

Practical Aspects of the Process Safety Lifecycle



pro6com

dé consultants voor de chemische industrie



Practical Aspects of the Process Safety Lifecycle

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For : PS Congres Dordrecht

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Vision

Creating a better world
by making processes
safer and more efficient





Mission

We create value for our customers by making their invisible **process safety risks** and **energy or production losses** visible.

This allows targeted actions to be taken to reduce these risks and optimize the plant performance





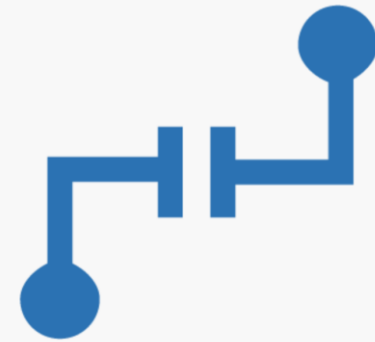
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**Process
Safety**



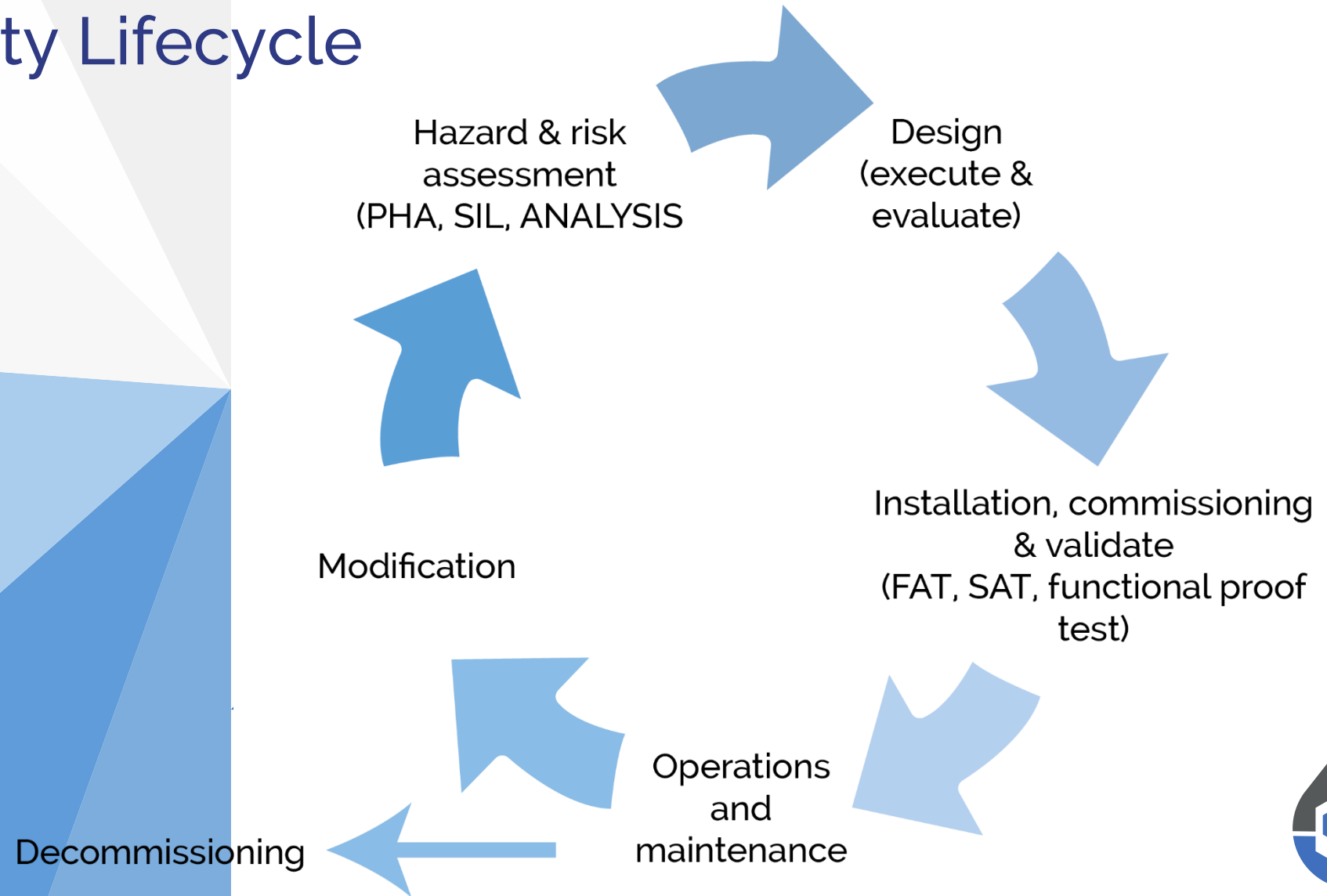
**Process
Optimization**



**Technology
Transfer**



Process Safety Lifecycle



Process Safety Lifecycle

- Assumptions during PHA (HAZOP, LOPA)
 - Likelihood
 - Allocation Safeguards
 - Modifiers

| | | Consequences | | | | | | |
|---|---|---|--|---|------------|-------------------------------------|-------------|-----------------------|
| | | Xref ▾ ▹ | * De ▾ ▹ | Consequence ▾ ▹ | TMEL:S ▾ ▹ | TMEL:E ▾ ▹ | TMEL:PL ▾ ▹ | SIFTARGET-RRF:MAX ▾ ▹ |
| * | | Click here to add a new Consequence | | | | | | |
| 1 | node 1.11.1 | Pressure - Higher | No removal vapour from headspace. Increased pressure in C-001. Possible exceeding designpressure C-001. Failure C-001. LOC flammable liquid. If ignited VCE. Possible fatalities | 1.00e-5 | 1.00e-4 | 1.00e-4 | 22 | |
| | | Causes | | | | | | |
| | | * Cause ▾ ▹ | Basis ▾ ▹ | | FRE ▴ ▾ ▹ | | | |
| * | | Click here to add a new Cause | | | | | | |
| 1 | Closed HV in overhead C-001 | | | Human error during a non-routine task th... | | | 0.01 | |
| 2 | Close HV in coolingwater pipeline topcondensor E-001 | | | Human error during a non-routine task th... | | | 0.01 | |
| 3 | Failure PIC-001 to close PCV-001 | | | BPCS Instrument Loop Failure clean service | | | 0.1 | |
| 4 | Failure TIC-001 to close TCV-001 in coolingwater pipeline E-... | | | BPCS Instrument Loop Failure clean service | | | 0.1 | |
| | | Safeguards | | | | | | |
| | | * Safeguard ▾ ▹ | Basis ▾ ▹ | Credite ▾ ▹ | PFD ▾ ▹ | | | |
| * | | Click here to add a new Safeguard <input checked="" type="checkbox"/> | | | | | | |
| 1 | HTA-001 | | | Human response to an... | | <input type="checkbox"/> | 0.1 | |
| 2 | HPS-001 to close feed and heatinginput reboiler | | | SIF | | <input checked="" type="checkbox"/> | 1 | |
| 3 | SV-001 | | | Pilot-operated pressure... | | <input checked="" type="checkbox"/> | 0.01 | |
| | | Frequency Modifiers | | | | | | |
| | | * Frequency Modifier ▴ ▾ ▹ | Current ▾ ▹ | S& ▾ ▹ | E ▾ ▹ | PL ▾ ▹ | | |
| * | | Click here to add a new Frequency Modifier | | | | | | |
| 1 | Probability of Ignition 0.1 | | <input checked="" type="checkbox"/> | 0.1 | 1 | 0.1 | | |
| 2 | Time at risk operator =1 | | <input checked="" type="checkbox"/> | 1 | 1 | 1 | | |

Process Safety Lifecycle

- Unknown incompetency of using IEC 61511
 - Pipe to pipe engineering



Process Safety Lifecycle

- Unknown incompetency of using IEC 61511
 - Too much information

Systematic Capability: SC 3 (SIL 3 Capable)

Random Capability: Type A, Route 2_H Device

IEC 61508 Failure Rates¹ in FIT²

| AccuTrak Series Switch Circuit Qty (Option Code) | λ_{SD} | λ_{SU} | λ_{DD} | λ_{DU} |
|---|----------------|----------------|----------------|----------------|
| 1 Switch Circuit (5, 6, 7 or 9) | 0 | 11 | 0 | 94 |
| 2 Switch Circuits (5, 6, 7 or 9) | 0 | 23 | 0 | 119 |
| 3 Switch Circuits (5, 6, 7 or 9) | 0 | 34 | 0 | 149 |
| 4 Switch Circuits (5, 6, 7 or 9) | 0 | 45 | 0 | 174 |
| 6 Switch Circuits (5, 6, 7 or 9) | 0 | 68 | 0 | 229 |
| 8 Switch Circuits (6) | 0 | 80 | 0 | 239 |
| 1 Switch Circuit (5, 6, 7 or 9) w/PVST ³ | 11 | 0 | 86 | 8 |
| 2 Switch Circuits (5, 6, 7 or 9) w/PVST | 23 | 0 | 110 | 9 |
| 3 Switch Circuits (5, 6, 7 or 9) w/PVST | 34 | 0 | 139 | 10 |
| 4 Switch Circuits (5, 6, 7 or 9) w/PVST | 45 | 0 | 163 | 11 |
| 6 Switch Circuits (5, 6, 7 or 9) w/PVST | 68 | 0 | 216 | 13 |
| 8 Switch Circuits (6) w/PVST | 80 | 0 | 225 | 14 |

**PFD_{AVG} and Architecture Constraints
must be verified for each application**

HFT=1, SC 3

SFF 69%

Low Demand vs High Demand



Process Safety Lifecycle

- Unknown incompetency of using IEC 61511
 - Missing information

Standards of compliance

| | | |
|------------------------------|--------------------------|---|
| Factory certification | ISO 9001-2008 | Quality management system |
| Actuator design | ISO 5211 | Industrial valves - part-turn actuator attachments |
| | VDI/VDE 3845 (NAMUR) | Industrial process control - pneumatic control valves - Interfaces of valves and auxiliary equipment |
| Certifications | ATEX 2014/34/EU | equipment and protective systems intended for use in potentially explosive atmospheres |
| | DNV | Rules of classification of ships 'Det Norske Veritas' offshore standards |
| | IEC 61508-2 SIL 2/3 | Safety integrity level - functional safety of electrical/ electronic/programmable electronic safety-related systems (optional for actuated unit only) |
| Documentation | EN 10204 2.2 / 3.1 / 3.2 | Metallic materials - types of inspection documents |



Process Safety Lifecycle

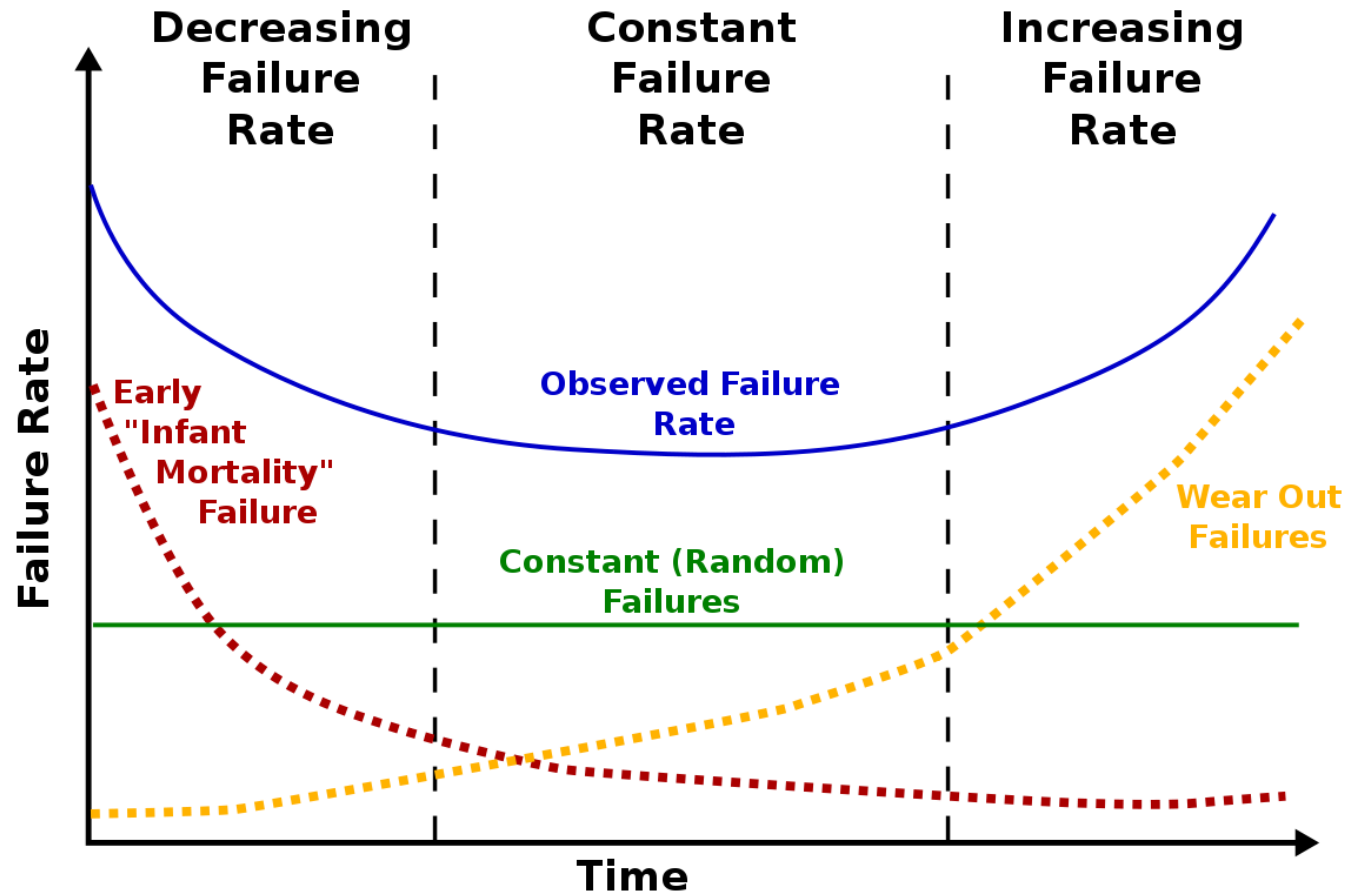
- Unknown incompetency of using IEC 61511
 - Prior use
 - how long does the history data go back?
 - have parts already been replaced?
 - is the lifetime (bath-tub model) taken into account?

Prior use is telling you more about failures in the past but do not guarantee that the same type of failures occur in the future.

Needs **evidence** according IEC 61511

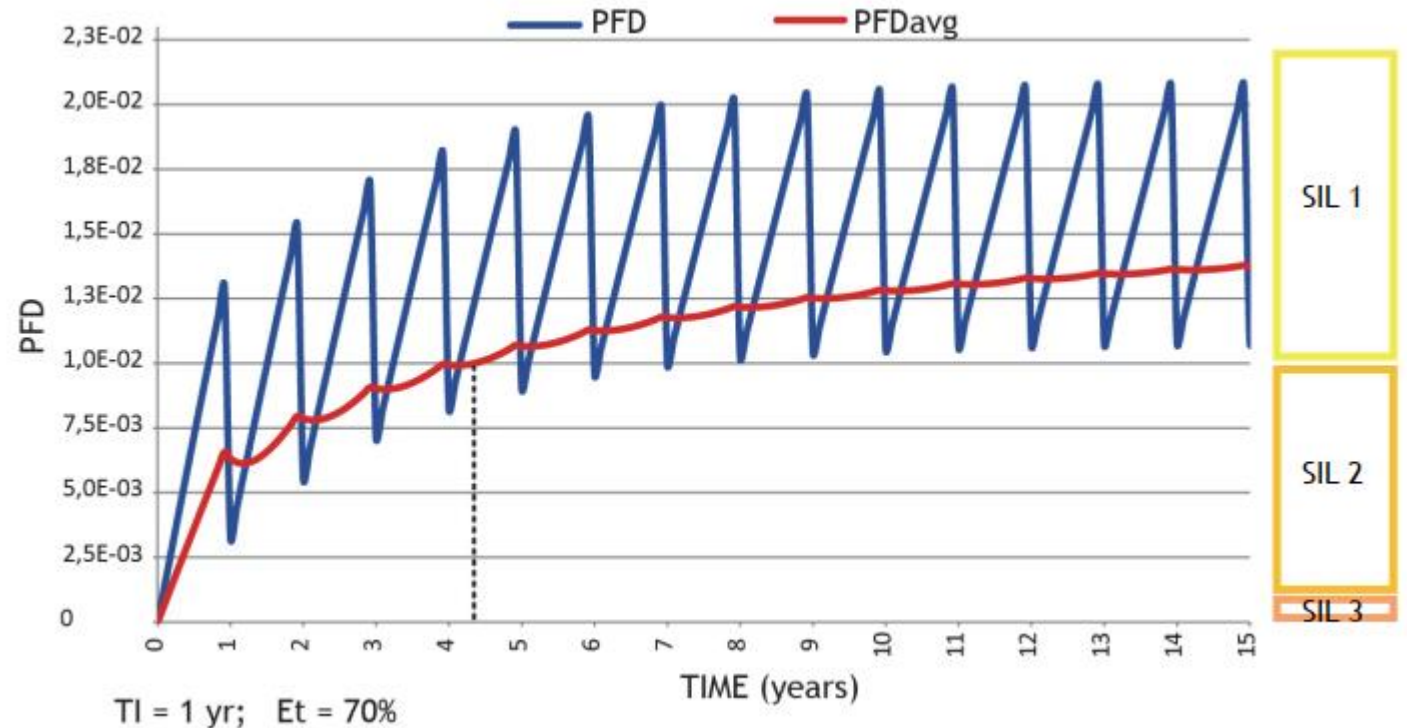


Process Safety Lifecycle

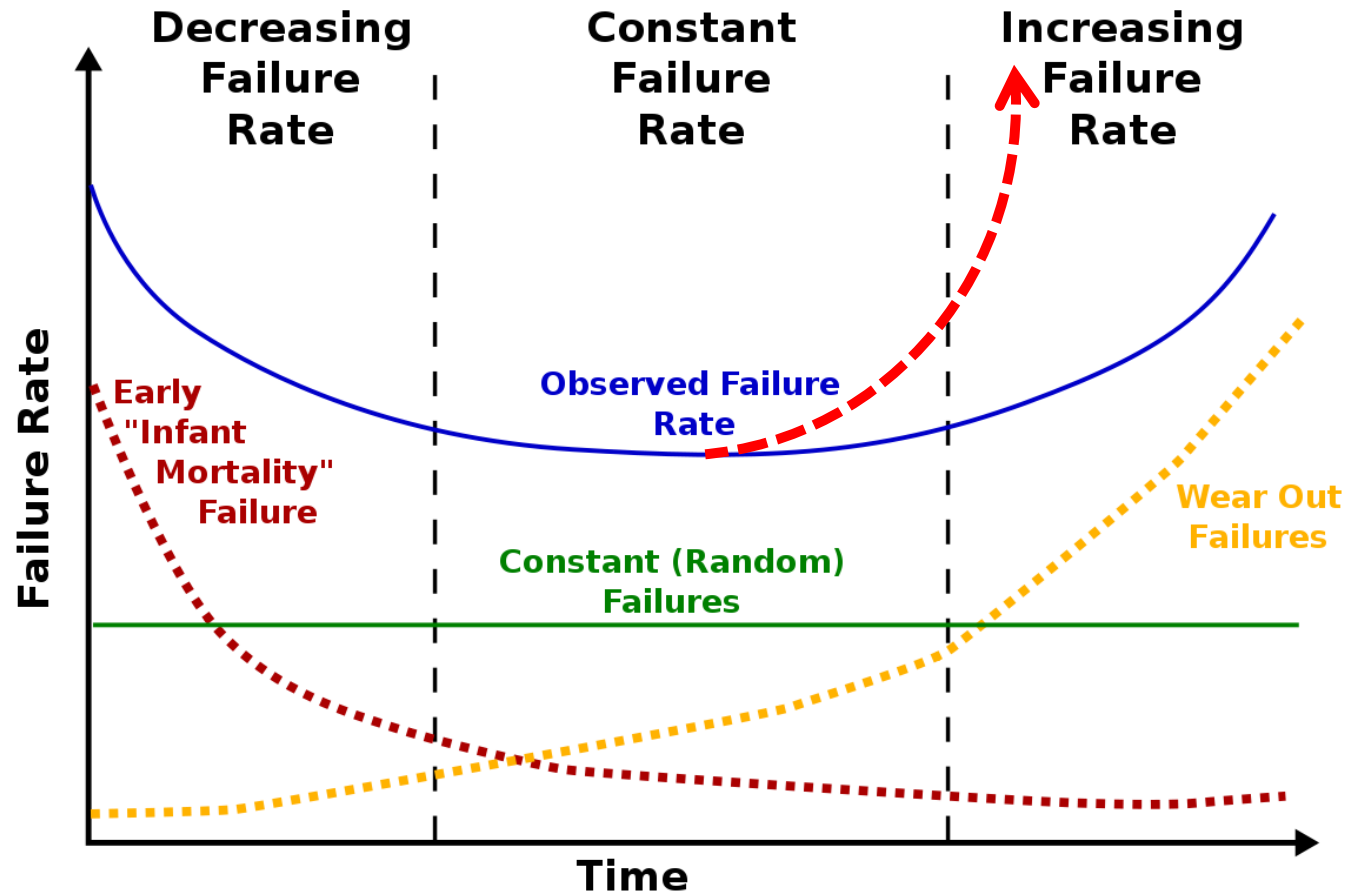


Process Safety Lifecycle

- Operational phase – assumptions vs reality
 - Testcoverage



Process Safety Lifecycle



Process Safety Lifecycle

- Operational phase – assumptions vs reality
 - Estimated risk

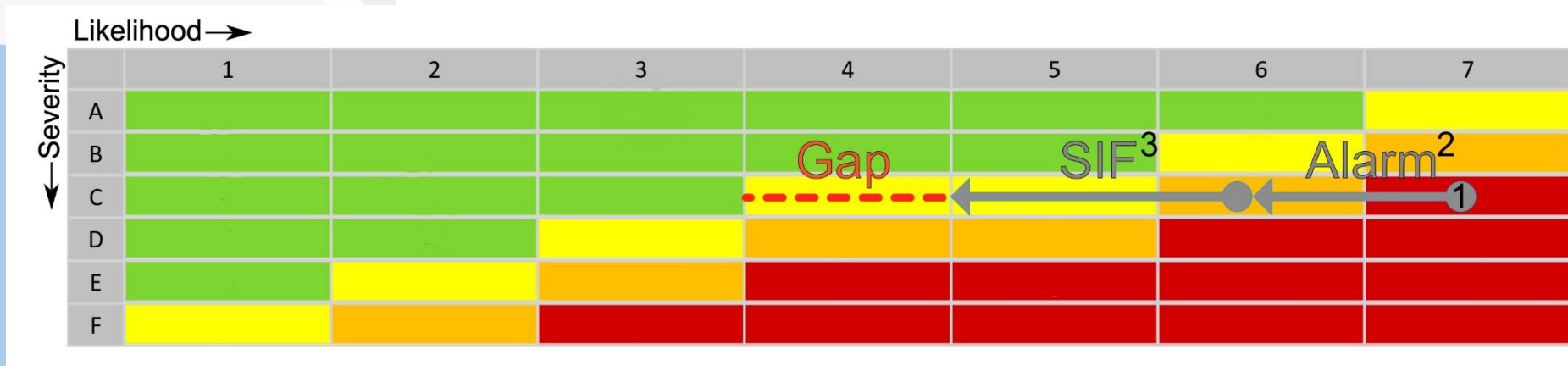


1. likelihood of occurrence
2. Available alarm
3. SIF



Process Safety Lifecycle

- Operational phase – assumptions vs reality
 - Actual risk – invisible?



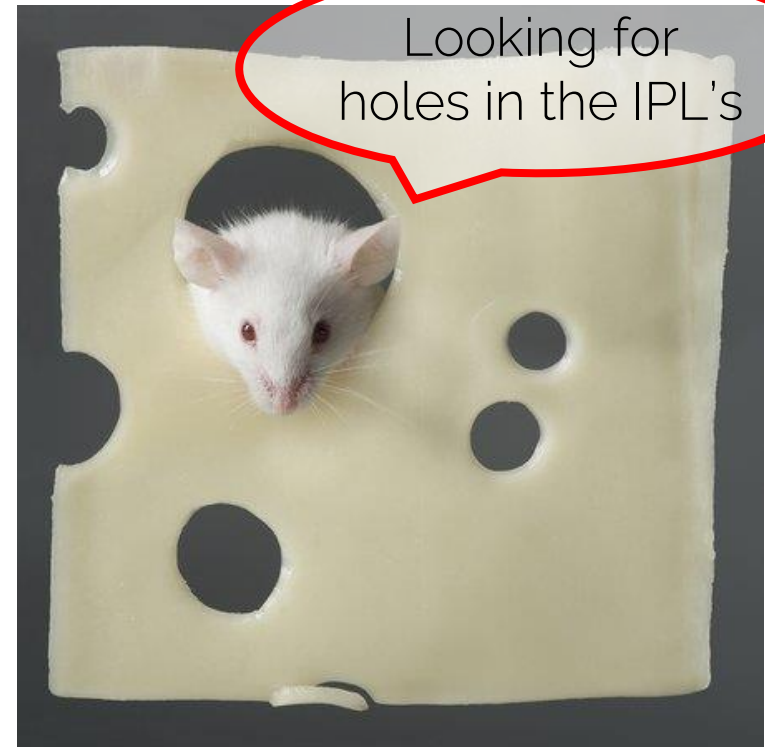
1. likelyhood of occurance
2. Available alarm
3. SIF



Process Safety Lifecycle

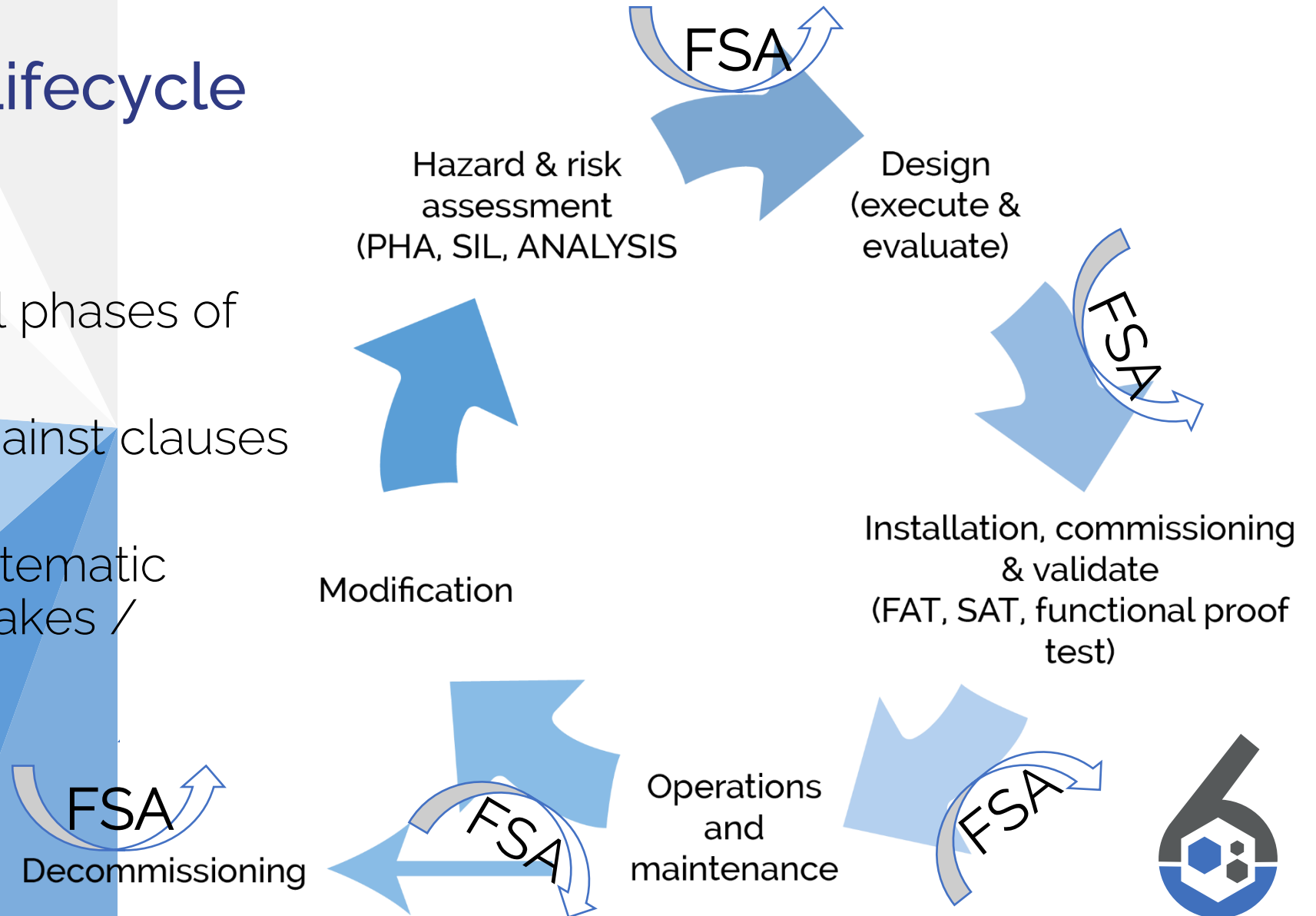
How to avoid?

- Functional Safety Assessments (FSA)
- Data analysis



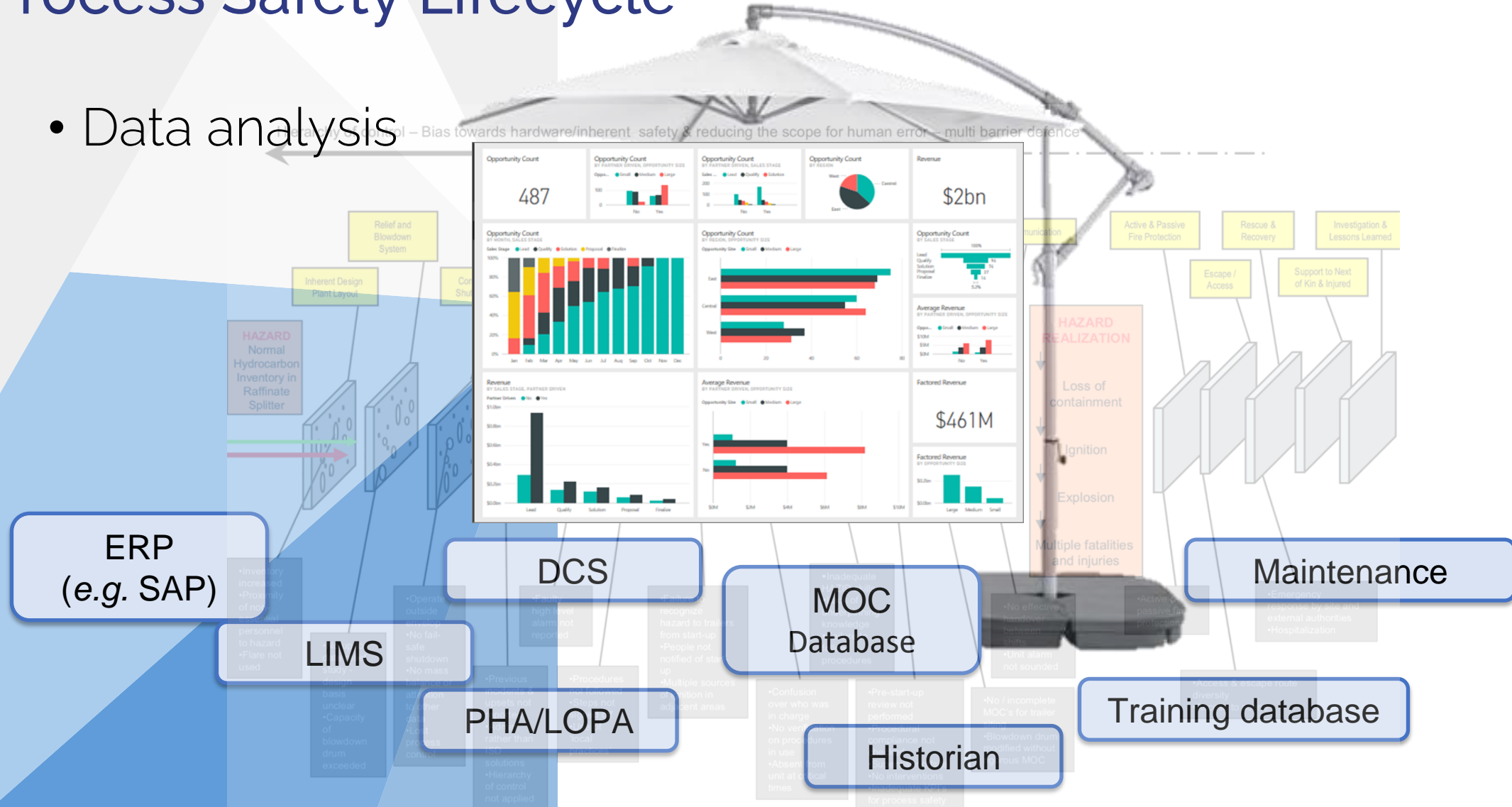
Process Safety Lifecycle

- FSA
 - During several phases of the lifecycle
 - Verification against clauses IEC 61511
 - Eliminates systematic failures / mistakes / assumptions
 - **Mandatory !**

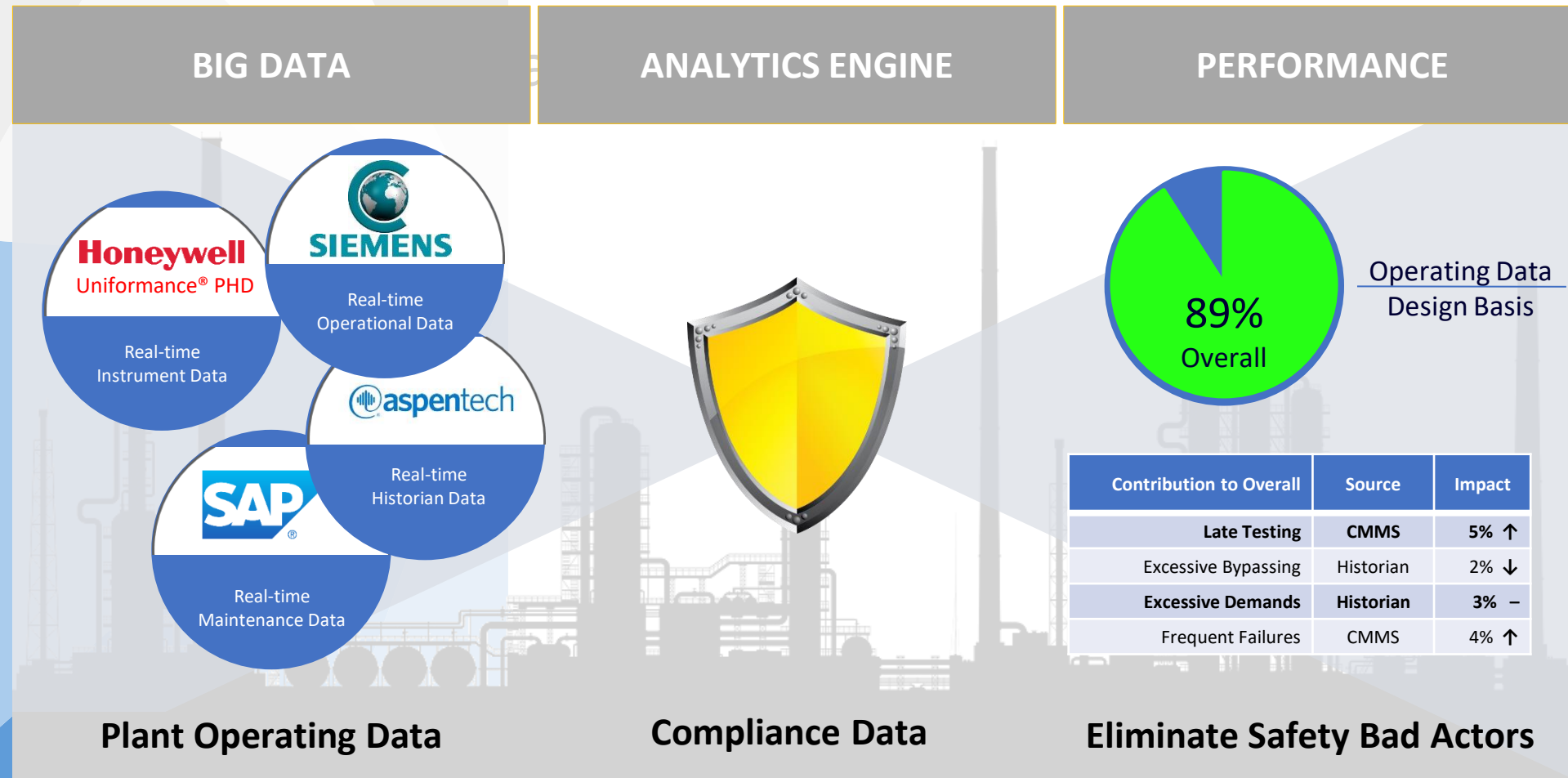


Process Safety Lifecycle

- Data analysis



Process Safety Lifecycle



Questions



**There's More Than
One Terrific Reason
to Be Safe at Work**



THEY NEED US

