TSA
Tank Storage Association

Chemical and Downstream Oil Industries Forum

Understanding Major Hazard Human Harm Risk Assessment (MHHHRA) for COMAH

Jim Neilson, Head of Major Hazard Risk Assessment, Health and Safety Executive
Carolyn Nicholls, Managing Director, RAS Limited

Overview

- Why did CDOIF undertake this work
- How was this work taken forward
- What will be delivered
- Next steps

Why did CDOIF undertake this work

Background

- In 2020, Trade Associations representing COMAH businesses, including TSA and RAS, approached HSE asking for clarification on MHHHRA expectations
- It was recognised that although MHHHRA guidance had been formally published in practitioner textbooks, online and in peer reviewed papers, it could usefully be brought together in a single guideline
- The lack of sector guidance in some MHHHRA areas, such as tolerability assessments, has resulted in the misinterpretation of expectations and some inappropriate approaches being adopted
- TSA obtained CDOIF agreement to undertake work to produce a MHHHRA guideline. This work started in September 2021

How was this work taken forward

Delivery Structures

- In collaboration with a range of key stakeholders (e.g. Trade Associations, operators, third party providers and regulators) CDOIF formed a risk assessment working group to agree the ToR and oversee this work
- A smaller CDOIF risk assessment technical sub-group was created, with MHHHRA practitioners, to consider the detailed technical issues and agree guideline contributions
- Peter Davidson from TSA, was appointed Chair of both Groups as he had a strong track record of managing such groups and overseeing the production of technical guidance
- CDOIF worked to agree a common MHHHRA language between relevant stakeholders and then identifying high level MHHHRA principles, with examples of good practice. This has been technically complex and demanding work

What was the scope?

- The intention was to produce a guideline on MHHHRA principles and good practice

- This was to apply across the full range of COMAH businesses from simple storage of single substances (e.g. bulk LPG), through to complex chemical processing

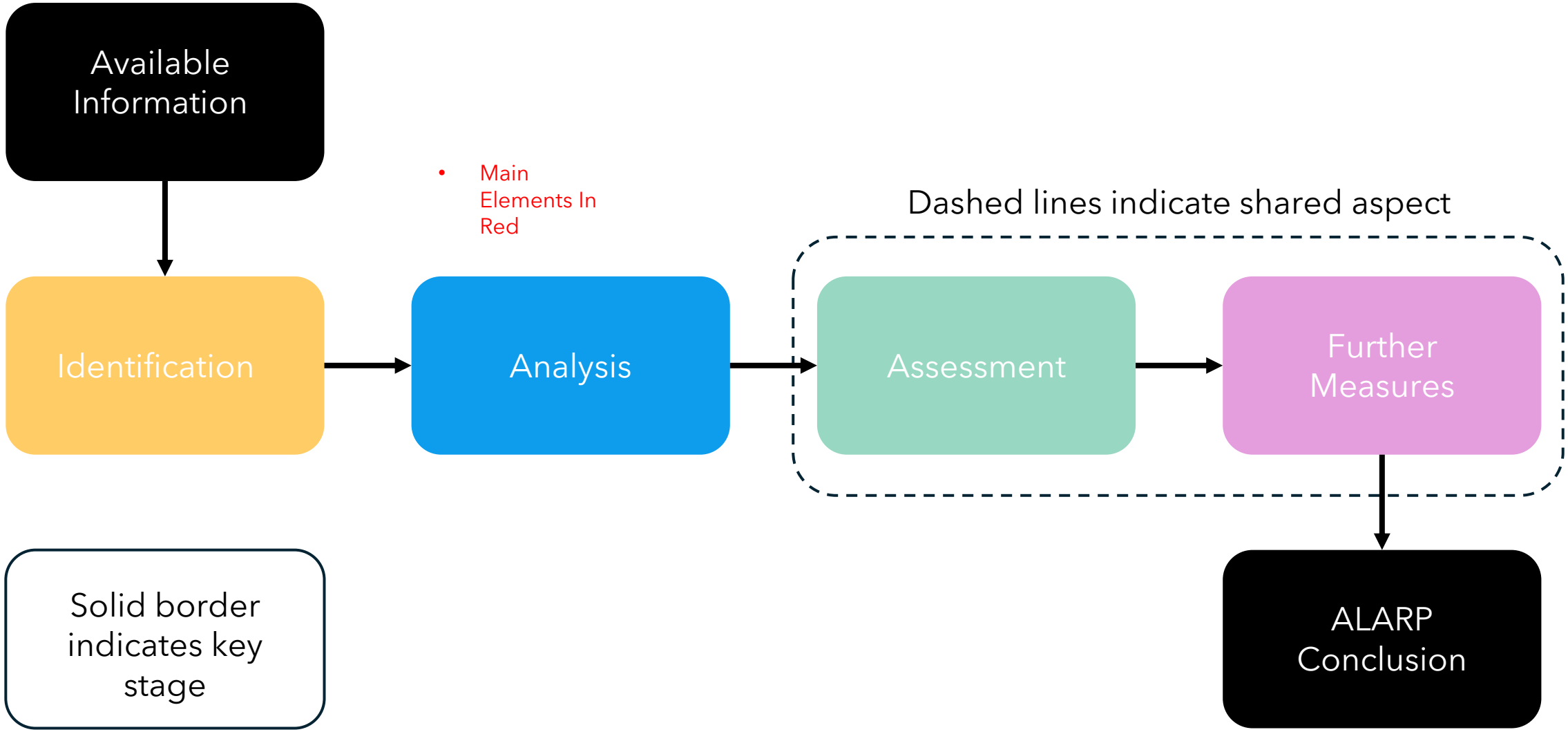
- The purpose of this guidance was to promote consistency of risk assessment approach within COMAH, and provide operators, third parties and regulators with a common agreed reference

- The MHHHRA guideline would align with published guidance and current thinking

What will be delivered

Process Flow Legend

Identification → Analysis → Assessment → Further Measures



Regulatory Context

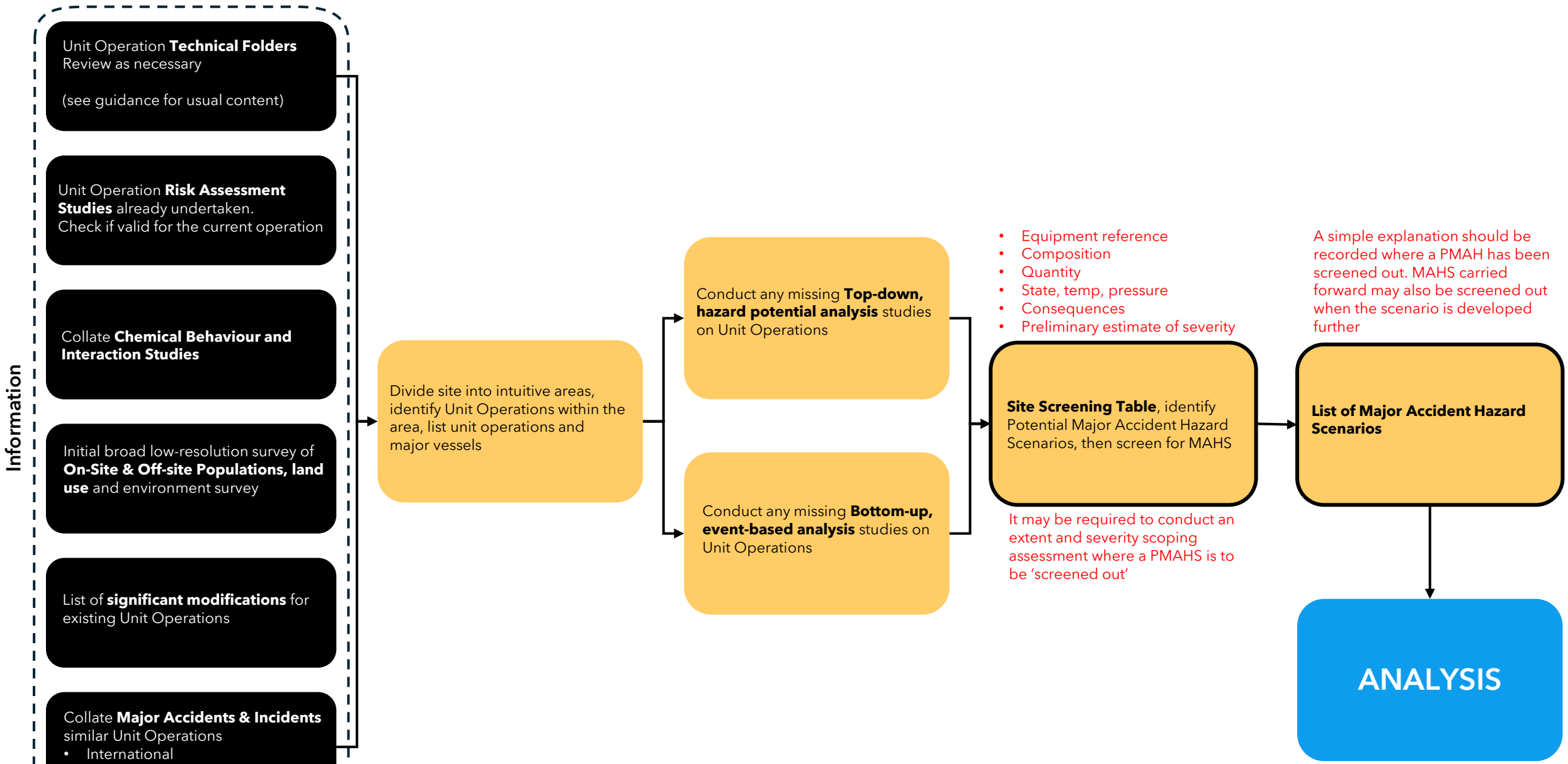
- To control the risk of human harm from the operations performed at COMAH establishments, the Management of Health and Safety at work Regulations 1999, requires employers to undertake a suitable and sufficient risk assessment

- This guideline is written for both operators and practitioners, to understand the elements that should be present in a suitable and sufficient MHHHRA

- COMAH requires the identification and assessment of potential major accident hazards and the implementation of all measures necessary

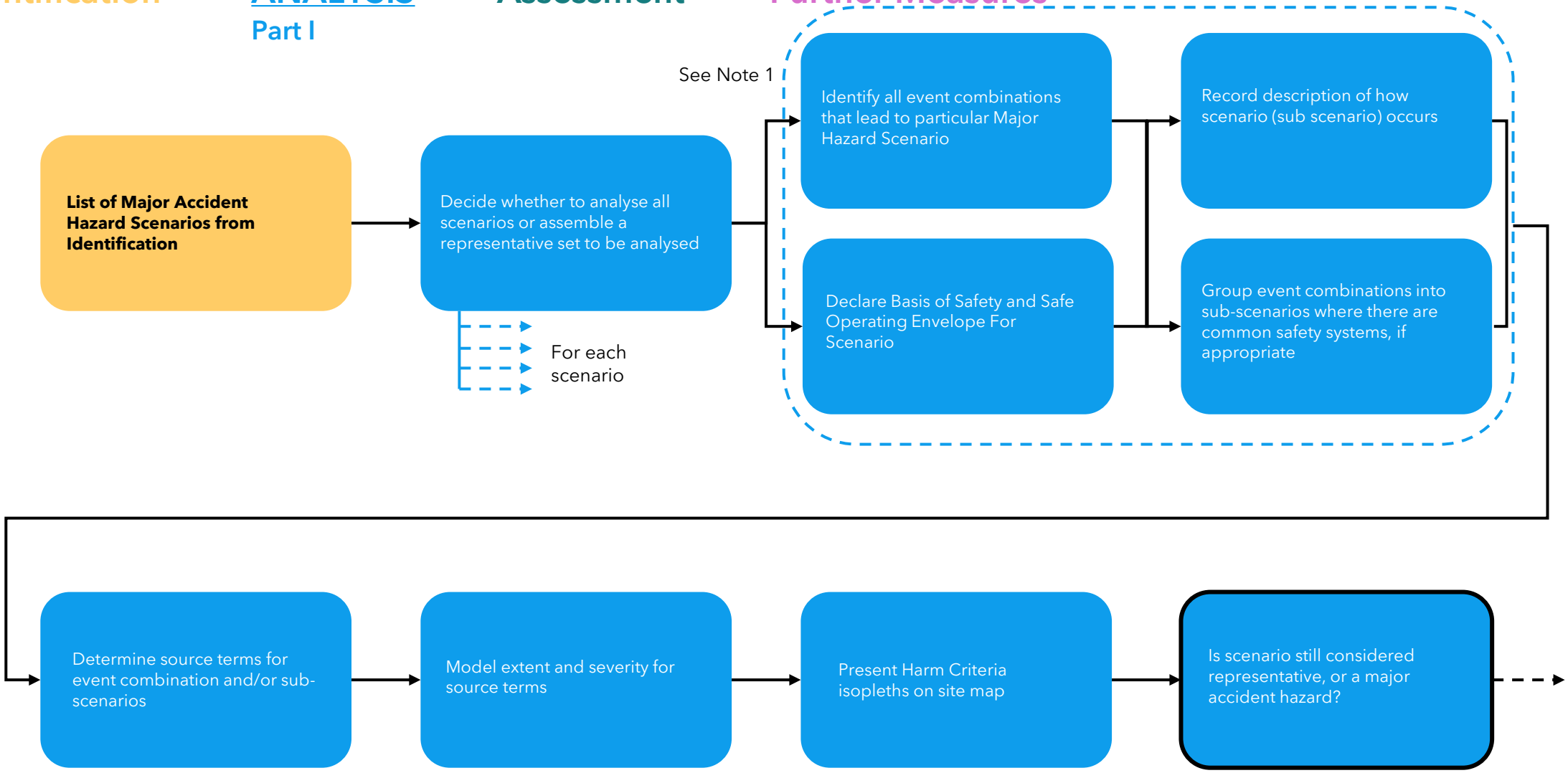
- COMAH sits within the framework of the Health and Safety at Work Act etc 1974 and its requirement to reduce risk ‘so far as is reasonably practicable’ (SFAIRP). HSE calls the legal requirement on SFAIRP, the ‘as low as reasonably practicable’ (ALARP) principle

- When considering major hazard human harm, “all measures necessary” requirements are under SFAIRP (ALARP principle)


IDENTIFICATION → Analysis → Assessment → Further Measures
Information
Unit Operation **Technical Folders** Review as necessary
(see guidance for usual content)
Unit Operation **Risk Assessment Studies** already undertaken. Check if valid for the current operation
Collate **Chemical Behaviour and Interaction Studies**
Initial broad low-resolution survey of **On-Site & Off-site Populations, land use** and environment survey
List of **significant modifications** for existing Unit Operations
Collate **Major Accidents & Incidents** similar Unit Operations
• International
• On-site
Divide site into intuitive areas, identify Unit Operations within the area, list unit operations and major vessels
Conduct any missing **Top-down, hazard potential analysis** studies on Unit Operations
Conduct any missing **Bottom-up, event-based analysis** studies on Unit Operations
• Equipment reference
• Composition
• Quantity
• State, temp, pressure
• Consequences
• Preliminary estimate of severity
Site Screening Table, identify Potential Major Accident Hazard Scenarios, then screen for MAHS
It may be required to conduct an extent and severity scoping assessment where a PMAHS is to be 'screened out'
A simple explanation should be recorded where a PMAH has been screened out. MAHS carried forward may also be screened out when the scenario is developed further
List of Major Accident Hazard Scenarios
ANALYSIS

Identification → ANALYSIS → Assessment → Further Measures

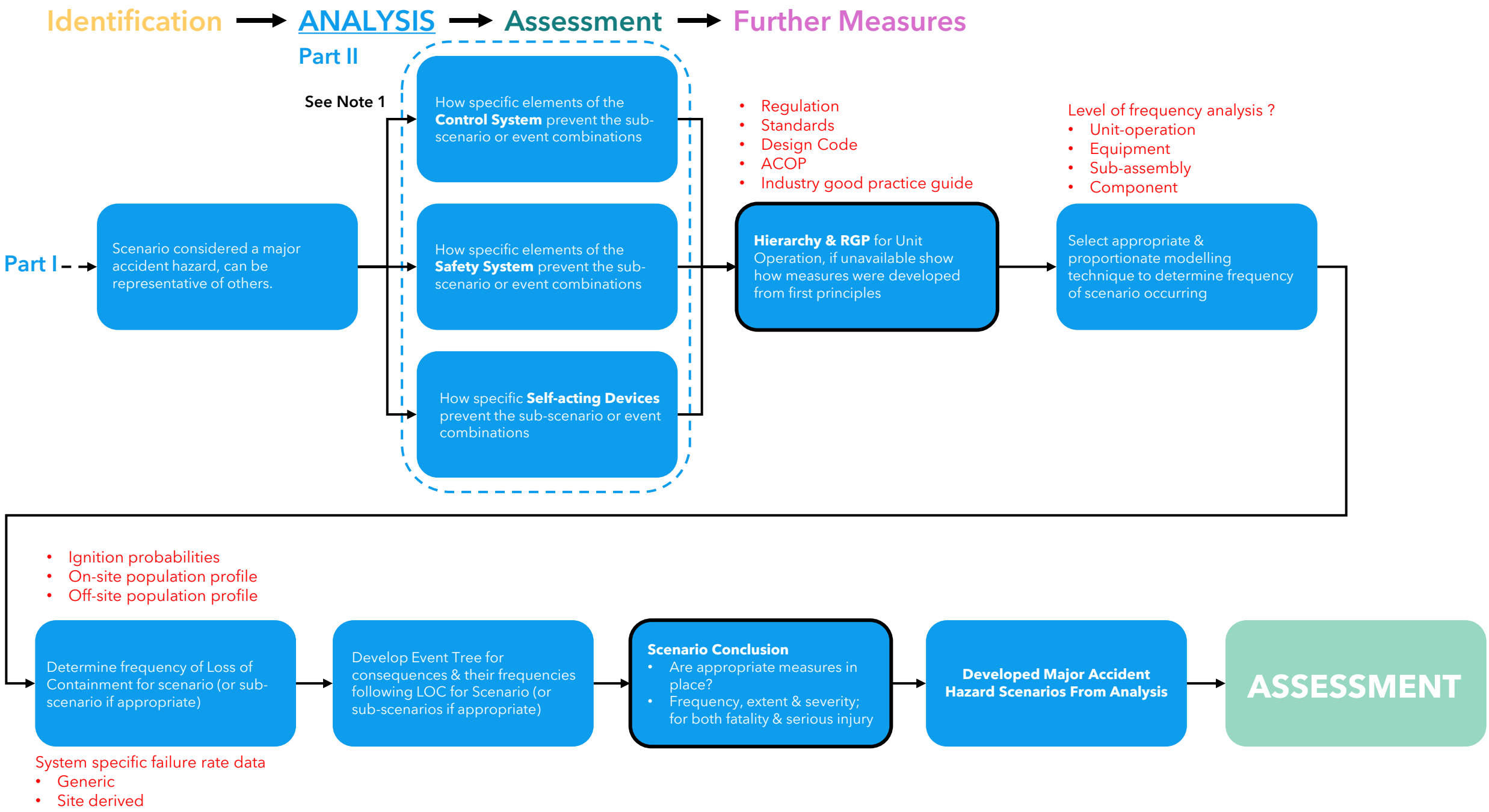
Part I



- Indoors
- Outdoors
- Weather
- Physical features
- Escalation source term

Select appropriate Harm Criteria for both fatality & serious injury

Note 1: description aspect can be split into two sections to avoid unnecessary work should the scenario prove not to be MAHS on close inspection.


Identification → ANALYSIS → Assessment → Further Measures
Part II
See Note 1
How specific elements of the **Control System** prevent the sub-scenario or event combinations
How specific elements of the **Safety System** prevent the sub-scenario or event combinations
How specific **Self-acting Devices** prevent the sub-scenario or event combinations
Part I
Scenario considered a major accident hazard, can be representative of others.
• Regulation
• Standards
• Design Code
• ACOP
• Industry good practice guide
Hierarchy & RGP for Unit Operation, if unavailable show how measures were developed from first principles
Level of frequency analysis ?
• Unit-operation
• Equipment
• Sub-assembly
• Component
Select appropriate & proportionate modelling technique to determine frequency of scenario occurring
• Ignition probabilities
• On-site population profile
• Off-site population profile
Determine frequency of Loss of Containment for scenario (or sub-scenario if appropriate)
Develop Event Tree for consequences & their frequencies following LOC for Scenario (or sub-scenarios if appropriate)
Scenario Conclusion
• Are appropriate measures in place?
• Frequency, extent & severity; for both fatality & serious injury
Developed Major Accident Hazard Scenarios From Analysis
ASSESSMENT
System specific failure rate data
• Generic
• Site derived

Identification → Analysis → ASSESSMENT → Further Measures

Developed Major Accident Hazard Scenarios From Analysis

On-Site: Identify area of the site at risk within Hazard Isopleths and determine population profile within it

On-Site: Determine on-site population profile & **job functions*2** within areas considered at greatest cumulative risk

Assemble **On-Site Risk Profile** using outputs of each scenario analysis together with the population profiles

Identify Job Functions*2 which have the maximum cumulative individual risk for both fatality & serious injury

Off-Site: Determine the types of development & population densities within the Hazard Isopleths

Off-Site: Determine population densities within **areas & locations** considered at greatest cumulative risk

Assemble **Off-Site Risk Profile** using outputs of each scenario analysis together with the population profiles

Identify off-site locations which have the maximum cumulative individual risk for both fatality & serious injury

Some scoping work may be required to identify the Job Function*2 at greatest risk

Representative Set Multipliers to be used where appropriate

Produce Risk Summary for Job Function*2 at greatest Cumulative Individual Risk

Produce Cumulative Risk FN Curve from MAHS Risk Profile

For each Scenario check if risk contribution indicates analysis is at the appropriate resolution

Determine if both the On-Site & Off-site Cumulative Individual Risk are tolerable by applying the HSE Criteria

Off-site and on-site cumulative risk for both fatality and serious injury

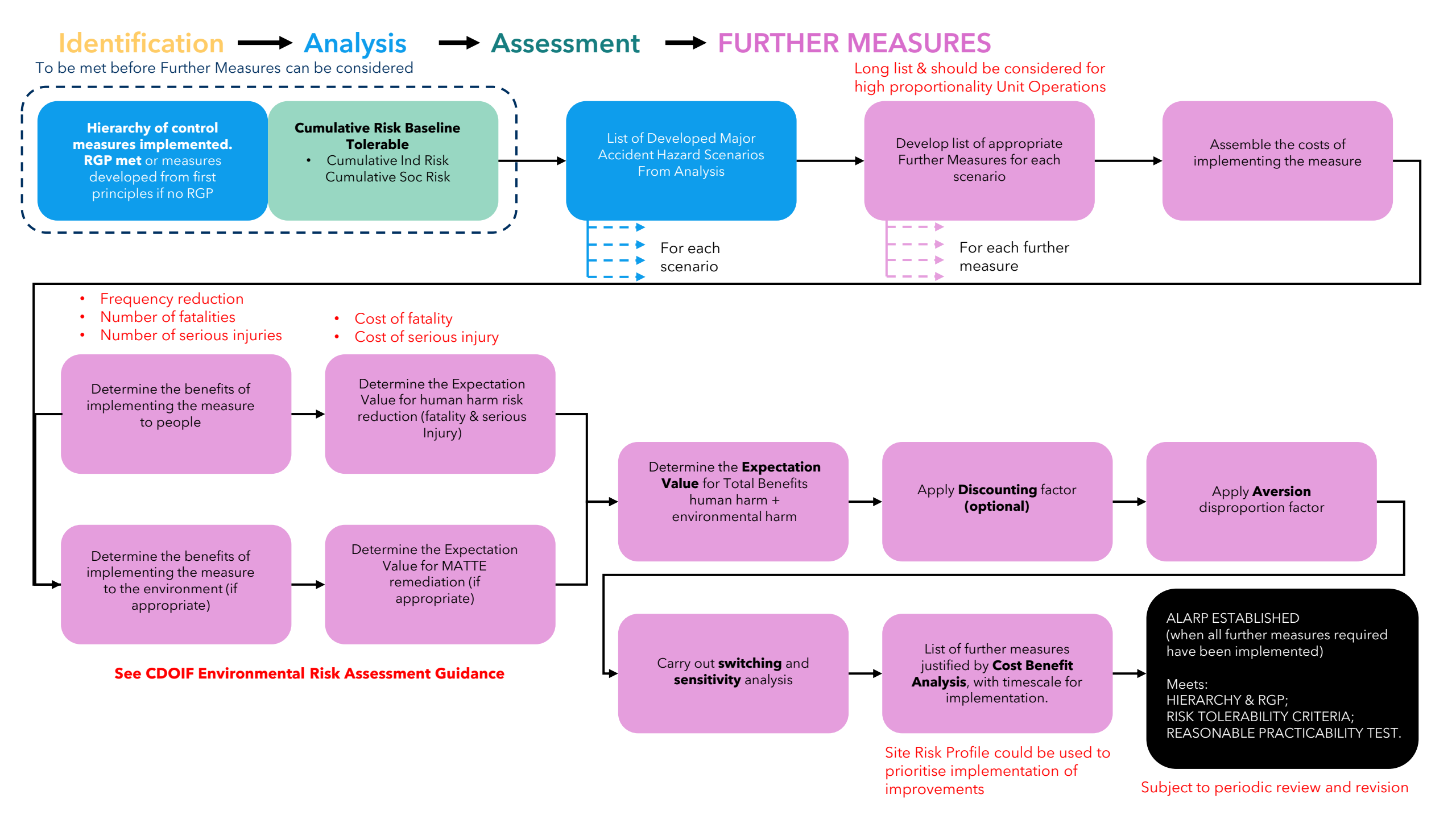
Determine if the Cumulative Societal Risk is tolerable by applying the HSE Criteria

If Risk is **Not Tolerable** Consider the resolution of analysis are all the appropriate measures in place?

Cumulative Risk Baseline Established
- Cumulative Ind Risk
- Cumulative Soc Risk

FURTHER MEASURES

Note 2: in some cases, Location Cumulative Individual Risk, also referred to as hypothetical person, could be used.


Identification → Analysis → Assessment → FURTHER MEASURES
To be met before Further Measures can be considered
Long list & should be considered for high proportionality Unit Operations
Hierarchy of control measures implemented. RGP met or measures developed from first principles if no RGP
Cumulative Risk Baseline Tolerable
• Cumulative Ind Risk
Cumulative Soc Risk
List of Developed Major Accident Hazard Scenarios From Analysis
For each scenario
Develop list of appropriate Further Measures for each scenario
For each further measure
Assemble the costs of implementing the measure
• Frequency reduction
• Number of fatalities
• Number of serious injuries
• Cost of fatality
• Cost of serious injury
Determine the benefits of implementing the measure to people
Determine the Expectation Value for human harm risk reduction (fatality & serious Injury)
Determine the benefits of implementing the measure to the environment (if appropriate)
Determine the Expectation Value for MATTE remediation (if appropriate)
See CDOIF Environmental Risk Assessment Guidance
Determine the Expectation Value for Total Benefits human harm + environmental harm
Apply Discounting factor (optional)
Apply Aversion disproportion factor
Carry out switching and sensitivity analysis
List of further measures justified by Cost Benefit Analysis, with timescale for implementation.
Site Risk Profile could be used to prioritise implementation of improvements
ALARP ESTABLISHED
(when all further measures required have been implemented)
Meets:
HIERARCHY & RGP;
RISK TOLERABILITY CRITERIA;
REASONABLE PRACTICABILITY TEST.
Subject to periodic review and revision

Challenging areas addressed

- Growth of simplified parts count using the offshore hydrocarbon release database - Any analysis needs to be conducted at a level which represents the unit operation being analysed and consider its particular failure modes

- R2P2 is often interpreted as industry guidance, it is not; it was a discussion document on how HSE Regulates. The CDOIF guideline outlines the working group's view on how to undertake a tolerability of risk assessment if you are a COMAH operator

- This includes ensuring serious injury and not just death is considered and how you could determine the maximum cumulative risk to the person from the establishment's MAH risks

- It was suggested by some operators that once the maximum cumulative individual risk of a person is determined, this could be divided by the numbers of shifts (e.g. 3) or teams on site (e.g. 5), as a specific person was only there for a fraction of the time

- The working group concluded a way forward on different types of risk fractionation

Next Steps

Editing and Clearance Processes

- CDOIF appointed a technical editor to refine the guideline to enhance layout and readability
- The working group will review the output from the technical editor (expected end of August)
- A 10-week CDOIF stakeholder review will be initiated in September. The working group will re-convene to review and respond to comments raised
- Planned publication, on the Process Safety Forum Website will be Q1/Q2 2026

Communication Plans

- CDOIF is working with stakeholders to agree opportunities to raise awareness of the guideline before publication (e.g. Trade Association and sector webinars)
- A formal press release will be issued to support publication
- Technical webinars, and support workshops, will be planned to support operators

THANK YOU FOR LISTENING

Any questions?