

# LNG Terminal Safety Instrumented System (SIS) Requirements & Specifications



*Mitigating Risk. Improving Performance.*

## LNG Terminal Safety Instrumented System (SIS) Requirements and Specifications

ABS Consulting provides services for proposed LNG terminals to determine appropriate safety integrity levels (SILs) and develop safety requirements specifications (SRSs) for their safety instrumented functions (SIFs). SIL evaluations and SRSs are required for new LNG terminals to meet industry standards (e.g., IEC 61511, IEC 61508, ANSI/ISA-84.00.01-2004 [IEC 61511 Mod]) for the design of safety instrumented systems (SISs).

ABS Consulting has over 50 years of experience in the LNG, oil & gas, petrochemical, petroleum, and related industries. Its engineers are recognized experts in the field. They stay at the forefront of changing safety system requirements by participating as members of ISA and related industry committees.

The following are examples of SIS-related services ABS Consulting can provide:

- **Develop risk tolerance criteria/protocols.**

SIL determination is greatly influenced by a company's risk tolerance criteria. ABS Consulting has experience helping companies develop risk tolerance criteria and protocols that (1) reflect the companies' risk thresholds and (2) conform to common industry practice.

- **Identify accident scenarios that may require SIFs.**

ABS Consulting can lead or participate in design/hazard reviews and use its HazardReview LEADER™ software to record/filter potential high-risk scenarios where SIFs are to be provided or may be needed for risk reduction.

- **Apply layer of protection analysis (LOPA) and related techniques to determine SIL requirements.**

ABS Consulting co-authored the book on LOPA, entitled *Layer of Protection Analysis: Simplified Process Risk Assessment*, published by the American Institute of Chemical Engineers' (AIChE's) Center for Chemical Process Safety (CCPS). HazardReview LEADER software automatically generates LOPA worksheets for high severity or high-risk scenarios, allowing efficient assessment of initiating event frequencies and protection layer failure probabilities using lookup tables based on industry standard data ranges.

- **Identify and evaluate SIF design/testing options.**

There are usually multiple ways to address a SIL requirement. Our engineers bring a wealth of industry experience to the table, enabling your team to consider more than one possible combination of SIF component design and testing methods/ frequencies that will meet the SIL requirement.

- **Define the functional and performance requirements for SIFs.**

ABS Consulting has helped a number of companies develop detailed SRSs that meet Clause 10 of ANSI/ISA-84.00.01-2004 Part 1. This includes describing the desired SIF operating philosophy, SIF trip conditions, resulting process actions, and performance requirements for the sensors, logic solvers, and final control elements.



# Safety Instrumented Function

ABS Consulting will develop an SRS for each SIF needed in your LNG terminal. A typical SRS contains detailed descriptions and supporting data and references for the following:

- Hazardous event to be controlled by the SIF
- Desired safety function to be provided
- Overall functional requirements of the SIF
- Input device type & performance requirements
- Final control element type & performance requirements
- Logic solver performance requirements
- SIF interface & alarms
- Estimated failure probabilities/calculations
- SIF common-cause failure considerations
- Related feedback/process actions needed

## HazardReview LEADER LOPA/SIL Evaluation Software

ABS Consulting's world-class LEADER software efficiently generates LOPA worksheets from design/hazard review data to quickly determine SIL requirements and evaluate risk reduction options.

**Low temperature embrittlement of carbon steel natural gas header due to loss of vaporization caused by vaporizer temperature control loop failure**

Scenario Results	Case	SIL Requirement
I.E-01	Unmitigated (without IPLs)	SIL 3
I.E-05	Mitigated (with IPLs)	

  

Severity Category	Description
SI	Release of high pressure natural gas (and possibly LNG carrying over from vaporizer); fire hazard

  

Initiating Event	Type	Description
I.E-01	BPCS Instrument Loop Failure	vaporizer inlet flow control valve (FV-9006A) opening too much due to failure of temperature control loop (TIC-9012A)

  

Enabling Condition	Probability	Initiating Event Type:
1.00	Probability of	Select type of initiating event to assign the typical frequency. Or, manually input a frequency and add a comment.

  

Conditional Modifiers	Probability	Probability of Person Present	Probability of Fatality
1.00	Probability of	Probability of Person Present	Probability of Fatality

  

Independent Protection Layers (IPLs)	Type	Description
I.E-01	BPCS	Temperature indication TI-9013A with low temperature alarms and low-low temperature interlock (via BPCS logic solver) that closes vaporizer inlet valve
I.E+00		Extend stainless steel piping farther downstream of vaporizers if needed to provide adequate response time for listed IPLs to work effectively
I.E-01	SIL-1 SIF	Heating system temperature indication TIC-9015A with low temperature alarm
I.E-02	SIL-2 SIF	Add SIL-2 SIF to stop LNG flow through vaporizer on low temperature
I.E-01	BPCS	Automatic heating controls through independent logic solver to quickly

**LOPA/SIL Worksheet**  
HazardReview LEADER

## LNG Terminals - SIS FAQs

- What kind of processor should we purchase for the ESD system?
- How many level instruments do we need on the LNG storage tanks?
- How often do we need to functionally test the high level trips?
- What logic configuration (e.g., 1oo2, 1oo3) is needed?
- How can we best provide the required redundancy?



For more information, contact:

Myron Casada  
Vice President - Risk Services  
Tel: 1-865-671-5815  
mcasada@absconsulting.com

ABS Consulting  
Risk Consulting Division  
Tel: 1-865-966-5232  
www.absconsulting.com