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Demonstration of ALARP

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In a previous post my colleague Sarah Bickerstaffe discussed how to define a representative set of Major Accident Hazard scenarios for the purposes of a COMAH Safety Report submission. From here you can carry out consequence modelling and frequency assessments (Consequence – Likelihood Ranking) in order to assess the risk associated with the representative scenarios. All very good but one of the most common failings highlighted in COMAH submission feedback is that despite all of this assessment the duty holder has not fully demonstrated the residual risk is ALARP.

ALARP ("as low as reasonably practicable") is goal-setting, rather than being prescriptive which has a great advantage because it allows the duty holder to choose the method of demonstration that is most suited to them. However, this brings with it a potential area of disagreement as it also requires both the duty holder and the Competent Authority (CA) to exercise judgement and agree, which very often materializes as the COMAH report feedback stating that ALARP has not been adequately demonstrated.

In practical terms there are two steps to demonstrate ALARP and I will discuss them under the headings of Relevant Good Practice and Additional Risk Reduction Measures:

Relevant Good Practice

Compliance with 'Relevant Good Practice' can be very simple if there is a published guidance document or code that states you must do x, y and z and by the way everybody else in the industry does the same. So, you have to carry out an audit to make sure you are in compliance with the good practice or if you deviate, then you must carefully justify why you deviate or else develop a plan to ensure full compliance in an appropriate timescale.

The situation can become more complex if for example there is no defined or published relevant good practice such as in the case of a novel process technology or a unique application. In such cases, good engineering practice should be followed as far as it can be, and then consideration given to whether more can be done to reduce the risk.

Additional Risk Reduction

So how do we assess what 'Additional Risk Reduction Measures' should be implemented? The first step that is often applied here is a monetary one, or to give it the correct term 'Cost Benefit Analysis'. This will determine how much money can be justifiably spent. A useful method is provided by the HSE on their website but there is a potential problem here, not with the method, but with how it can be applied, the method can be used in a very 'negative' way.

An example, if you have completed a HAZOP for a process you may have identified an overpressure event that if protective measures fail could rupture a pressure vessel leading to a single on-site fatality. You then carry out a Layer of Protection Analysis (LOPA) which says the fatality frequency is 10^{-5} per year which is sensible because you already have a good Safety Instrumented System and a relief valve on the vessel and it probably means the risk is 'tolerable if ALARP' as per the following diagram published by the HSE.

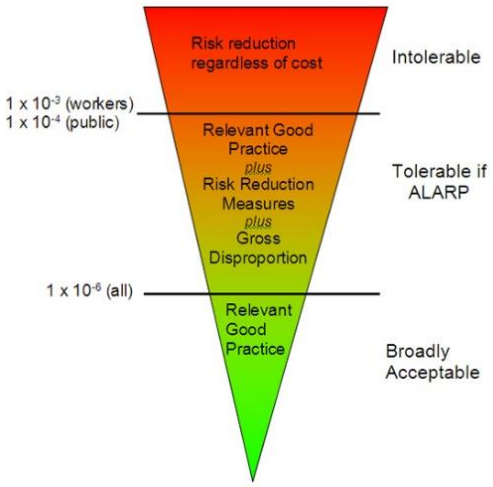

Figure1: Types of ALARP demonstration, HSE website

A cost benefit analysis would probably say the justifiable expenditure on additional measures is less than £4,000. It is very easy to draw the conclusion that we cannot design anything new or put in more hardware for such a small amount of money, so that's it, there is nothing else to be done and the risk is ALARP.

In effect cost benefit analysis is used to justify doing nothing.

The problem here is that no additional risk reduction measures have been considered. The answer is:

- Cost benefit analysis is the last step in the process, not the first.
- The first step is to ask the question 'what more can I do, and why have I not done it?'.

One of the simplest ways of identifying potential additional risk reduction measures is to apply the hierarchy of controls as guidewords as part of your HAZOP study or LOPA study. The team members will be the same ones you would need to complete the ALARP demonstration. An example is given below and a word of note, all potential measures are listed and are only assessed in a qualitative manner, i.e. no exact costs are applied.

Guideword	Potential risk reduction measure	Feasibility of the option
Inherent	Re-rate the vessel to withstand the maximum supply pressure.	Would require a replacement vessel, by inspection the cost is grossly disproportionate.
Inherent	De-rate the feed pump to within 1.5 times the design pressure of the vessel thus eliminating the rupture case.	Replacing the pump impellor could achieve this aim. Option to be progressed.
Control	Provide a BPCS function for start-up to avoid manual control of vessel level.	Feasible option to be progressed.
Prevention	Upgrade the high pressure trip to SIL2.	Requires replacement of existing trip with SIL2 certified equipment. Not required if inherent measures applied.
Mitigation	Relocate operator at start-up.	BPCS start-up function removes the operator from the vulnerable location during start-up. Feasibility to be investigated.

Figure 2: An example of applying the hierarchy of controls as guidewords as part of a HAZOP or LOPA study

What does the ALARP demonstration show:

1. The cost of some options will be 'clearly disproportionate' in terms of a stand-alone modification such as replacing the vessel. It is worth writing them down because the ALARP demonstration should be periodically reviewed, e.g. every few years. In a few years' time another project may come along which

means the differential cost of adding the ALARP option to it may be relatively small so it could then be progressed.

2. It will highlight simple options, procedural updates, alarm and control set point changes, fitting of minimum stops to valves, changing impellor sizes. These are of no or relatively low cost so will fall into the category of 'just do it'.

3. It will allow you to challenge the Basis of Safety, i.e. can you make the system inherently safe?

All of the above would have been missed if the dominating mindset was based only on having no more than £4,000 to spend.

In summary

ALARP demonstration is based on two steps, relevant good practice and additional risk reduction measures. The relevant good practice element can be troublesome to define, but the additional risk reduction measures element is very simple. In my opinion if you always ask yourself the question 'what more can I do, and why have I not done it?' and then robustly document your thoughts and reasoning, then you are well on the way to an effective ALARP demonstration. Also, your ALARP demonstrations should be periodically reviewed and update, for example when you are revalidating your HAZOP and LOPA or your COMAH Safety Report.

For further information please email me at Stephen Beedle or see ABB COMAH support