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Pitfalls in risk assessment: examples from the UK

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Abstract

Risk assessment is an implicit requirement of the UK Health and Safety at Work etc. Act (HSW, 1974) and is also explicitly required by other general and industry-specific regulations. A suitable and sufficient risk assessment, with effective use made of the findings, is seen as an integral part of successful health and safety management. However, there are a number of common mistakes or 'pitfalls' that are often made or encountered when carrying out a risk assessment. This paper sets out to illustrate some of the most commonly encountered pitfalls through a series of case studies taken from a range of UK industry sectors. A discussion of good practice is also presented in each case.
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1. Introduction

Sections 2(1) and 3(1) of the Health and Safety at Work etc. Act (HSW, 1974) place a general duty on every employer to conduct their undertaking in such a way as to ensure, so far as is reasonably practicable (SFAIRP), that both employees and persons not in their employment who may be affected thereby are not exposed to risks to their health or safety. HSW (1974), therefore, includes an implicit requirement for risk assessment. A number of other regulations, both general and industry sector specific, include explicit requirements for risk assessment.

The Management of Health and Safety at Work Regulations 1999 (MHSWR, 1999) include the general requirement for all employers to assess the risks to employees and any others who may be affected by their undertaking, to enable them to identify measures necessary to comply with their duties under health and safety

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law. Examples of industry sector specific legislation that includes explicit requirements for risk assessment are: Control of Substances Hazardous to Health Regulations 1999 (COSHH, 1999); Offshore (Safety Case) Regulations 1992 (OSC, 1998); Control of Major Accident Hazard Regulations 1999 (COMAH, 1999), Railways (Safety Case) Regulations 2000 (HSE, 2001a), and Nuclear Site Licensing arrangements (HSE, 1992).

Risk assessment is, therefore, recognised as an integral part of successful health and safety management. The effective management of health and safety will depend, amongst other things, on suitable and sufficient risk assessments being carried out and on the findings being used effectively. A number of pitfalls are, however, commonly encountered by industry when carrying out risk assessments. Simpson (1996) outlines common problems and misunderstandings raised by risk assessment practitioners, and Beale (2001) identifies five common pitfalls that can undermine the usefulness of the risk assessment approach.

The aim of this paper is to illustrate commonly seen pitfalls in industry risk assessments through a series of case study examples, so that the pitfalls can be understood and more readily avoided in the future. This paper is concerned only with the assessment and control of risks to people's health and safety arising from work activities (for example, the assessment of risks to the environment or of health and safety risks arising from non work-related activities are not within scope).

2. The risk assessment process

The purpose of carrying out a risk assessment is to determine whether the level of risk arising from workplace activities is acceptable, or whether more needs to be done to control or reduce the risk. Risk assessment involves both an estimation of the magnitude of the risk (i.e. how big is it?) and an evaluation of the significance of the risk (i.e. is it acceptable?). The process of risk assessment should be carried out in a rational, logical and structured manner.

The findings from a risk assessment can be used to inform decisions as to whether any existing precautions or control measures are adequate, or whether additional prevention or control measures are needed. Risk assessment can also be used to perform a systematic comparison of different risk control/reduction options so that the optimal decision can be made.

The process of using risk assessment to inform decisions relating to the control and reduction of workplace risks can be conveniently divided into three stages:

- Preparing for the assessment;
- Carrying out the assessment;
- Post-assessment activities.

In practice, the distinctions between the three stages outlined are not clear cut, but this division provides a useful framework for outlining the guiding principles and factors that should be considered throughout the process.

In preparing for the assessment, the following factors should be considered:

- What is the appropriate scope for the assessment?
- What is an appropriate approach, and what level of detail is needed?
- Who is going to be involved?

In carrying out the assessment, the basic steps to be followed are:

- Identify the hazards;
- Identify the possible consequences;
- Estimate the likelihood of the possible consequences;
- Estimate the risk;
- Evaluate the risk;
- Record the findings.

The order presented for the identification of possible consequences and estimation of their likelihood is not intended to be prescriptive; these steps can be completed in either order, or simultaneously, but both are needed in order to estimate the risk.

In carrying out the risk assessment it is also very important to:

- Ensure transparency throughout;
- Ensure appropriate and adequate consideration of human factors;
- Ensure adequate handling of uncertainty.

Once the assessment has been completed, it is essential that appropriate action is taken. It is essential that:

- The findings are acted upon;
- There is a system for regular review of the assessment.

Pitfalls are commonly encountered at each stage of the risk assessment process. Case study examples of pitfalls in industry risk assessments have been identified by collating experience from the Health & Safety Executive (HSE) operating divisions and from the Health & Safety Laboratory's own experience from carrying out support and research work for HSE. The case studies were chosen by HSL and HSE experts, after subjectively examining the most commonly occurring types of pitfall Details of the identified pitfalls are given in Section 3, accompanied by a selection of illustrative case study examples. Further case study examples and an outline of good practice in the use of risk assessment are given in Gadd et al. (2003).

3. ALARP and TOR discussion

Once an estimate of the risk from a particular situation or task has been made, consideration then needs to given to the level of this risk and whether it is acceptable

or whether more needs to be done to control or reduce it. The Health and Safety at Work act (1974) effectively defines the legally acceptable level of risk in any situation.

HSE considers that the general duty on employers to reduce risks *so far as is reasonably practicable* (SFAIRP) will be achieved if risks are reduced *as low as reasonably practicable* (ALARP). It also considers that duties to ensure health and safety SFAIRP and duties to reduce risk ALARP call for the same set of tests to be applied (HSE, 2002a).

Reducing risks ALARP means that if it is reasonably practicable to implement a risk reduction measure, it must be implemented. Duty holders should consider what more could be done to reduce a risk and why it is not being done, i.e. whether or not it is reasonably practicable to implement any possible additional measures that are identified.

In determining whether the implementation of additional risk reduction measures are reasonably practicable or not, relevant case law has determined that an assessment should be made of the risks to be avoided, and of the sacrifice (in terms of money, time and effort) involved in taking measures to avoid that risk. A comparison should be made of the two and the test of gross disproportion applied (HSE, 2002a,b). For a measure not to be implemented, the disproportion between the cost and benefits must be gross (HSE, 2002a,b).

The ALARP principle is embodied in the HSE's Tolerability of Risk (TOR) framework (HSE, 2001b). This is illustrated in Fig. 1. The TOR triangle includes three zones or regions, in which different approaches to evaluating risk and reaching decisions as to whether or not it is reasonable practicable to implement additional risk reduction measures are appropriate.

The TOR triangle reflects increasing levels of individual risk and societal concerns for a particular activity with the increasing scale from the bottom to the top.

The zone between the unacceptable and broadly acceptable regions is the tolerable region. Risk in this region are typical of those people are prepared to tolerate in order to secure certain benefits. Within this region risks must be ALARP and the

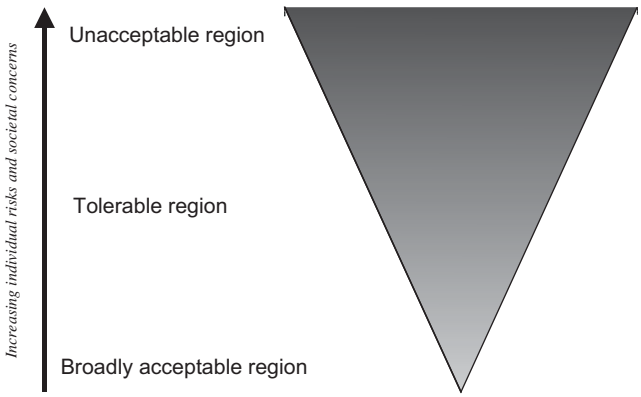

Fig. 1. HSE Framework for the tolerability of risk (HSE, 2001b).

greater the level of risk (i.e. the further up the TOR triangle the risk is situated) the greater the level of detail that is needed in arguments to demonstrate this (HSE, 2001b).

4. Identified pitfalls and illustrative case study examples

Case studies taken from UK industry were examined to identify some of the most commonly encountered pitfalls. An outline of good practice is presented with each pitfall and a selection of illustrative case study examples is also included. The identified pitfalls were as follows:

4.1. Carrying out a risk assessment to support a decision that has already been made

The findings from a risk assessment can be used to inform decisions as to whether any existing precautions or control measures are adequate, or whether additional prevention or control measures are needed. Risk assessment can also be used to perform a systematic comparison of different risk control/reduction options so that the optimal decision can be made. It is not appropriate to carry out a risk assessment to attempt to justify a decision that has already been made.

Case study 1: '*Carrying out a risk assessment to support a decision that has already been made*'

Projectiles were being thrown from the doors and windows of trains crossing a viaduct, aimed at a car showroom. Twenty-eight projectiles were known to have been thrown in 30 months including a headrest, seat and stones. HSE viewed this as an obvious and serious risk of death or injury to members of the public and served an Improvement Notice on the rail operator to erect a fence at an approximate cost of £100k. The duty holders subsequently employed consultants to carry out a Quantified Risk Assessment (QRA), which included a cost benefit analysis (CBA), to attempt to show that the cost involved was grossly disproportionate to the improvement in risk.

Pitfall—The QRA was used to attempt to justify a decision that had already been made, i.e. doing nothing, rather than doing a risk assessment in advance to inform the decision making process.

4.2. Using a generic assessment when a site-specific assessment is needed

An approach that is commonly taken to assessing workplace risks, where there are similar activities and hazards across different work activities, areas of the workplace, or at different sites owned by the same company is to carry out a generic risk assessment, considering all common hazards in a single assessment. For any

particular work activity, area of the workplace, or site it is necessary to consider whether all hazards are included in the generic assessment, and also whether the circumstances are such that the generic assessment is valid, even if it has considered the appropriate hazards. It is probably most useful to use generic risk assessments as the starting point for site-specific assessments, and consider in a systematic way whether there are any additional hazards, or significant differences in the specific situation that require any additions or modifications to the generic assessment.

4.3. Carrying out a detailed quantified risk assessment without first considering whether any relevant good practice was applicable, or when relevant good practice exists

HSE starts with the expectation that controls in place must, at a minimum, achieve the standards of relevant good practice precautions, irrespective of specific risk estimates (HSE, 2001b). Relevant good practice provides duty holders with generic advice for controlling the risk from a hazard. In so far as they can adopt relevant good practice, duty holders are relieved of the need (but not the legal duty) to take explicit account of individual risk, costs, technical feasibility and the acceptability of the residual risk, since these will all have been considered when the good practice was established (HSE, 2002a). In practice, if relevant good practice exists and is adopted for all workplace hazards, explicit evaluations of risk rarely need to be made in relation to day-to-day hazards; in these situations the risk assessment duty can be said to be discharged by the appropriate adoption of relevant good practice.

4.4. Carrying out a risk assessment using inappropriate good practice

It is important that the good practice adopted must be appropriate to the activity considered, relevant to the risks from the undertaking and cover all the risks from that undertaking (HSE, 2002a). The good practice must also be up to date, i.e. the guidance should reflect the current situation.

4.5. Making decisions on the basis of individual risk estimates when societal risk is the appropriate measure

There are two commonly used types of risk measure: individual risk measures and societal risk measures. Individual risk is defined as the frequency at which an individual may be expected to sustain a given level of harm from the realisation of specified hazards (IChemE, 1985). Societal risk is defined as the relationship between frequency and the number of people suffering from a specified level of harm in a given population from the realisation of specified hazards (IChemE, 1985).

Individual and societal risks are different presentations of the same underlying combinations of incident frequency and consequences (AIChemE, 1989). Individual risk is a measure of the risk to a particular individual, while societal risk on the other hand is a measure of the risk to society as a whole.

In deciding whether it is appropriate to consider individual or societal risk, or both, it is important to consider the number of people that could be affected at the same time, from realisation of the hazards considered. If the hazards being considered have the potential to affect only individuals, or a few people at the same time, it would be appropriate to only consider individual risk. However, if the hazards being considered have the potential to affect a large number of people at the same time, it would also be necessary to consider societal risk, even if the individual risk was estimated to be low.

Case study 2: '*Making decisions on the basis of individual risk estimates when societal risk is the appropriate measure*'

A safety case for a new rail terminus was presented to HSE. The safety case encompassed all aspects of the operation of the terminal and considered risks to employees, passengers and members of the public. The risk assessment considered individual risk to workers, which is acceptable, but then used similar methodologies to consider risks to the public and passengers. For example, risks from fire/evacuation/overcrowding were calculated as individual risk and not societal risk. It was then argued that because a regular traveller will not be spending long (when calculated on a yearly basis) in the terminal, the risk could be considered negligible.

Pitfall—Societal risks must be determined when there is the potential for harm to large numbers of people. These risks may not be negligible due to the large numbers of people who may be exposed, even when each individual has minimal exposure.

4.6. Only considering the risk from one activity

When considering the risk a worker is exposed to it is important to consider all the tasks that they undertake. It is not appropriate to only consider the risk from what appears to be the most hazardous activity. All the hazards to which a worker is exposed must be taken into account when estimating the overall individual risk. It is also appropriate to take account of the overall exposure time of the worker, for example to estimate the risk over a typical working week.

Case study 3: '*Only considering the risk from one activity*'

A large item of gas fired plant was fitted with an enclosure. Occasionally access by personnel was necessary for maintenance purposes. Should a leak of gas occur during the maintenance procedure and ignite, there would be a high likelihood of death or serious injury to the personnel. Data were available on

the frequency of leaks from pipework and the probability of ignition. This showed the likelihood of this happening coincidentally with the presence of the personnel to be acceptably low compared to published tolerability criteria.

Pitfall—This was a worthless comparison because the personnel may have been at similar risk through other tasks carried out during their working day/week/year and it is the total risk from all the activities that a person carries out that should be compared with the criteria.

4.7. Dividing the time spent on the hazardous activity between several individuals—the 'salami slicing' approach to risk estimation

When considering the risk from a particular activity, situation or process to which individuals are exposed for only a short time, care is needed to ensure that an accurate picture of the risk is obtained. It is not appropriate to divide the time spent on the hazardous activity between several individuals and estimate the risk on this basis (the 'salami slicing' technique). For example, if any one person is only exposed to the hazard for a short time, but someone is always exposed, it would give a misleading picture of the risk to estimate the risk from this hazard by taking into account the exposure time of each individual. Instead, a truer picture of the risk would be obtained by constructing a hypothetical person. A hypothetical person is a description of a person who is in some fixed relation to the hazard, e.g. the person most exposed, or the person living at some fixed distance (HSE, 2001b). In this case it would be necessary to define precisely the hypothetical person's location/interaction with respect to the hazard. The hypothetical person will be exposed to the hazard 100% of the time, or for the proportion of time that any individual is exposed.

Case study 4: 'Incorrectly defining the appropriate hypothetical person—the 'salami slicing' approach to risk estimation'

An operator, when carrying out a risk assessment for a safety case, was considering the risks associated with a particularly 'high risk' activity. A hypothetical worker was defined as one who works 40 h per week but only spends a proportion of their time working on the high risk task thus reducing their overall individual risk. However, when the first worker stops performing the high risk task, they are replaced by a second worker. In the extreme, there may always be someone performing the task, just not the same person.

Pitfall—The employer is confusing the individual risk of a specific person with the risk to anyone performing the high risk activity. The hypothetical person defined (when considering the high risk activity) should represent the worst case for occupancy of the task. That is, if the task is performed contin-

uously by a team of workers in rotation, then the individual risk should be calculated on the basis of 100% exposure rather than the fraction of time any one of the team is performing the task.

4.8. Not involving a team of people in the assessment or not including employees with practical knowledge of the process/activity being assessed

The individuals or working group involved in the risk assessment process should be familiar with the assessment methods used, have a thorough knowledge of the subject under consideration and other necessary specialised knowledge should be provided and integrated into the assessment as required (BS 8444, 1996). That is, all those involved in the risk assessment process should be competent to undertake the task.

4.9. Ineffective use of consultants

The use of consultants to carry out risk assessments should be treated with caution. Over-reliance on consultants (whether external or internal to the company) can mean that those responsible for the activity lose some of the value of the risk assessment process, as their own understanding of the issues is not developed to the same depth. In addition, a risk assessment that is unrealistic or with inappropriate conclusions can be produced if the process is not managed to ensure that the consultants have adequate knowledge of the process/operation, and work closely with those responsible for the activity. Where consultants are utilised, the process should be well managed by the company to ensure that the consultants work closely with the company to avoid such problems.

4.10. Failure to identify all hazards associated with a particular activity

Hazards associated with work activities can be present as a result of any one or a combination of the following: substances, machinery/processes, work organisation, tasks, procedures and the people and circumstances in which the activities take place including the physical aspects of the plant and/or premises. It is important that all these different elements are addressed to ensure that the hazard identification process is as thorough as possible. As well as identifying the 'intrinsic hazards' in the workplace, the hazard identification process also involves the identification of all possible routes to failure, i.e. identification of the various mechanisms by which the hazards could be realised.

Case study 5: '*Failure to identify all relevant modes of operation*'

During the hazard identification stage of a risk assessment, to identify faults that can occur during operation, the duty-holder did not include all operational

states. In particular, a transient state, which involved reducing the cooling to the vessel such that some of the temperature alarm settings were exceeded, was not considered. This was important, as it required a different approach to control for this stage of plant operations. It is particularly important to include all operational states, that require different control requirements, when identifying faults. In this case, the choice between performing cool down with a standing alarm or changing the alarm setting, both of which raise issues of safety management, was not subject to proper assessment, being left to local plant management to decide; nor was the possibility of alternative protection considered.

Pitfall—There are often transient states, such as start-up and shut down of plant, which in varying ways can mean that safety measures used in normal operations are not available or have to be changed. By omitting these states, the risks during them are not assessed and may become dominant.

Case study 6: 'Failure to identify all hazards associated with a particular activity'

An employee was undertaking maintenance work, which involved the use of high pressure water jetting equipment whilst suspended by ropes. He slipped causing the water jet to come into contact with his body resulting in a deep cut. Prior to the maintenance work beginning, a risk assessment had been undertaken which identified hazards associated with both high pressure water and working at height. Consequently the team of workers was made aware of procedures for both rope access operations and water jetting before commencing work. The subsequent investigation found that the duty-holder had not carried out a suitable and sufficient risk assessment. They had not identified the additional hazards associated with the use of rope access techniques in conjunction with high pressure water jetting and consequently had not identified any appropriate risk reduction measures, e.g. consideration of alternative access techniques or provision of adequate personal protective equipment.

Pitfall—The pitfall in this example was failure to properly analyse the operations being carried out, as a result of which all associated hazards were not identified.

4.11. Failure to fully consider all possible outcomes

Once the hazards have been identified, the possible consequences of the realisation of the hazards must be considered, that is, an assessment of who might be harmed, and of the effects and severity of the harm caused. This involves the estimation of both the magnitude of the physical effects arising from realisation of each hazardous

event and the estimation of the severity of the harm caused to all those who may be affected (within the scope of the risk assessment). When considering the action of persons and systems following the occurrence of an initiating event, it is necessary to ensure that the whole range of possible behaviour with respect to time is considered. In addition, when considering events with more than one outcome, it is necessary to adopt cautious assumptions for each outcome.

4.12. Inappropriate use of data

If a quantitative or semi quantitative risk assessment is being carried out, then estimates of the hazardous event likelihoods are usually derived in a quantified manner. This is based on use of some or all of the following: analysis of historical data, expert judgment and analytical modelling techniques. For many rigorous QRAs, full quantification of fault and event trees is required. Therefore, it is vital that appropriate data sets are used to inform the risk assessment.

Case study 7: '*Inappropriate use of generic failure data*'

Using generic failure data for large items of plant rather than carrying out a detailed analysis can lead to failure to recognise the importance of specific parts of the system. It is common practice to do this, for example, for cranes where an overall frequency is applied for dropping loads. There are several protective systems which can be used to reduce the likelihood of this happening and if a generic approach is used without first checking that the particular crane has the same systems as those on which the generic data are based, a crane which is not adequate may appear to be so.

Pitfall—This is a particular example of the dangers of using generic data rather than specific data. Reliability and failure data are often quoted with insufficient information regarding the environment in which the system is used, the maintenance required and the type of operation carried out. This can lead to significant errors if the data are used without due consideration.

Case study 8: '*Inappropriate use of historical data*'

A company employed workers who carried out tasks on top of stacked containers on board ships at heights of 15 m or more. The company argued against the routine use of safety harnesses or guardrails on the basis that the risk of falling was negligible, the time spent at the edge of the containers was short, and that use of the safety equipment reduced productivity. They also tried to show, via a QRA and CBA, that implementation of additional control measures would be grossly disproportionate to the reduction in risk. However, they assumed that because no accident had occurred in recent history (the last 10 years)

the risk was effectively zero. In addition they also failed to recognise that it was UK industry practice to protect workers at heights.

Pitfall—Accident statistics based on limited sample exposures must be used with care and established statistical techniques for deriving the likelihood of an event need to be used. Such techniques, in this case, showed that the risk was not negligible and, therefore, the company needed to put additional reasonably practicable measures in place to control the risk.

4.13. Inappropriate definition of a representative sample of events

An useful approach in estimating risk that is often employed in more extensive analyses (e.g. typically in semi-quantitative or detailed quantitative assessments where the number of possible sequences of events can become very large and unmanageable) is to carry out the assessment using a representative sample of events. Rather than analysing the whole system explicitly, a discrete set of scenarios is selected to represent the whole. Care must be taken if such an approach is adopted to ensure that the chosen set of scenarios is truly representative of the whole system.

4.14. Inappropriate use of risk criteria

HSE has established indicative numerical individual risk criteria (applicable to estimates of the total risk from an activity) for the boundaries between the unacceptable, tolerable and broadly acceptable regions of the Tolerability of Risk (TOR) framework. These criteria, and the assumptions underlying their derivation are given in HSE (2001b). Developing criteria on the tolerability of risks giving rise to societal concerns has proved more difficult, but the criteria that have currently been adopted by HSE are also outlined in HSE (2001b). It is important to ensure that the appropriate risk criterion is used depending on whether you are considering individual or societal risk.

4.15. No consideration of ALARP or further measures that could be taken

In general (for risks that are below the unacceptable region of the TOR framework), in decisions relating to the reasonable practicability of implementing additional risk control measures, the greater the level of risk under consideration, the greater the degree of rigor and robustness (and hence the greater level of detail) HSE requires in arguments to show that risks have been reduced ALARP (HSE, 2002a).

In practice, for risks in the broadly acceptable region or towards the bottom of the tolerable region, HSE may accept the application of relevant good practice in an appropriate manner as a sufficient demonstration of part or all of a risk/sacrifice computation (HSE, 2002b). Good practice is a generic term for standards for con-

trolling risks. Examples of good practice include following HSC Approved Codes of Practice (ACoPs), following HSE Guidance or guidance produced by other government departments or by following standards set by standard bodies such as BSI and CEN. Additional examples of good practice are given in HSE (2002b). For risks in the tolerable region, decisions relating to the reasonable practicability of implementing additional control measures are likely to require more detailed justification. It will be necessary to explicitly identify possible risk reduction options, and assess whether they are reasonably practicable. Where a number of options exist, all options, or combination of options that are reasonably practicable must be implemented. In measuring the risk to be reduced, and the sacrifice involved in measures to achieve that reduction, the starting point should be the present situation; if there are several options, they should each be considered as against the present situation (HSE, 2002a).

4.16. Inappropriate use of cost benefit analysis (CBA)

It is important to consider whether there is any relevant good practice applicable to the situation under consideration before performing detailed cost benefit analyses to assess the reasonable practicability of implementing possible risk reduction measures. In carrying out comparisons of costs and benefits, only costs (in money, time or trouble) incurred by the duty-holder that are necessary and sufficient to implement the measures identified to reduce the risk can be taken into account. Details of the sorts of costs that typically need to be considered are given in HSE (2002a).

Case study 9: 'Inappropriate use of CBA'

A cost benefit analysis was undertaken to determine whether expenditure on a gas detection system was reasonably practicable. Having determined the value of the potential losses, a detection system was described which was considerably more expensive. The study, therefore, concluded that the expenditure was not justified, as the costs were grossly disproportionate to the benefits. However, alternative cheaper gas detection systems, that were not grossly disproportionate to the potential losses, were not considered.

Pitfall—'Gold plating' of the costs involved rendered the decision worthless. When carrying out a CBA, care should be taken to provide valid cost estimates and not only consider the most expensive option.

4.17. Using 'Reverse ALARP' arguments (i.e. using cost benefit analysis to attempt to argue that it is acceptable to reduce existing safety standards)

Attempts are sometimes made to use cost benefit analysis to argue for the removal of an existing risk control measure that achieves only a small reduction in the risk at

significant cost. In these cases, it is claimed that the cost benefit analysis shows that the cost of the existing measure is grossly disproportionate to the benefit achieved in terms of risk reduction, and hence that the continued implementation of the control measure is not reasonably practicable. However, such arguments are not acceptable as the removal of an existing control measure would result in an increase in the level of risk, and would mean that risks are no longer being controlled ALARP; the current implementation of the control measure effectively demonstrates its reasonable practicability. Arguments along such lines are sometimes termed 'Reverse ALARP' or 'Inverse ALARP' arguments.

Case study 10: '*Reverse ALARP*'

A public utility produced a new design for a piece of apparatus that formed part of a system. The new item posed a higher risk than the existing item. The utility tried to show that, compared to published tolerability criteria, the risks associated with the new design were still acceptable. However, when doing this, the item was considered in isolation and not as part of the system. Also third party interference with the item was excluded from consideration, even though the new item was more vulnerable to this than the existing design.

Pitfall—This is an example of 'Reverse ALARP'; it is not correct to use a risk assessment to justify a reduction in standards. As the old piece of apparatus had been installed and operational, it follows that this design was reasonably practicable to use and, therefore, the new design was not reducing risks ALARP.

4.18. Not linking hazards with risk controls

The risk assessment findings should be documented and include:

- Details of the identified hazards associated with the work activity;
- Details of the severity of the possible consequences;
- Details of the precautions that are (or should be) in place to control the risks;
- Improvements/further actions identified as necessary to control risks ALARP.

New or additional risk reduction measures or risk control systems must be implemented. This may involve several stages; it is likely that there will first be a review of the assessment findings and recommendations by an independent team. Following this review, the identified actions will need to be costed and prioritised, leading to the development of an action plan. The action plan should include the identification of individuals with clearly allocated responsibility for each element of the plan and define timescales for completion of actions. It is good practice to build in to the plan the task of following up on the recommendations to ensure they have

been implemented, and also to examine their effectiveness, and consider whether any unexpected risks have been inadvertently created.

4.19. Not doing anything with the results of the assessment

It is essential that action is taken as a result of the findings of the risk assessment. Risk assessment should never be just a paper exercise; the entire process will have been a waste of time if the findings are merely noted, but no action taken as a result. Risk assessment should be an integral part of the company's safety management system. The assessment will almost inevitably result in recommendations for improvements and further actions to control and reduce risk; any identified new or additional risk reduction measures or risk control systems must be implemented.

5. Summary

The work presented in this paper is the result of a project carried out by HSL for HSE to identify critiques of risk assessment methodologies and identify common pitfalls within risk assessment.

A comprehensive literature review was carried out at the start of this work to identify any published critiques of both general and specific risk assessment methodologies, or any references that include descriptions of risk assessment pitfalls or mistakes. While there exists a large body of published material in the general topic of risk assessment and its application, very little material could be found that includes critical reviews of methodologies or examples of risk assessment pitfalls. Simpson (1996) and Beale (2001) discussed in Section 1 are two examples.

To address this apparent gap in risk assessment information, a large number of examples of inadequate industry risk assessments were identified, by collating experience from HSE operational divisions and HSL's own experience of carrying out work in this area for HSE. These case studies were examined and used to produce a list of common risk assessment pitfalls.

These pitfalls are summarised below:

- Carrying out a risk assessment to attempt to justify a decision that has already been made;
- Using a generic assessment when a site-specific assessment is needed;
- Carrying out a detailed quantified risk assessment without first considering whether any relevant good practice was applicable, or when relevant good practice exists;
- Carrying out a risk assessment using inappropriate good practice;
- Making decisions on the basis of individual risk estimates when societal risk is the appropriate measure;
- Only considering the risk from one activity;
- Dividing the time spent on the hazardous activity between several individuals—the 'salami slicing' approach to risk estimation;

- Not involving a team of people in the assessment or not including employees with practical knowledge of the process/activity being assessed;
- Ineffective use of consultants;
- Failure to identify all hazards associated with a particular activity;
- Failure to fully consider all possible outcomes;
- Inappropriate use of data;
- Inappropriate definition of a representative sample of events;
- Inappropriate use of risk criteria;
- No consideration of ALARP or further measures that could be taken;
- Inappropriate use of cost benefit analysis;
- Using 'Reverse ALARP' arguments (i.e. using cost benefit analysis to attempt to argue that it is acceptable to reduce existing safety standards);
- Not linking hazards with risk controls;
- Not doing anything with the results of the assessment.

The 10 case studies presented in this paper have been selected from the initial case study list to illustrate some of the most commonly encountered pitfalls. The examples are intended to provide information and highlight certain areas where caution is required.

Risk assessment should not be a one off activity, but should be ongoing and be part of the process of continuous improvement. Risk assessments should be reviewed as part of the standard health and safety management practice. They should also be reviewed if there is reason to suspect that they may no longer be appropriate or valid, for example after an accident, incident or near miss, or when significant new information or techniques become available. However, used appropriately a risk assessment is the cornerstone of a successful health and safety management system and provides an invaluable tool in helping to ensure a safe working environment.

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