

KEY ISSUES AFTER 30 YEARS OF IMPLEMENTING LOPA

FROM THE ORIGINATORS OF LOPA

LOPA INTENT

One of many methods for assessing if the risk of a scenario is tolerable or not

Applies to single Cause-Consequence pair

Uses rigid rules to simplify the assessment

Provides an order of magnitude estimate

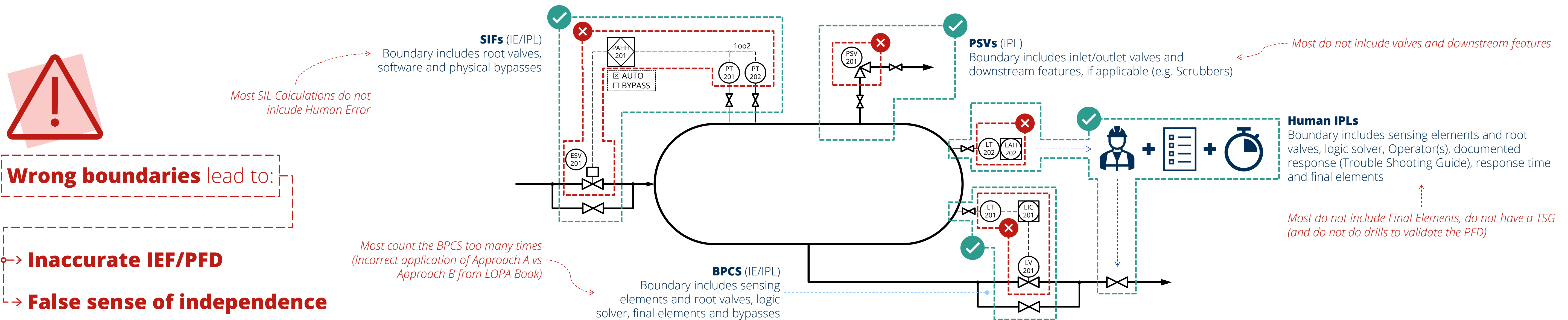
INDEPENDENCE

Independence is fairly well understood and applied across companies. Main Independence issues are related to:

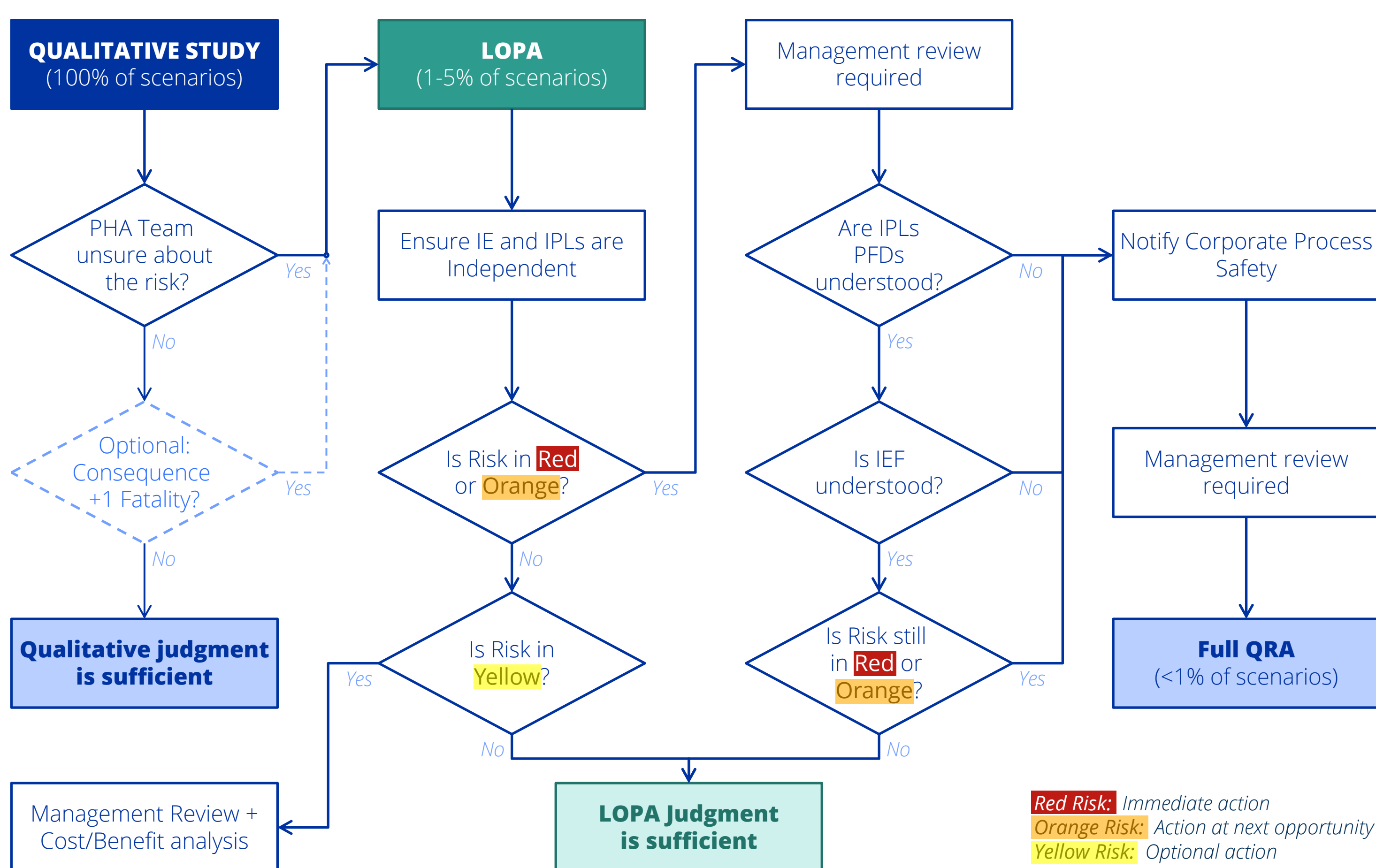
Counting BPCS/SIS/PLCs too many times
Incorrect IE/IPL boundaries (see below)

Using Humans more than once in a scenario (rarely valid)

INCORRECT IE/IPL BOUNDARIES



MISUSE OF LOPA



TIMING	PROS	CONS	
During the PHA, scenario by scenario	Scenarios are fresh in mind of personnel If the Process Safety Information is in the minds of personnel (not well-documented), they may be able to answer questions	Counterproductive to switch from PHA brainstorming (inductive) to LOPA (deductive) thought process All the hazards and candidate IPLs have not been identified yet Wastes time of PHA team May lack needed expertise	NOT RECOMMENDED
Separate LOPA meeting after the PHA Full PHA Team	If the Process Safety Information is in the minds of personnel (not well-documented), they may be able to answer questions	Wastes time of the team (except for 1 or 2 people). Duplicated effort: Unnecessary duplicate discussion on Consequences, IPLs and other scenario details.	NOT RECOMMENDED
Outside of PHA Single analyst (+help on demand)	Provides efficient use of personnel time	Requires well documented Process Safety Information Requires well documented PHA	RECOMMENDED

MISUSE OF ECs AND CMs

Most Companies count Time-At-Risk when they shouldn't (unrevealed failures)

Most Companies set Tolerable Risk too low leading to an overuse of ECs/CMs

Most Companies underestimate the "Personnel Presence" probability

ECs and CMs are not included appropriately in the MOC programs

LACK OF VALIDATION

Major weakness in most companies implementing LOPA

Most Companies do a good job with some IPLs with industry Standards such as PSVs and SIS but fail to update if data shows worse performance than standard.

Most Companies do a poor job on IPLs such as Check Valves and Human IPLs

Most Companies do not treat IEs with the same rigour as IPLs

Most Companies do not test/validate and track the ECs or CMs at all

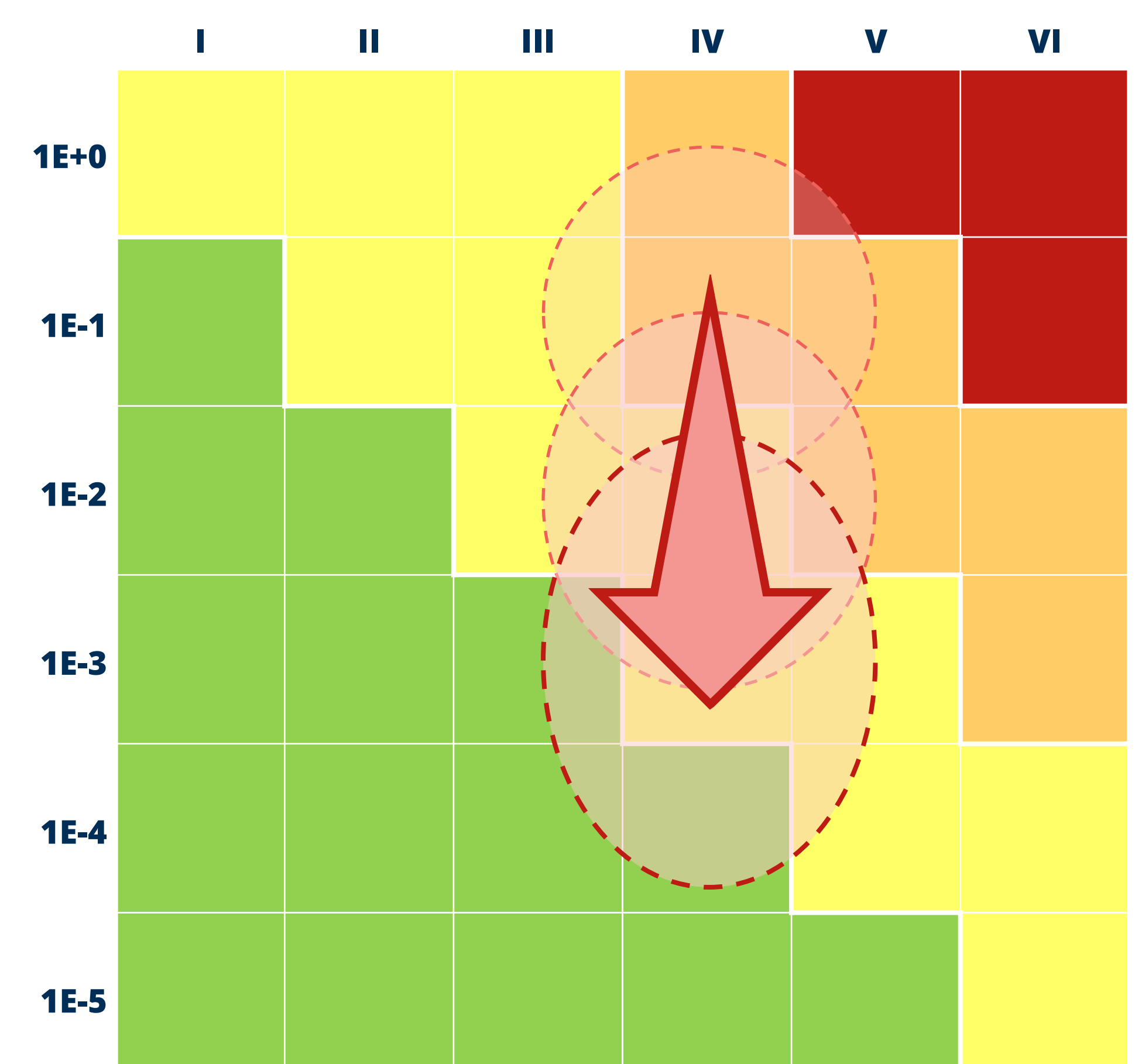
OVERCONFIDENCE IN THE RESULTS

Factors used in LOPA calculations usually have a range of **plus and minus an order of magnitude.**

Confidence in the resulting calculated values cannot be better than the factor with the largest range used in the calculation.

10^{x±1}

LOPA ACCURACY



SUMMARY

Ensure IEs/IPLs **boundaries** are **correct**

Validate (test and document) all IEFs/PFDs/ECs/CMs

Do **not use ECs/CMs**; they are usually wrong!

Do **not overuse LOPA** or duplicate PHA efforts

It's an **order of magnitude estimation**

KISS
Keep It Simple and Safe!

ACRONYMS BPCS: Basic Process Control System CM: Conditional Modifier EC: Enabling Condition IE: Initiating Event IEF: Initiating Event Frequency IPL: Independent Protection Layer LOPA: Layers Of Protection Analysis PFD: Probability of Failure on Demand PLC: Programmable Logic Controller PSV: Pressure Safety Valve SIF: Safety Instrumented Function SIS: Safety Instrumented System

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