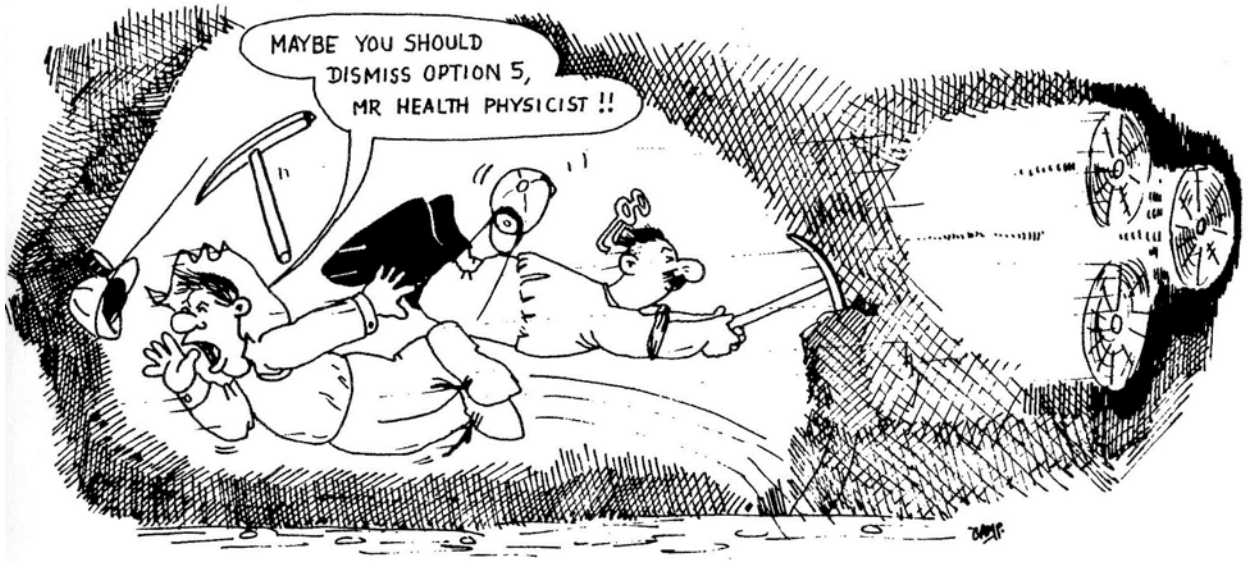
THE SOCIETY FOR RADIOLOGICAL PROTECTION

Integration of Risks from Multiple Hazards into a Holistic ALARA / ALARP demonstration

Pete Bryant | SRP President Elect

p.bryant@liverpool.ac.uk

Registered Charity No: 112804
www.srp-uk.org



The levels of dose and the financial costs may not be the only relevant factors - Example of ventilation measures in a uranium mine.

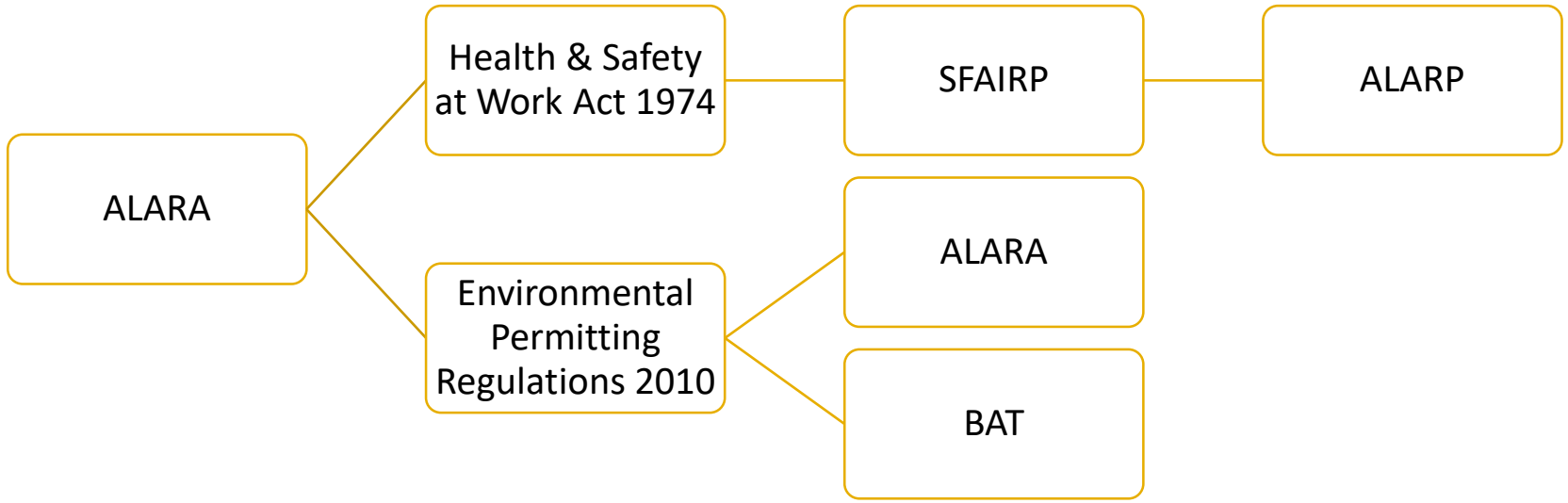
Introduction

- The “optimisation” principle is at the core of radiation protection. It is often referred to as ALARA, short for keeping all doses “As Low As Reasonably Achievable”.
- The vast majority of situations involve a range of hazards.
- There is a natural tendency to assess radiological and other hazards, such as chemical and manual handling, independently. This can result in a lack of proportionality in the treatment of each hazard or even the introduction of new hazards as a result of mitigating another hazard.
- Taking a balanced view of a range of hazards and risks is something that operational safety staff do every day. **But how do you make that judgement?**

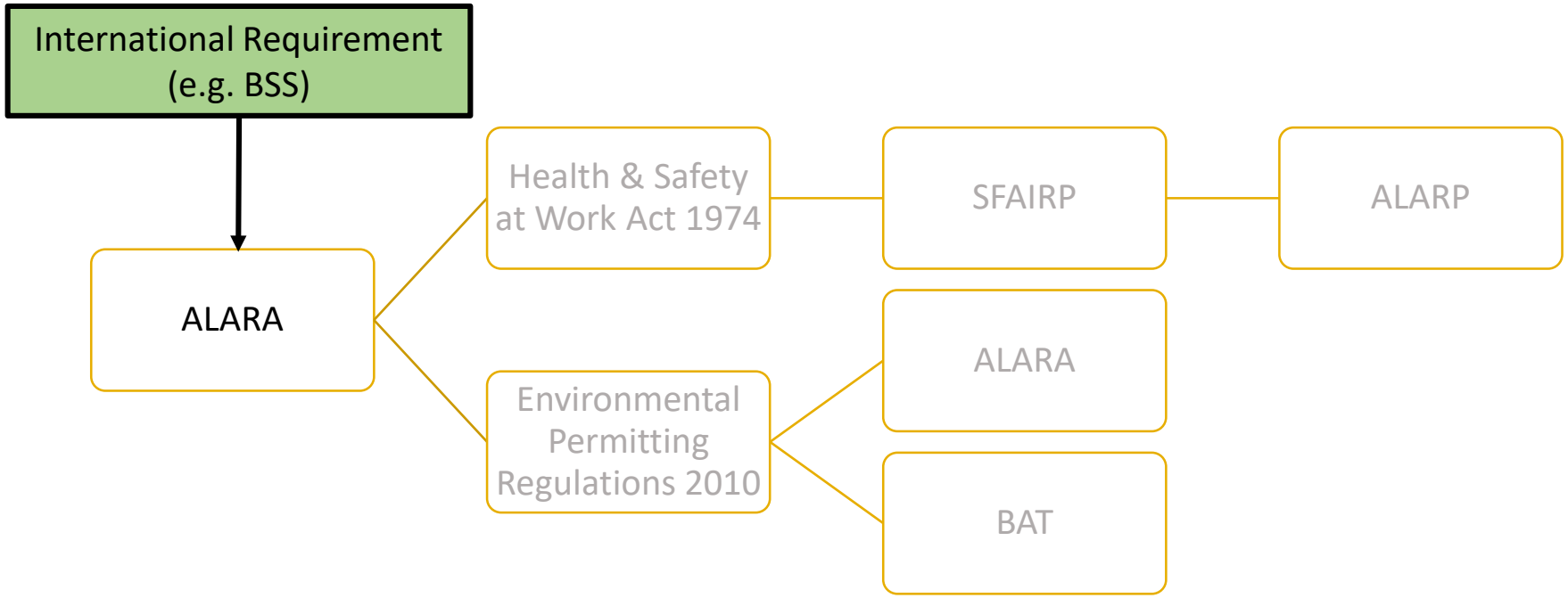
Historical Overview

- Throughout the 1980s and early 1990s, CEPN and NRPB collaborated in several Commission of the European Communities research projects with the objective of developing the understanding of ALARA and its practical implementation.
- The initial focus for the development of an understanding of ALARA was on mechanistic approaches using quantitative decision aiding techniques.
- By the late 1980's, it was becoming clear that, whilst the development of structured approaches provided 'tools' to pursue ALARA, this did not necessarily achieve anything in practice unless there was a will to positively pursue the ALARA principle.
- Over the years, the commitment to ALARA has become part of what we would now recognise as **(Radiation) Safety Culture**.

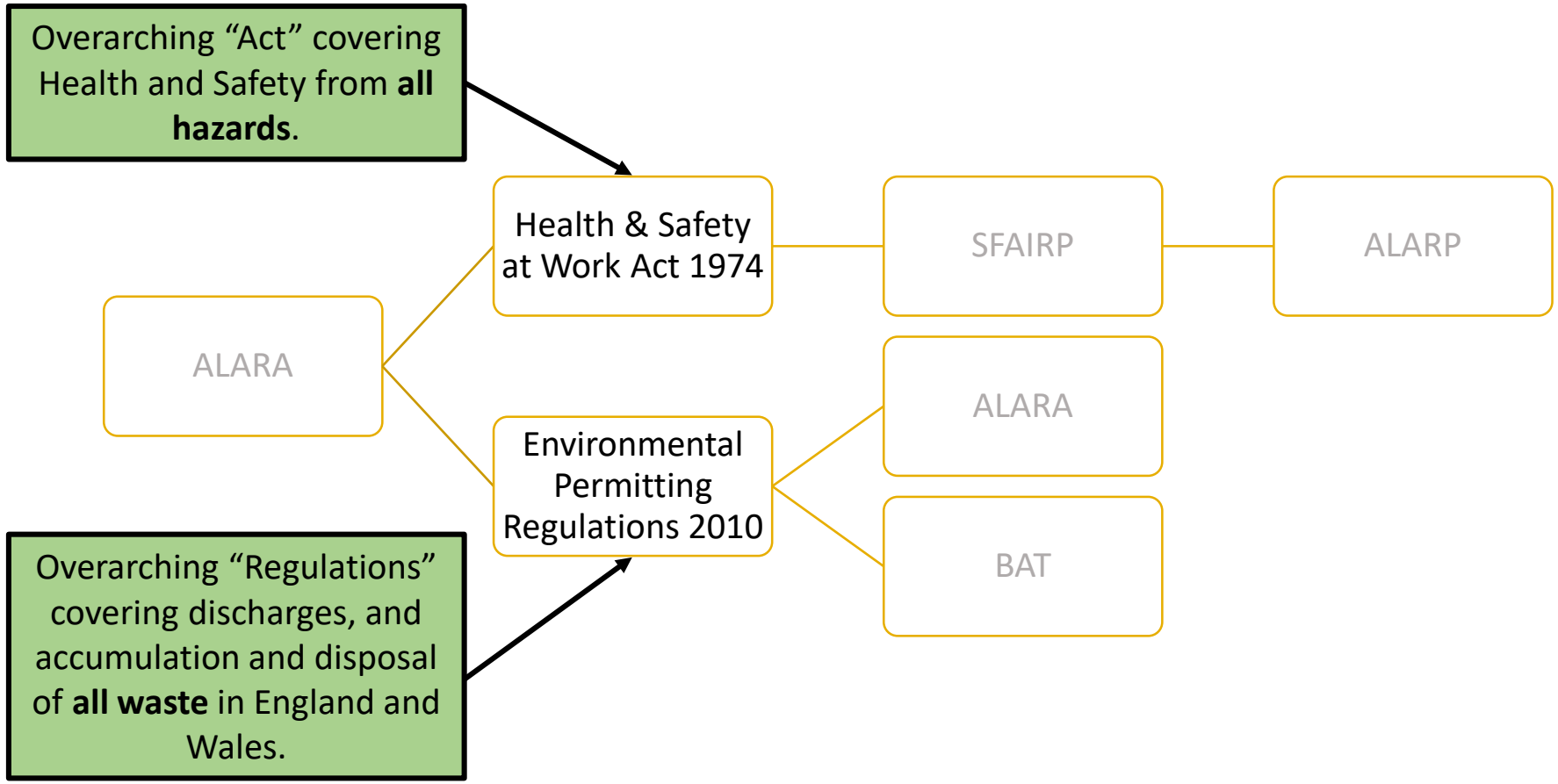
ALARA in the UK Regulatory Regime



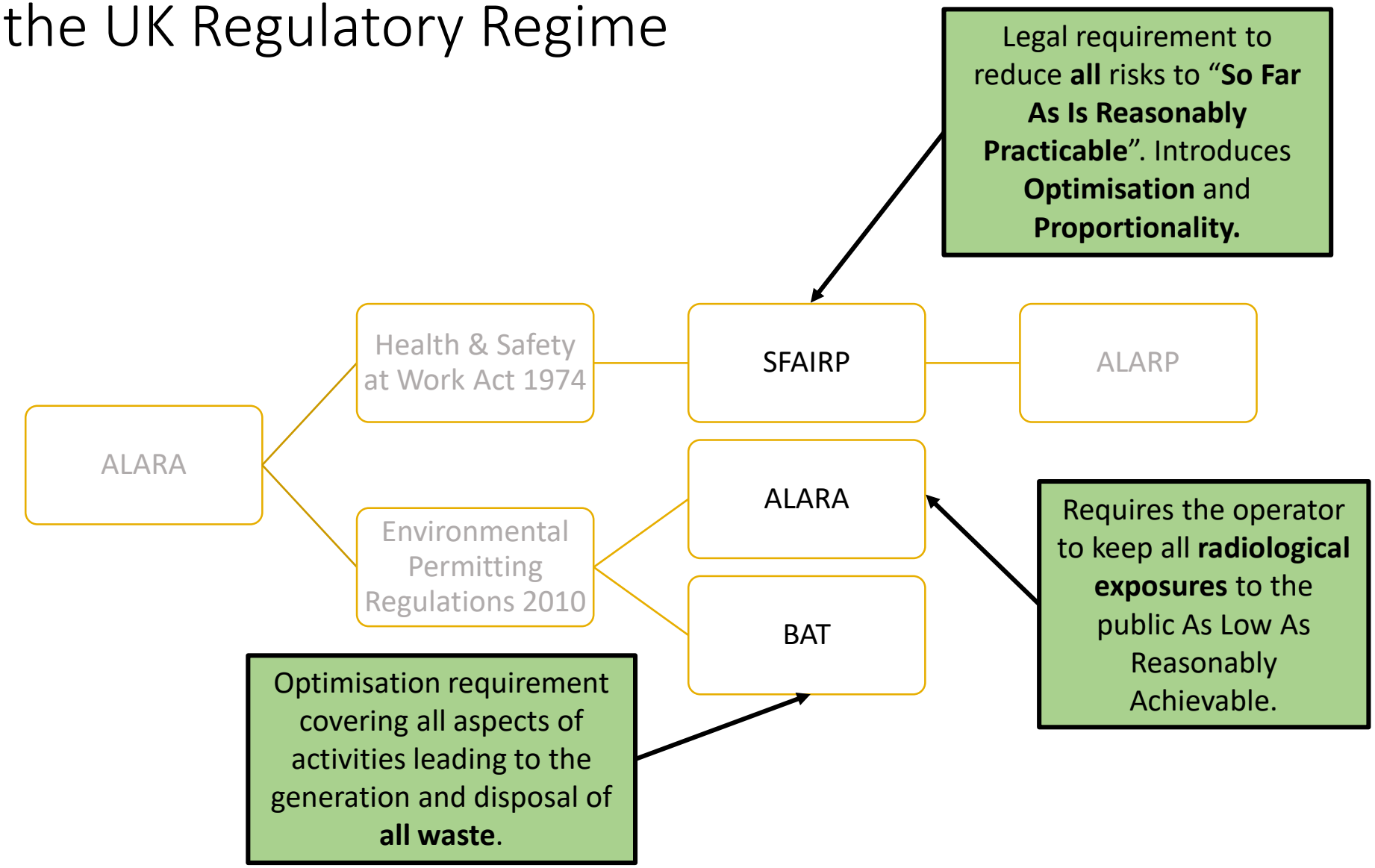
ALARA in the UK Regulatory Regime



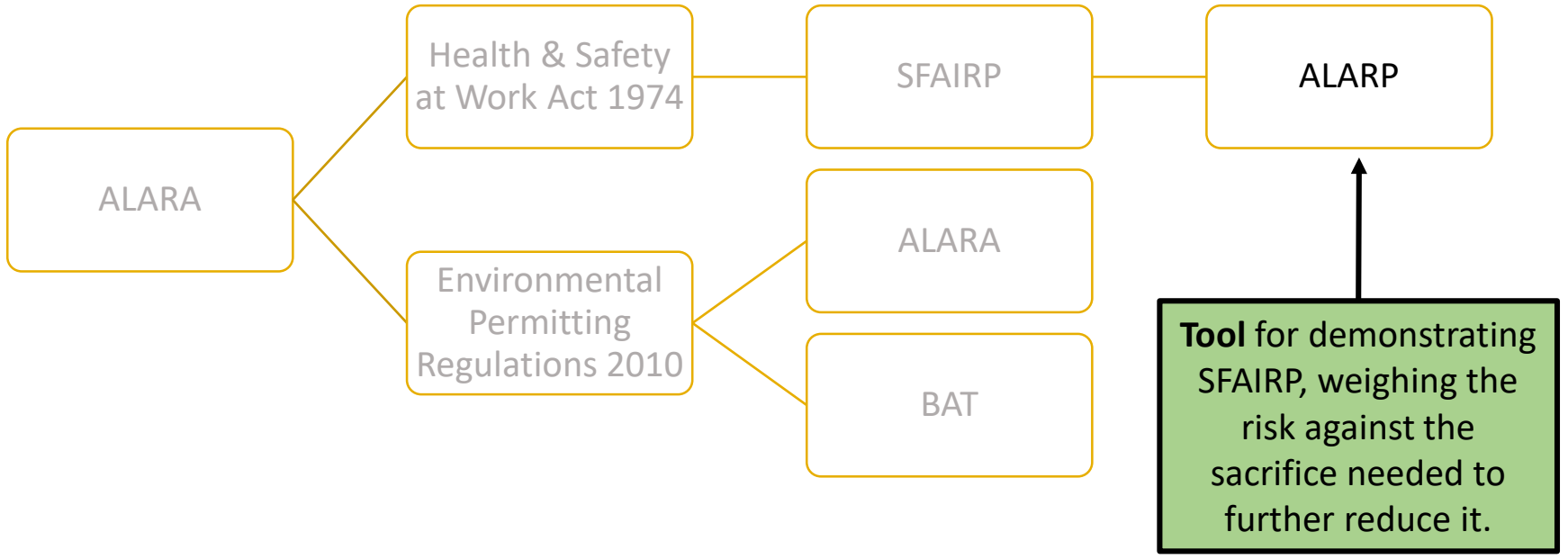
ALARA in the UK Regulatory Regime



ALARA in the UK Regulatory Regime



ALARA in the UK Regulatory Regime



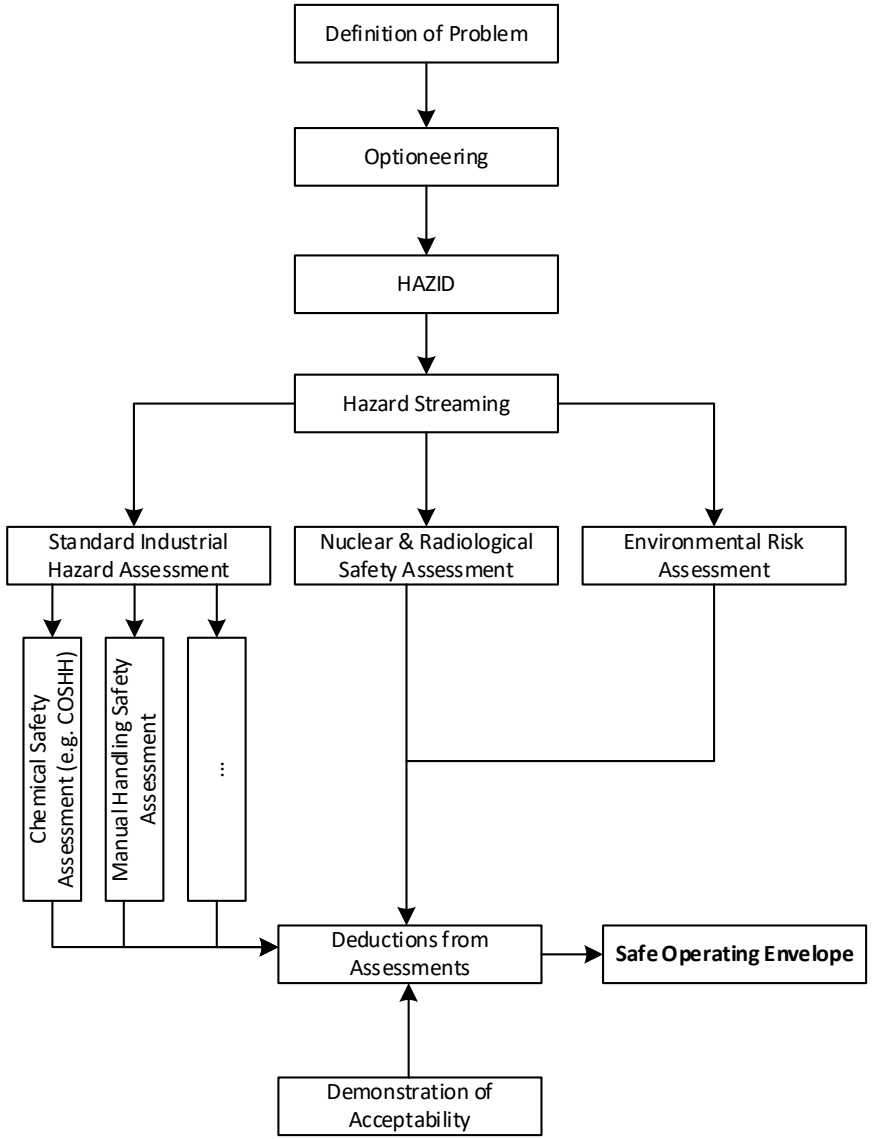
Integration of different risks in the UK

- High Hazard Industries (Nuclear, Oil and Gas, Rail etc.) are **Heavily Regulated**.
- Nuclear Industry most heavily regulated. Gold Standard in UK Health & Safety.
  - Significant effort in the **integration of different risks as part of the ALARP Argument**.
- What about the Lower Hazard Industries or Medical Sector? Is there an **all risk approach**?
- It appears there is **not yet a consistent approach across industries** for the treatment, yet alone integration of risks. For instance Deterministic vs Probabilistic Treatment of Risks in different sectors.

The Nuclear Industry and Safety Case

- The Safety Case is a requirement in UK Law (Health and Safety at Work Act and Nuclear Installations Act).
- NIA requires a site licence to be issued prior to the construction and operation of a Nuclear Facility.
- **Safety Case** - The documentation that demonstrates how the operators meets there License Conditions and has reduced the risks to ALARP.
- The Safety Case has a strong link to the Radiological Risk Assessment and System of Protection. However this is **applied to all hazards**. Not just Nuclear or Radiological.
- **A learning opportunity for other sectors?**

Example Framework for the Integration of Risks from Multiple Hazards into a Holistic ALARA / ALARP demonstration



Optioneering

- Provides the **foundation to the ALARP argument**.
- First off there must be a clear definition of the problem.
- Key Steps:
  - Define Requirements (e.g. Functional Requirements)
  - Identify Options
  - Define Selection Criteria - Assurance (including Radiological Safety, Conventional Safety, Environmental Risks), Engineering, Business etc.
  - Analyse Options - Assess against criteria
  - Scoring and Ranking
  - Down Selection - Identify Preferred Option(s)

Optioneering

- When defining the selection criteria due consideration should not only given to one hazard such as radiological or nuclear safety, but consideration is given to all hazards, including Environmental Risks.
- A Scoring System should be decided prior to undertaking the analysis of the options, along with any weighting to be applied to the criteria, to take account of the relative importance.
- Recording and reporting of the above provides an auditable trail that underpins the justification and supports the ALARP argument.
- A Quorate Group of Specialists may be required.

Hazard Identification (HAZID)

- A Safety Case or Risk Assessment requires a systematic method of hazard identification. This provides a means of **testing the preferred option**.
- The hazard identification process must identify all significant hazards, i.e. those that could lead to loss of life, injury or ill health to a facility worker, on-site worker and member of the public. Potential hazards include radiological and standard industrial hazards (conventional hazards). Combinations of hazards must also be considered (where these can not be eliminated by the design).
- In addition, all releases that could potentially pollute the environment must also be identified.
- The HAZID should be accurately recorded and documented to provide an auditable trail that underpins the ALARP argument.

Hazard / Safety Assessments

- Regardless of the Hazard Type whether Nuclear / Radiological, Industrial or Environmental in nature a **proportionate approach** should be undertaken to assessing the hazard.
  - For those hazards capable of causing a significant consequence (fatality or a number of serious injuries) it is **reasonable** to undergo additional assessment to **understand the potential fault sequences and consequences**, and to correctly determine the relevant safety controls.
  - Those hazards with a lower consequence are less likely to require an in depth assessment to identify any controls.

Hazard / Safety Assessments

- **Relevant Good Practice** should be applied to all hazards as a minimum.
- Those hazards capable of causing a significant consequence may require specialist assessments tailored to the hazard type. For instance explosive hazards.
- It should be noted that in certain cases controls put in place to limit or reduce the risk associated with one hazard type, may also be used to limit or reduce the risk associated with another hazard type. (e.g. Chemical and Radiological Contamination Hazards). In such cases it is important to make sure any **claims placed on the control are recorded** in both hazard assessments.

Deductions from Assessments & Safe Operating Envelope

- The output of the various assessments should be reviewed in combination, to ensure that there are no conflicts, for instance any controls or mitigations put in place for one hazard type have not created any new hazards, or impacted on any of the other hazard assessments.
- These deductions are then used to define the Safe Operating Envelope. This review should be undertaken by SQEP panel, who have a demonstrable understanding of the various hazard types.
- The SOE includes **Bounding Conditions**, Engineered and/or Managerial Safety Controls (and requirements placed on the controls, including **maintenance**), which are to be implemented by the facilities safety management arrangements.

Demonstration of Acceptability

- As part of the Hazard / Safety Assessments claims are placed on Engineered Controls and Managerial Controls.
- These claims need to be substantiated in order to demonstrate they can be met.
- The extent of substantiation is proportionate to the level of risk reduction and confidence required for the safety measure. This may range from compliance with relevant standards, to a more in-depth assessment of failure modes or through limiting factors.

Challenges with the Integration of Risks

- The described framework has been applied to varying degrees at several Nuclear Facilities in the UK, in particular the Nuclear Defence Establishments.
- This has included Research Facilities where only minor quantities of Nuclear or Radioactive Materials maybe handled, to the higher hazard facilities handling larger quantities of enriched nuclear materials.
- The application of this framework is not without its challenges both within its use in the Nuclear Sector, and extending it to wider industries. A summary of some of the key challenges are provided in the subsequent slides, along with some tips and lessons learnt.

Challenges with the Integration of Risks

- **Balancing the risks during the optioneering stage**.
  - For instance, one option may result in a reduction in the radiological risks but an increase in the risks associated with industrial hazards.
  - This emphasises the importance of the careful selection of the criteria used to assess the options including due consideration of all hazards.
  - It is crucial that any reasoning behind Scoring and Ranking, is well documented and defendable. As discussed earlier this forms the foundation of the ALARP argument.

Challenges with the Integration of Risks

- **Lack of a consistent approach within industries**.
  - There is no one consistent approach for assessing risks across industries, and differences even within specific industries (e.g. Nuclear). To continue driving an integrated approach forward it is key that we encourage:
    - Knowledge sharing across industries and within industries.
    - Regulators encourage the use of best practice approaches as part of their expectations.
    - Adoption of a common lexicon of risk terminology across all hazard types and industries.

Challenges with the Integration of Risks

- **Management of materials with multiple hazards.**
  - Materials such as uranium are both radiologically and chemically toxic. In such instances, it is important to identify the dominant health detriment from that form of the material, in the situation being assessed, and use this as the primary basis for identifying the controls.
  - As part of the assessment due consideration should be taken that the form of the material may change as part of the initiating event leading the hazard being realised.
  - A check should also be made to ensure the identified controls for the dominant health detriment (e.g. chemical toxicity), are suitable and sufficient to control the other hazards (e.g. radiological toxicity).

Summary / Conclusions

- The UK Nuclear Industry has placed significant effort of the integration of different risks as part of the ALARP Argument.
- However, there is not yet a consistent approach across industries or even within the sector.
- Can the System of Protection be applied to all hazards?
- Challenges associated with balancing the risks from multiple hazards.
- Work still to be done!
  - Opportunities to improve how we exchange experiences.
- *Full paper found in Journal of Radiological Protection, Volume 38, Number 1.*

Any

Questions?