A method for demonstration of ALARP for noise control

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ABSTRACT

The regulatory environment for offshore facilities is moving away from hard limits to "As Low as Reasonably Practicable". As noise control experts, if we want to see our designs and recommendations implemented, acousticians must move beyond the realm of what is possible, and noise control design in isolation, into the realm of operations and practicality of implementation on a broader scale. Getting buy-in to noise controls in the design phase has historically been difficult as we must first overcome entrenched attitudes to noise risk and the value of noise control. SVT Engineering Consultants has developed a quantitative method for undertaking this analysis and determining an ALARP position, which has been used on a number of projects and seen the successful implementation of noise control. A particular feature of the process is its resistance to inherent bias in attitudes to noise control by all parties. This paper presents an overview of the process.

Keywords: Noise control, ALARP, Practicable I-INCE Classification of Subjects Number(s): 30

1. INTRODUCTION

Environmental and occupational laws and regulations in a number of jurisdictions use a combined limit and duty of care approach. The limits are generally interpreted as the separation between an acceptable and an unacceptable impact, with a breach of the limits leading to the possibility of regulatory enforcement action. Much of the focus in the past has been on demonstrating attainment of the limit, as this defines the point at which the regulator is clearly justified in taking an enforcement approach. As any enforcement action can lead to unplanned operational costs (either directly or indirectly) this has also understandably been the focus of operating companies, and therefore the focus of experts servicing them, including noise consultants.

However, the 'duty of care' aspects of the laws often use the words 'implement all reasonable and practicable controls' or similar words to the same effect. In the Oil and Gas field the common terminology is 'As Low as Reasonably Practicable', or ALARP for short. Often this requirement is not directly linked to the attainment of the regulatory limit, and is therefore a parallel requirement to the prescriptive limit. Strict interpretation would lead the reader to conclude that the requirement to implement all reasonable controls exists regardless of whether the regulated prescriptive limit is demonstrated to be met. This interpretation is however generally at odds with the way regulators have approached their enforcement efforts up to the present day.

The commonwealth regulator for the offshore petroleum industry in Australia - NOPSEMA - is one such body with a law of this type in place. For several years now NOPSEMA has become increasingly interested in facility operators demonstrating that ALARP has been achieved for existing facilities with high levels of noise occupational noise exposure. Coupled with this NOPSEMA has also expressed an expectation that the Safety Case for new design / new build facilities demonstrates that the risks to health and safety on the facility, *including noise*, have been reduced to ALARP by design. In addition to the actions by this one regulator, recent changes to laws and codes of practice are placing increasing emphasis on the demonstration of ALARP for noise across a number of jurisdictions.

ALARP is a particular term that has an accepted legal definition in some jurisdictions. An law case from England (Edwards v. National Coal Board, [1949] (1), provided the following definition which

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has since been ratified by the Australian High Court (2): " 'Reasonably practicable' is a narrower term than 'physically possible' and seems to me to imply that a computation must be made by the owner, in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed in the other; and that if it be shown that there is a gross disproportion between them - the risk being insignificant in relation to the sacrifice - the defendants discharge the onus on them. Moreover, this computation falls to be made by the owner at a point of time anterior to the accident". Key items of this definition to note are: a *computation* of the risk-benefit balance must be undertaken; *cost is only one potential factor* in determining the sacrifice, and a gross *disproportion* is required to be demonstrated. Additionally the quantification of ALARP should be made *prior* to an incident or complaint, not in response to it.

To meet the needs of our clients, SVT Engineering Consultants, in collaboration with those clients, has defined a method for evaluating the effect of noise controls that can be used to quantify the ALARP status of an area of a facility, or a particular item of plant, with regards to noise hazards. The system can be used for occupational, environmental and underwater noise impact evaluation, however only the configuration of the process for occupational noise is discussed in this paper.

2. CLASSIFYING THE POTENTIAL IMPACTS

In defining the process to calculate the benefit/sacrifice balance it is first necessary to determine what the potential benefits and sacrifices are. SVT eventually arrived at four separate categories to be considered:

- Benefits;
- Cost;
- Safety; and
- Practicability.

Each of the above categories and the specific factors considered in each category is described below.

2.1 Benefits

The benefits category captures the anticipated improvement in noise levels. Two factors in this category allow us to capture the benefit of controls that target a particular worker group, and balance it with the potential for the control to benefit a larger proportion of the facility workforce. Some noise sources may affect local noise levels but will be relatively insignificant in regard to the overall project process area. Others (for example piping noise) may affect a large area of the facility. The factors are:

Reduction in Worker Group Noise Exposure Levels, and

Noise Reduction across the affected areas.

The area noise reduction is an important consideration as the outcome may have a knock-on effect to the success or otherwise of noise control efforts on other equipment in the same area.

2.2 Cost

The factor for cost refers only to direct cost of implementing the solution. Costs associated with added safety measures, delays, or manpower mobilization, reduced production or lost opportunity are considered separately in the project impact factor of the practicability component.

2.3 Occupational Health and Safety (OH&S)

Process safety and operating safely is a headline requirement for every facility. Therefore this factor has been specially categorized outside the Practicability factors. This factor grades the residual operational safety hazards introduced or removed by the introduction of the noise control treatment. Aspects of safety considered here exclude 'noise issues'.

2.4 Practicability

Practicability is a broad category that defines a number of potentially less obvious impacts. However it is often these less tangible issues that if left unaddressed in a noise control evaluation assessment, lead to veto-votes from engineering teams or managers. The factors identified on the category are summarized in Table 1, and described in more detail below the table.

Table 1 – Factors of Practicability of Noise Control Implementation

Practicability Impacts Factor	Descriptor
Operability costs	Does the control impact operation of the equipment?
Maintainability costs	Does the control impact equipment maintenance?
Process costs	Can the control impact overall facility performance?
Integrity of the solution	Is it proven or novel technology?
Project execution costs	Is the project schedule impacted?

Impact on Operability:

This factor addresses how the noise control treatment impacts the way the plant operator interacts with the equipment. For example, introducing a noise control may cause personnel to spend more time (or less) in hazardous areas, or if it may contribute to a need for increased facility manning.

Impact on Maintainability

This factor assesses the maintenance impact of the treatment, including the requirements for maintenance of the treatment, the equipment being treated, and the facility as a whole. It includes consideration of impacts on access or material handling routes, and the maintenance interval. The potential for increasing shutdown / plant turn-around time, or increasing the manning required to conduct maintenance is also included in this factor.

Impact on the Process

This factor assesses the noise control treatment's impact on the plant process and systems. For example, whether the treatment degraded or improved the process performance or if there was a potential for a significant impact on process performance if the treatment failed. Some treatments may also draw on other resources that are limited in supply at the facility.

Solution integrity (or additional benefits)

Several intangible elements are grouped in this factor. This factor assesses the noise control treatment integrity from a bench marking aspect, that is, is it best practice, good practice, or standard practice. Facilities that omit some controls might be considered to be below current standard practice. Additionally we must consider how trustworthy a particular solution is – has it been tested in the field elsewhere, or is it a new product with so far limited implementation, or potentially is the proposed control a new idea never tested before – a novel technology.

Impact on Project Execution

Introducing a control can have a multiplying effect of indirect costs. These indirect costs are classed as project execution impacts and broadly include potential impacts related to environment, project schedule, cost associated with project delays, additional weight for floating facilities, impacts on facility layout size or arrangement, or impacts on other completed studies and system designs.

3. QUANTIFYING THE POTENTIAL IMPACTS

The overall system can be roughly described as a 'balanced-scoring' approach. Each factor for each potential control will be assigned a Rating. Additionally each factor is assigned a Weighting. These are described below.

3.1 Weightings

The weightings are designed to reflect the values of a corporation or operator into the evaluation procedure. Individual organizations, and indeed different projects within the same organization, will place different relative values on the various factors - these may change depending upon the stressors associated with a particular project. For example some companies instruct that only well-proven technology be used, while others are prepared to consider newer technological opportunities.

The weightings are defined on a scale (nominally 1 to 10), representing attitudes ranging from a particular factor being irrelevant to crucial. The center of the range represents a neutral view. The weighting are determined prior to the process being used and without reference to any particular noise sources or control. This provides a degree of separation between the determination of the weightings and any potentially pre-determined outcome.

3.2 Ratings

For each of the proposed noise controls subject matter experts associated with each factor are queried for their assessment of the impact of the control on the factor. Each assessment is quantified by applying a Rating score to the impact assessment. One version of the impact ratings is provided in Table 2 – in this case high Ratings representing no impact or an improvement, and lower Ratings representing increasingly unacceptable impacts.

Table 2 – Factors of Practicability of Noise Control Implementation

Level of Impact	Rating Score
Improvement	100
No difference	80
Minor Impact	60
Major Impact	40
Significant Impact	20
Unacceptable Impact	0

The Ratings generally follow the guidance provided in Table 2, although the scale is mathematically arbitrary and selected more for the purposes of communication clarity. The words which describe the relative level of impact are the more important component, as these allows us to link the words spoken by each subject matter expert to the scale in a transparent and consistent manner. Intermediate scoring is also allowed where the separation of relatively similar impacts is desired.

Cost is scored on a linear scale with the top of the scale being either relative to the total cost of the equipment package or the budget available for noise control (for example in retrofit projects). Where the actual cost is unknown bands of cost bracket bands can be defined to allow estimates to be used.

The benefits (noise reductions) are scaled appropriately from the expected noise reductions, with a high noise or exposure reduction equating to a high score. The reductions are determined by calculation.

3.3 ALARP Score

The weightings and ratings for each factor are combined (usually as a product, but a division has also been used successfully provided that the scales are appropriately adjusted) and then summed to produce an ALARP Score for each noise control. The "do nothing" case is always considered as an option, and is included as a "noise control case". A mathematical expression of this process is provided below:

$$ALARPScore = \sum (Rating \times Weighting) \quad (1)$$

The noise control with the highest score is then the control selected for implementation by the process. The outcome is usually subject to management approval; however the rigor of the process has been such that a veto event by higher management has been very rare.

4. OUTCOMES

SVT has used the ALARP tool on a number of projects, ranging from new designs, to retrofit on aged facilities. We believe the results demonstrate the effectiveness of the tool in determining appropriate acceptable and implementable noise control that align with corporate vision of the operator and account for the input of influential personnel within the organization.

Noise measurements on a recently commissioned new build gas producing facility demonstrate that noise on the facility is dominated almost exclusively by equipment from which design noise emission estimates from fabricators were substantially different to the infield performance. The majority of the facility area has overall noise levels below the regulatory limit. In all cases the areas with residual high noise levels can be mitigated by treatments that will be easily implemented while the facility is in operation.

In another instance a noise control spend of $5m on a project of over $1.3b has resulted in reduction of calculated noise exposures of over 15 dB for personnel working on the facility. The flexibility of the system to work with approximate data allows it to be effective at very early stages of the project design, where the cost of purchasing on noise control is lowest, and the impact on other factors more manageable.

For several retrofit projects, where the life of aged facilities was being extended, the process has allowed a very tight budget for noise control to be effectively targeted resulting significant reduction to noise exposures of personnel and reduction of noise levels in the plant area. In a number of cases the very-high noise areas of facilities that previously required stringent administrative noise exposure controls have been eliminated.

There have also been several occasions where the process resulted in recommending a “do-nothing” outcome.

Like all such systems the process may be open to potential manipulation; however its openness and clarity make it more difficult for any one person to steer it to justify a predetermined outcome.

When used feedback from operators where the process has been used has been positive. We understand several facilities have effectively extinguished ‘improvement notices to demonstrate ALARP’ from the regulator using the process.

5. CONCLUSIONS

A system has been developed to undertake the calculation of reasonable practicability of implementing noise control. The process is designed to address the need to demonstrate that all reasonably practicable noise controls have been implemented. It provides a method for quantifying the various potential sacrifices associated with implementing noise control, and calculating which control, or mix of controls, provides the best balance of benefit and sacrifice. Use of the process has seen successful implementation of noise controls which effectively target occupational noise exposure on a number of new and existing facilities. Feedback from clients has been positive despite sometimes a high level of initial reservation. The process is particularly successful in engaging relevant stakeholders and is resistant to overt and / or inadvertent outcome manipulation by individuals.

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