Criticality Hazards Analysis

A View from the UK

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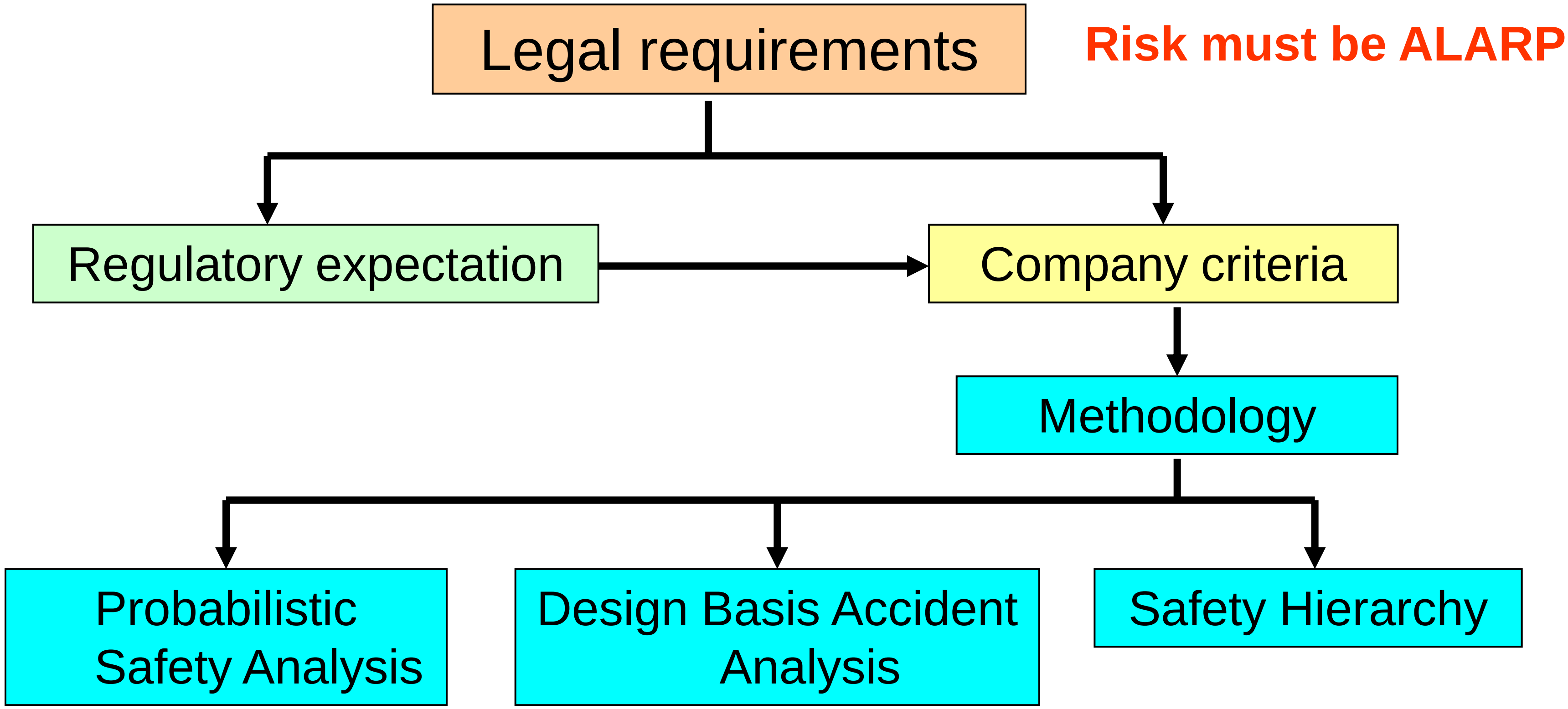
Aims of Presentation

- Overview of Sellafield Ltd ‘Hazards Analysis’ process
  - Compare and contrast with US techniques and processes

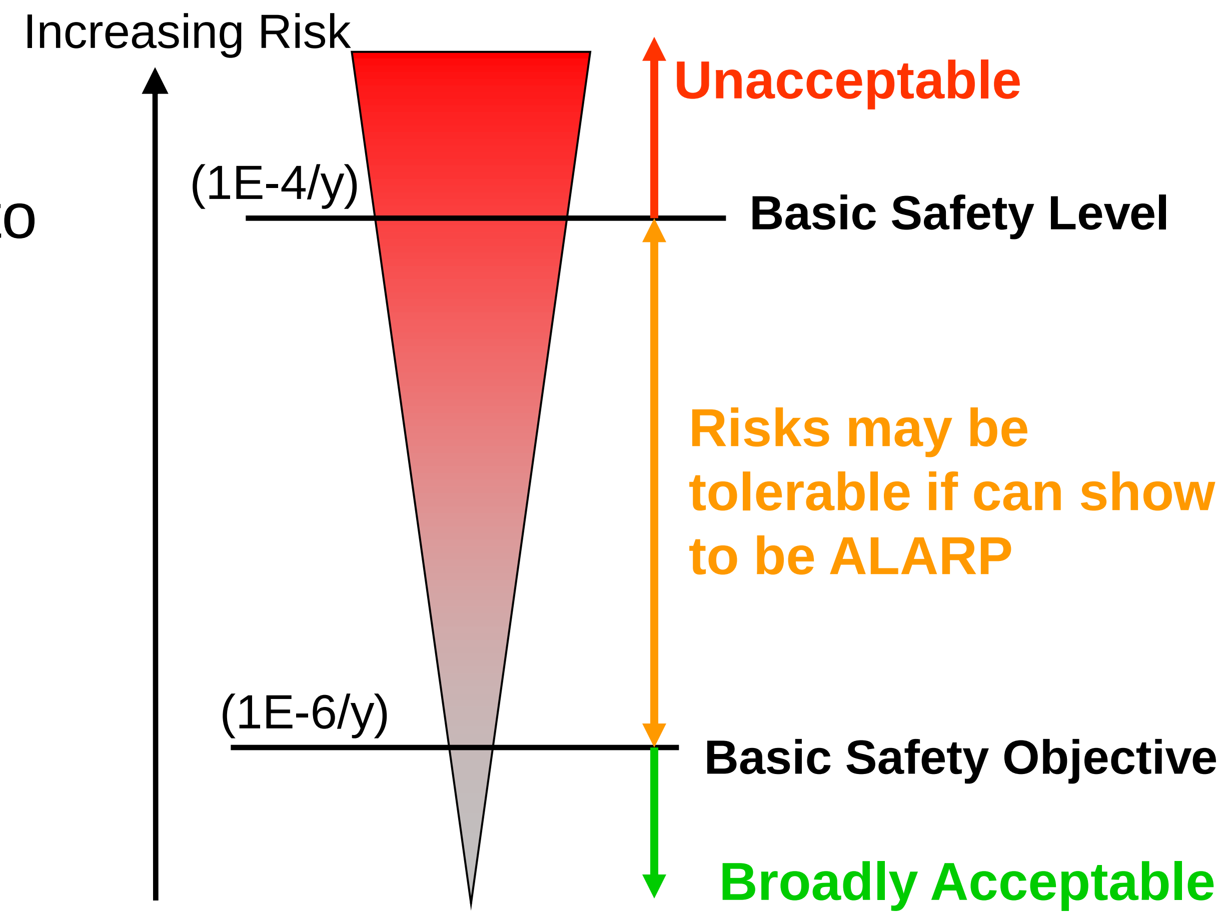
- Concentrating on:
  - Application of ALARP principle
  - Optioneering
  - Fault tolerance (Design Basis Accident Analysis)
  - Specifying safety requirements

Safety Criteria and Methodology

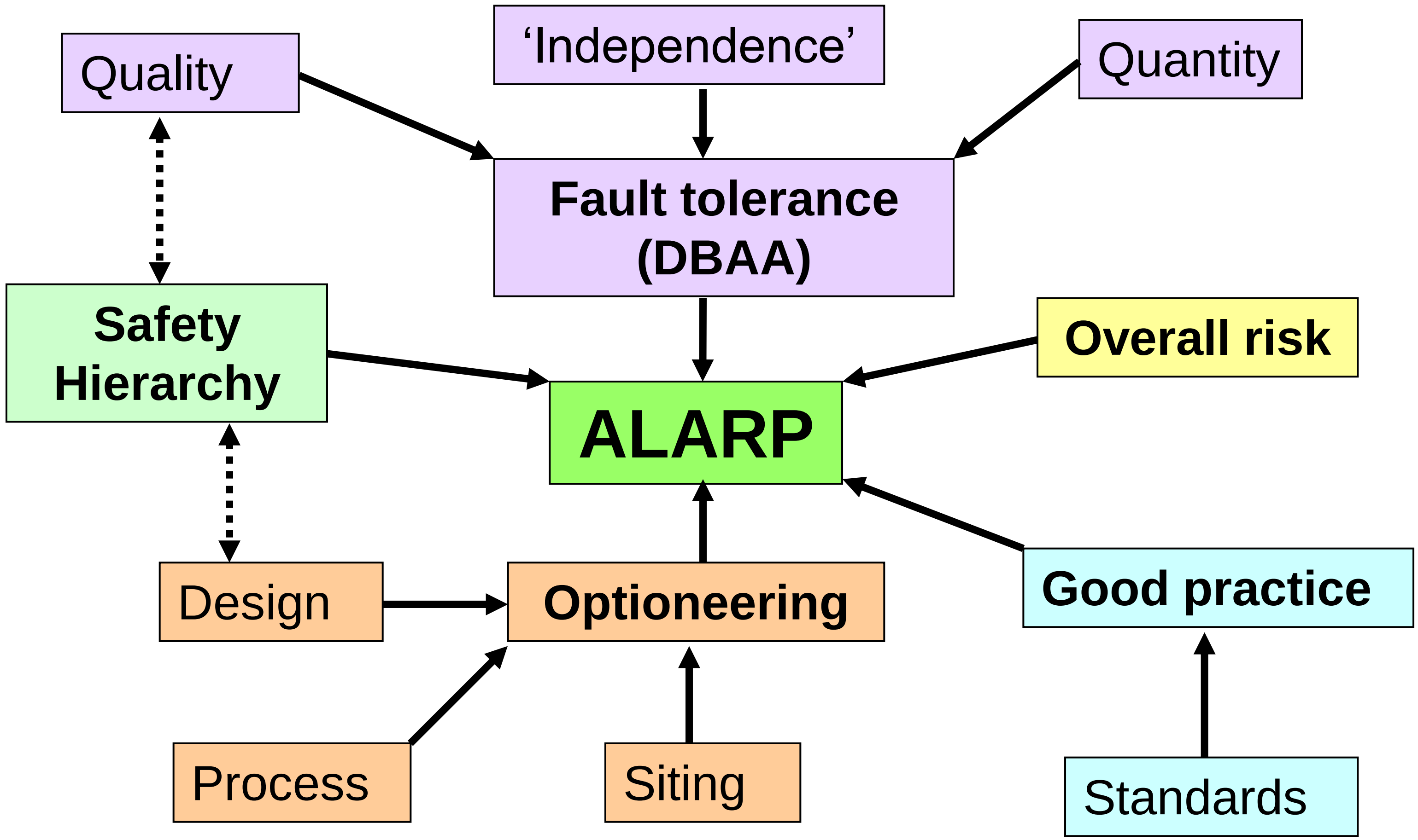


Is Criticality Risk 'Acceptable'?

- Based on risk to worker/ public
- ALARP is key



ALARP – key aspects



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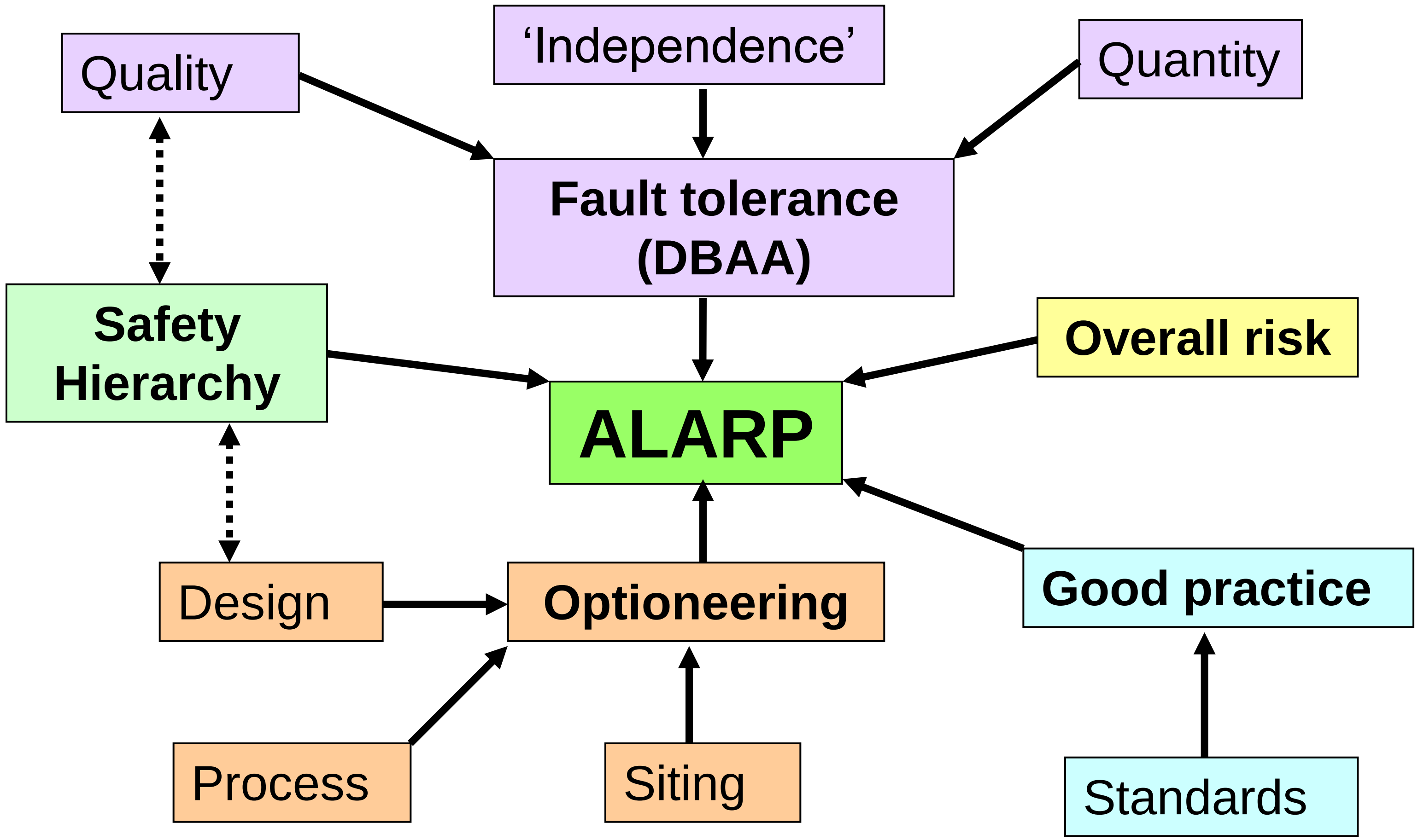
ALARP – key aspects



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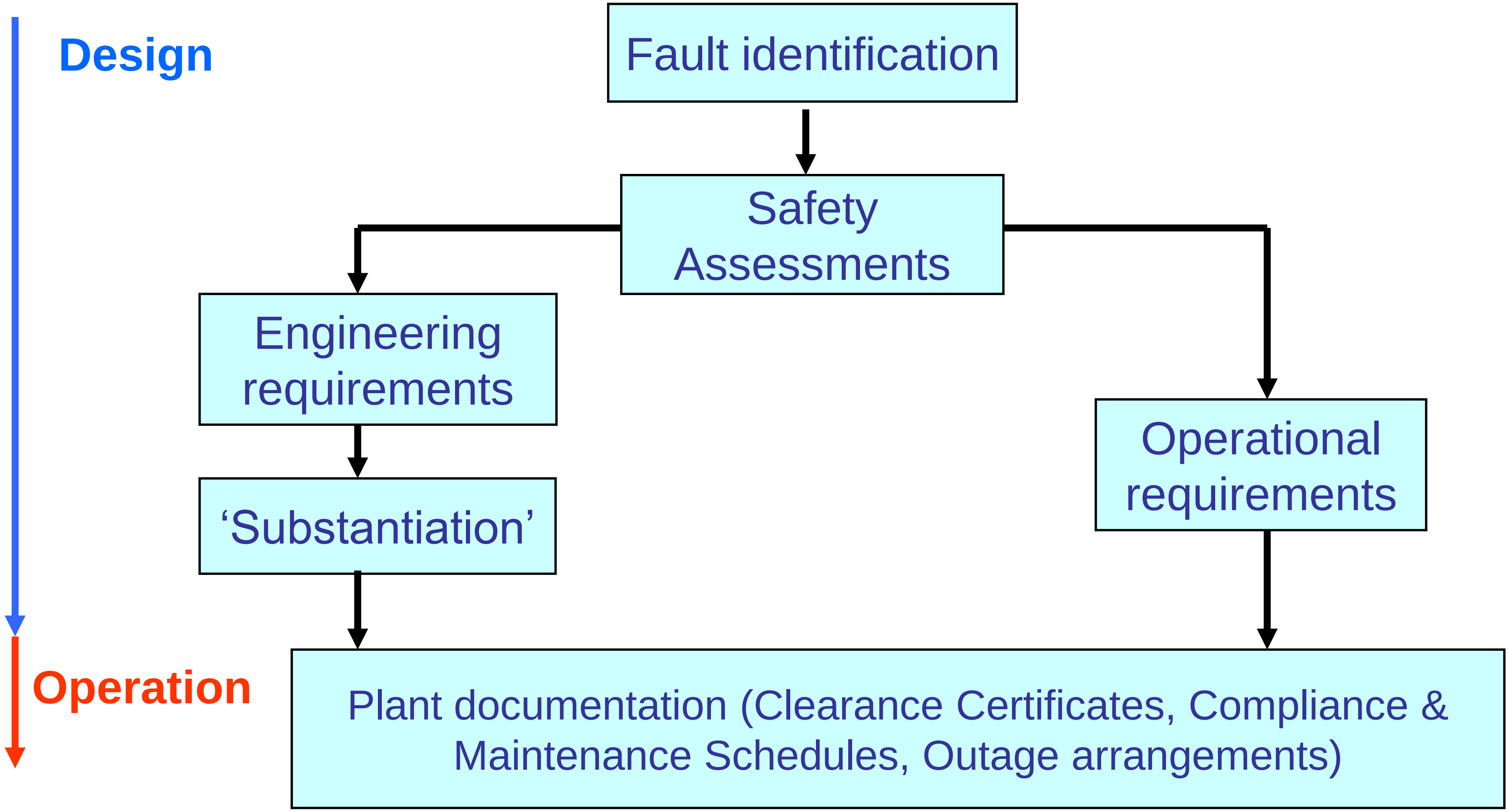
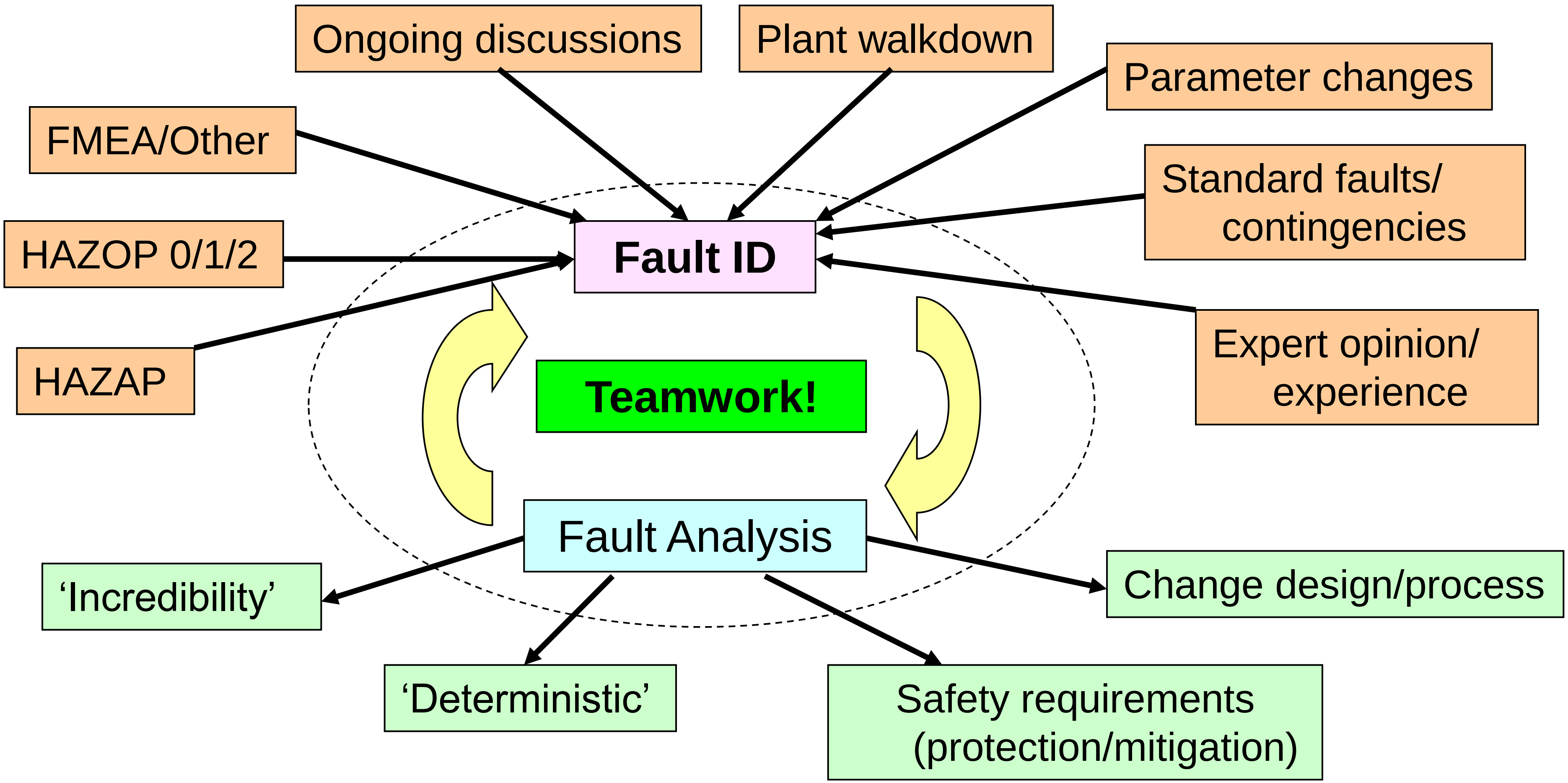
Safety Assessment Process



An ongoing process



HAZAP and HAZOP 0 - Optioneering

HAZAP – identify inherent hazards associated with the processes and the materials involved (pre HAZOP 0)

HAZOP 0 - Identify principal hazards due to materials present / proposed process (standard HAZOP 1 keywords)

- Ensure Hazard Management strategy available for each fault.
  - can these hazards be eliminated?
  - if not, how can the hazard be managed - propose options
- Record and challenge any assumptions with the process

HAZOP 1

- Used to consider outline designs / processes
- Check Hazard Management strategy.
- Support to optioneering and process selection.

DEVIATION	CAUSE	CONSEQUENCE	SAFEGUARDS
Criticality	Moderator ingress to crate.	Criticality	1. Do not move under wet weather conditions. 2. Multiple barriers i.e. iso-freight and over-crate during transport.

HAZOP 2

- Failure based approach (Bottom Up – fault led).
- Used to analyse detailed designs and operational processes.
- Identify specific initiating events

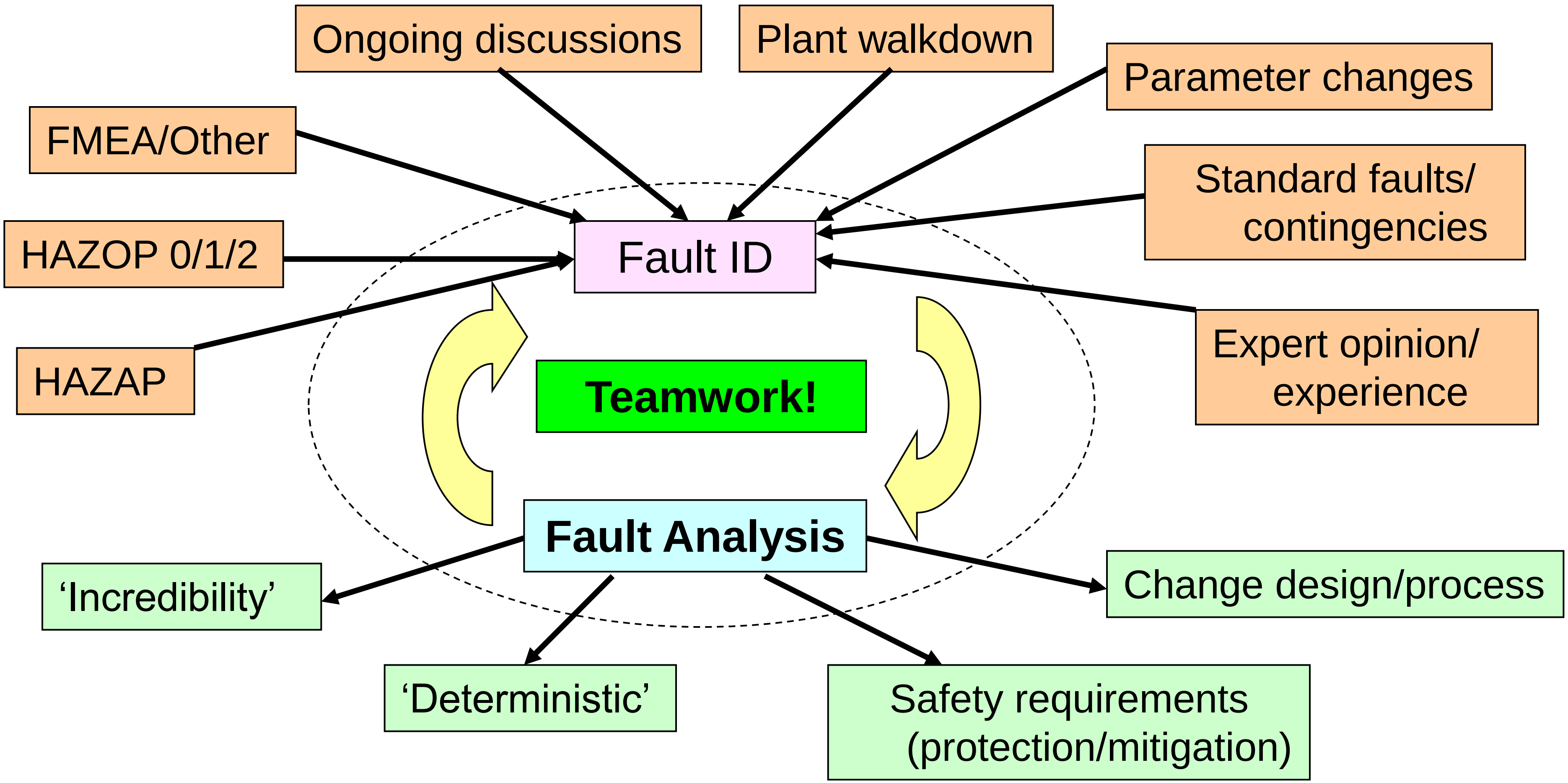
DEVIATION	CAUSE	CONSEQUENCE	SAFEGUARDS
Movement Less/Part only	Cradle not present to receive can.	Potential to drop cans - potential for criticality if multiple cans are dropped over an extended period of time. Ctgy: [OP] [CR]	1. Cradle needs to be physically present to open gate. 2. Control system confirms cradle is present prior to transferring can.

HAZOP – General Points

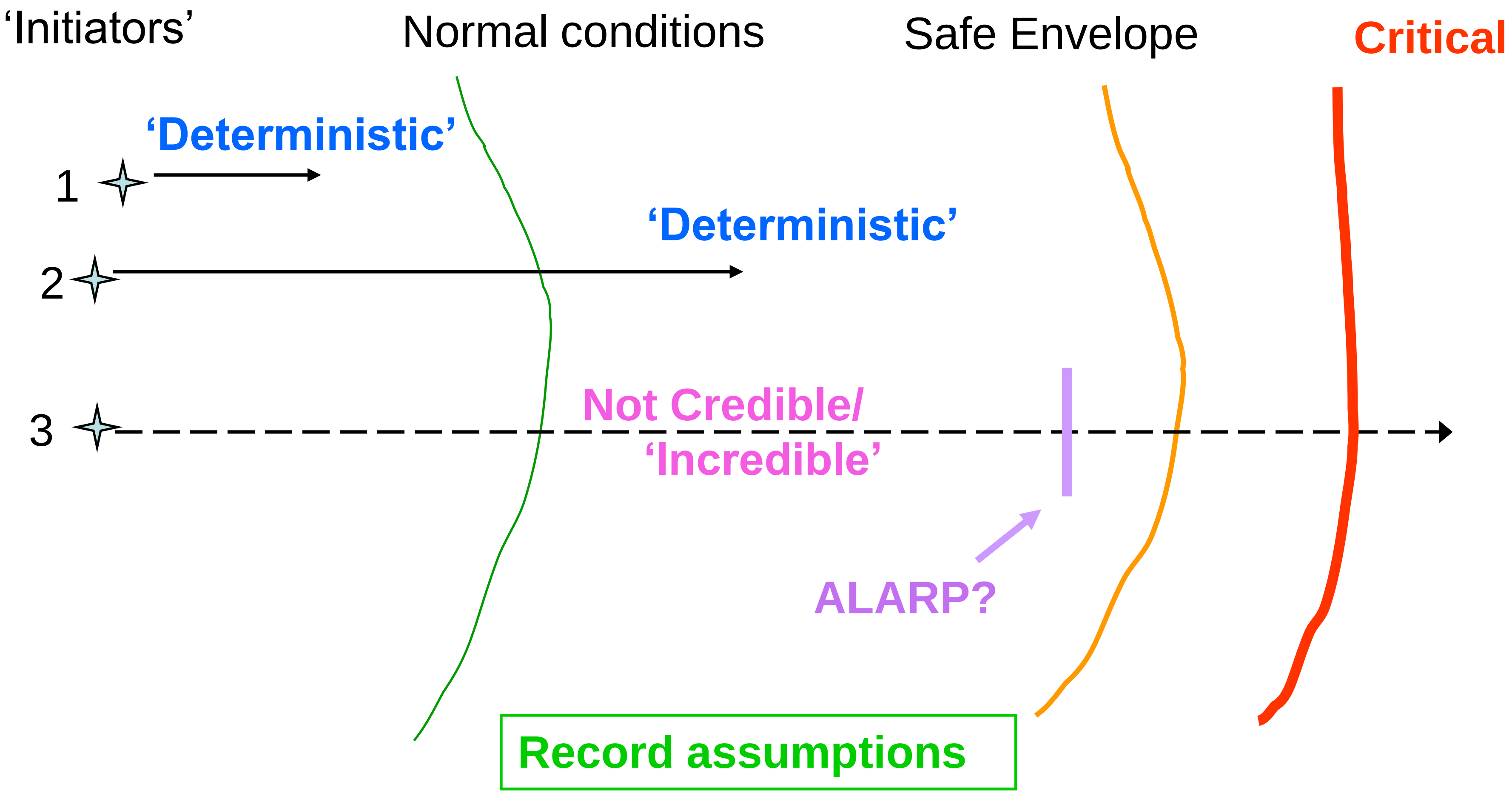
- HAZOP studies are structured and systematic
- HAZOP is a widely accepted technique for hazard identification

- **HAZOP is only as good as the HAZOP team/information available**
- **HAZOP is not guaranteed to identify all potential fault initiators**
- **HAZOP is not always the best fault identification technique**

An ongoing process



‘Is Risk Acceptable?’ – No DBA Requirements



Defense in Depth/ Fault Tolerance

- *Historically used Double Contingency Principle:*
  - '… **at least two unlikely, independent and concurrent changes** … before a criticality accident is possible.'
- *Now use Design Basis Accident Analysis (DBAA) Methodology:*
  - A robust demonstration of the *fault tolerance* of the design i.e. the degree of defense-in-depth
  - **Quantity**
  - **Quality (Hierarchy, robustness/ reliability)**
  - **Independence**

Minimum number of DBA Safety Measures

	Frequency of criticality with no 'protection'		
Dose (mSv)	<1E-5/y	1E-5 – 1E-3/y	>1E-3/y
<20	0	0	2
20 - 1000	0	1	2
>1000	0	2	2

1000mSv = 100Rem

A '**safety measure'** must provide a complete line of defense

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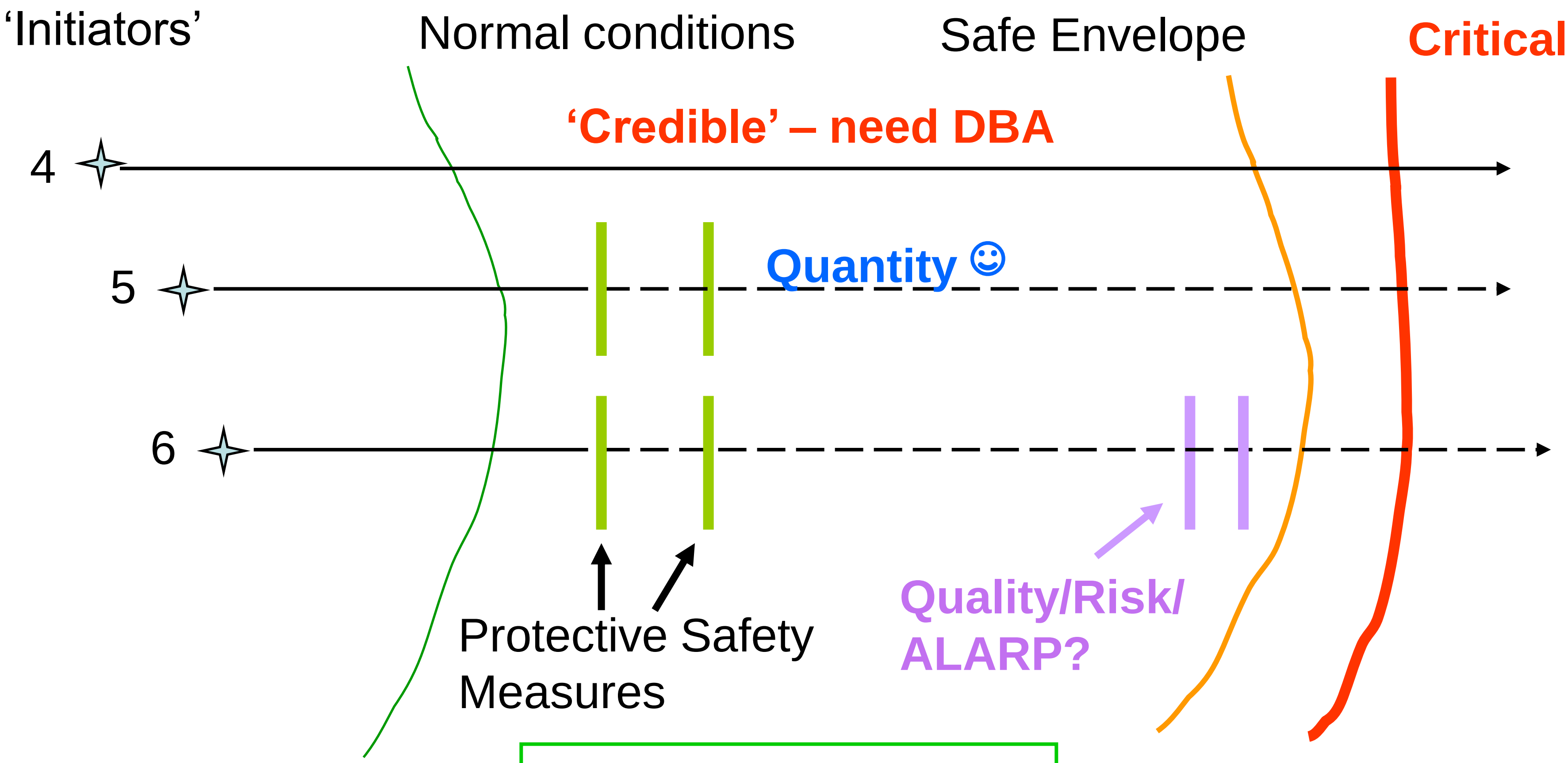
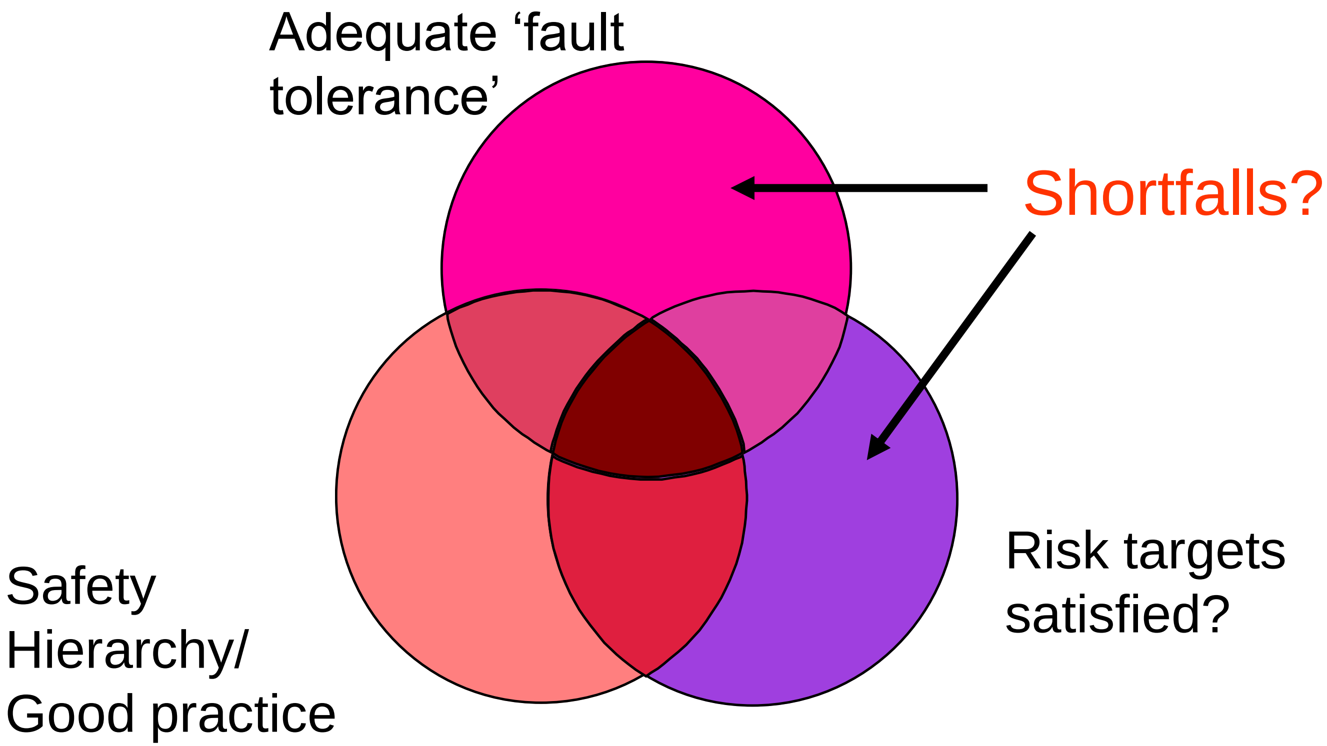
'Is Risk Acceptable' – With DBA Requirements



Record assumptions

Measures of Success?



Specifying Safety Requirements

Record all Assumptions and Requirements

Structure, System or Component	Safety Function(s)	Safety Function Class	Design/Performance/ Additional Requirements
Storage Racking	To ensure that packages within the store are retained within a criticality safe geometry for normal, credible fault and seismic conditions.	1	1. To maintain centre to centre separation distances of at least *xx* mm vertical and *xx* mm horizontal between packages in the storage racks. 2. Seismically qualified to withstand DBE (0.25g). 3. Storage rack no longer than *xx* mm 4. Storage racks will not collect and retain water

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Include ALL requirements

Important for completeness, maintenance and checking independence

Description	Detection	Decision	Termination
Prevention of further liquor arising in Vessel *xxx*	Level indicator in Vessel *xxx* and high level alarm in control room	If Vessel *xxx* high level alarm is activated, close Valve B	Manual valve B on feed line to Vessel *xxx*

Equipment **Operator** **Equipment**

Summary

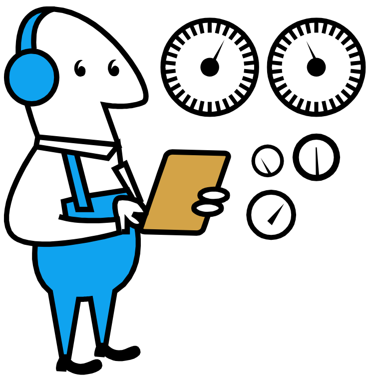
- Lots of similar concepts … with different names

- Differences
  - Different Regulatory system
  - More emphasis on ALARP?

- Fault tolerance (DBA) vs Double Contingency

Question

- Which is 'safer'?
  - Operator control



or

  - Automated control system