



DE&S SAFETY AND ENVIRONMENTAL PROTECTION LEAFLET 02/2011

ALARP IN A MILITARY EQUIPMENT CAPABILITY CONTEXT

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INTRODUCTION

1. The Secretary of State for Defence requires the MOD to implement policy which aligns with statute by reducing safety risk 'so far as is reasonably practicable'. JSP 815 interprets this requirement to 'as low as reasonably practicable' (ALARP). This guidance clarifies existing MOD guidance on ALARP and assists those managing safety risk by providing a process for first achieving reduction of risk to ALARP, and subsequently progressively reducing any residual risk, ie maintaining risk at any moment in time to ALARP.

2. This Leaflet does not provide the definitive advice to undertaking risk assessment and analysis, which is contained within References A-H and the Project Oriented Safety Management

System's (POSMS's) SMP07 (Risk & ALARP Evaluation)¹ and SMP08 (Risk Reduction),² and domain-specific functional safety publications.

PRINCIPLES

3. The 'Health and Safety at Work etc Act' places a duty on every employer to reduce risks associated with their operations 'So Far As is Reasonably Practicable' (SFAIRP). The same principle applies within the MOD, but here the term ALARP is used.

4. ALARP recognizes that no activity is risk-free, and the burden of risk reduction must be weighed against the benefits and necessity of the activity being conducted. 'Reasonably Practicable' can be represented in a hierarchy of legal requirements. In order of precedence these standards are:

Absolute duty. The words 'shall' or 'shall not', used in statutory provisions, impose an absolute obligation to do, or not to do, the act in question.

Practicable. Where the obligation is qualified by the word 'practicable', the standard is stricter than 'reasonably practicable', the Duty Holder should do what is necessary to reduce the risk regardless of the cost (in time or money). The measures must be possible in the light of current knowledge and invention.

Reasonably Practicable. 'Reasonably practicable' is a lesser standard than 'practicable'. The Duty Holder must balance the risk against the sacrifice (whether in money, time or trouble) involved in taking the measures needed to avert the risk. If there is a gross disproportion between them, the risk being insignificant relative to the sacrifice, the Duty Holder is not required to take any further measures and so discharges the duty.

5. Determining that risks have been reduced to ALARP therefore involves an assessment of the **risk** to be avoided, of the **sacrifice** (in money, time, trouble and capability) involved in taking measures to avoid that risk, and a **comparison** of the two. This process can involve varying degrees of rigour that will depend on the nature of the hazard, the extent of the risk and the control measures to be adopted. In general, the greater the initial level of risk under consideration, the greater the degree of rigour required in demonstrating that those risks have been reduced to ALARP. Uniquely, in the military context, it may also be necessary for the ALARP assessment to take account of the operational imperative. This means a credible case for declaring a risk to be ALARP and Tolerable before all mitigation measures are implemented fully may be constructed to maintain essential capability, which would not be permissible if monetary cost was the only factor being considered in the ALARP assessment. Subsequent sections of this Leaflet define the circumstances when this approach may be adopted.

THE OVERRIDING PRINCIPLE IS THAT EQUIPMENT MUST NOT BE OPERATED WITH RISKS THAT HAVE NOT BEEN FORMALLY ASSESSED, JUSTIFIED AND DECLARED TO BE ALARP & TOLERABLE.

In this context, 'operation' means any activity that presents a safety risk across all stages of the CADMID/T cycle, including development, trials and disposal; it is not confined to operational use. In exceptional circumstances, Military Commanders retain the right to operate for very short periods outside the ALARP boundary in order to satisfy an immediate operational imperative.

1. <http://aof.uwh.diif.r.mil.uk/aofcontent/tactical/safety/downloads/asems/smp07.pdf>

2. <http://aof.uwh.diif.r.mil.uk/aofcontent/tactical/safety/downloads/asems/smp08-g-01.pdf>

ALARP & Tolerability Criteria

6 JSP 815 defines tolerability as ‘the willingness to live with a risk so as to secure certain benefits and in the confidence that it is being properly controlled. To tolerate risk means that it is not regarded as negligible or something that can be ignored, but something that must be kept under review and reduced still further if and when it can be. ‘Tolerable’ does not mean ‘acceptable’. For a risk to be ‘acceptable’ means that, for purposes of life or work, society is prepared to take the risk ‘as it is’ without further mitigation.

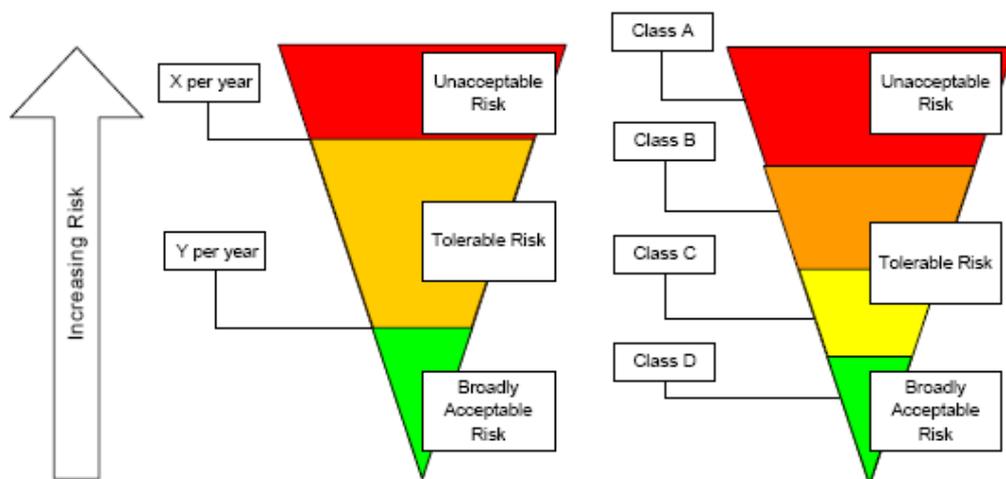
7. Tolerability criteria provide the means for categorizing risks as either ‘Unacceptable’, ‘Tolerable’ or ‘Broadly Acceptable’; distinct tolerability criteria may be agreed for different groups of people. For instance, one set of tolerability criteria might be defined for trained personnel who are involved directly with the equipment or system. Another, more stringent, set of tolerability criteria may be defined for people such as MOD employees, who are indirectly involved with the equipment or system during the course of their duties. A third set, more stringent still, may be defined for people who are independent third parties, such as the general public.

8. Whilst the Project Safety Committee (PSC) is responsible for setting tolerability criteria for their individual projects, criteria must always be set in conjunction with the Duty Holder as it can only be established when the range of threats (or at least the key risk drivers) presented to individuals or groups of individuals are known. This will ensure that the aggregated risk posed by a series of equipments, systems of platforms does not exceed the overall tolerability criteria, and prevent a single project inadvertently assuming the entire risk budget. Project Teams (PTs) should seek additional guidance on tolerability criteria for a particular domain, function or accident type from the domain specific JSP or regulation. Where specific tolerability criteria are not available, Health & Safety Executive (HSE) guidance in this area should be consulted. The tolerability criteria used for a project must be recorded in its Safety Management Plan or other relevant documentation.

9. The tolerability criteria should be devised such that the aggregated risk posed by the whole system can be assessed.

10. Fig 1 below illustrates the relationship between the Quantitative and Qualitative Tolerability Criteria, Risk Classification and ALARP. Note this is an example of an approach, and the tolerability limits will need to be derived through analysis on a case-by-case basis.

Fig. 1 Categories of Risk



11. The diagram on the left of Fig 1 uses quantitative boundaries to separate the categories of Unacceptable, Tolerable and Broadly Acceptable levels of risk. The boundaries could be set by project requirements, or by comparison with HSE statistics for accident rates in comparable industries.

12. The diagram on the right shows a four-category semi-quantitative risk classification scheme:

- a. Qualitative boundaries are used to define the corresponding boundaries of the semi-quantitative scheme (A/B and C/D in the example).
- b. Boundaries may be made more conservative if desired.
- c. Intermediate boundaries may also be set if further subdivisions are needed (B/C in the example). These could be used to show levels of risk that receive different treatments, eg different authority required for risk acceptance, or a different factor for demonstrating a grossly disproportionate cost.

PROCEDURES

13. The procedure illustrated in Annex A has been developed for use in MOD. The procedure can be applied to a wide range of scenarios and is consistent with current UK legislation, HSE guidance and MOD policy. The procedure identifies a series of steps to be taken as part of the decision process and provides guidance on how they are to be applied. The procedure takes account of the level of safety risk being managed describing the extent of evaluation and demonstration that should be applied. The following sections provide additional clarification.

Risk Evaluation

14. The objective of safety management is to reduce residual safety risks to a level that is tolerable and demonstrably ALARP. Evaluation of a safety risk is undertaken to determine whether that risk currently meets ALARP and Tolerability criteria, or identify future action to be taken. Evaluation is used to inform and underpin safety management decisions, or future action. The essential process is set out and explained in POSMS SMP07 (Risk & ALARP Evaluation).

15. The level of evaluation will depend on the level of safety risk being managed. Those risks determined as having significant consequences invariably require a higher degree and more robust evaluation to support justification of their acceptance than less significant risks.

Risk Evaluation Methods

16. The methods of evaluation can vary dependant on level of safety risk. For low-level risks this may range from: adoption of recognized good practice or standard through to compliance with a regulation. Where the circumstances are new or cannot be addressed in this way, then a joint decision would need to be made by subject matter experts through the PSC. For more significant risks the acceptance and ALARP justification need assessment and analysis of the options.

Factors to Consider in Evaluation of ALARP

17. **Gross Disproportion.** The concept of gross disproportion requires Duty Holders to weigh the sacrifice (money, time and trouble) involved in a proposed control measure against its risk reduction benefits. Specifically, a proposed control measure must be implemented if the sacrifice (or cost) is not grossly disproportionate to the benefit achieved by the measure. However, there is no authoritative guidance from the Law Courts as to what factors should be taken into account in determining whether cost is grossly disproportionate. The Duty Holder needs to take account of both the level of individual risk and the extent and severity of the consequences together with individual domain guidance and advice. For a given benefit, the higher these risks, the higher must be the ratio of costs to benefits before rejecting the proposal. Each proposal and judgement must be considered and made on a case-by-case basis.

18. **Cost Benefit Analysis (CBA).** CBA aids the decision-making process by giving monetary values to the costs and benefits and to enable a comparison of like qualities. The analysis can help make an informed choice between risk-reduction options; however, the CBA cannot form the sole argument of an ALARP decision, nor can it be used to justify not applying existing standards and good practice.

19. **Sensitivity Analysis.** A sensitivity analysis involves varying one or more of the assumptions used in the CBA to see how these variations affect the CBA outcomes. Duty Holders should conduct a sensitivity analysis, particularly if the CBA is being used to show that further measures are not reasonably practicable. When undertaking a CBA, Duty Holders are likely to have limited information about some of the key inputs such as the frequency of events and the number of potential fatalities. Sensitivity analysis is a way to deal with these uncertainties. A sensitivity analysis highlights whether suitably cautious assumptions have been made and allows the Duty Holder to assess the robustness of the outcomes of the CBA. The more robust the results of the CBA, the more suitable it is as a tool for ALARP decisions.

20. **Societal Concerns.** Societal concerns arise when the realization of a risk impacts on society as a whole. The impact may produce an adverse social-political response that results in a loss of confidence by society in the provisions and arrangements in place for protecting people and, consequently, a loss of trust in the Duty Holder's control of the particular hazard and hazards more generally. This might arise where large numbers of people are killed at one time (societal risk), where victims are particularly vulnerable (such as children) or where the nature of the risks inspire dread (such as long-term or irreversible effects). Although there is no guidance from the Law Courts as to whether societal concerns should be taken into account by Duty Holders in deciding what is grossly disproportionate, HSE believes that, in all cases, the judgement as to whether measures are grossly disproportionate should reflect societal concerns. This is because society has a greater aversion to an accident killing ten people than ten accidents killing one person each.

21. **Order of Precedence for Risk Reduction Strategies.** Guidance on potential risk reduction can be found in POSMS SMP08 (Risk Reduction).

ALARP in the Military Context

22. It has previously been stated that equipment or systems must not be operated with risks that have not formally been declared ALARP and Tolerable. This remains the cornerstone of DE&S ALARP policy. However, ALARP cannot be looked upon as a steady state; whilst traditional cost benefit analysis may demonstrate that a mitigation measure is *financially* practicable, this does not necessarily mean that a risk can only be declared ALARP once all mitigation is fully implemented. In the military context, the 'time and trouble' elements of the CBA include assessing the impacts that result from withdrawing the capability from service as this may itself have direct safety implications and increased overall risk. An example would be equipment that provides an essential layer of defence or capabilities that ensure the safety of vital operations. In such cases, Duty Holders must decide whether the resultant risk outweighs those associated with continued operation of the equipment. If the decision is taken to continue operating, the risk assessment must be reviewed to see what can be done to reduce risks today. Short-term or interim measures (either physical or procedural) that can maintain the ALARP status in the period when more permanent risk reduction measures are being designed, tested and implemented must be identified and adopted until the engineered solution is finally implemented. Such decisions require a series of factors to be addressed before the ALARP declaration is made:

- A fully costed programme for introducing the engineered solution as soon as reasonably practicable must be implemented. Failure to achieve stated timescales, in particular for financial reasons, will invalidate the ALARP status.

- In lieu of the engineered solution, all interim mitigation measures must be investigated and implemented where practicable.
- The decision to operate prior to full implementation of the engineered solution must be based on a closely defined operational imperative. Exclusions (for example, non-operational use) must be explicitly clearly stated.
- Changes to the operational imperative will require the ALARP status to be revalidated.
- Where the level of residual risk remains unacceptable, the decision to tolerate it must be endorsed at the appropriate level using the DE&S Risk Referral Process³ and/or associated Duty Holder processes.
- Once implemented, interim mitigation must be subject to continual review to ensure/validate its effectiveness. If there are any changes in situation or any doubt in the effectiveness of control measures, further risk analysis must be carried out.
- All mitigation options must be entered into the equipment or system Hazard Log and associated documentation including the Safety Case and Safety Management Plan.

Example

An 'unacceptable' risk has been identified in a military system. The (operational) benefits of maintaining the system in service are such that elimination of the hazard (at the top of the hierarchy of controls as defined within POSMS SMP08 (Risk Reduction)) is not feasible, but other reasonably practicable controls and mitigations have been identified and assessed (using good practice and/or cost benefit analysis) as 'reasonably practicable'. The PT has two options, namely:

Option 1 - An engineering control involving a modification of the system; however, this will take considerable time to design, test and implement.

Option 2 - An interim control, whilst lower in the hierarchy of control, can be implemented swiftly.

Both options bring the risk down: Option 1 into the 'broadly acceptable' range and Option 2 into the 'tolerable' range.

*As Option 1 will take time to implement, Option 2 can be put in place as an immediate control measure to enable continued use of the system **as long as it reduces the risk to the 'tolerable' region AND the Operating Authority Duty Holder, usually via the PSC, has agreed to manage the risk.***

*Option 2 can be declared ALARP (with the appropriate justification statement and after addressing the issues outlined in Para 22 above) at point of implementation, **with the caveat** that Option 1 must be implemented as soon as reasonably practicable through a fully-funded and approved plan in order to further reduce the residual risk. **Option 1 must not be abandoned or delayed purely for financial reasons.***

Once implemented, Option 2 must be subject to continual review to ensure/validate its effectiveness. If there is any doubt in the effectiveness of control measures, further risk analysis must be carried out.

3. http://aof.uwh.diif.r.mil.uk/aofcontent/tactical/safety/downloads/asems/sep_leaflet_03_2011.pdf

Both options must be entered into the equipment or system Hazard Log and associated documentation including the Safety Case and Safety Management Plan; and recognizing in all of this work that risk assessment is a thinking process, a means to an end and not an end in itself.

Addition Factors to Consider

23. **Referral of Risk Decisions.** There may be a point during the risk analysis process that the residual risk, although considered ALARP, is unacceptable or the risk can only be controlled to a tolerable state by operational or procedural constraints. If this occurs, the decision to accept the risk (or not) must be formally referred through the appropriate chain of command using the DE&S Risk Referral Process, either through DE&S or the Operating Authority, depending on who the Duty Holder of that risk is. An individual PT Leader or project manager can only make decisions about the acceptance and management of safety within the limits of the delegation held and the agreed levels of the tolerability of risk and safety requirements of the project, being procured or managed. If it is not possible within the resources allocated, then if the capability is still required the decision on the acceptance of risk needs to be escalated to a level of authority able to either accept or reject the risk

24. **Recording Decisions.** Resulting decisions must be maintained via robust and accurate records which are then entered into the appropriate documentation including the Safety Case, Hazard Log, Operating Manuals, etc. It is essential that engineering judgements and thinking are recorded adequately to enable an auditable trail of risk management decisions, review of change proposals and investigation of incidents.

25. **Managing Safety Risks.** Having properly identified a safety risk and put in place, and justified, suitable mitigations and controls, the task is then to ensure that the measures taken are providing the performance expected. As with evaluation and justification, the response to monitoring performance needs to be proportional to the level of risk.

Maintaining the ALARP Status

26. Whenever a system has the potential to harm personnel, the risks must be reduced to ALARP. However what is 'reasonably practicable', based on suitable and sufficient good practice and/or CBA, will change throughout the project lifecycle.

27. Once the system has reached 'ALARP status' it must be continually reviewed. Any changes to the system or the way it is used may add or change the hazards or level of risk involved. Incidents or accidents may reveal new hazards or new technologies may present new methods of risk reduction.

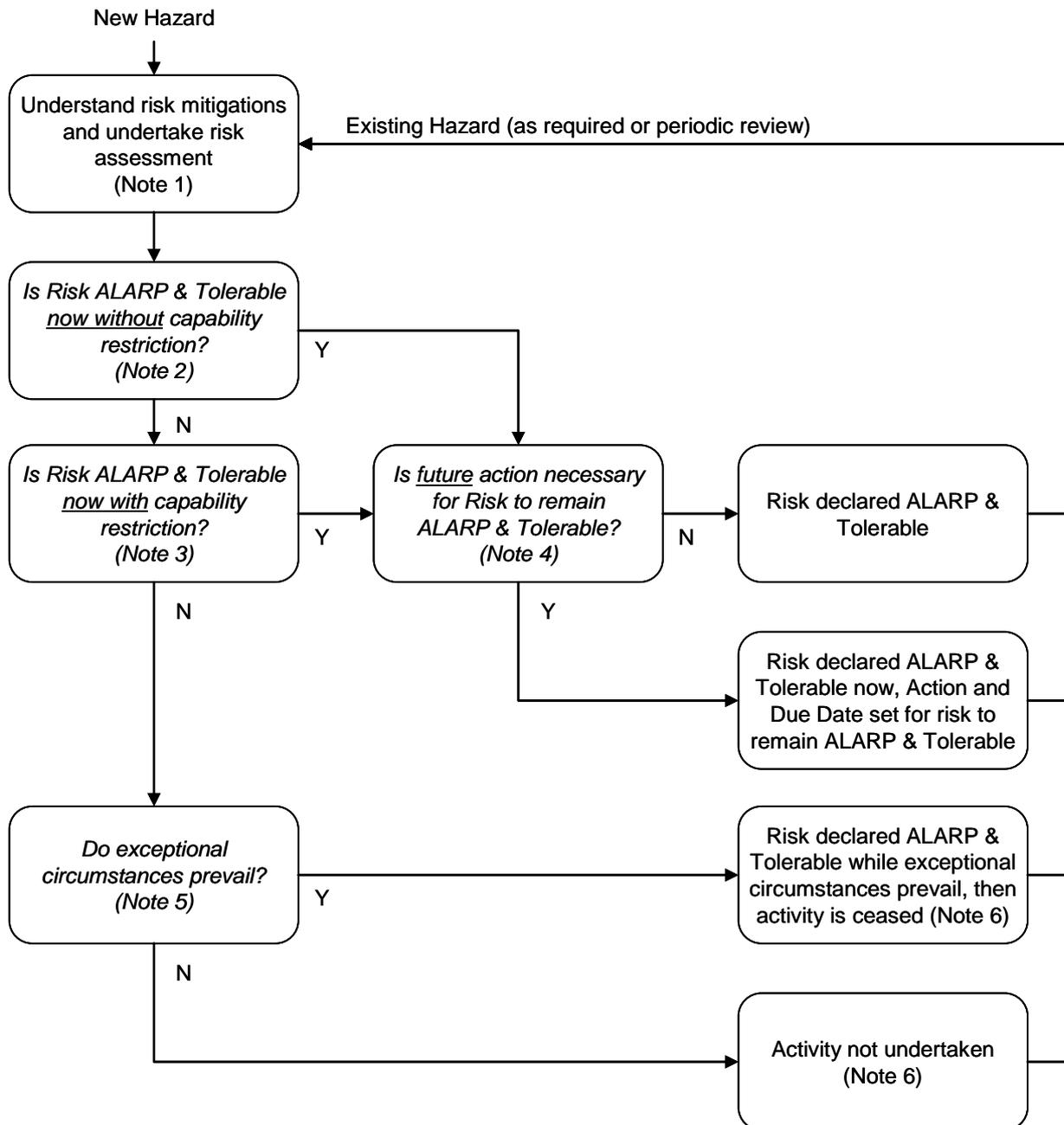
28. If new information becomes available that, after suitable analysis, is found to provide practicable risk reduction, it does not necessarily mean that the existing risk is no longer ALARP, but it does mean that the new risk reduction method needs to be implemented as soon as is reasonably practicable. This decision must be based on comparison of the sacrifice required to implement the mitigation and the risk being held. At any point in time there must be the ability to demonstrate that all that is reasonably practicable to be done has been done and that the overall level of residual risk is tolerable or better. This may mean putting in place controls or limitations in the short term, until the longer-term solutions can be developed or rolled out.

Annex:

A. ALARP & Tolerability Pan-Domain Process

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ALARP & TOLERABILITY PAN-DOMAIN PROCESS



Notes:

- 1 Level of analysis and technique adopted to be proportionate to the level of risk. Risk mitigations should be considered firstly by elimination or reduction through design, secondly through procedures, restrictions or limitations.
- 2 Operating Duty Holder to be informed/involved as appropriate. Additional procedures may be required for risk to be ALARP & Tolerable.
- 3 Operating Duty Holder to be involved. Additional restrictions or limitations may be required for risk to be ALARP & Tolerable.
- 4 Future changes in legislation, regulation or standards, or opportunities such as technological advances that enable safety improvements to be made, may invalidate current Tolerable and ALARP status.
- 5 Operating Duty Holder to lead. Exceptional circumstances are where failure to conduct an activity presents a greater risk to safety or national security than ceasing the activity. Begin investigation of potential safety improvements.
- 6 Activity is that associated with the hazard under consideration. Investigate and implement options as soon as possible to establish risk as ALARP & Tolerable and permit activity.