

Elizabeth M. Smith, PE **Staff Engineer, Kenexis**

Fields of Competence

Fire & Gas System Design
Safety Instrumented System Engineering
Layer of Protection Analysis (LOPA)
Safety Integrity Level (SIL) Selection
Safety Integrity Level (SIL) Verification
Safety Requirements Specifications (SRS)
Functional Test Plans
Quantitative Risk Analysis
Process Hazards Analysis / Hazard Identification (PHA, HAZID)
Chemical Engineering
Fault Tree Analysis
Quantitative Consequence Modeling

Experience Summary

Ms. Smith has experience in Fire & Gas Systems (FGS) and safety instrumented systems design and consequence / hazards analysis. During her time with Kenexis she has been in charge of project management of Safety Instrumented System design basis development for over 15 upstream oil & gas facilities. Ms. Smith also has experience in several Layer of Protection Analyses (LOPA) and Hazard and Operability Analyses (HAZOP). She has experience in FGS design and implementation for a number of offshore facilities. Specialized in performance-based FGS design including risk-based techniques for FGS integrity analysis and fire & gas detector mapping techniques.

Credentials:

B.S., Chemical Engineering, The Ohio State University

Registered Professional Engineer (Chemical Engineering), State of Ohio

Qualified on Safety Instrumented System – Front End Engineering Design Part 1 and Part 2
ISA EC50 Qualified, SIS Design, Analysis, and Justification
ISA EC52 Advanced Safety Integrity Level (SIL) Selection
ISA EC54 Advanced Design and SIL Verification
ISA 84 Expert: SIS Fundamentals Specialist, SIL Selection Specialist, SIL Verification Specialist

Affiliations:

International Society of Automation (ISA)
Columbus Chapter Education Chair

Key Projects:

HAZOP/LOPA study of full facilities including: integrated oil & gas production facility in Alaska. Project included Instrumented Protective Functions (IPF) list development. PHA Study covered all major units of the facilities which include:

- Oil and Gas Separation Systems
- Turbine Driven Gas Compression
- Produced water Injection
- Crude Oil shipping pumps / metering
- Fired Heaters
- Glycol Utility Systems
- Waste Heat Recovery Units
- TEG Regeneration Systems
- Production and Injection Wells
 - Miscible/ Water Injection
 - Gas Lift
 - HP / LP Production
- Production Manifolds and Flowlines
- Flare Systems

Project included SIL Selection, SIL Verification, identification of performance gaps, recommendations to change SIS design / testing to meet customer's risk tolerance guidelines.

LOPA study of gas handling and natural gas liquids recovery and gas compression facilities. Project included development of a Safety Instrumented Function (SIF) List, SIL selection using Layer of Protection Analysis (LOPA) study results, SIL Verification calculations, Fault Tree Analysis (FTA) to analyze complex systems, identification of performance gaps and recommendations for design / testing of SIS to meet customer objectives. Projects included numerous compressor shutdown functions, identifying independent protection layers to reduce SIL requirements. Analyzed risk gaps based on backflow prevention through compressors during shutdowns.

Developed SIS Design Basis information for oil & gas Central Gathering / Processing Centers. Performed detailed fault tree analysis calculations for inlet manifold overpressure protection. Performed full facility SIL verification calculations for all safety and equipment protective functions for each facility. Included analysis / selection of appropriate failure data to characterize failure frequencies, calculation of achieved SIL. Developed recommendations to modify SIS design and maintenance to achieve desired SIL targets.

Developed SIS Design Basis for three oil, gas and produced water flow gathering / processing stations. Project included SIL Selection using Layer of Protection (LOPA), SIL Verification, and development of recommendations to reduce risk / meet SIL targets.

Executed Fire & Gas System design and validation projects for numerous offshore facilities. These projects included both process and non-process areas, incorporating risk-based design for process areas. Projects include hazard identification, risk-based analysis of existing fire & gas systems, FGS SIL Assessment design of fire & gas system and, Fire & gas detector coverage mapping analysis.

- Offshore oil & gas production
- Gas Treatment and Separations Plants
- H2S and HF Detection Systems at Upstream Facilities

Estimated loss of profits during plant shutdown of flow stations. Project included the following equipment:

- Inlet manifolds
- Slug Catchers
- Oil and Gas Separation Systems
- Turbine Driven Gas Compression
- Produced water Handling, Processing, Pumping
- Crude Oil shipping pumps / metering
- Fired Heaters
- Glycol Utility Systems
- Flare Systems

Produced complete IPF list of well heads and production headers within numerous well-pads and satellite drilling facilities located in Alaska. Reviewed safety risks of over and under pressure hazards based upon mode of well head operation (seawater / water injection, miscible injection, gas lift injection, and gas lifted production wells). Identified design intent of protective functions for future PHA / LOPA activates.

Comprehensive risk assessment studies of two large integrated oil & gas production and processing facilities. Developed list of instrumented protective functions for facility wide LOPA / SIL Selection, SIL verification study. Conducted calculations to verify existing SIS hardware satisfies requirement of SIL selection study. Cross referenced the list of Safety Instrumented Functions with LOPA to determine selected SIL and required Risk Reduction Factors. Recommendations to improve SIS design based on Gap analysis.

Conducted quantitative consequence modeling of hazards associated with release of hydrocarbons from a coker unit through vent stack. Analyzed the composition, size, shape, and dispersion of plume of flammable hydrocarbons released from the stack. Calculated the potential for heavy hydrocarbon rain out from the plume and potential for resulting pool fires. Analyzed toxic gas dispersion of hydrogen sulfide hazards. Analyzed energy release / temperature of a potential jet fire / delayed ignition vapor cloud explosion of plume from the stack. Determined appropriate category of hazard scenario to assist in proper classification of the risks and identify appropriate risk reduction alternatives to mitigate risks.

LOPA / SIL Selection of Natural Gas to Liquid units producing synthetic diesel including Sulfur Recovery and Tail Gas Unit. Project included development of Safety Instrumented Function (SIF) list, Layer of Protection Analysis (LOPA), SIL selection, SIL Verification calculations, and Safety Requirements Specification (SRS) Development. Recommendations made to reduce risk and specify design of major upgrade to the facility's Safety Instrumented System (SIS).

Managed project involving SIS Design Basis development of an offshore oil & gas production facility. Included oversight of project team responsible for SIL Selection, SIL Verification and development of recommendations to meet customer requirements for design of SIS.

Conducted SIL Verification calculations for offshore oil and gas production. Included analysis / selection of appropriate failure data to characterize failure frequencies, calculation of achieved SIL, and recommendation of maintenance and testing alternatives to allow the customer to meet the desired risk tolerance targets.

Comprehensive SRS work for two Ammonia plants. Developed SRS documentation as well as creating Safety System Cause and Effects and Full Functional Test Plans.

Projects specific to PHA, HAZOP / SIL Selection, and SIL Verification include:

- LNG Train (Atlantic LNG) – PHA / LOPA / SIL
- Subsea Well (BP GoM) – PHA / LOPA / SIL
- Oil / Gas Separation (BP GoM & BPXA) – PHA / LOPA / SIL - multiple
- Oil / Gas Gathering Centers (BPXA) – PHA / LOPA / SIL - multiple
- Injection Compressor (BPXA) – PHA / LOPA / SIL
- Gas to Liquids Plant (BPXA) – PHA / LOPA / SIL
- Flare System (CITGO) – PHA / LOPA
- Hydrocarbon Blending & Transfer (FMC) – PHA / LOPA / SIL
- FPSO Disconnection Sequence (SBM) – SIL / FTA