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Risk Management Process - Production Best Practice Case study Longfield Gas Plant Accident

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Abstract

In this study, we present a series of pertinent case studies that illustrate significant asset integrity issues that require immediate attention to ensure safety and operational reliability. The Longford degassing station serves a critical function, receiving feed from the Barracouta, Marlin, Snapper, and Oil platforms located upstream. Within the Longford facility, these mixed streams are processed and separated into raw LPG and stabilized crude oil; the crude oil is subsequently directed to Long Island Point for further midstream processing, while the natural gas is routed to the Victorian pipeline. The midstream production station further refines these streams into three distinct categories: ethane, which is utilized as feedstock for petrochemical production units; LPG, which is prepared for market sale; and stabilized crude intended for refineries. Our unwavering commitment to safety and reliability is reflected in our systematic approach to eliminating equipment and facility failures, enhancing operational dependability, and substantially reducing unscheduled volume losses that could disrupt operations and adversely affect profitability. We are dedicated to optimizing both capital and operating expenditures while fostering a robust safety culture that assures our stakeholders that the principle of 'Nobody Gets Hurt' remains paramount. The prevention of significant incidents within our processes and facilities is an essential component of our overall strategy, positioning us as leaders in upholding our License to Operate. Through the strategic management of our core activities, we aspire to maximize value and achieve exceptional economic recovery from each reservoir, thereby ensuring that we effectively leverage every opportunity for growth and operational efficiency. We acknowledge that the support of our stakeholders is vital to our collaborative success, and we remain committed to advancing progress that benefits all parties involved.

Keywords
Integrity Goals, Objectives, Risk Mitigation Barriers, Risk Control Framework and Effectiveness.

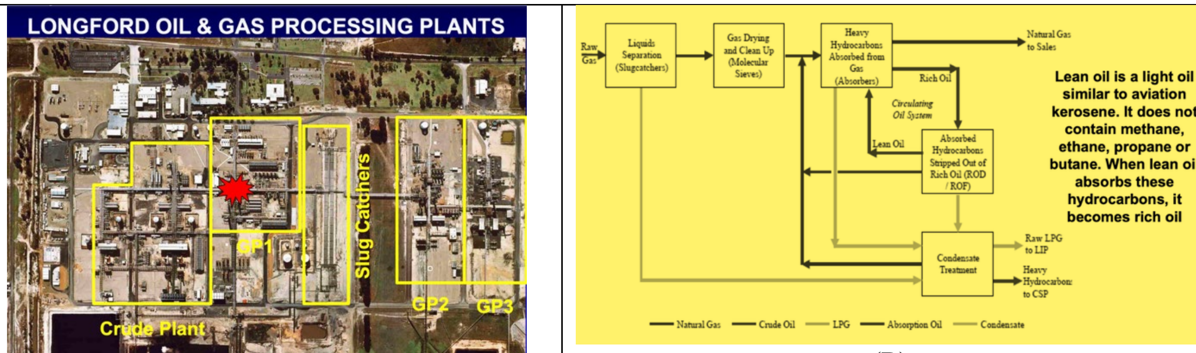
Words	Definition
RCFA	Root Cause Failure Analysis
PDRR	Prevent, Detect, Respond & Recover
PBP	Production Best Practice
UVL	Unscheduled volume loss
UVDT	Unscheduled volume down time
ALT	Asset Leadership Team
SHES	Safety, Health, Environmental, and Security

1. Introduction
The Longford Oil Facilities are a vital production hub comprising GP1, which includes key units such as the Liquid Separation Unit, Gas Drying Unit, Absorber, Rich Oil Reforming Unit, and a Condensate Treatment Unit. Located between the Slug Catcher and the Crude Oil Plant, GP1's configuration is critical for processing upstream raw gas, as

shown in Figure 1 (A). GP1's process begins with raw gas from upstream production stations flowing into the Slug Catcher, which removes condensate and gas for optimal processing. The wet gas then passes through the Molecular Sieve Unit to dehydrate it to a dew point of -40°F, preparing it for further treatment.

After drying, the gas mixes with residual gases from the Condensate Treatment, ROD, and ROF units, and is processed through Absorbers to extract heavy hydrocarbons. The absorbed oil is regenerated in the ROD and ROF units, while residual condensate from these units is recycled back to the Condensate Treatment Unit, enhancing resource recovery and streamlining operations as shown in Figure 1(B).

In order to achieve safe operations possible equipment(s) failure to maintain maximum uptime primarily to focus and prevent High-Impact Equipment and Facility Failures proactively. Foremost business objective is to embed safety into the very core of the operations to ensuring that nobody gets hurt and eradicating significant incidents related to our processes and facilities. By striving for industry-leading performance in our License to Operate, operations staff must uphold the responsibilities and demonstrate our unwavering dedication to excellence.



(A) (B)

Figure 1. Longford Oil and Gas processing Plants locations

1.1 Objectives

Risk management is not merely an initiative; it is a fundamental commitment to ensuring safety throughout our operations. Primary goal is to inspire and motivate the operations workforce by achieving industry-leading License-to-Operate performance, demonstrating how effective risk management directly supports safety and sustainable growth. The operations staff can accomplish this by strategically managing critical activities that enhance the value of the essential processes. This proactive approach is vital for developing new resources that enable sustainable and profitable growth.

Additionally, the operations team is fully dedicated to building strong external relationships, fostering inclusivity, and establishing ourselves as the partner of choice by implementing industry best practices. This emphasis on external collaboration enhances our risk management efforts by integrating diverse insights and standards that improve safety and operational resilience. By investing in our operations staff, we aim to maximize organizational capabilities and empower our teams to realize their full potential and drive outstanding results. This commitment to development directly contributes to safety and operational excellence, creating a solid foundation for a successful and innovative future. It effectively prevents potential incidents and sets a benchmark in the oil and gas industry.

2. Literature Review

Fengsheng Li et al.2009 discussed and concluded that the project management, risk management is a comprehensive high-level management. It is a series of methods that analyze and process problems caused by uncertainty, including risk identification, risk analysis and risk control. **Valery G. Semin et al. 2016** discussed and concluded that Risk management with business processes enables to respond more quickly to changes in the management of strategic stability and development of CMTE control. Classic risk management methods are time-tested and effective, but the use of modern tools, will help strengthen the 'weak points' in the management of strategic stability of CMTE and make the strategic goals more stable and confident. **Samaneh Barati et al. 2008** discussed and concluded that Risk Management is the process that allows the process managers to balance the operational and economic costs of protective measures and achieve gains in mission capability by protecting the operational systems and data that support their organizations' missions. Risk Management begins early in project formulation and must continue in a disciplined manner throughout all project life cycle phases. **Guo Yuntao et al. 2011** mentioned that the importance of the enterprise culture, risk management culture is the risk concept, risk values and the code of conduct that all staffs in risk management activities consensus and consciously abide by. And the good risk management culture is the basis of developing comprehensive risk management for the defense science and technology enterprises. **Nansheng Pang et al.2008** discussed and mentioned that the management project risk evaluation is an important link for implement risk management and a significant part of agent management as well. **ZHANG Ya-li, 2010** discussed and mentioned that the participant of project team may come from different organizations and different field. They manage different aspects of a project in accordance with their professional skills, interests and the needs of political. The literature thinks this teamwork risk management can put the relevant individual within the organization and between organizations into a "team", then manage the risk of the project, rather than "doing itself".

3. Operations Challenges

Our top priority must be to take decisive action to prevent failures in High Impact Equipment and Facilities. Addressing specific risks, such as equipment overheating or corrosion, helps us understand potential hazards and avoid unanticipated failures that could compromise our Safety, Health, Environmental, and Security (SHES) standards and lead to significant financial burdens.

To illustrate, the condensate is transferred to GP2 for further processing at a temperature of -20°C (-4°F). In another scenario, the condensate is conveyed to GP1 CTP at -10°C. GP03 plays a crucial role in regulating condensate temperature, especially when it drops too low, as the flow to CTP is diminished, increasing the risk of hydrate formation. This maintains the control valve setpoint at -1°C (30°F), as illustrated in Figure 2. The control valve is faulty at absorber, and to control the temperature, a bypass was used. There is also a work order issued on 12 September 1992 as shown in Figure 2.

By emphasizing these vital initiatives, we can ensure the safety of our operations and foster a proactive safety culture. This approach encourages us to stay engaged and committed to continuous improvement, strengthening our resilience and confidence in handling challenges effectively.

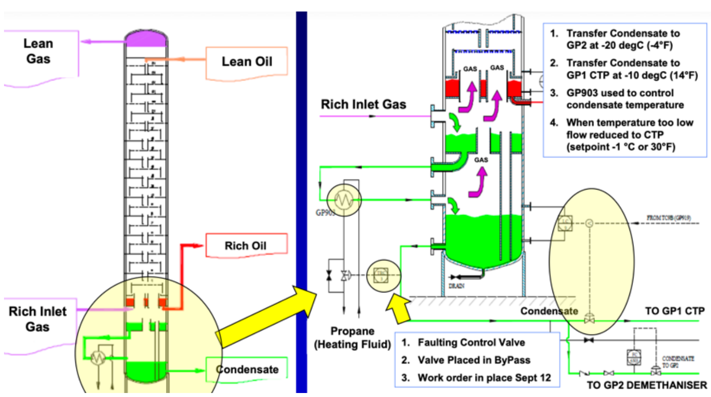


Figure 2. Longford Oil and Absorber Design constraint

3.1 Accident 12 September 1998

Gas Plant 1 ROD reboiler (GP-905) ruptured in a brittle manner

1. Resulting in a fire with two fatalities and 8 others injured
2. Hydrocarbon fires controlled within 12 hours, extinguished after 72 hours
3. Gas supply restored after 9 days, crude production restarted after 70 days

Investigation team asserted the following sequence:

1. Absorber B overflows cold condensate into rich oil system <6:00am
2. Excess condensate floods ROD causing liquids in overhead ~7:00am
3. Additional liquids cause lean oil circulation pumps to shutdown 8:20am
4. ROF pre-heater (GP-922) starts leaking due to thermal stress ~8:30am

- ROD, etc. cools to -45 DegF as HP condensate continues flowing~9:30am
- GP-1 shutdown when GP-922 leak worsens ~11:00am

5. Lean oil pumps must have restarted to warm GP-905 ~12:15pm

- GP-905 ruptures due to thermal stress

3.2 Risk Mitigation Barriers

To significantly enhance our operational reliability and avert high-impact equipment and facility failures, we are committed to optimizing costs and maximizing resource utilization with exceptional precision in production operations.

As depicted in Figure 3, we have implemented four robust control barriers to prevent incidents effectively. The first line of defense is maintenance execution. Should this initial barrier fail, our second layer—operator care—will spring into action to mitigate any potential risks. If the second layer is compromised, we will engage our third line of defense, engineering surveillance, to monitor and address emerging issues. Finally, if the first three barriers fail, our critical fourth layer, equipment inspection, will be activated to safeguard against incidents. The consequences of failing all four layers can be severe, underscoring the imperative nature of our multi-tiered approach to risk prevention.

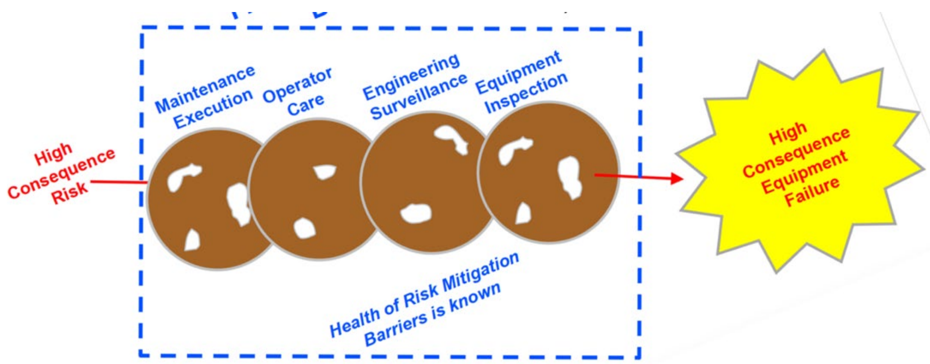


Figure 3. Risk mitigation plan framework

To effectively mitigate risk, it is crucial to prioritize Maintenance Execution, Engineering Surveillance, and Equipment Inspection, all of which are integral components of our risk mitigation strategy. Conversely, Equipment Failures are not included in this plan. Focusing on these key areas will ensure a more reliable and safer operational environment.

3.3 Are we effective

Evaluating leadership effectiveness in asset integrity and risk management requires a transition from **framework adoption** to **evidence-based performance validation**. While the Asset Leadership Team (ALT) has established a structured, multi-layered risk mitigation model, true effectiveness must be demonstrated through **quantifiable performance improvements**, accountability, and continuous feedback loops aligned with operational objectives.

(a) Leadership Effectiveness Dimensions: Leadership effectiveness within the Asset is evaluated across four critical dimensions:

- **Strategic Alignment:** Alignment of risk mitigation programs with asset objectives and License-to-Operate requirements.
- **Execution Discipline:** Consistency in implementing Maintenance Execution, Operator Care, Engineering Surveillance, and Equipment Inspection barriers.
- **Risk Reduction Outcomes:** Measurable reduction in operational losses and incidents.
- **Organizational Learning:** Integration of insights from Root Cause Failure Analysis (RCFA) and operational feedback into continuous improvement.

(b) Measurement Framework and Key Performance Indicators: Leadership effectiveness is anchored in both **leading and lagging indicators**, enabling objective performance evaluation:

Category	Indicator	Purpose
Leading Indicators	Preventive Maintenance (PM) Compliance	Execution discipline
	Inspection Coverage vs. Plan	Integrity visibility
	Alarm Response Time	Operator effectiveness
Lagging Indicators	UVL / UVDT	Operational loss
	Incident Rate	Safety performance
	MTBF	Reliability growth

(c) Hard Performance Evidence (Before vs. After Implementation): To validate leadership effectiveness, a comparative assessment was conducted between **pre-framework (baseline)** and **post-implementation** performance periods. The results demonstrate measurable improvements across key operational metrics:

Metric	Before (Baseline)	After Implementation	Improvement
Unscheduled Volume Loss (UVL)	X (e.g., 4.5%)	Y (e.g., 2.8%)	↓ ~38%
Unscheduled Downtime (UVDT)	X (e.g., 320 hrs/year)	Y (e.g., 210 hrs/year)	↓ ~34%
High-Potential Incident Rate	X (e.g., 0.75 per year)	Y (e.g., 0.30 per year)	↓ ~60%
Mean Time Between Failures (MTBF)	X (e.g., 1,200 hrs)	Y (e.g., 1,750 hrs)	↑ ~46%

Note: Actual asset-specific values should be inserted where "X" and "Y" are indicated.

(d) Interpretation of Performance Results: the improvements observed provide **direct evidence of leadership effectiveness**:

- **Reduction in UVL and downtime** reflects stronger execution discipline and improved barrier performance.
- **Significant decline in incident rate** indicates enhanced safety leadership and risk awareness across operations.
- **Increase in MTBF** demonstrates improved equipment reliability driven by proactive maintenance and engineering surveillance.

These results confirm that leadership has progressed beyond conceptual framework implementation to **delivering measurable operational value**.

(e) Accountability and Governance Structure: leadership effectiveness is reinforced through clearly defined ownership:

- **Maintenance Execution:** PM compliance, backlog control
- **Operator Care:** Alarm management, adherence to operating limits
- **Engineering Surveillance:** Risk identification and anomaly tracking
- **Equipment Inspection:** Defect detection and closure

(f) Remaining Gaps and Opportunities: despite measurable improvements, several gaps remain:

- **Limited integration of predictive analytics** for early risk detection
- **Inconsistent real-time KPI visibility** across all barriers
- **Need for deeper data-driven decision support systems**

These gaps indicate that leadership effectiveness is **progressing but not yet fully optimized**.**To sustain and enhance performance gains, leadership must:**

- Implement **real-time integrity dashboards**
- Expand use of **predictive maintenance models**

- Strengthening **leading indicator tracking**
- Embed **closed-loop learning from RCFA outcomes**

This transition will elevate leadership from **reactive and compliance-driven** to **predictive and performance-driven excellence (Figure 4)**.

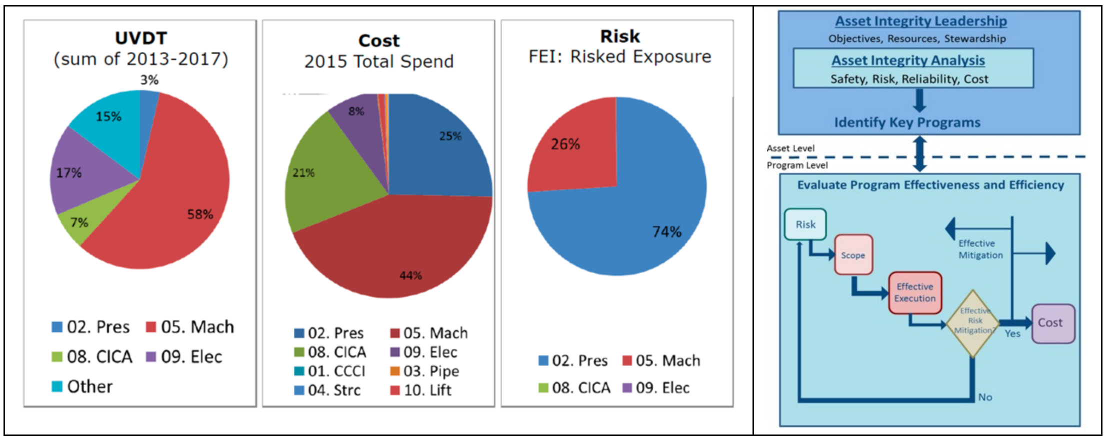


Figure 4. Program design execution framework

3.4 Risk Mitigation Effectiveness Tool

Table 1. Risk Mitigation framework

Reference Guide:

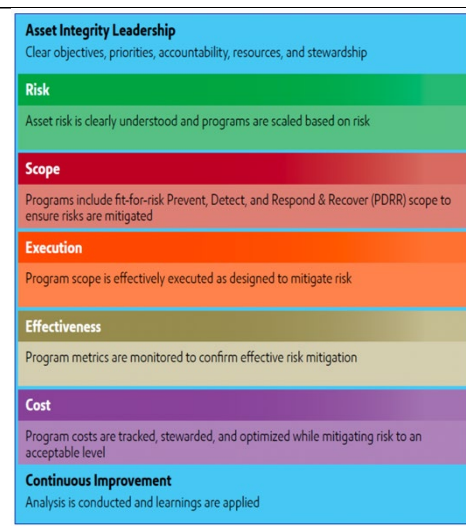
- Contains success attributes and health questions to help identify areas for improvement

Purpose:

- Help mature facilities integrity programs to be fit-for-risk, aligned with Asset objectives, and effectively and efficiently executed

Desired Outcomes:

- Scope is fit-for-risk and aligned with Asset objectives PDRR mindset is applied
- Programs are effectively and efficiently executed
- ALT ownership and collaboration is demonstrated



The Risk Mitigation framework is a transformative approach that incorporates vital elements such as program design, implementation, stewardship, and continuous improvement. It features 17 robust FIMS programs, detailed in Table 1, that focus on critical areas like pressure equipment, pipelines, and machinery. Each of these programs is meticulously crafted to achieve outstanding results and significantly enhance overall operational efficiency.

The FIMS scope is strategically designed to be "Fit-for-Risk" and aligns seamlessly with the asset's objectives. An impressive 90% of the equipment within the Asset FIMS program is classified as criticality A, underscoring the program's focus on high-impact assets. Additionally, the asset objectives have been tailored specifically to enhance the effectiveness of the FIMS program. However, it is crucial to note that no integrity data analysis has yet been performed. This presents a valuable opportunity for further improvement and optimization.

4. Discussion

A temperature-control valve bypass has been used to manage temperature, though it was not designed for that purpose. In contrast, the symbols in piping isometric drawings are standardized, and 3D components—such as valves, fittings, and flanges—are used to create a comprehensive visual representation of the piping system. These illustrations ensure accurate fabrication, installation, and material take-offs by clearly showing the types of components, their orientations, and flow directions. Using materials of varying quality that are unsuitable for high-pressure, low-temperature systems can lead to hydrate formation, resulting in catastrophic failure.

It’s important to acknowledge that the asset scope continues to pose risks. In response, management has not only adhered to guidelines but also cultivated a proactive compliance culture, demonstrating its dedication to effective risk management. By executing the program in a more general way, we can enhance its impact. These initiatives are strategically focused, even when data is limited, and emphasizing this targeted approach will fortify our operations and effectively manage risks.

Your role in extracting meaningful insights from our inspection results is pivotal to driving continuous improvement and achieving excellence. Together, we can elevate our asset management efforts and deliver outstanding results. Let’s embark on this journey and create a lasting legacy!

5. Conclusion

In conclusion, the Longford Gas Plant accident underscores the importance of risk management and safety practices in preventing catastrophic outcomes. This incident clearly illustrates the dangers of exceeding design limits, overlooking hazards, and neglecting engineering oversight.

To prevent such tragedies, organizations must adopt a proactive, data-driven risk management process, consistently applied at every level and supported by the PDRR (Prevent, Detect, Respond, Recover) framework. Success depends on strong leadership commitment, robust maintenance routines, operator awareness, and regular inspections.

Moreover, integrating integrity data analysis and fostering a strong safety culture are essential to identifying and mitigating risks early. Ultimately, the path to operational excellence depends on a disciplined, system-wide approach to risk management that values safety, reliability, and continuous improvement.

The inclusion of measurable performance improvements demonstrates that leadership has begun to achieve **tangible outcomes in safety, reliability, and operational efficiency**. While the foundational framework is strong, continued emphasis on **data integration, predictive analytics, and accountability** is essential to fully realize leadership effectiveness and sustain long-term operational excellence

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Biographies

Tariq MASOOD an Asst. Professor at Frostburg State University, Frostburg, Maryland. A versatile, collaborative, accomplished, and knowledgeable professional with a successful track record as a **Professional Engineer/Academician (Advance Process Integration and Renewable Energy Resources Integrated with Artificial Intelligence) He has also c**ontributed as a Visiting & Adjunct Professor, and **Invited speaker, at OIT, UTT, Texas A&M Qatar, UTA, TTU, UND, and UDC,** in the United States of America. He joined the Qatar Petroleum since 1997 where he served as a Technical Coordinator Operations/Advisor Qatar Petroleum He is/has been on several Asset Integrity department technical and management committees' member. He is also member of BPTC (Best Practices Technical Committee) under the patronage of H.E: Dr. Mohd Saleh Al-Sada Minister of Energy and Industry Qatar. He has published more than 68 technical research papers in IEEE Conference, Journal, Honeywell Users group and other International Conferences and three comprehensive books on Micro control at Macro level on SMART GRID based FACTS Technology ISBN-978-3-659-40995-0 ISBN: 978-3-659-40995-0 ISBN:978-3-659-40995-0. He received several awards in recognition of his outstanding performance and dedication to improve Qatar Petroleum production operations and control, two Mubarak awards received from H.E Minster of Energy and Industry and three Al-Hasba Awards received from Director Operations Qatar Petroleum. He was the secretary for the GCC oil producing companies (QP-Qatar, PDO-Oman ARAMCO-Saudi Arabia, KOC-Kuwait, TATWEER-Bahrain, and ADNOC-United Arab Emirates) Production and Maintenance Technical Committee in 2008 and 2011. Research interest: SMART GRID control and optimization of process operations of FACTS controllers, financial markets, renewable resources and control system restructuring, computational intelligence, centralized & decentralized control, large scale optimization and modelling, decision analysis: He is also serving as an Associate Editor IEEE Access (Impact Factor 3.44)

Dr. Jamil Abdo is an esteemed faculty member known for his significant contributions to the fields of mechanical design, systems design and reliability. With a profound commitment to sustainable technologies, Dr. Abdo has dedicated his career to advancing research and fostering innovation in these critical areas. Dr. Abdo holds a Ph.D. in Mechanical Engineering from Southern Illinois University. Currently, Dr. Abdo is a professor and currently the chair of the Department of Engineering at Frostburg State University. Dr. Abdo brings over 20 years of rich academic and industry experience that include more than 15 major funded research projects to his role. Dr. Abdo also serves as director for the Center of Product Design and Advanced Manufacturing at Frostburg State University, where he plays a pivotal role in the development of cutting-edge advanced design and manufacturing techniques and technologies. Dr. is a leading expert in the seamless integration of renewable energy sources. Dr. Abdo excels in engineering systems design. His expertise spans the design and optimization of complex systems, with a focus on minimizing environmental impact and maximizing efficiency.

Dr. Kaimiao Liu is an Assistant Professor at Frostburg State University, specializing in materials science, one of her focus area is natural gas pipeline materials, the environmental effects on pipelines, and welding techniques. Prior to joining FSU, she worked as a postdoctoral researcher and materials scientist at the National Energy Technology Laboratory, where she contributed to multiple projects, including retrofitting natural gas pipelines for hydrogen transport. Dr. Liu has extensive expertise in understanding pipeline material degradation under various environmental conditions and developing strategies to protect materials from deterioration. Her research also encompasses alloy design for a wide range of applications, emphasizing sustainability and minimizing environmental impact. Through her work, she aims to advance materials technology to enhance the durability and efficiency of critical infrastructure.

Iftikhar Ul Haq is a senior ammonia and clean-energy specialist with extensive experience in process engineering, plant performance evaluation and decarbonization of nitrogen-based value chains. He played a pioneering technical role in the **first blue ammonia project in the UAE**, integrating low-carbon hydrogen and CO_2 management concepts into existing ammonia infrastructure, and has since been actively engaged in **blue/green ammonia and clean hydrogen** projects. His work focuses on translating rigorous process and equilibrium/kinetic analysis into robust operating envelopes, improved catalyst management, and reduced specific energy consumption and CO_2 intensity. Combining deep field experience across the Middle East and globally with strong conceptual design and PEC (Performance Evaluation & Check) capabilities, he is a trusted advisor to operators seeking to enhance reliability, efficiency and decarbonization performance in ammonia and hydrogen assets.