

Dr. Pratap Nair



Founder, President & CEO, Ingenero *(since 2002)*

- Chemical Engineer with 36 years of experience in the process industry
- B. Tech from IIT Bombay; PhD from Rice University, Houston
- Recipient of the Distinguished Alumnus award from IIT Bombay

- Pioneer in leveraging advanced analytics for continuous remote support and collaboration in process manufacturing, including Midstream, Refining, Petrochemicals and Energy
- Extensive experience in developing and deploying process optimization software solutions
- Early adopter and implementer of Applied AI based digital solutions for the process industry
- Proven track record in scaling up and commercializing process technologies from CSIR labs
- Global business development experience, including joint ventures, alliances and licensing across the USA, Europe, Middle East, APAC, Japan and India
- Diverse operational experience in Chemicals, Biotech, Agro, Bulk Actives, Pharma, and application software sectors in the USA and India, with roles in Operations, Technical services, R&D, Business Development and executive leadership positions

INGENERO
Excellence Through Insight

Houston * Mumbai * Jubail * Doha

World class Engineering, Technology and Software solutions for:

- Optimal Asset Effectiveness (Throughput, Yield, Availability, Cost, Sustainability, Safety)
- Digital Solutions (Applied AI, Digital Twins, GenAI, Big Data Analytics, Agentic AI, IloP)
- Safety (PSM Compliance, RBPS)
- Engineering (Capital projects, Process design, Brownfield, Value)
- Sustainability (CCUS, Hydrogen, Digital tracking & reporting, Value engineering)

Typical PSM Performance Challenges

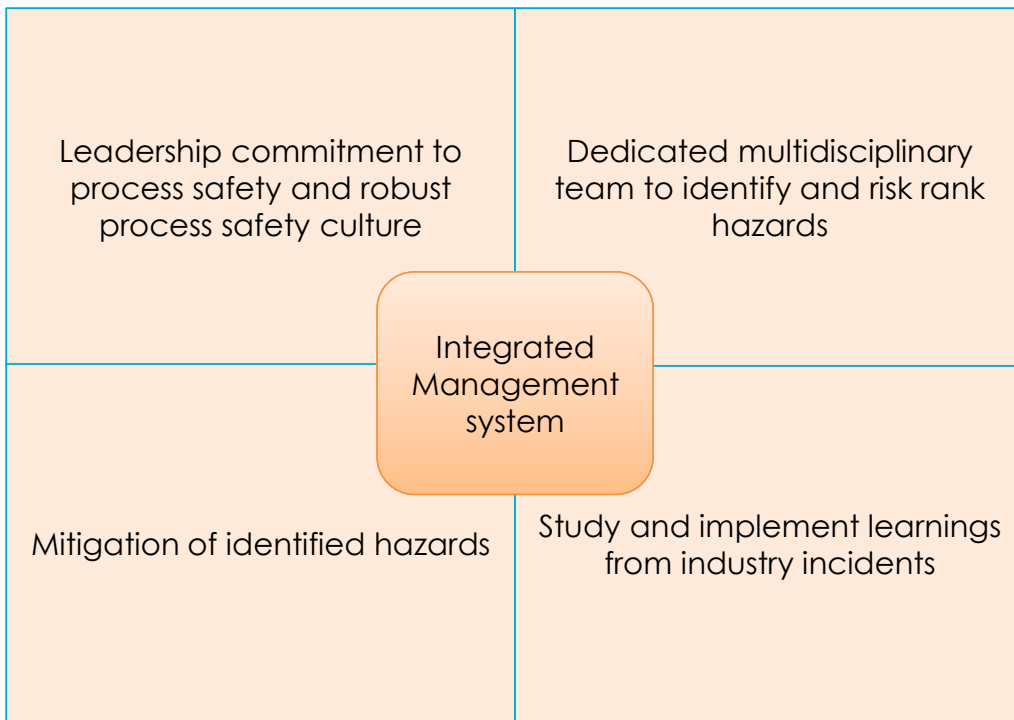
Major causes of industry incidents

- Technology failure
- Human errors
- Failure of management system
- External factors



- Minimum cost compliance-based approach: “if isn’t a regulatory requirement, I am not doing it”
- Disproportionate focus on personal safety (measurable) as opposed to process safety
- Lack of understanding of RAGAGEP (*Recognized and Generally Accepted Good Engineering Practices*)
 - Standards cannot cover all scenarios
- Lack of widely recognized measurement systems (insufficient instrumentation of key safety KPIs)
- Lack of commitment to audits (cost & resource availability)
- Lack of Risk ranking of hazards (critical items not mitigated)
- Increased pressure to achieve short term financial goals and production over safety
- Complacent approach (hasn’t happened before)

Review Of Best Practices – Management



		Event Frequency (per year)							
		10^{-7} - 10^{-6}	10^{-6} - 10^{-5}	10^{-5} - 10^{-4}	10^{-4} - 10^{-3}	10^{-3} - 10^{-2}	10^{-2} - 10^{-1}	0.1-1	1-10
		H	G	F	E	D	C	B	A
Consequence Severity Category	5	EHS - 1	EHS - 2	EHS - 3	EHS - 3	EHS - 3	EHS - 4	EHS - 4	EHS - 4
	4	EHS - 1	EHS - 2	EHS - 2	EHS - 3	EHS - 3	EHS - 3	EHS - 4	EHS - 4
	3	EHS - 1	EHS - 1	EHS - 2	EHS - 2	EHS - 2	EHS - 3	EHS - 3	EHS - 4
	2	EHS - 1	EHS - 1	EHS - 1	EHS - 2	EHS - 2	EHS - 2	EHS - 3	EHS - 3
	1	EHS - 1	EHS - 1	EHS - 1	EHS - 1	EHS - 1	EHS - 2	EHS - 2	EHS - 3

Have developed this matrix for clients and classified risk based on consequences if no mitigation measures in place and helped with mitigation selectively

Seek Learnings

Drilldown

Implement

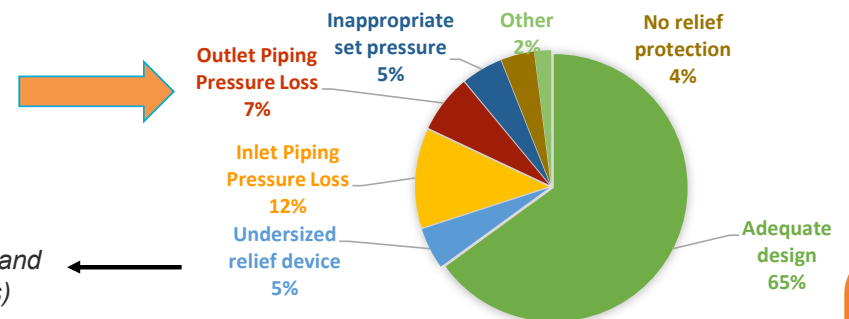
Review Of Best Practices – Select PSM Elements

International best practices in Safety are driven by guidelines, standards and regulatory frameworks by leading organizations (OSHA, CCPS, ILO, EU, API, ISO, etc.) → Examples:

- OSHA PSM (29 CFR 1910.119)
- Seveso III Directive (EU 2012/18/EU)
- RBPS (CCPS/AIChE)
- Risk Management & Safety case approach (UK)
- ISO 45001:2018 (Occupational Health & Safety)
- Relief & Flare System Revalidation per API & ASME (API 520/521/526/2000/537)

Select Practices we have encountered and found effective:

Inherently safer designs	AI/ML techniques to reduce non-routine operations	Enhanced automation to reduce PFOD (<i>Probability of failure upon demand</i>)	PSM elements Audit
Training	Procedures	Develop KPIs to measure effectiveness of PSM	Robust MOC process
Safe discharge evaluation	Enhanced employee involvement	Uncover deficiencies in safeguards	



Deficiency distribution

Based on analysis done by Ingenero for all the major refiners, petrochemical plants, and chemical complexes across the globe (~80,000 relief devices and ~2 million man-hrs)