div 2

Thermometric alternatives



Predictive maintenance

Network audio



Automated alerts



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# Thank you!







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**POWAT 2009, Habitat world on 24-25 April 2009**



**POWAT 2010, Hotel Sheraton on 28-29 May 2010**



**PNID 2011, Hotel Taj Palace on 26<sup>th</sup> Sep. 2011**



**POWAT 2012, Hotel The Grand on 13-14 Jan 2012**



**PNID 2012, Hotel Taj Palace on 5<sup>th</sup> Oct. 2012**



**at PNID 2013, Hotel Taj Palace on 3<sup>rd</sup> Oct. 2013**



**POWAT 2013, Hotel Hyatt on 12-13 April 2013**



**PPA Meet Eros Hotel on 10-11 April 2015**



**PPA Meet, Eros Hotel on 8-9 April 2016**



**PPA Meet, Eros Hotel, New Delhi on 21-22 April 2017**



**PPA Meet, Eros Hotel, on 20-21 April 2018**



**PPA Meet, Taj Palace Hotel, on 3<sup>rd</sup> & 4<sup>th</sup> May 2019**





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Total 2021



LDP 2023 Shillong



PPAM 2023



PPAM 2023



Cyber Security Program 2022



Cyber Security Program 2022



Cyber Security Program 2023



Cyber Security Program 2023



Fertilizer Symposium 2015



Fertilizer Symposium 2016



Fertilizer Symposium 2017



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**Fertilizer Symposium 2018**



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**GLIMPSES OF ISA (D) PAST EVENTS**



AGM 2018



AGM 2019



AGM 2021



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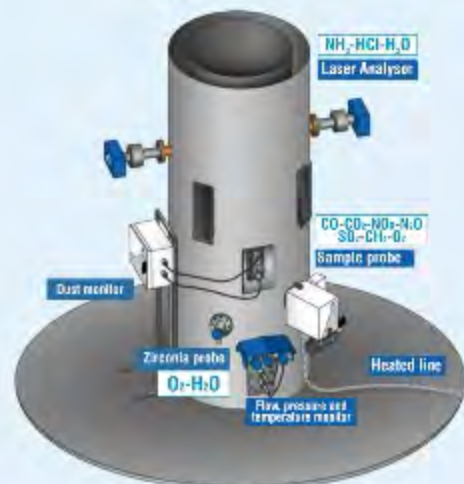
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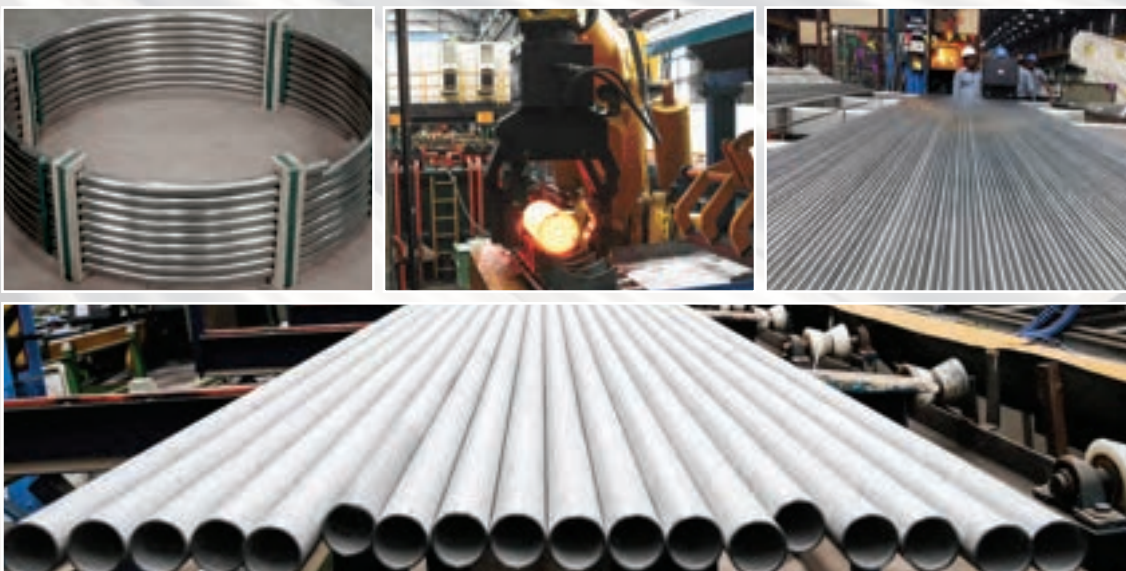




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## Grades:

6 Mo, 904 L, 625, 825, 13% Cr, T91, T92, Duplex, Super Duplex, Lean Duplex, 300 Series, 347H, 410

## Coiled Tubing:

Size: 6mm to 19.05 m, Thickness: 0.8 to 2.11 mm, Length: Up to 250 mtr (without joint)

## Value Added Services:

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## Ultra Smooth Surface Tubes:

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## Advantage:

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### PRECISION INDICATORS



### REFERENCE PROBES



### CALIBRATORS AND DMMS



### PROCESS CALIBRATORS



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## Isothermal Technology Private Limited

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Phone: +91-120-4169460 Email: [sales@isotech.co.in](mailto:sales@isotech.co.in) Website: [www.itplindia.co.in](http://www.itplindia.co.in)



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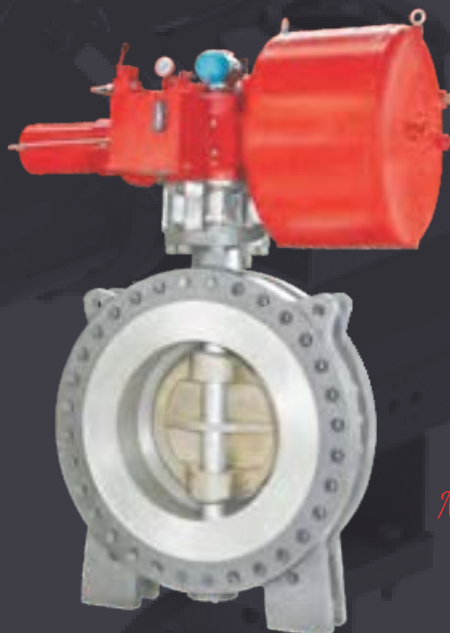
END TO END VALVE  
**AUTOMATION**  
SOLUTIONS

**Motor Operated  
Valves (MOV)**

**Valves with  
Electro-Hydraulic  
(E/H) Actuator**

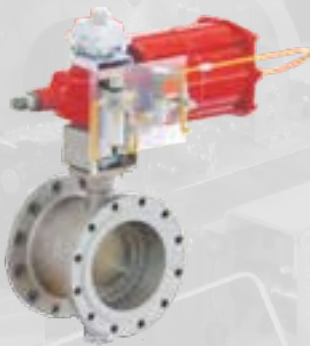
**On-Off / ROSOV  
Valves with  
Pneumatic Actuator**

**Control Valves  
with Pneumatic  
Actuator**





Major Applications of Instrumentation Valves



**On-off:**  
Our valves are designed to ensure a tight seal at the highest rated pressure in both directions. The unique trim design provides a preferred sealing direction, where a tight seal is achieved with less torque. This is especially beneficial for on-off applications, which usually only work in one direction. Typically, on-off applications involve opening or closing the valve entirely, often only in one flow direction. By optimizing the seal in this way, we make it easier to achieve the necessary shut-off with lower actuation forces, reducing wear and tear on the valve and actuator.



**Emergency Shutdown (ESD):**  
With the right material and actuator choices, our valves provide higher safety levels (SIL) in critical applications like shutdown, non-return, bypass blow-off, blow-down, and venting. When installed in the preferred sealing direction, pressure helps keep the valve closed, ensuring safer operation during emergency shutdowns. If installed in the opposite direction, where pressure would open the valve, it enhances safety during emergency blow-off or venting. By offering these adaptable safety mechanisms, our valves can be tailored to specific system requirements, enhancing both operational safety and efficiency in critical applications.



**High frequency / switching:**  
Our triple offset valves have a non-rubbing design, which completely prevents wear between the sealing parts. The entire valve trim, including bearings and thrust bearings, is built for heavy-duty use. These valves are ideal for high-frequency opening and closing, like in the molecular sieve process. By incorporating Advanced Valves' Triple Offset Butterfly Valves into your system, you can count on valves that not only provide exceptional control but also stand up to the challenges of frequent operation. Designed for longevity, reliability, and high performance, our valves deliver peace of mind for applications requiring high-frequency switching and demanding cycles.



**Flow Control:**  
Our quarter-turn triple offset valve with throttling trim offers excellent performance for controlling flow. It has a very low and consistent torque throughout the 90° rotation, ensuring precise control of flow and pressure, even when the valve is only slightly open. Our Triple Offset Butterfly Valve features a unique design that eliminates the risk of seat wear, offering reliable performance in high-pressure and high-temperature environments. Its innovative sealing mechanism ensures tight shut-off and minimized leakage, while the valve's advanced geometry allows for smooth throttling and fine flow adjustment.

- Key Benefits:**
- ◆ **Precise Flow Control:** Ideal for throttling applications, ensuring stable and accurate flow regulation.
  - ◆ **Durable and Reliable:** Designed to withstand extreme operating conditions with minimal maintenance.
  - ◆ **Leak-Free Performance:** Advanced sealing technology for tight shut-off and minimal leakage.

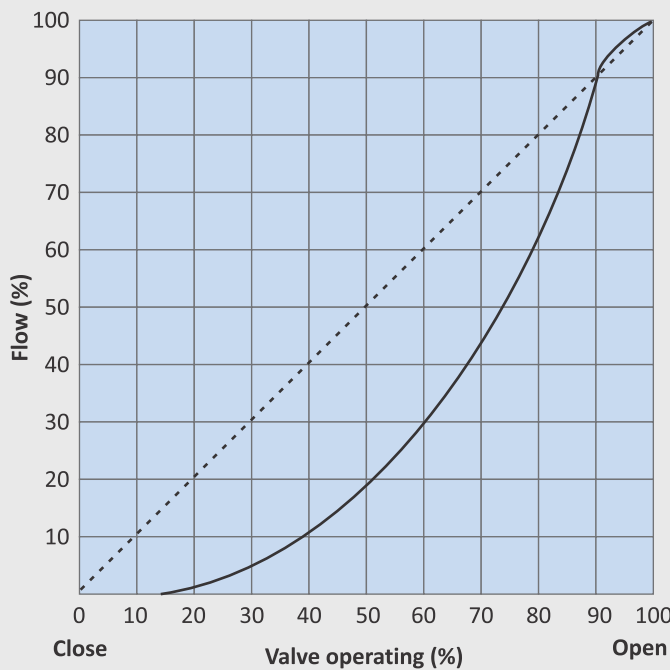
Cv Testing - In-house Fully Computerized Test Set-up



Control Valve Flow Coefficient (Cv) Table

Control Valve Size (in DN – in NPS)	FLOW COEFFICIENT (Cv)_INTEGRAL DESIGN			
	CL 150	CL 300	CL 600	CL 900
80 (3)	128	99	81	75
100 (4)	216	293	70	*
150 (6)	664	873	314	*
200 (8)	1505	1220	1085	350
250 (10)	2406	2481	2406	520
300 (12)	4547	3990	2633	*
350 (14)	5755	5042	4639	1932
400 (16)	8081	6099	5145	2429
450 (18)	10988	8859	8837	*
500 (20)	13156	11603	11497	*
600 (24)	17617	17462	14955	7510
650 (26)	16436	17663	16790	*
700 (28)	27003	20786	23619	*
750 (30)	27917	23649	*	*
800 (32)	30764	26391	*	*
900 (36)	41792	34091	33744	23429
1000 (40)	52656	57280	*	*

Control Valve Flow Coefficient (Cv) Table



The Advanced Valves' Triple Offset Control Valves feature a modified equal percentage inherent characteristic, making them highly suitable for control applications.

Advance valves- SIL 3 Certified Triple Offset Butterfly Valves

At Advance Valves, we take reliability and safety to the next level. Our Triple Offset Butterfly Valves are SIL 3 certified, ensuring superior performance in critical applications.

Key Features:

- ◆ SIL 3 certified: Ensuring the highest level of safety & reliability
- ◆ Size Range: NPS 3 to NPS 120
- ◆ Pressure Classes: CL 150, CL 300, CL 600, CL 900 & CL 1500
- ◆ Precision Engineered: for zero-leakage, high-performance applications
- ◆ 100% valves are tested for seat leakage and functional test along with actuator assembly for automated valves.
- ◆ Ideal for critical industries: including oil & gas, power, & chemical processing

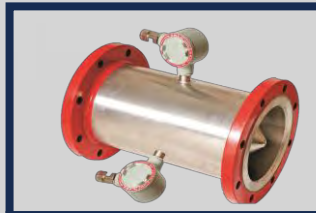
Trust Advance Valve for cutting-edge solutions in flow control, performance & reliability.



## PRODUCTS & SERVICES

- Custody Transfer Turbine Flowmeter
- Inline Turbine Flowmeter
- Wafer Turbine Flowmeter
- Wingnut Hammer Union Turbine Flowmeter
- Insertion Turbine Flowmeter
- Fuel Gas Turbine Flowmeter
- Positive Displacement Flowmeter
- Ultrasonic Flowmeter
- Single and Dual Chamber Orifice Flowmeter
- V Cone Flowmeter
- Thermal Mass Flowmeter
- Flow Readout Units and Accessories
- Filtration, Pressure Reduction and Metering Skid
- District Regulation Station
- Check Metering Skid
- NABL Accredited Flow Calibration Laboratory

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NON CONTACT  
RADAR LEVEL  
TRANSMITTER



ULTRASONIC  
LEVEL TRANSMITTER



DISPLACEMENT TYPE  
LEVEL TRANSMITTER  
(SMART WITH HART PROTOCOL)



GUIDED WAVE  
RADAR LEVEL  
TRANSMITTER



DIFFERENTIAL  
PRESSURE TYPE



PRESSURE TRANSMITTER

# LEVEL

Transmitter



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(40+years)**

**Global  
Customers  
300+**

**Sales Territory  
26 States  
20 Countries**

**Head Office  
New Delhi  
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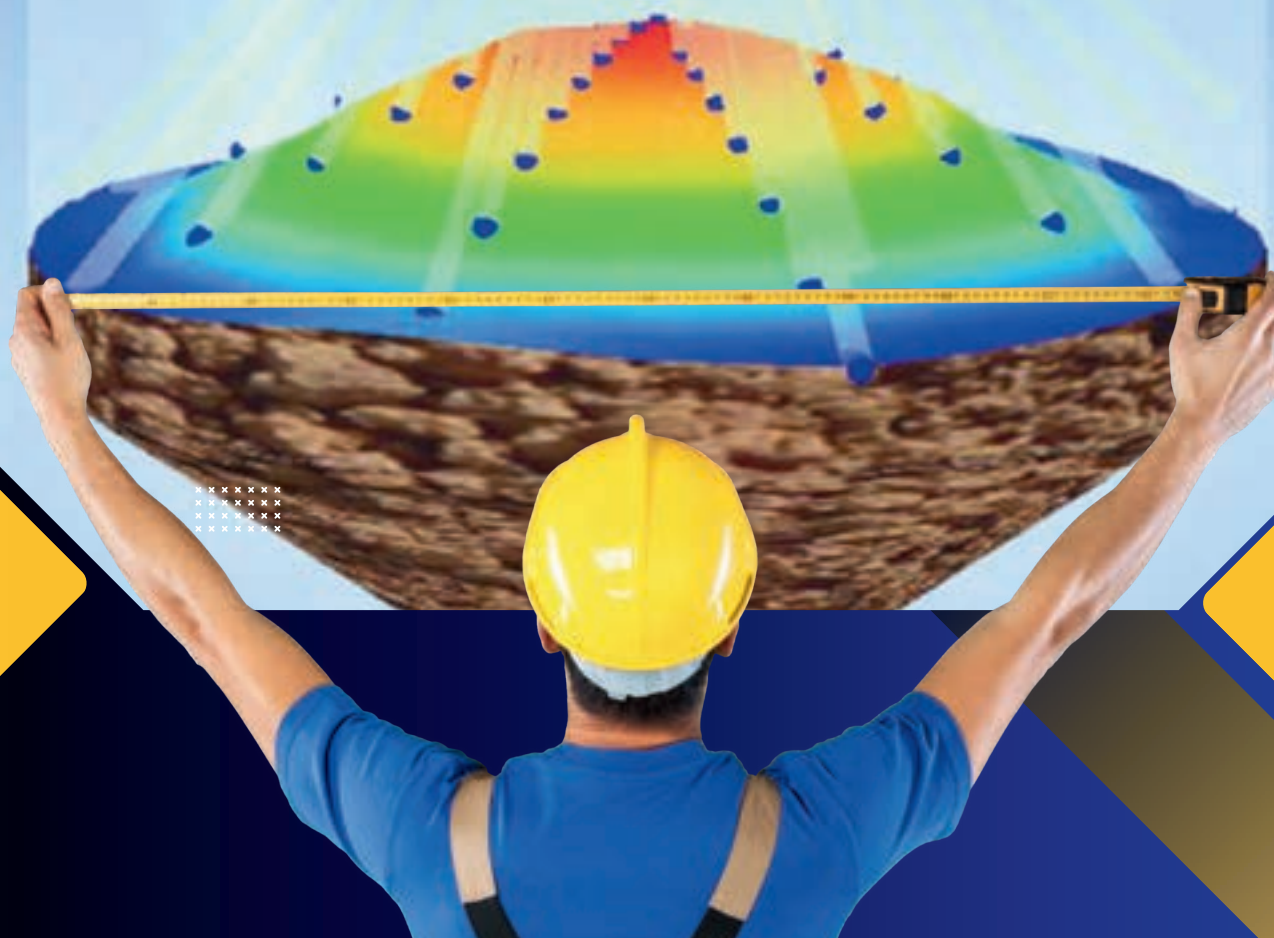
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## LEVEL $\neq$ VOLUME

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Bulk Solids & Powders Measurement

- 1) MULTIPLE POINT SCANNING
- 2) REAL TIME 3D PROFILE
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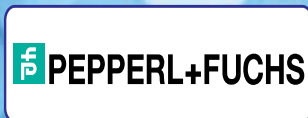
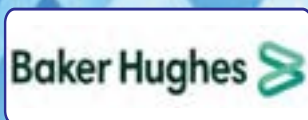
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