ICSS implementation in gas liquefaction plant

Key highlights

The Gas Liquefaction Unit (UTG) project represents a significant achievement for developing a complex energy infrastructure within a challenging environment. This initiative involved successfully implementing a comprehensive Integrated Control and Safety System (ICSS), meticulously designed to manage the intricacies of primary treatment. At the same time, the Liquefaction Package Unit executed the liquefaction process. Our system reads its information and presents it in the FactoryTalk View SE.

+ **Comprehensive ICSS Deployment:** Successfully implemented an Integrated Control and Safety System (ICSS) integrating
  - Process Control System (PCS),
  - Safety Instrumented System (SIS), and
  - Fire & Gas System (FGS) for unified plant management.
+ **Optimized Operational Efficiency:** Improved control over gas production, treatment, and liquefaction through advanced automation, maximizing throughput and energy utilization.
+ **High Safety & Environmental Standards:** Implemented SIL 2, using ControlLogix Certified Safety Instrumented System (SIS) and Fire & Gas System (FGS), demonstrating commitment to personnel safety and environmental protection.

Sensia successfully delivered a comprehensive Integrated Control and Safety System (ICSS) to the Gas Liquefaction Unit, overcoming extreme logistical and environmental challenges to enable reliable natural gas liquefaction. The solution combines process control and safety instrumented systems on a single Rockwell Automation-based platform, ensuring seamless plant management and SIL 2-certified safety compliance. Built on a redundant architecture designed to withstand humidity and instability, the project achieved an exceptional 99.9999% availability. Featuring advanced hydrate management and self-generation capabilities for autonomous operation, it transformed a remote site into a resilient energy asset. This achievement demonstrates Sensia's ability to execute complex engineering projects that prioritize personnel safety, operational continuity, and sustainable infrastructure in the world's most demanding environments.

Challenge

Remote and Harsh Environment: The equatorial climate brought extreme stressors like high temperatures, intense humidity, and frequent lightning, necessitating robust infrastructure. Maintaining consistent power availability and reliable communication in this isolated setting also proved problematic, impacting digital oil field solutions.

Complex System Integration: A significant technical challenge involved integrating many disparate systems and vendor packages, including the UTP, UGNL, auto generation plant, various auxiliary utility skids, and fiscal metering systems into a single, cohesive ICSS. This required extensive engineering to ensure seamless data exchange, synchronized operations, and consistent safety interlocks across diverse platforms, compounded by the need for close alignment with multiple vendors.

Critical Process Control Requirements: Managing the natural gas liquefaction process, particularly preventing hydrate formation, was critical due to the risk of severe blockages and safety hazards, necessitating precise, real-time control of pressure and temperature, especially following significant pressure drops.

Ensuring High Availability and Safety Integrity: Achieving and maintaining exceptionally high system availability (a target of 99.9999%) alongside the highest level of safety integrity (SIL 2 certification) presented another significant challenge, demanding advanced hardware, software, and rigorous testing protocols to prevent catastrophic events and ensure business continuity.

Long-Term Support and Obsolescence Management: The remote location and extended operational lifecycle introduced long-term equipment support and obsolescence challenges, requiring a 10-year component supply guarantee and local repair capabilities in Brazil.

Transition to Proactive Operations: A fundamental shift from traditional reactive responses to a proactive management approach was necessary, involving leveraging real-time data, advanced diagnostics, and new workflows to anticipate issues, optimize performance, and identify trends, necessitating significant investment in training and adaptation for operational teams.

+ **Resilient Infrastructure:** Successfully deployed systems, overcoming logistical and environmental challenges like hydrate formation and power supply.
+ **Sustainable Energy Solutions:** Integrated robust self-generation capabilities and resilient power solutions for continuous, autonomous operation.
+ **Seamless System Integration:** Established cohesive plant operation through advanced network architecture and diverse protocol integration (Ethernet TCP, Modbus TCP, Profibus DP).

Solution

To address the multifaceted challenges, robust and innovative solutions were implemented, starting with a fully tropicalized infrastructure and IP-54 protection to withstand the climate, ensuring long-term operational integrity and reduced maintenance. A highly integrated ICSS was central, unifying PCS, SIS, and FGS for comprehensive monitoring and emergency management. This system features advanced control and safety mechanisms, including PCS with hot standby CPU configurations and redundant HSDN for real-time control, TÜV-certified SIL 2 CLPs for critical safety functions in the SIS, and seamlessly integrated SIL 2 FGS for fire and gas detection.

The comprehensive implementation of an Integrated Control and Safety System (ICSS) is central to the project's operational integrity. This system unifies the Process Control System (PCS), Safety Instrumented System (SIS), and Fire & Gas System (FGS), providing integrated supervision and control across all UTG operations, from hardware and software engineering to cabinet build, system staging for Factory Acceptance Tests (FAT), and site services for 600 I/O + 2,000 soft tags using a customer library that included controllers, workstations, and fiber optic network infrastructure.

An advanced hydrate management system with electric heaters and real-time monitoring maintains a minimum 5°C safety margin above hydrate formation temperature, ensuring process stability. Comprehensive data management and operational intelligence are facilitated by dedicated SCADA/SOE servers and a GPS server for precise time synchronization, with 1ms digital input resolution enabling granular event analysis and predictive maintenance. Long-term continuity and risk mitigation were ensured through mandated local repair capabilities and a 10-year component supply guarantee.

Result

The ICSS for the Gas Liquefaction Plant stands as a testament to advanced engineering and strategic project execution in a demanding environment. The project successfully deployed a highly integrated, robust, and safe control system that meets stringent operational and safety requirements and demonstrates a forward-thinking approach to energy infrastructure development. The comprehensive integration of PCS, SIS, and FGS provides a unified operational backbone, ensuring efficient process control and critical safety functions. The commitment to SIL 2 certification and TMR architecture for safety systems and an ambitious 99.9999% availability target underscores a deep-seated dedication to operational resilience and risk mitigation. This proactive stance is particularly vital given the remote and challenging environment, where environmental stressors and logistical complexities could otherwise severely impact project viability.

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