THE SOCIETY FOR RADIOLOGICAL PROTECTION

Examples of ALARA/ALARP in the UK nuclear sector, and challenges for the future

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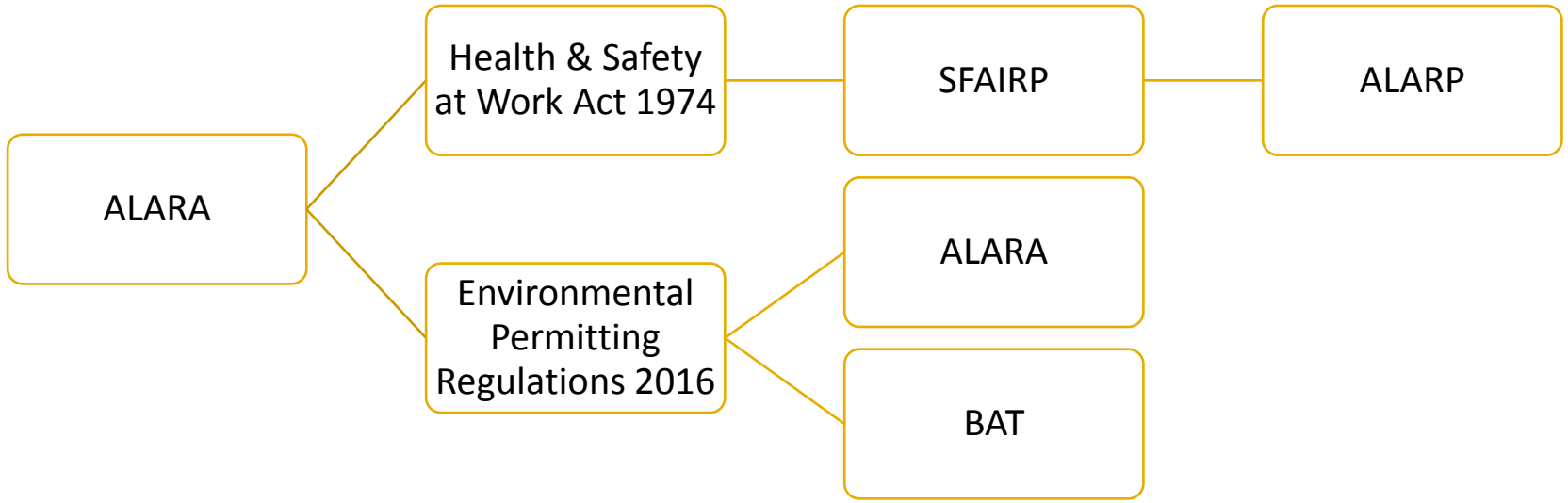
SRP Practical ALARP Meeting (29th June 2017, Birmingham)

- Focus on ALARP (Nuclear Safety & Operational Radiation Protection)
- Talks included:
  - Reactor Fuel Pond Decommissioning, Mark Liston, Magnox Ltd
  - Nuvia RPA experiences, Ian Pearman, Nuvia Ltd
  - ALARP and the LLWR Environmental Safety Case, Shelly Mobbs, Eden Nuclear
  - ALARP at Sellafield, Kevan Lee, Sellafield
  - A Regulator's View, Liz Thomas, ONR

- This talk summarises the outputs of this meeting along with some additional Nuclear New Build Examples.

ALARA in the UK Regulatory Regime



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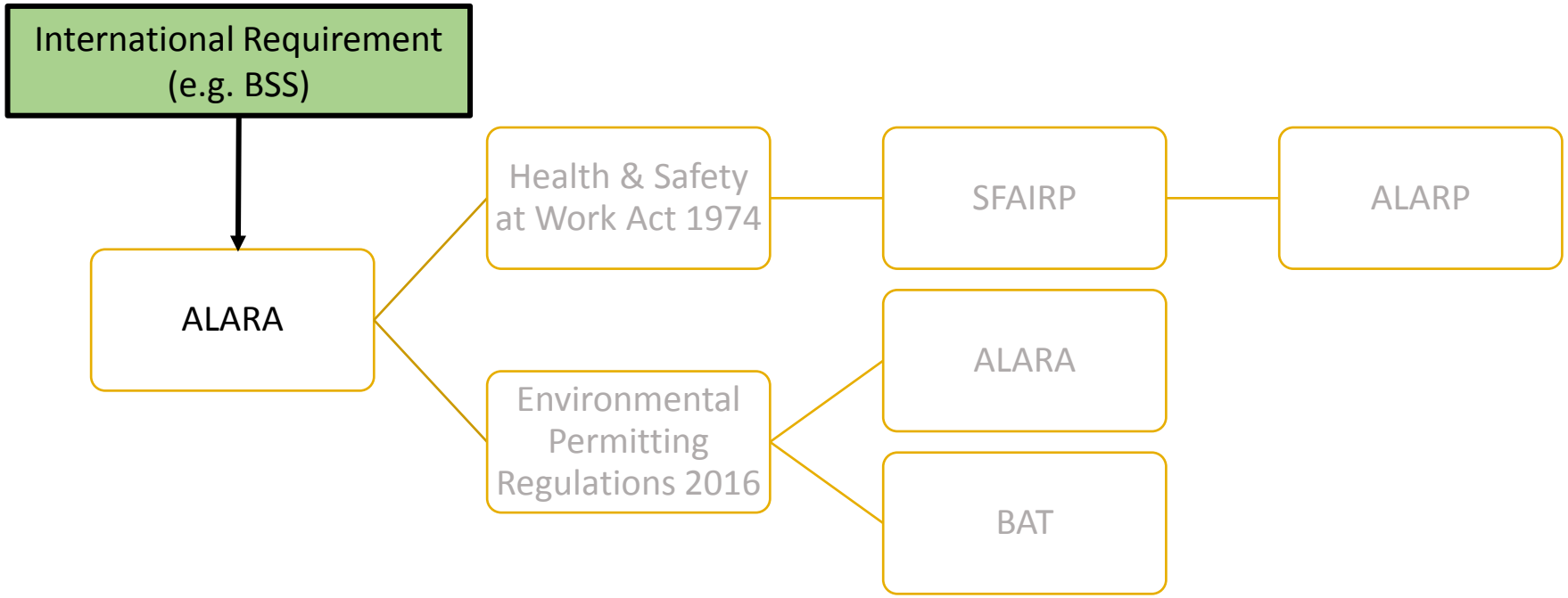

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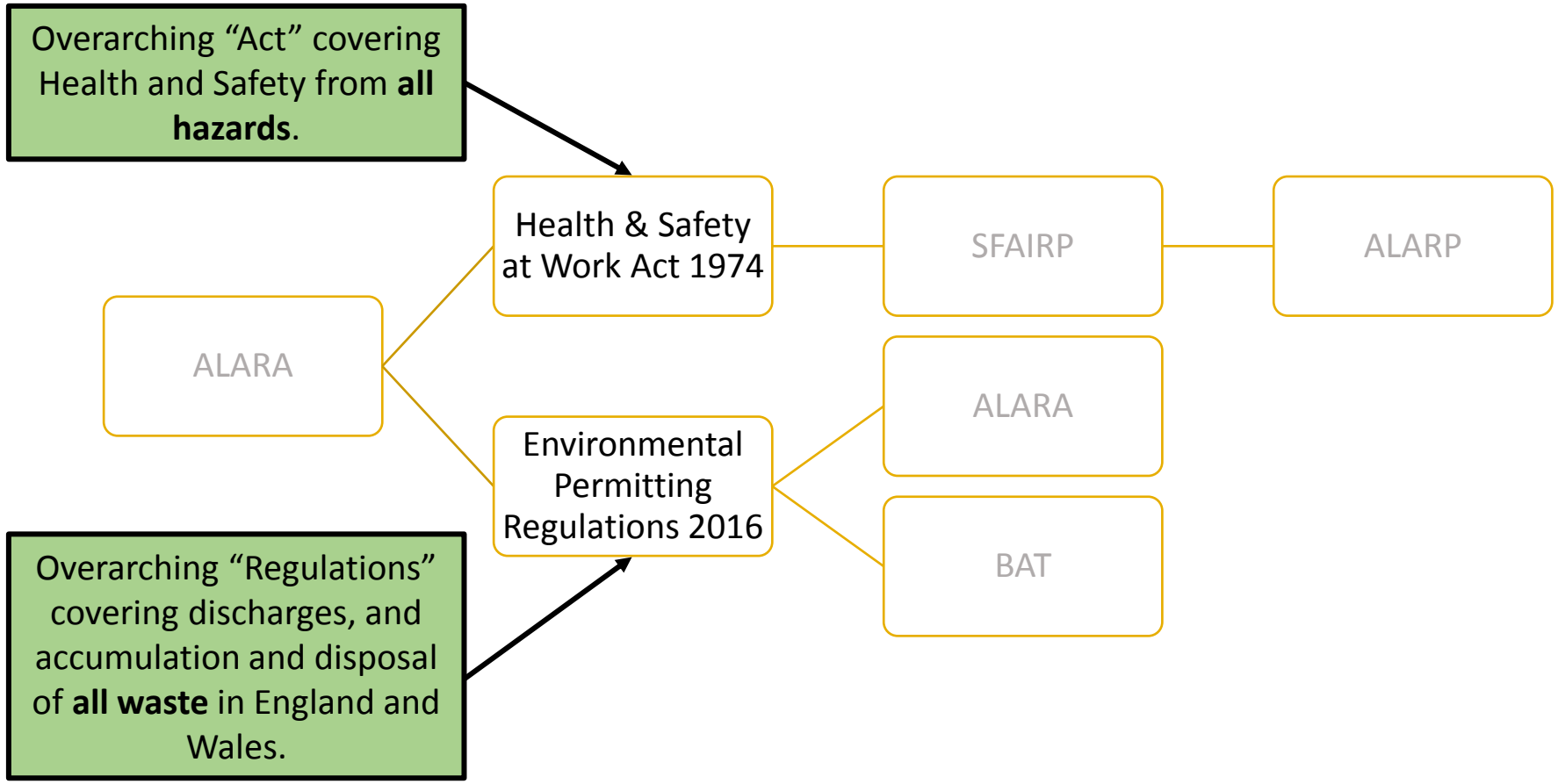

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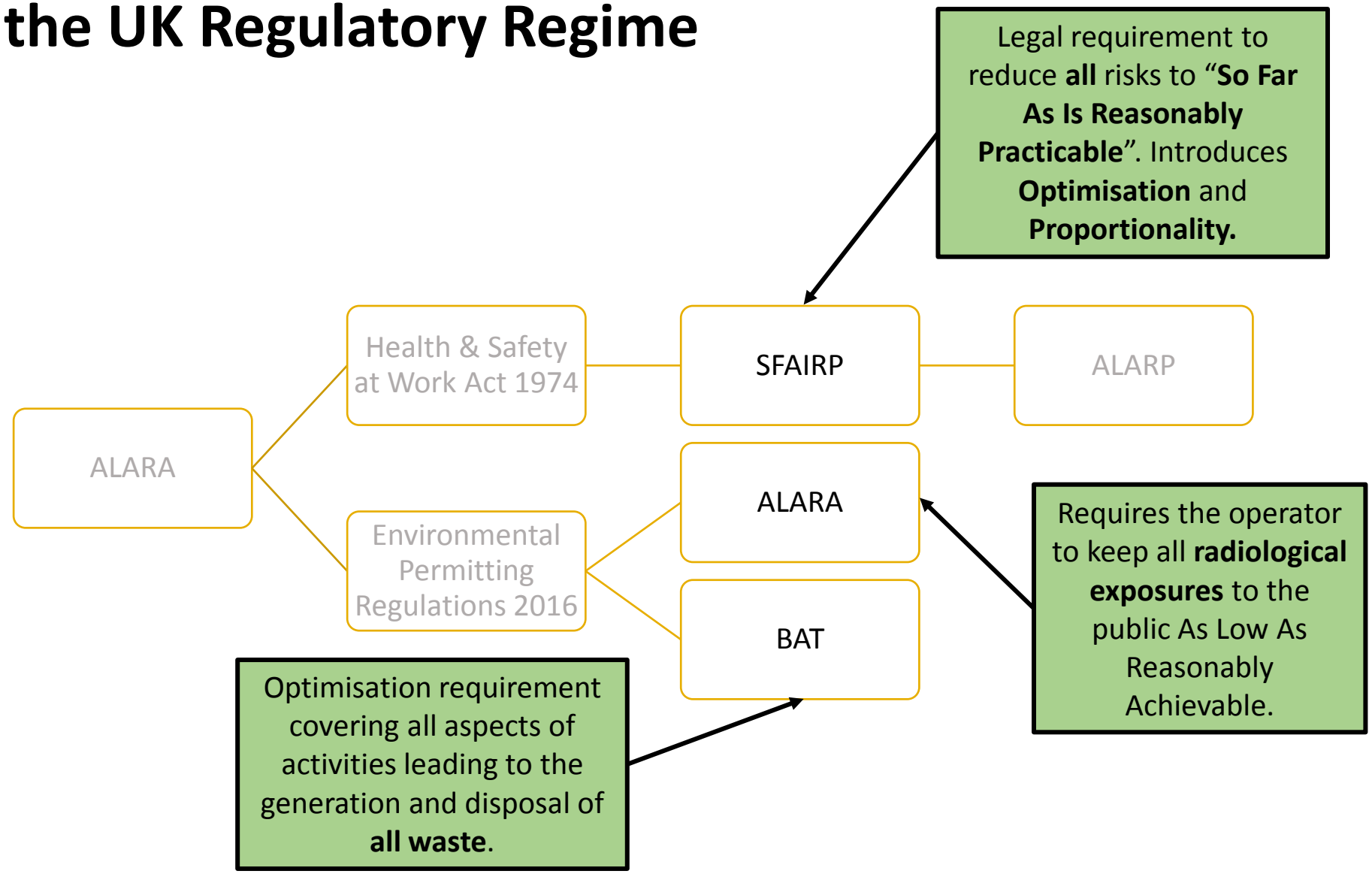

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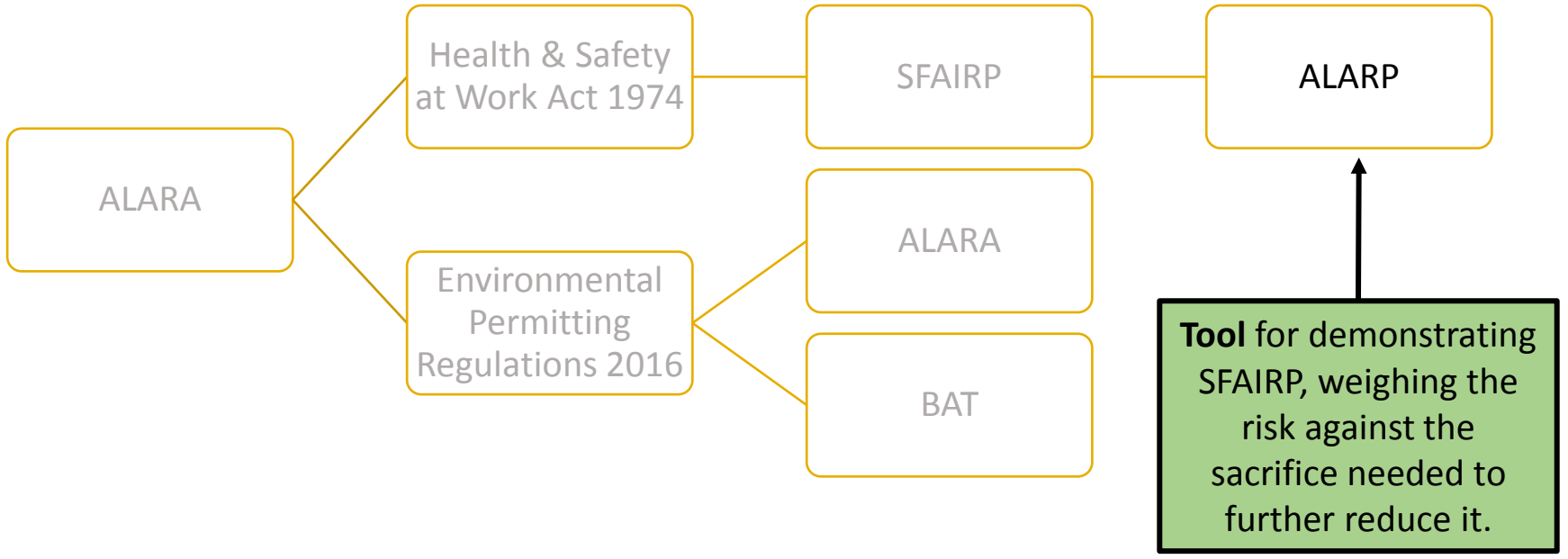


Examples of ALARA/ALARP in the UK nuclear sector, and challenges for the future

ALARP – It's a Balance

Defining "reasonably practicable" in SFAIRP

- Based on legal precedent
- Edwards vs. National Coal Board, 1949

"A computation must be made in which the quantum of risk is placed on one scale and the sacrifice, whether in money, time or trouble, involved in the measures necessary to avert the risk is placed in the other ……

…….and that, if shown that there is a

gross disproportion between them, the risk being insignificant in relation to the sacrifice, the person upon whom the duty is laid discharges the burden of proving that compliance was not reasonably practicable"

Regulatory Expectations (ONR)

- Making judgements on what is reasonably practicable
- Explicit balancing does not have to be done each and every time.
- We have concept of Relevant Good Practice, RGP

Source: presentation by Liz Thomas, ONR

ONR Guidance on the Demonstration of ALARP - NS-TAST-GD-005 - General Principles (selection)

- Affordability should not be a factor
- Options should be considered, potentially safest first
- Partial & multiple options should not be ignored
- Presentation and discussion of discarded options is imperative for transparency
- Balance of risk (public vs. worker, conventional vs. radiological, immediate vs. longer-term …)
- Balance of safety and environmental concerns

ONR Guidance on the Demonstration of ALARP - NS-TAST-GD-005 - General Principles (selection)

- Existing and new plant can be different
- The higher the risk / hazard the more rigorous the case
- CBA only acceptable as part of a safety submission

http://www.hse.gov.uk/risk/theory/alarpcheck.htm

- Gross Disproportion is the test
- ONR position on Gross Disproportion based on former HSE DG, J Locke: up to 3 for workers, between 2 and 10 for public

Starting point is Relevant Good Practice

ALARP - Examples of Good Practice
Planning, Work Scheduling & Worker Briefings

Examples include:

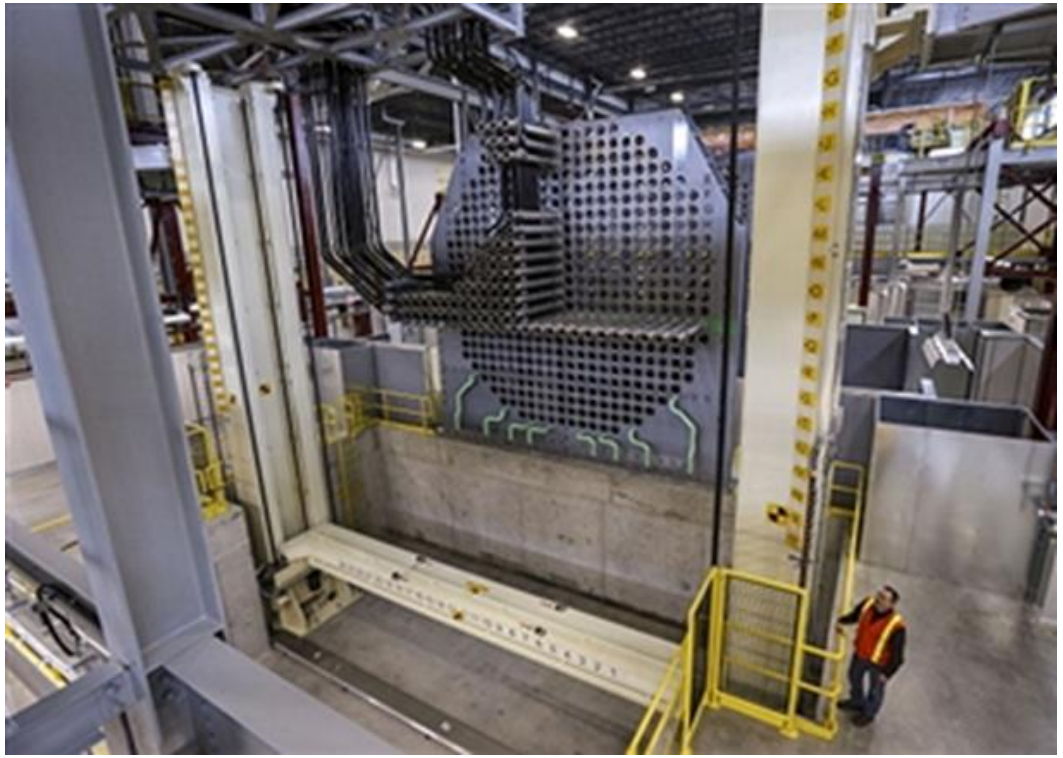
- Daily delivery meetings
- Interactive setting to work briefs
- Avoidance of undue dose sharing
- Use of EPD task codes and real time dosimetry

ALARP - Good Practice
Training & Inactive Trial Mock-ups

Source: presentation by Liz Thomas, ONR

Examples include:

- Core loading trials
- Waste retrievals
- Manual operational tasks required in high dose rate areas



ALARP – Examples of Good Practice
Post Work De-brief & Learning from Experience

- Post outage ALARP reviews
- Web based portal allowing staff to search for events, learning briefs and external OPEX (Operating Experience)
- Participation in industry groups
- Site wide poster briefs following significant events

ALARP – Examples of Good Practice (4)

- Pro-active ALARP committees
- Worker involvement
- Benchmarking of activities with internal and external

The Application of ALARP to Radiological Risk
A Nuclear Industry Good Practice Guide
Published by
The Industry Radiological Protection Co-ordination Group (IRPCG) on behalf of
The Nuclear Industry Safety Directors Forum (SDF) in 2012

https://srp-uk.org/_getDocument/262

Source: presentation by Mark Liston, Magnox

Reactor Fuel Pond Decommissioning, Oldbury

- Waste removal
- Sludge removal
- Drain and stabilise
- Decontaminate Pond walls
- Ancillary De-plant
- Care & maintenance configuration

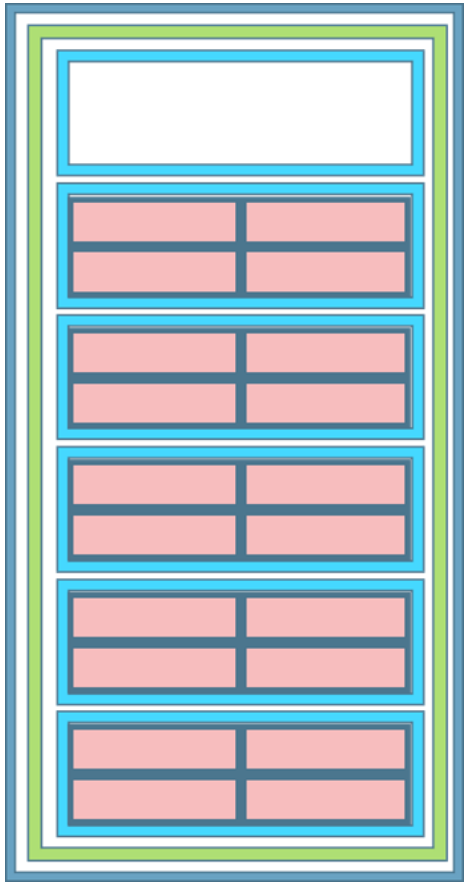
- Many Sub-stages and Work packages
- Regulatory Engagement throughout

Enablers

- Learning from other sites
- Integrated project team
- SQEP workforce
- Project management support
- Simple solutions
- Innovation

Source: presentation by Ian Pearman of Nuvia Ltd

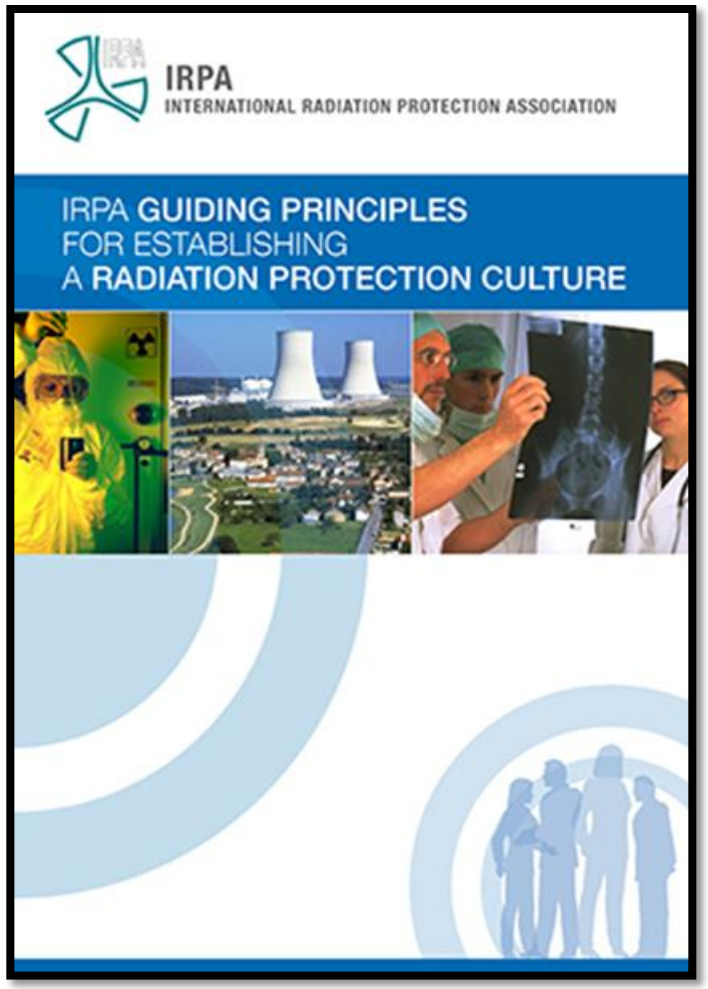
Decommissioning of High Level Activity tanks, Harwell



Regulatory Context and Safety Culture

Important elements for ALARA / ALARP

- Regulatory framework
- Presence and Tone of the regulators
- (Radiation) Safety Culture of the operator
  - All hazards
  - Relevant Good Practice

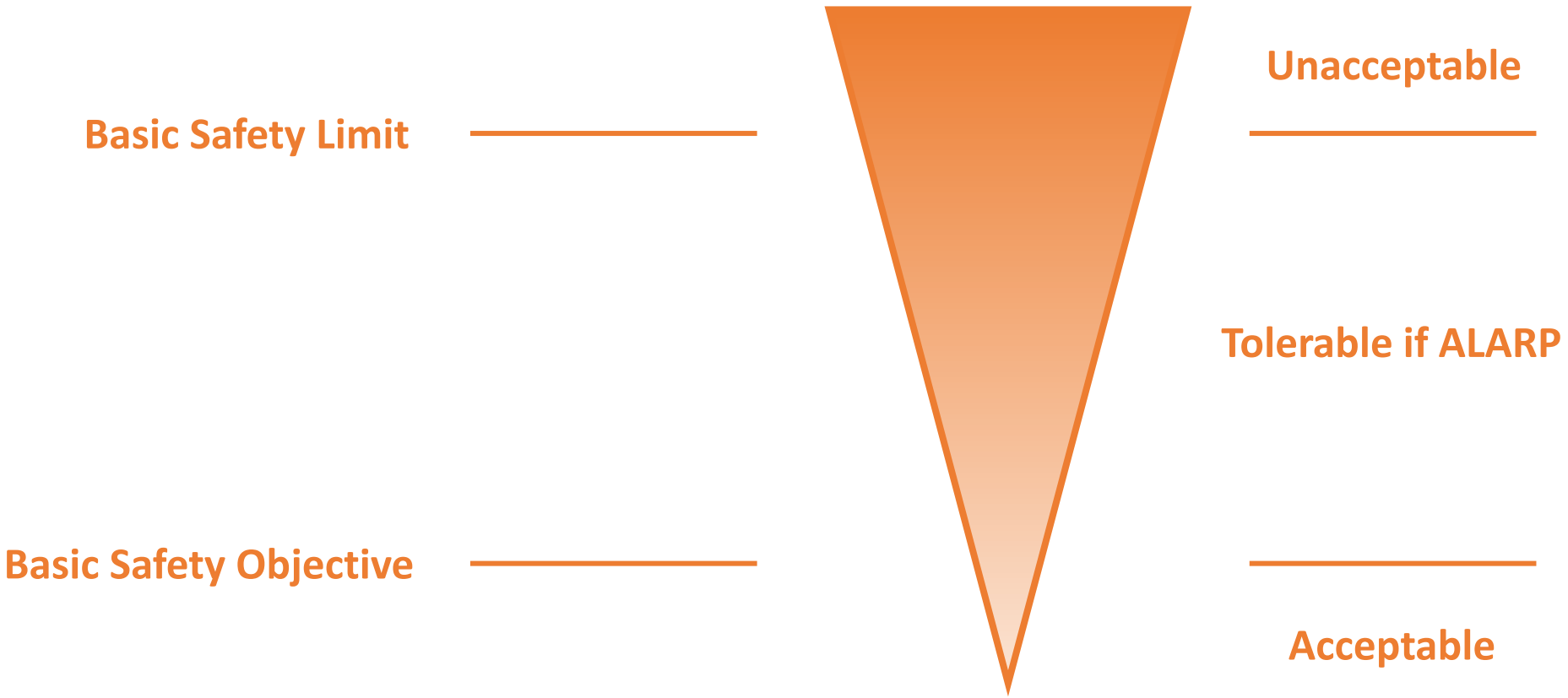


New Build - Regulatory Expectations

- Worker Doses below the Basic Safety Objective (1 mSv Normal Operations and 0.1 mSv under Fault Conditions).
- Public Doses below the Basic Safety Objective (0.02 mSv Normal Operations and 0.01 mSv under Fault Conditions)
- Remove dependency on Time at Risk Arguments.
- Passive Safety favoured over Active Safety.
- Removal of Human from System.
- Application of the Hierarchy of Controls (Not Built Yet!)

Optimisation or Minimisation?

New Build - Regulatory Expectations



Design of Radioactive Waste Effluent Treatment System

- New Build Facility was designed for storage / handling used fuel from a submarine. Fuel modules moved from submarine to facility in a Module Removal Container.
- A small quantity of water from the submarine core accompanied the fuel module to assist cooling during the journey (not a fundamental safety function due to low decay heat). This created the need to handle this contaminated water at the Facility.
- An effluent treatment system was designed to handle the water. Regulatory expectations led to a conservative approach namely minimal operator occupancy / exposure and the conservative source term activity in the water.
- This led to a very complex system with lots of control functions and safety measures to minimise the need for operator interaction / exposure, i.e. to minimise doses.
- Ultimately, the treatment system design was far too complex and the design was scrapped for a simpler one in which operator occupancy was expected and designed for.
- Overall significant expenditure on effort due to being overly conservative in the estimated doses with ALARP being over-zealously applied.

Fissile Material Processing Facility

Fissile movement control system

- Initially the focus was ensuring a robust system with no reliance on humans, i.e. minimising errors by removing people.
- Resulted in the system being defined a very low frequency target - 1E-5/year resulting in a high SIL rating / unachievable system which was ultimately scrapped.
- What was missed in the above project was the bigger picture - the need to move out of older, vulnerable facility to a new robust facility significantly improving safety - An ALARP solution.
- Instead the focus was making sure the facility was perfect for the future - bounding all potential outcomes which lead to complexity in the design and cost escalations etc.

Spent Fuel Dry Storage

- Divergence in the design of the Spent Fuel Dry Storage technology for 2 PWR Reactors in the UK.
- The new facility proposed a lower level of shielding at the top and bottom of the container noting the height of the store, and less restrictive site layout.
- The reduction in shielding was increase the dose rates at the bottom of the container by 250%, to 0.12 mSv/h. Predicted total dose increase from 12 microSv to 30 microSv.
- The regulator raised concerns about the future inclusion of non-fuel core components in these casks, and whether the building / shielding design needed to be revised.
- The argument was made that even if the dose rates doubled (to 0.24 mSv/h) this was only an increase of 30 microSv to operator dose which was <1% of the predicted collective dose for the whole Spent Fuel Store operations (at 3.86 man-mSv); as such it was tolerable and, due to the excessive cost of altering the design building, also ALARP.
- The regulator accepted this argument, under the condition that detailed design work would be conducted in future which would include NFCC.

Public Doses from Dry Spent Fuel Store

- As part of the design of the Dry Spent Fuel Store for a New Nuclear Build an assessment of the doses to the members of the public was required.
- The representative person was identified as a “Dog Walker” e.g. member of the public walking along the coastal footpath **each day of the year**, spending about **20 minutes** walking past the site boundary (122 hours per year) with the closest distance to the Spent Fuel Store Building being 40 m.
- The dose assessment estimated a conservative dose which is less than half of the BSO and is broadly acceptable.
- The regulator however has asked for further evidence that this is ALARP in the form of a detailed safety justification.

New Build Discussion Points

- Is the BSO set to low?
- What emphasis should be placed on lowering doses below the BSO?
- Are we focusing on the detail and missing the bigger ALARP / ALARA picture?
- Has “Optimisation” become “Minimisation”?
- Do we have a Radiation Safety Culture Issue?

Any

Questions?