Layer of Protection Analysis (LOPA)

Why LOPA?

Layer of Protection Analysis is a process to determine the risk associated with various hazardous events by applying semi-quantitative measures to the frequency and probability of failure of the protective layers. While qualitative risk assessments such as Hazard and Operability (HAZOP) are good for identifying hazardous events, initiating causes, event severity, and initiating likelihood, Process Hazard Analysis (PHA) teams may list safeguards that only partially mitigate process risk. In addition, HAZOP does not address whether safeguards are independent from one another. This often leads to teams taking credit for more risk reduction than is possible based upon the integrity of the individual components. A team's perception of the integrity of a specific safeguard may lead to inconsistency in the number of safeguards required to adequately mitigate risk. As a result, LOPA is a useful analytical tool for indicating that adequate risk reduction can be achieved. In the event that there are not enough Independent Protection Layers (IPLs), additional Safety Instrumented Functions (SIFs) may be required. LOPA provides specific criteria and restrictions for evaluating IPLs, eliminating much of the inherent subjectivity of qualitative techniques such as HAZOP.

What is an IPL?

An IPL is an independent protective function, which can be active or passive, that is capable of detecting a failure and preventing the consequences of a hazardous event such as loss of primary containment, explosion, or a runaway reaction.

Some IPLs include the following:

- Restricted access
- Dikes, berms, and blast walls
- Pressure relief devices and flares
- Operating procedures
- Safety Instrumented Systems (SIS)
- Basic Process Control System (BPCS)
- Alarms with a defined operator response
- Deluge systems

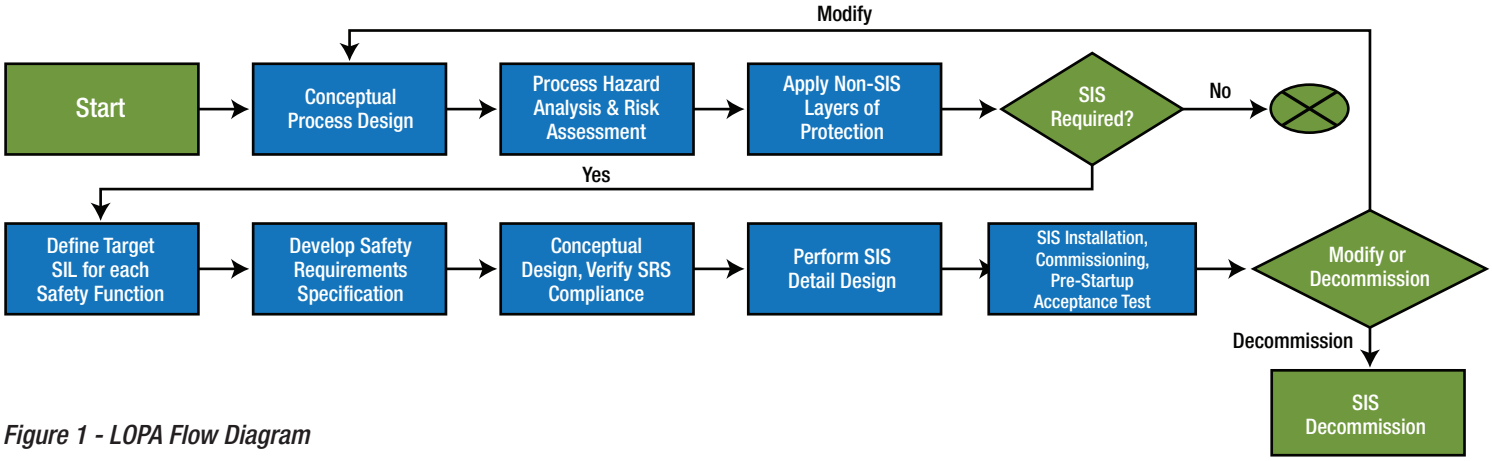

Figure 1 - LOPA Flow Diagram

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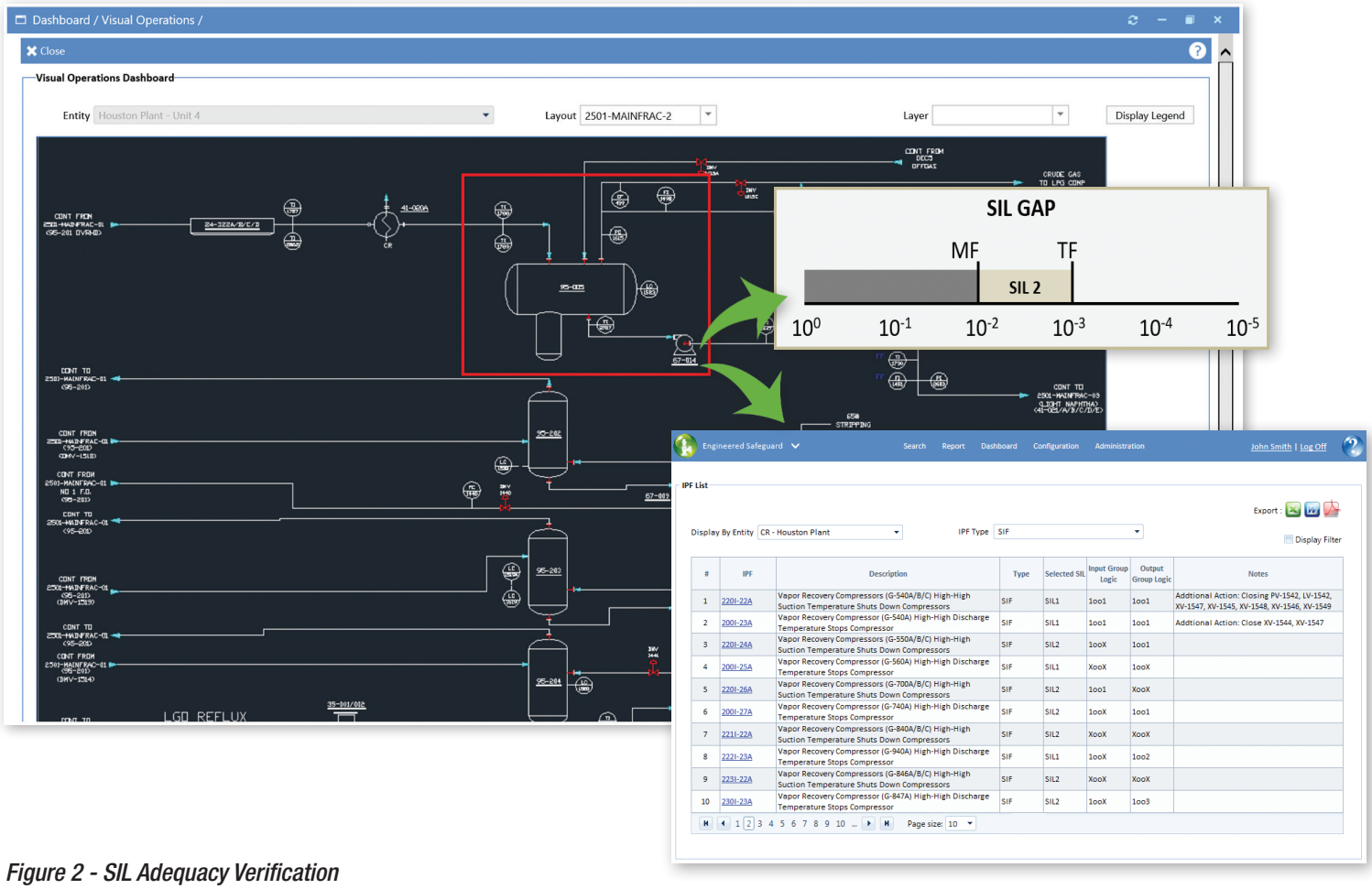
LOPA in Process Risk Manager

The Operational Sustainability, LLC® (OS) **OESuite™ Process Risk Manager Module** contains a LOPA template. The module calculates risks and compares them with tolerance criteria to determine if further risk reduction is required.



#	IPF	Description	Type	Selected SIL	Input Group Logic	Output Group Logic	Notes
1	220I-22A	Vapor Recovery Compressors (G-540A/B/C) High-High Suction Temperature Shuts Down Compressors	SIF	SIL1	1oo1	1oo1	Addtional Action: Closing PV-1542, LV-1542, XV-1547, XV-1545, XV-1548, XV-1546, XV-1549
2	200I-23A	Vapor Recovery Compressor (G-540A) High-High Discharge Temperature Stops Compressor	SIF	SIL1	1oo1	1oo1	Addtional Action: Close XV-1544, XV-1547
3	220I-24A	Vapor Recovery Compressors (G-550A/B/C) High-High Suction Temperature Shuts Down Compressors	SIF	SIL2	1ooX	1oo1	
4	200I-25A	Vapor Recovery Compressor (G-560A) High-High Discharge Temperature Stops Compressor	SIF	SIL1	XooX	1ooX	
5	220I-26A	Vapor Recovery Compressors (G-700A/B/C) High-High Suction Temperature Shuts Down Compressors	SIF	SIL2	1oo1	XooX	
6	200I-27A	Vapor Recovery Compressor (G-740A) High-High Discharge Temperature Stops Compressor	SIF	SIL2	1ooX	1oo1	
7	221I-22A	Vapor Recovery Compressors (G-840A/B/C) High-High Suction Temperature Shuts Down Compressors	SIF	SIL2	XooX	XooX	
8	222I-23A	Vapor Recovery Compressor (G-940A) High-High Discharge Temperature Stops Compressor	SIF	SIL1	1ooX	1oo2	
9	223I-22A	Vapor Recovery Compressors (G-846A/B/C) High-High Suction Temperature Shuts Down Compressors	SIF	SIL2	XooX	XooX	
10	230I-23A	Vapor Recovery Compressor (G-847A) High-High Discharge Temperature Stops Compressor	SIF	SIL2	1ooX	1oo3	

Figure 2 - SIL Adequacy Verification

For example, some risk criteria may require each scenario to be controlled so that it falls below a particular risk tolerance level. In some cases, an additional SIF may be required to get below that tolerable risk level. OESuite allows users to visually identify deficiencies in safeguards on the fly and to come up with viable alternatives. Any LOPA recommendations can be exported to our integrated **CAPA Module**.

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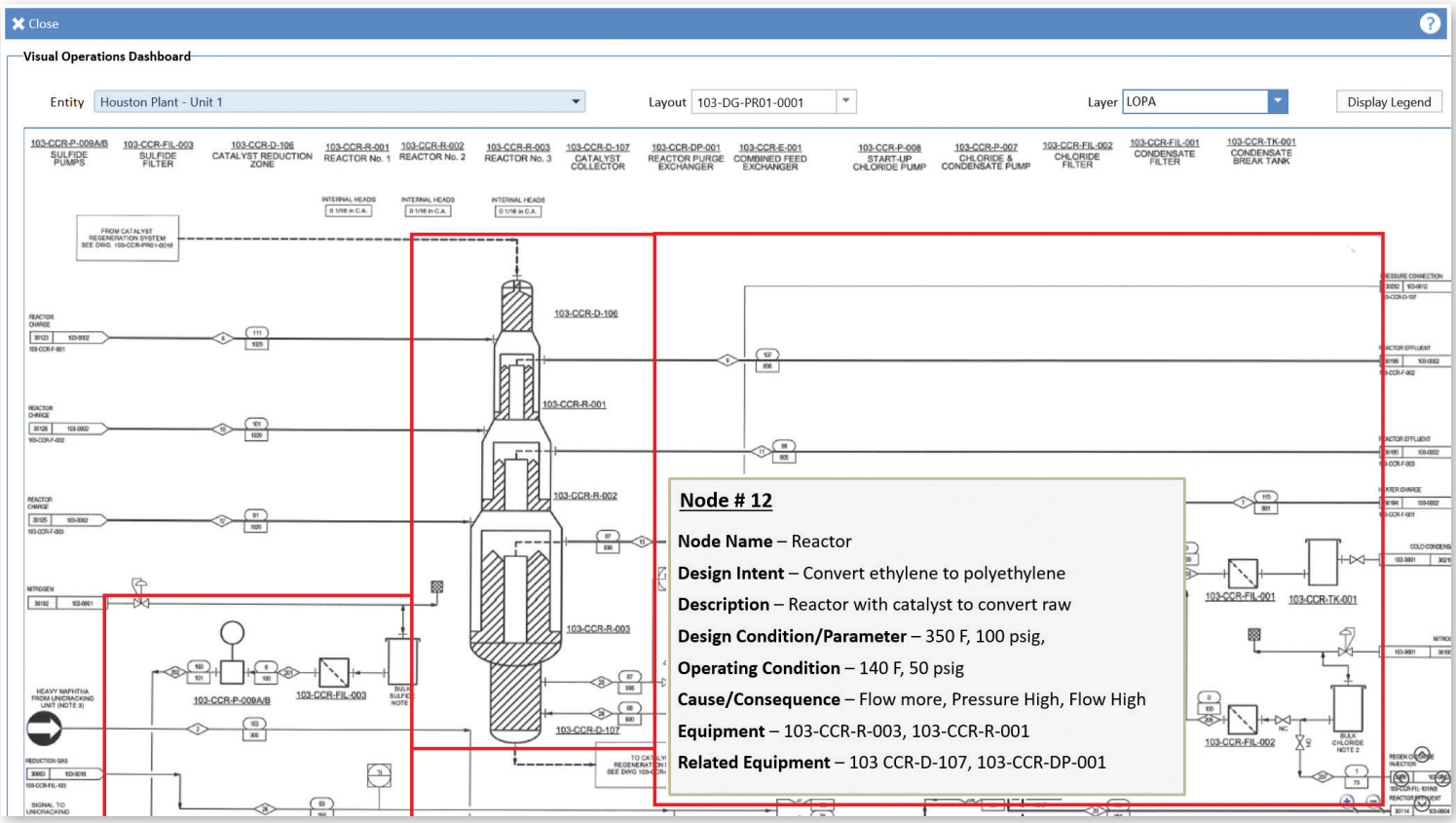

Figure 2 – OESuite™ Risk Visualization

We leverage Functional Safety Standards including ANSI/ISA-84.00.01, IEC 61508, and IEC 61511. In addition we assist clients with developing LOPA programs and procedures and can facilitate LOPA studies tailored to your culture.

Extended OESuite™ Modules

- Alarm Management
- Management of Change
- CAPA / Action Item Management
- Work Management / CMMS / EAM
- Document Management / Redlining
- Asset Strategy Management

For more information email us at info@DrivingOE.com or call (713) 355-2900.

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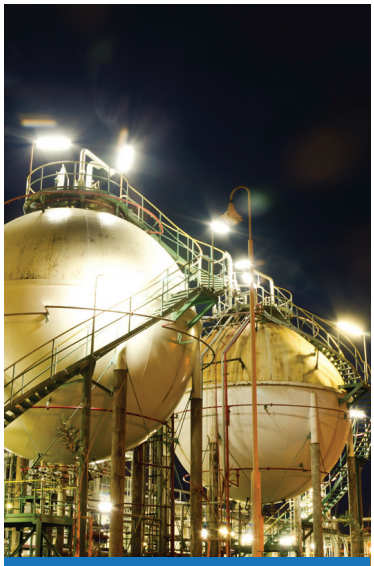
Driving Operational Excellence™

Workforce



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Succeeding in today's complex, highly-regulated industries depends on how well your company manages **operational risk**. Our world-class advisory services and our industry-leading cloud-based, mobile-enabled software work together to enable your company to realize **operational excellence** and **sustained operational integrity**. We identify and help you solve any issues to move to a real-time, mobilized risk-aware culture. With an average of more than 25 years of industry experience each, our advisors can design a solution tailored to your company's culture and needs.

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