SAFETY SERVICES ORGANISATION

SAFETY AND HAZARD ASSESSMENT MODULE

PRINCIPLES OF ALARP

ALARP – WHAT IS IT?

ALARP -

- As Low As Reasonably Practicable

The Secretary of State for Defence requires that the MOD:

> *'Minimise work-related fatalities, injuries, ill-health and adverse effects on the environment, and reduce health and safety risks so that they are as low as reasonably practicable (ALARP)'*

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SFAIRP -

- So Far As Is Reasonably Practicable

The Health and Safety at Work Act places a duty on every employer to:

'to reduce risks associated with their operations 'So Far As is Reasonably Practicable' (SFAIRP).'

ALARP – ALARP ≠ SFAIRP

SFAIRP -

- The term most often used in the Health and Safety at Work etc. Act and in Regulations
- What the courts will judge against
- Subjective.

ALARP -

- Term used by risk specialists, duty holders and HSE guidance
- The level to which HSE expect to see workplace risks controlled
- Requires Duty Holders to exercise judgement and is thus, also, subjective.

ALARP and SFAIRP both recognise that no activity is risk-free - the overriding principle is that any task, activity, trial, equipment etc must not be carried out or operated with risks that have not been formally assessed, justified, declared to be Tolerable and ALARP/SFAIRP with this judgement accepted by the relevant Duty Holder

ALARP – ALARP ≈ SFAIRP

The Health and Safety Executive (HSE) assess the terms SFAIRP and ALARP to *'mean essentially the same thing'* in that they *'call for the same set of tests to be applied'*. This is because both descriptions rely on the term:

'REASONABLY PRACTICABLE'

ALARP – A (BRIEF) HISTORY

"Those that fail to learn from history are doomed to repeat it"

Winston Churchill – House of Commons Speech - 1948

ALARP – A (BRIEF) HISTORY

Image source:
Getty Images
https://www.gettyimages.co.uk/detail/news-photo/front-row-from-left-lady-rachel-verney-british-liberal-news-photo/3398387?adppopup=true

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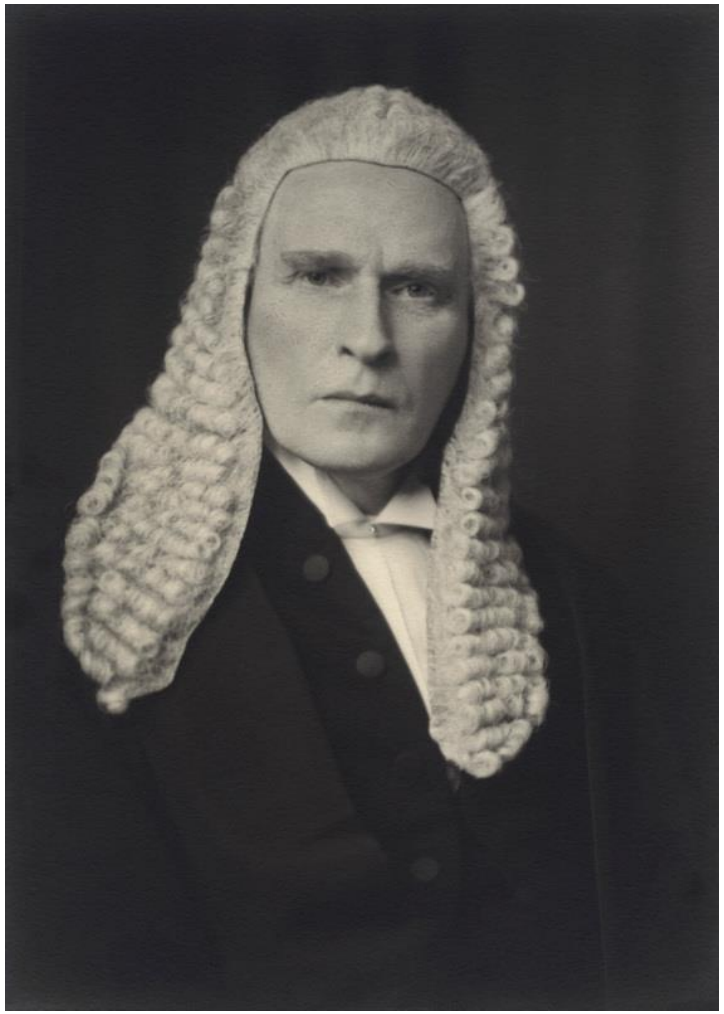

ALARP – A (BRIEF) HISTORY

Reasonably practicable is a narrower term than ‘physically possible’ and implies that a computation must be made... In which the quantum of risk is placed in one scale and the sacrifice involved in the measures necessary for averting the risk (whether in time, trouble or money) is placed in the other and that, if it be shown that there is a great disproportion between them – the risk being insignificant in relation to the sacrifice – the person upon whom the obligation is imposed discharges the onus which is upon him.

Lord Justice Cyril Asquith, Baron Asquith of Bishopstone - Edwards v National Coal Board - 1949

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Regardless of the term used, deciding whether a risk is ALARP (or SFAIRP) requires duty-holders to:

EXERCISE JUDGEMENT.

For the remainder of this lecture we will simply refer to ALARP.

ALARP – PRACTICALLY

ALARP - The cost (time, trouble, effort) of reducing the risk must be grossly disproportionate to the benefit gained from the risk reduction. The “cost” should not solely be based on budget.

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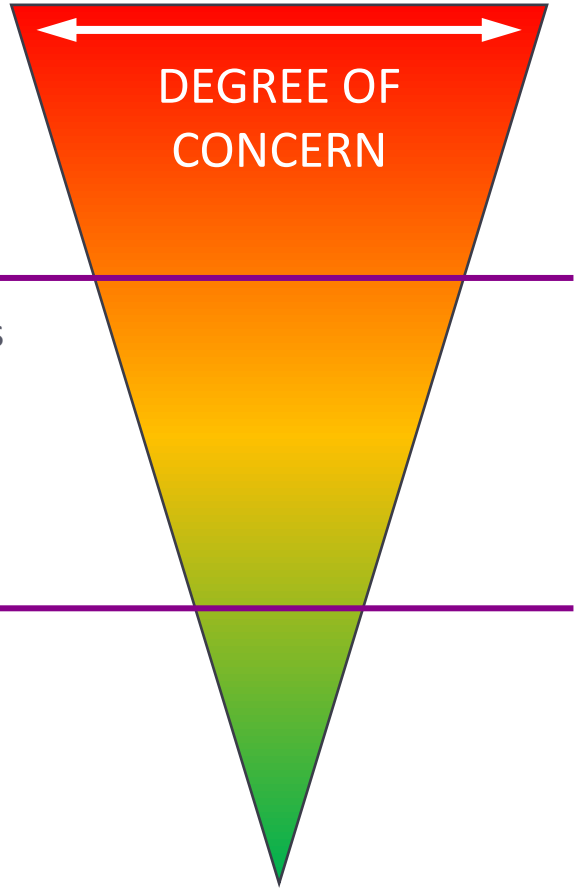
ALARP – PRACTICALLY

ALARP arguments generally scale based on risk tolerability (individual and societal).

UNACCEPTABLE REGION	Risk unacceptable regardless of associated benefits Activity to be ruled out or risk reduced to a lower category Activity or task can only be retained in exceptional circumstances
TOLERABLE REGION	Risk can be tolerated in order to secure the associated benefits Risk must be properly assessed and controlled so that the residual risk is kept ALARP Activity or task to reviewed periodically so ensure that it remains ALARP
BROADLY ACCEPTABLE REGION	Risk considered insignificant and well controlled Further risk reduction only required if reasonably practicable measure are available



ALARP – EXERCISE

IS RISK TOLERABILITY (IN TERMS OF SOCIETAL CONCERNS) THE SAME FOR ALL TYPES OF ACCIDENT?

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ALARP – SUMMARY SO FAR

A High risk isn't necessarily NOT ALARP.

A Low (or broadly acceptable risk) isn't necessarily ALARP.

'This is the way we have always done it without accidents' isn't necessarily ALARP.

ALARP is NOT just numbers with Cost Benefit Analysis (CBA).

ALARP – SUMMARY SO FAR

A High risk isn't necessarily NOT ALARP.

A Low (or broadly acceptable risk) isn't necessarily ALARP.

'This is the way we have always done it without accidents' isn't necessarily ALARP.

ALARP is NOT just numbers with Cost Benefit Analysis (CBA) – More on this shortly

ALARP is a JUDGEMENT made by the relevant Duty Holder, supported by suitable evidence and analysis.

ALARP is a legal requirement.

The environment & technology changes so what is ALARP today may not be tomorrow.

BREAK TIME

15 MINUTES FOR COFFEE

ALARP – ARGUMENT STRUCTURE

Identify the Risk/s

- Qualitative, Semi-quantitative, Quantitative?

Identify and Justify why we have to take the risk

Identify the Duty Holder

- Sufficient control of resources

Identify Existing Mitigation

- Includes all the un-documented controls

Identify all Relevant Legislation

- Ensure compliance

Identify all <u>Relevant</u> Recognized Good Practice

- Apply or strongly argue against

ALARP – ARGUMENT STRUCTURE

Consider Other Mitigation, Control Hierarchy Application (ERIC PD) etc.

Document what you are **NOT** going to and why.

Duty Holder decides.

ALARP – CBA AUGMENTATION

Cost Benefit Analysis (CBA) is a method of comparing risk mitigation options whereby all of the costs and benefits of enacting the mitigation are expressed in a common currency. This allows for direct comparison of costs against benefits and can aid a decision as to whether the costs are 'Grossly Disproportionate' to the benefits.

Note: cost in this case is not purely monetary, all 'costs' must be included; time, capability, effort etc. must also be included and simply shown as an equivalent monetary value to allow for comparison. The same goes for additional safety benefits resulting from a mitigation strategy. In short, it is necessary to take a holistic view when conducting CBA.

The CBA equation (given in a few slides) will give a threshold Grossly Disproportionate Cost (GDC). The actual costs of the implementation can then be compared against this value. If the actual costs are below the GDC then risk reduction should be implemented as the CBA indicates that the costs do not grossly outweigh the benefits.

ALARP – CBA AUGMENTATION - DEFINITIONS

Grossly Disproportionate -

- Used to determine what is Reasonably Practicable. An option can only be ruled out if it is determined that it is not reasonably practicable by virtue of the costs being grossly disproportionate to the risks. In practical terms this means that not only must the benefits outweigh the costs, they must outweigh them by a Grossly Disproportionate Factor (GDF). The GDF is dependant on risk, higher risks demand a higher GDF.

Sensitivity -

- Not covered in depth in this lecture. In crucial decisions when CBA is used as a key tool a full sensitivity analysis may be appropriate. Normally however, it is sufficient to consider any uncertainties and eliminate them by taking a pessimistic approach. This would normally involve overstating the costs and understating the benefits.

Annualization -

- Averaging out of costs and benefits over a year, achieved by summing all of the costs and benefits and dividing them by the length of time of the appraisal period in years. The appraisal period will vary depending on system under review. Annualization can allow better comparison of strategies with high implementation costs.

ALARP – CBA AUGMENTATION – EQUATION

$$Grossly\ Disproportionate\ Cost = P \times VPF \times GDF$$

Where

P	= Probability of accident under review
VPF	= Value of prevented fatality/injury/harm
GDF	= Grossly Disproportionate Factor

This is the simple version, useful for a single system over a single year – Assumes that the risk is totally removed.

ALARP – CBA AUGMENTATION – EQUATION 2

$$Grossly\ Disproportionate\ Cost = (N_{items} \times Y) \times P \times N_{Person} \times VPF \times GDF$$

Where

N_{items}	= Number of items/vehicles/buildings
Y	= Years of service remaining
P	= Probability of accident under review
N_{Person}	= Number of persons involved in accident under review
VPF	= Value of prevented fatality/injury/harm
GDF	= Grossly Disproportionate Factor

For multiple systems/vehicles/people/years – Assumes that the risk is totally removed still.

ALARP – CBA AUGMENTATION - VPF

Data source:
Health and Safety Executive
https://www.hse.gov.uk/managing/theory/alarpcheck.htm

INJURY TYPE	DESCRIPTOR	Values (VPF)
Fatality	Death	£1,336,800 (times 2 for cancer)
Permanent incapacitating injury	Moderate to severe pain for 1-4 weeks. Thereafter some pain gradually reducing but may recur when taking part in some activities. Some permanent restrictions to leisure and possibly some work activities.	£207,2000
Serious Injury	Slight to moderate pain for 2-7 days. Thereafter some pain/discomfort for several weeks. Some restrictions to work and/or leisure activities for several weeks/months. After 3-4 months return to normal health with no permanent disability.	£20,500
Slight Injury	Injury involving minor cuts and bruises with a quick and complete recovery.	£300
Permanent incapacitating illness	Same as for injury.	£193,100
Other cases of ill health	Over one week absence. No permanent health consequences.	£2,300 + £180 per day of absence
Minor	Up to one-week absence. No permanent health consequences.	£530

ALARP – CBA AUGMENTATION - GDF

INJURY TYPE	Gross Disproportionality Factor (GDF)
Fatality	10
Major Illness/Injury	5
Minor Illness/Injury	3

Note – These are example values, they are likely to vary between company and programme.

ALARP – CBA AUGMENTATION – EQUATION 3

$$Grossly\ Disproportionate\ Cost = VPF\ \times [(P_1\ \times\ GDF_1) - (P_2\ \times\ GDF_2)]$$

Where

VPF	= Value of prevented fatality/injury/harm
P_1	= Initial Probability of accident under review, per year
GDF_1	= Initial Grossly Disproportionate Factor
P_2	= Post Mitigation Probability of accident under review, per year
GDF_2	= Post Mitigation Grossly Disproportionate Factor

Finally, this equation allows the GDC of partly removing a hazard to be calculated

ALARP – CBA – HSE EXAMPLE

Data source:
Health and Safety Executive
https://www.hse.gov.uk/managing/theory/alarpcheck.htm

How much could 'Generic Explosives Company' reasonably spend to eliminate (reduce to zero) the risk of an explosion?

If the risk of explosion were to be eliminated the benefits can be assessed to be:

INJURY TYPE	NUMBER OF INJURIES	VPF	LIKELIHOOD	EXPECTED LIFE OF MITIGATION	TOTAL
Fatality	20	£1,336,800	$1X10^{-5}$	25 Years	£6684
Permanent Injury	40	£207,200	$1X10^{-5}$	25 Years	£2072
Serious Injury	100	£20,000	$1X10^{-5}$	25 Years	£500
Slight Injury	200	£300	$1X10^{-5}$	25 Years	£15
				TOTAL SPEND	£9,271

ALARP – CBA – HSE EXAMPLE 2

Data source:
Health and Safety Executive
https://www.hse.gov.uk/managing/theory/alarpcheck.htm

Therefore it might be reasonably practicable to spend up to somewhere in the region of £93,000 (£9300 x 10) to eliminate the risk of an explosion. The duty holder would have to justify use of a smaller GDF for injuries.

This type of simple analysis can be used to eliminate or include some measures by costing various alternative methods of eliminating or reducing risks.

ALARP – CBA – PRACTICAL EXAMPLE

How much should 'I am only asking for A Railing Inc.' reasonably spend to eliminate the risks below?

Assume the measure applied reduces the risk to zero:

INJURY TYPE	NUMBER OF INJURIES	VPF	LIKELIHOOD	GDF	EXPECTED LIFE OF MITIGATION	TOTAL
Fatality	5	£2,000,000	$6.85X10^{-5}$	10	10 Years	?
Permanent Injury	20	£250,000	$1.75X10^{-4}$	5	10 Years	?
Serious Injury	50	£20,000	$3.80X10^{-3}$	3	10 Years	?
Slight Injury	250	£300	$8.00X10^{-3}$	3	10 Years	?
					TOTAL SPEND	?

ALARP – CBA – PRACTICAL EXAMPLE

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Serious Injury	50	£20,000	$3.80X10^{-3}$	3	10 Years	?
Slight Injury	250	£300	$8.00X10^{-3}$	3	10 Years	?
					TOTAL SPEND	?

ALARP – CBA – PRACTICAL EXAMPLE

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Assume the measure applied reduces the risk to zero:

INJURY TYPE	NUMBER OF INJURIES	VPF	LIKELIHOOD	GDF	EXPECTED LIFE OF MITIGATION	TOTAL
Fatality	5	£2,000,000	$6.85X10^{-5}$	10	10 Years	£68,500
Permanent Injury	20	£250,000	$1.75X10^{-4}$	5	10 Years	£43,750
Serious Injury	50	£20,000	$3.80X10^{-3}$	3	10 Years	£144,000
Slight Injury	250	£300	$8.00X10^{-3}$	3	10 Years	£18,000
					TOTAL SPEND	£274,250

ALARP – CBA AUGMENTATION - SUMMARY

Cost Benefit Analysis (CBA) can be used to support an ALARP argument and / or consider alternative options, it cannot be the whole ALARP Case.

You must be able to clearly identify the harm and quantify the risk ($1x10^{-x}$)

- Individual (hypothetical person) and potentially societal risk.
- May include a lot of sensitivity analysis if uncertainty exists.
- You or your competent advisors can play the numbers if, subjectively, the risk isn't believed (confirmation bias – generating evidence to fit the hypothesis).
- 1e-x can seduce people into thinking there is more scientific rigor than actually exists.

You must decide what 'Grossly Disproportionate' means in your case, often know as the Disproportionality Factor (GDF), as well as Value of Preventing a Fatality (VPF).

- As the risk approaches intolerable the GDF is 'normally' taken as 10. (see HSE website).
- The GDF figure is open to debate as is the VPF depending on nature of hazard.

THANK YOU FOR LISTENING

ANY QUESTIONS?

SAFETY SERVICES ORGANISATION