



Noise Exposure and Control In The Offshore Oil and Gas Industry

AN INSPECTION TOOL FOR HSE/OSD INSPECTORS



INTRODUCTION

BACKGROUND

Under the Noise at Work Regulations (NAWR), duty holders are required to carry out noise exposure assessments, and where reasonably practicable, reduce exposure to noise by means other than the use of hearing protection. However, HSE have found that compliance with these regulations varies between operators and individual assets.

This inspection tool is intended as a guidance document and 'yardstick', primarily for HSE/OSD inspectors dealing with noise compliance issues offshore. It can be used to determine whether the **personnel noise exposure levels** or the **absolute area noise levels** on an installation are high compared with the industry norm. In addition, the tool can be used to assess proposals for new builds or modifications to existing installations or plant.

Duty holders may also find it helpful as part of their assessment and control of noise risks.

DATA SUMMARY

A total of 112 offshore installations were used to compile this booklet. The makeup of these installations is summarised below:

| | |
|----|----------------------|
| 31 | Drilling Rigs |
| 73 | Production Platforms |
| 8 | FPSO's |

Noise data has been grouped into a limited number of categories and some of these areas may include quieter zones away from major noise sources.

HOW TO USE THE INSPECTION TOOL

This inspection tool has been designed to help determine whether exposure to noise is as low as reasonably practicable. For example, if by reviewing the relevant data plots, it is clear that noise levels in a particular area are higher than the norm, then it might be possible to reduce noise levels by engineering means.

However, even where noise levels are comparable or lower than the industry norm, it may be that more can still be done to control noise at source. It is still the responsibility of the duty holder to demonstrate that they have implemented all reasonably practicable controls.

The data in this booklet has been split into the following main categories:

Work Area Noise Levels – These are split into the various functional modules found on offshore installations. This information is most likely to be used to help to assess whether it might be practicable to undertake engineering noise control measures on individual equipment.

Personnel Noise Exposure Levels – Based on the various trades found on most offshore installations.

Average Installation Noise Exposure Level – These are split into both age category and installation type and can be used to assess the overall noise status of the installation.

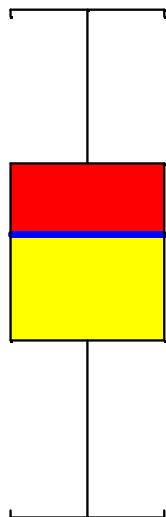
Installation NEMS Score – For installations using BVAT's Noise Exposure Management System (NEMS) a plot of installation NEMS scores has also been included to give a guideline to where an installation sits in respect to others. However, because the NEMS score is dependant upon the POB, the average noise exposure may be a better comparison.



INTRODUCTION

HOW TO USE BOX PLOTS

To use the data within this inspection tool it will be necessary to collate personnel exposure levels and area noise levels from the installation's noise records. The noise exposure, or noise level data, can be directly compared with the graphs, using the vertical axis, to see how that person / area compares with the industry norm. To assist in decision making, each box plot has been split into four quartiles as follows (this is relation to the offshore population):



ABOVE UPPER QUARTILE: Installations within this category have a much higher noise risk than average and priority should be given to reducing noise exposure levels, where reasonably practicable.

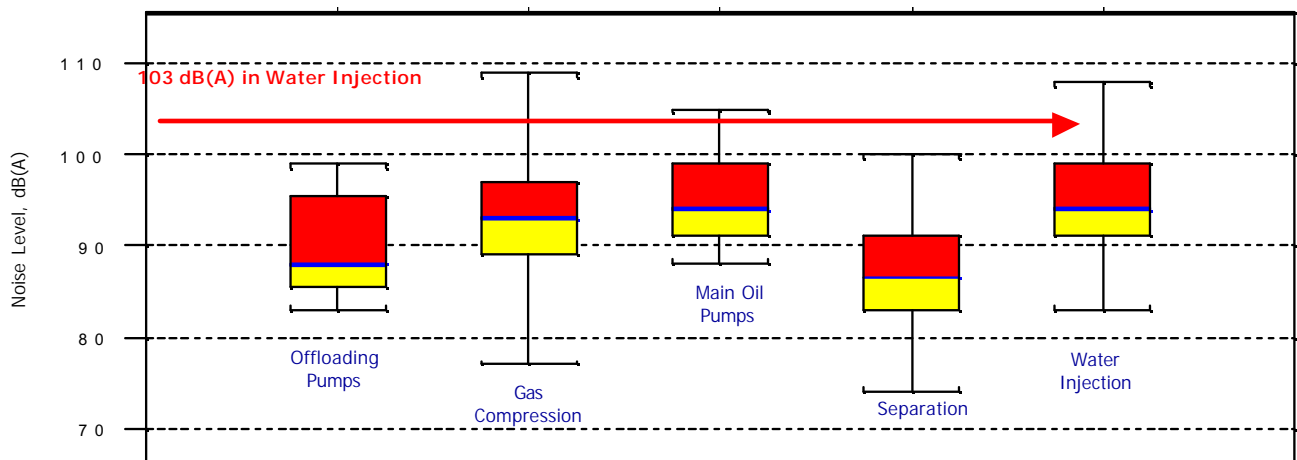
UPPER QUARTILE ZONE: Installations within this category have a slightly higher noise risk than average and it may be practicable to reduce noise exposure levels.

LOWER QUARTILE ZONE: Installations within this category have a slightly lower noise risk than average, although it may still be possible to reduce the risk further.

BELOW LOWER QUARTILE: Installations within this category have a much lower noise risk than average.

EXAMPLE

The average area noise level within a water injection module is found to be 103 dB(A). By comparing this value against the appropriate graph (see below), it can be seen that this is within the "above upper quartile" zone, and the area therefore has higher noise levels than would normally be expected. This could mean that noise levels from this equipment are not as low as is reasonably practicable. The operator should therefore be expected to carry out a detailed noise control study to investigate the possibility of reducing noise levels from this equipment.



METHODS OF NOISE CONTROL

Noise control at source is the best option. However, where this is not reasonably practicable the next approach is to treat the transmission path, and finally recourse may have to be made to treating the receiver e.g. peace havens.

Examples of the type of noise control measures available to offshore are summarised below:

Control at source

The selection of inherently quiet equipment e.g. low noise surge control valves.

Enclosure

Enclosures can be used on a wide range of equipment and often consist of acoustic panels with absorptive internal finishes. They can be small i.e. close fitting e.g. as found on HVAC units and gearboxes, or large, allowing personnel access e.g. gas turbine driven units. Particular attention should be paid to sealing around demountable panels, doors and any pipework penetrating through the enclosure. Vibration isolation from support structures may also be required.

Acoustic pipework lagging

Lagging consists of an outer dense impervious wrap isolated from pipework by a layer of flexible mineral wool or closed cell foam. The most important factors governing its performance are the quality of the sealing and the thoroughness of the insulation over flanges, junctions etc. The outer wrap should not make contact with the pipe, as this will allow noise to be transmitted to the outer surface and re-radiated as noise.

Cladding

The principle is the same as acoustic lagging in that a combination of outer massive wrap and flexible isolating layer is used. It is suitable where only part treatment of an operating unit is required e.g. gearboxes, or where enclosure is difficult e.g. on compressor/pump casings.

Barriers

Barriers are a form of enclosure with partial containment, useful for protecting workers carrying out maintenance/repairs in noisy areas;

Absorptive treatment

This is treatment applied to hard reflective surfaces within modules to reduce the reverberant field noise level. While the reduction in noise level is often small between 2 and 5 dB(A) this form of treatment is relatively easy as it can be carried out without major design changes. It is often used in emergency generator and fire pump rooms in the form of perforated steel sheet liners retaining mineral wool slabs.

METHODS OF NOISE CONTROL

In brief, other measures include:

Silencers

For example splitter silencers in HVAC systems, electric motor silencers.

Vibration damping

Application of viscous compound to reduce panel vibration (on equipment skids).

Vibration isolation

Mechanical de-coupling of a vibratory source from its foundations (equipment skids, pipework etc.)

Floating floors

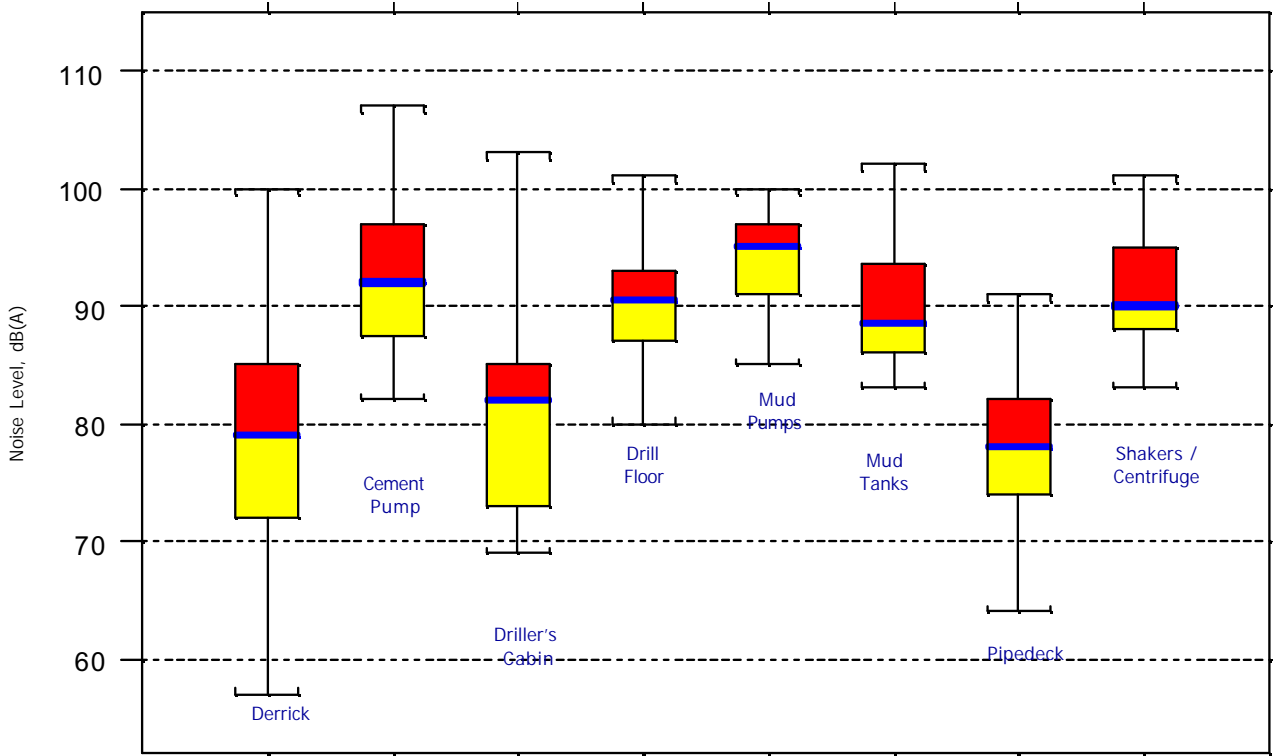
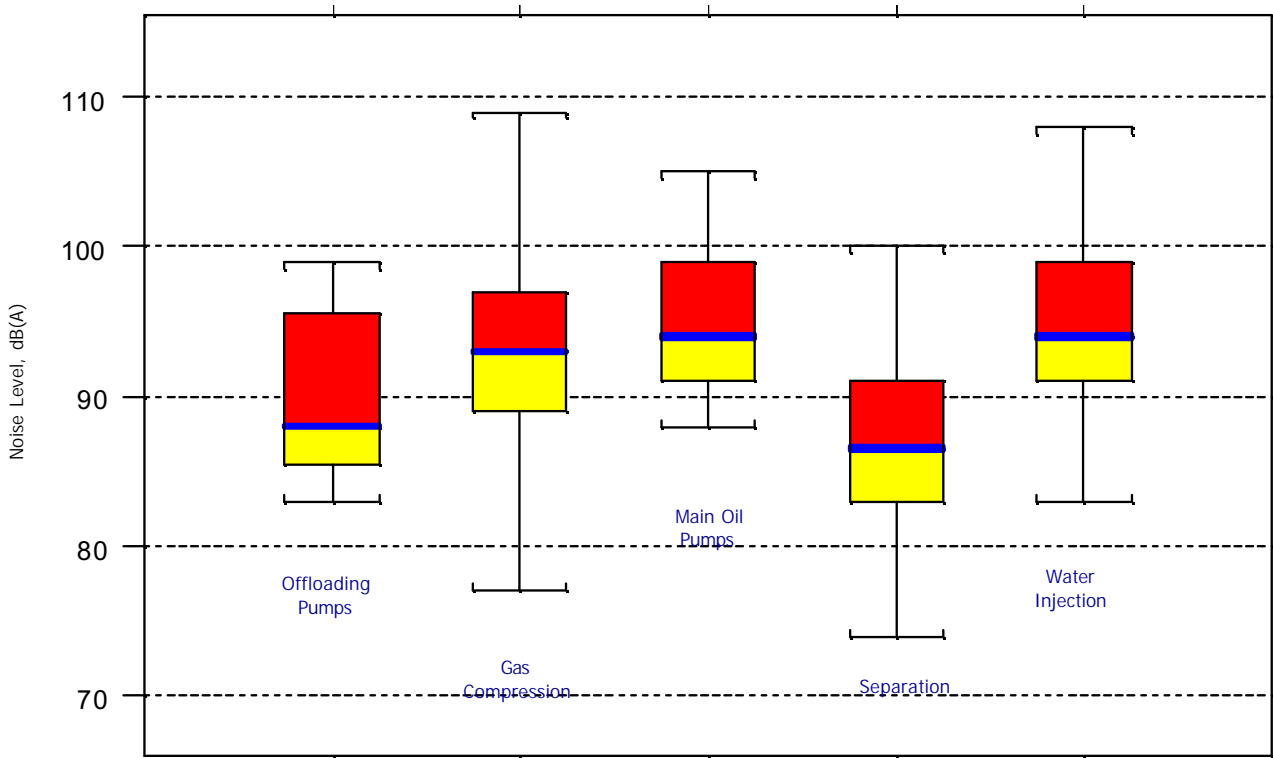
Mechanical isolation of personnel or sensitive equipment from a vibrating deck (control rooms etc.)

Peace havens

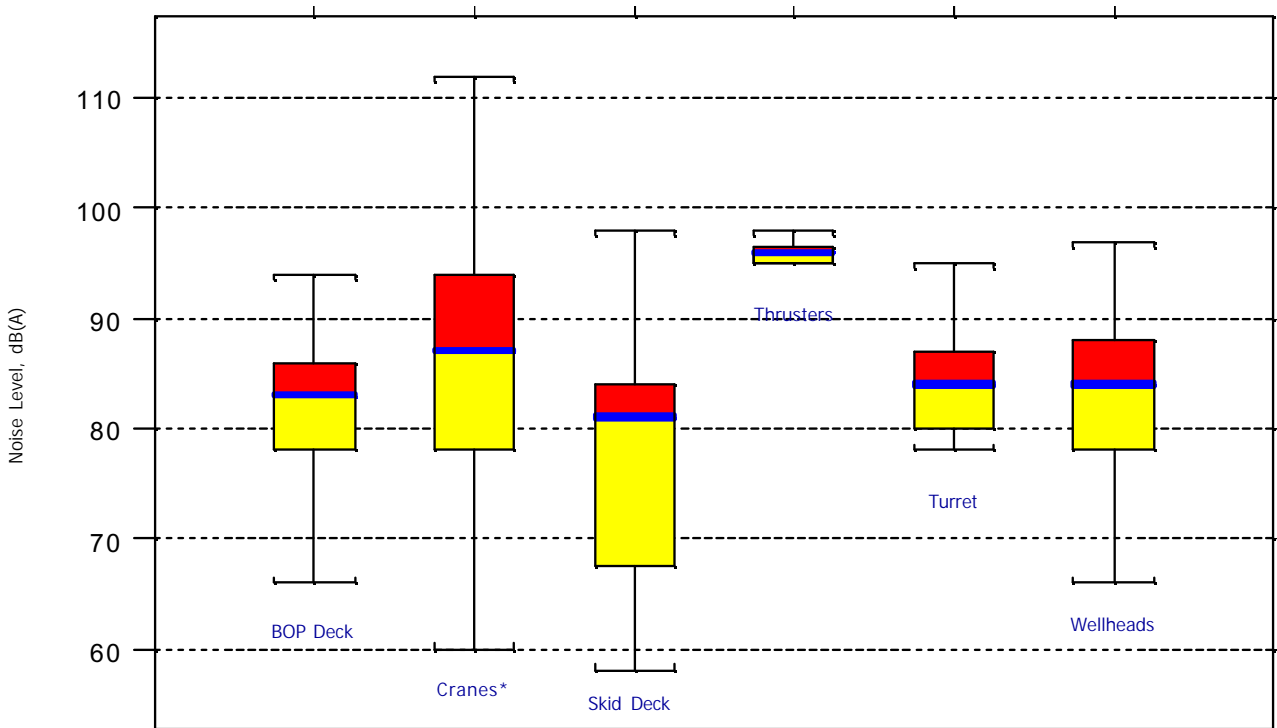
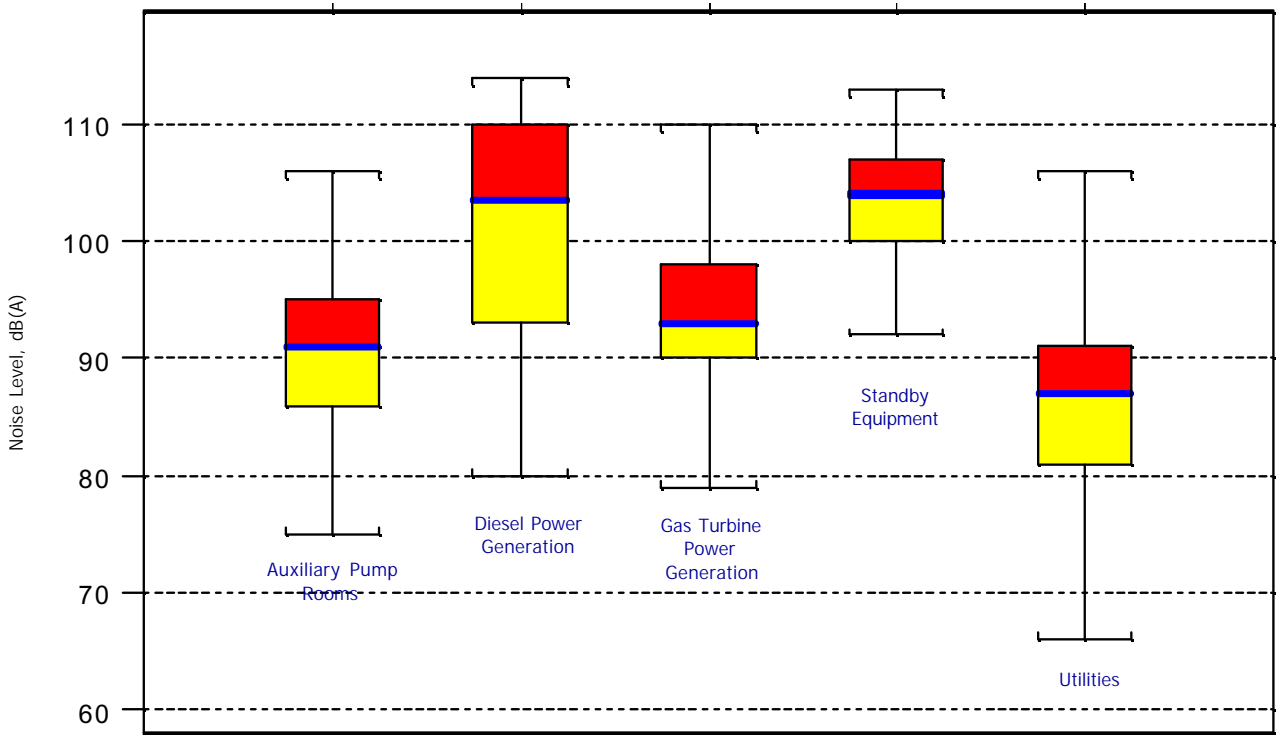
Isolation of an operator in purpose built enclosure (sometimes seen in drilling areas e.g. shaker house)

More detailed information regarding methods of noise control can be found in the references quoted on page 16.

PLOT 1: WORK AREA NOISE LEVELS - dB(A)

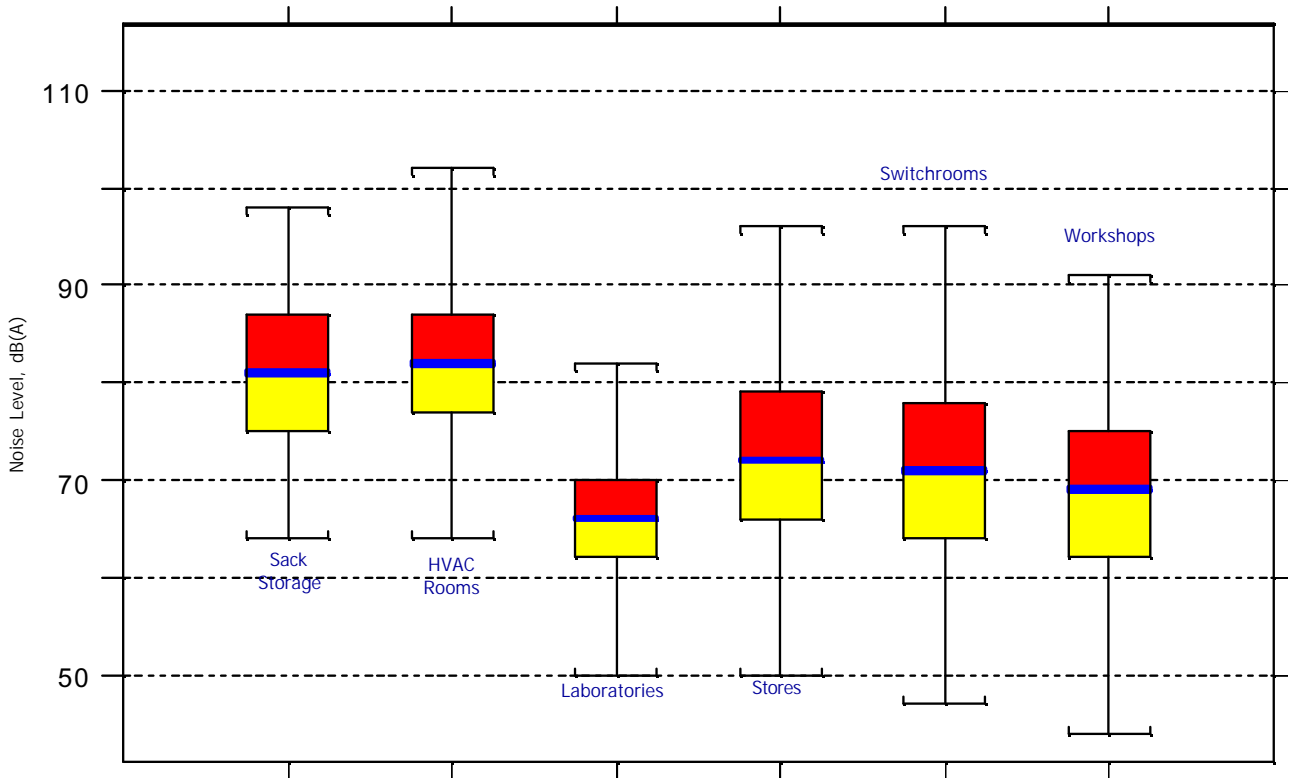


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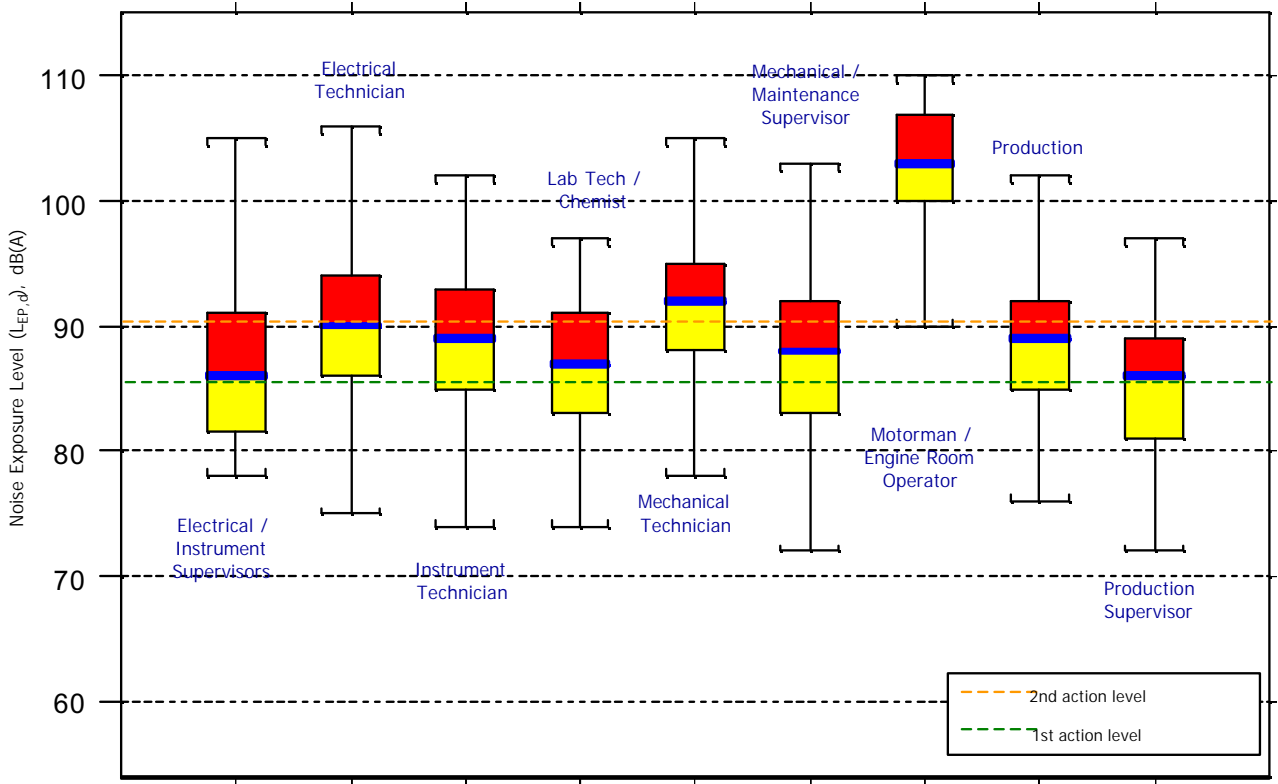
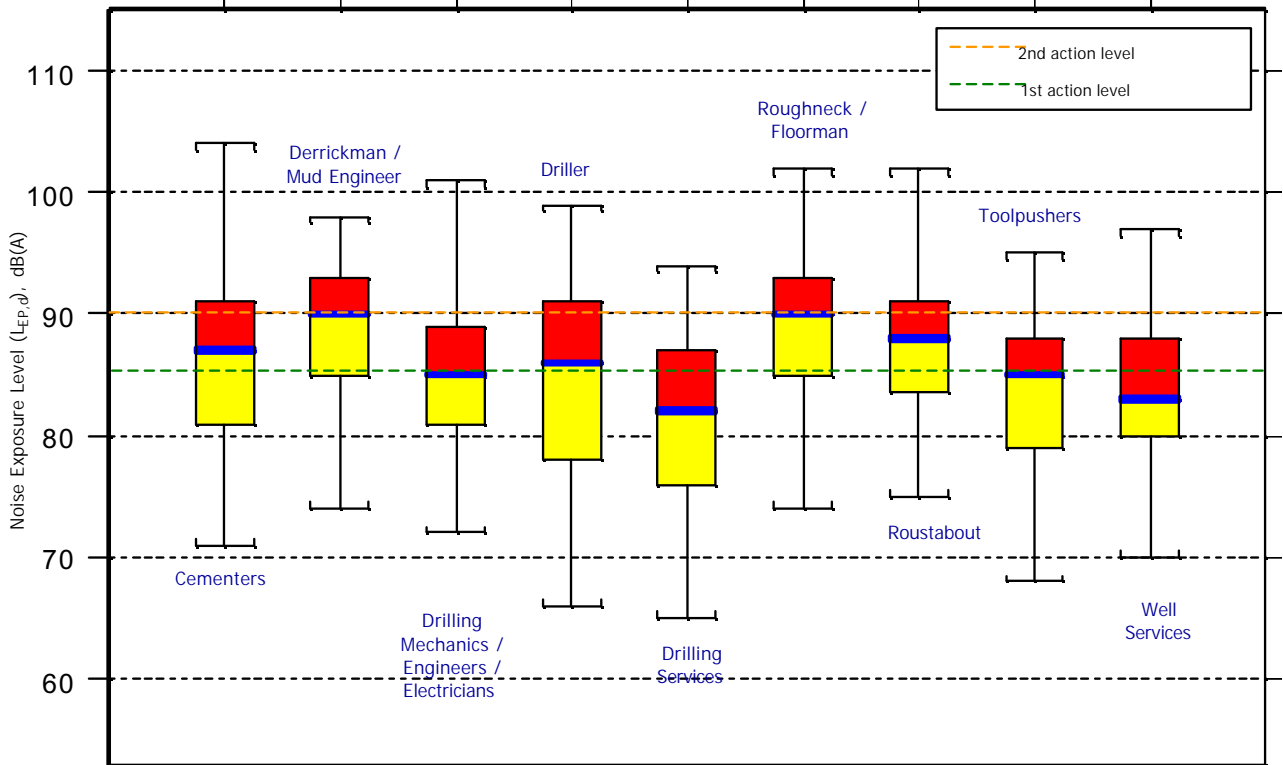


* This includes data from crane cabins and engine enclosures

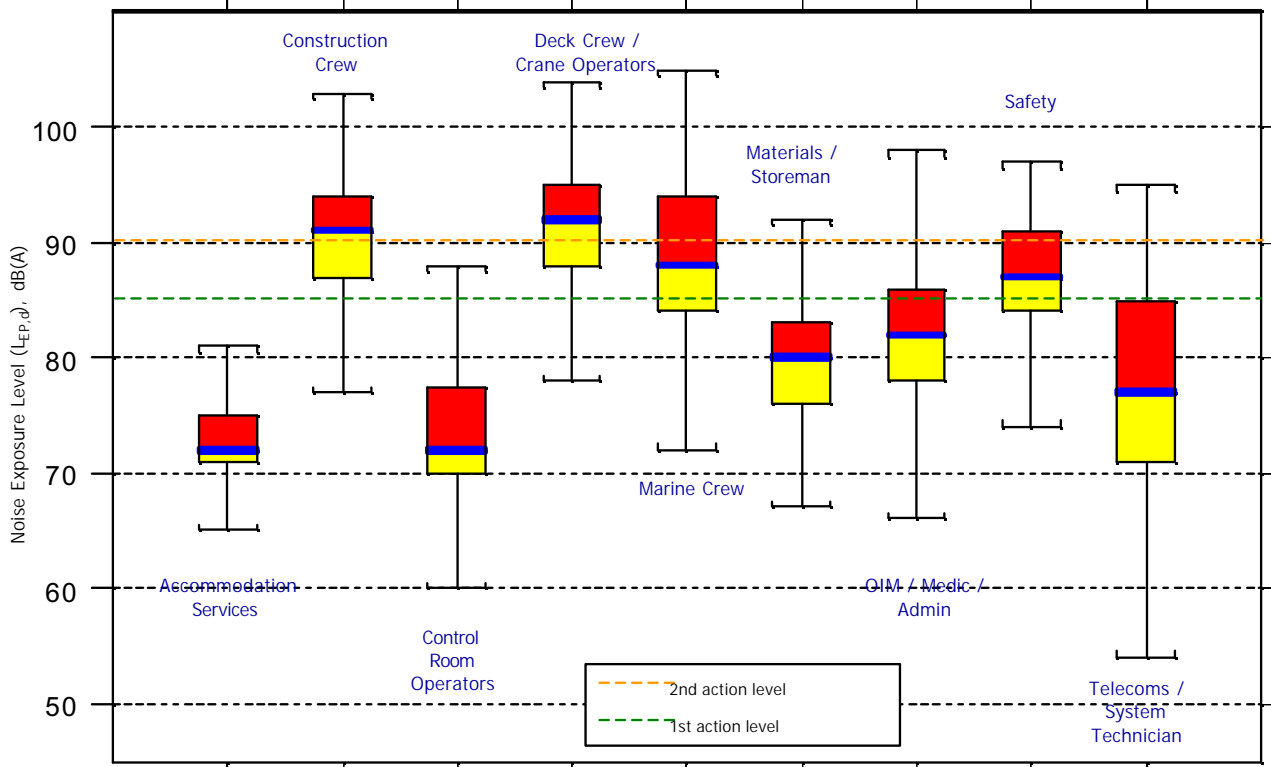
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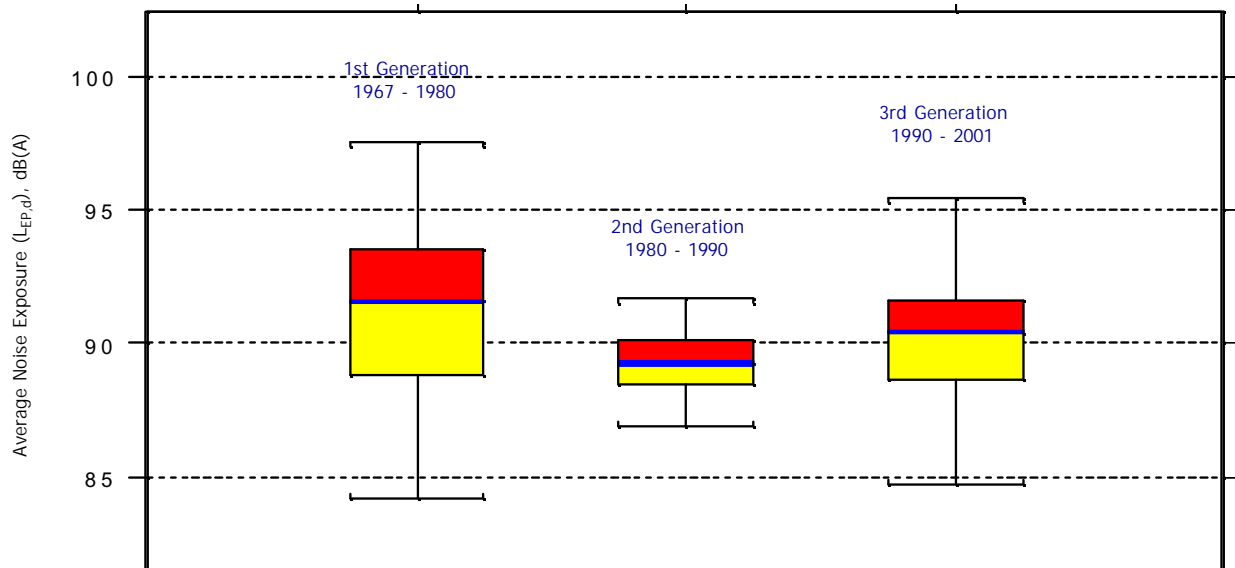
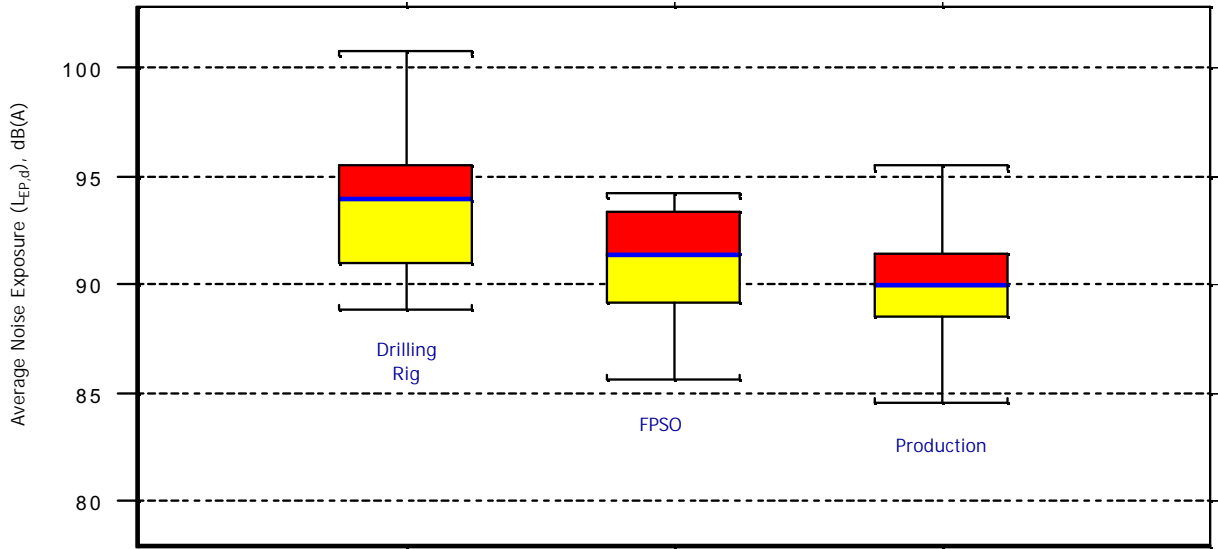
PLOT 2: TRADE NOISE EXPOSURES - $L_{EP,d}$



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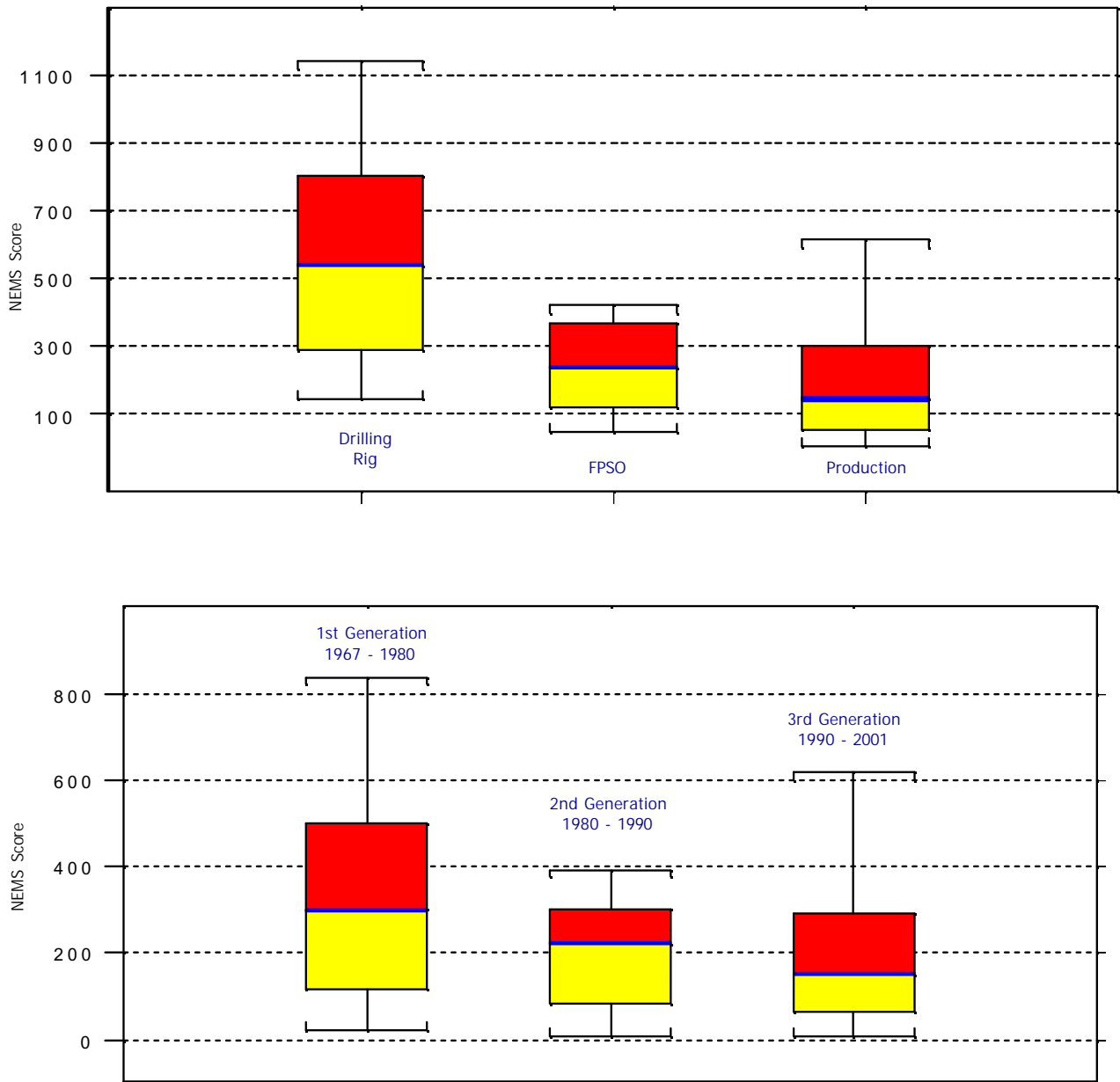


PLOT 3: INSTALLATION AVERAGE NOISE EXPOSURE - $L_{EP,d}$



The above plots compare the average installation $L_{EP,d}$ (i.e. the sum of the installation's noise exposure, for all personnel, divided by the number of people included within the assessment). It can be seen from the median lines that a person working on a drilling rig can be expected to have twice the noise exposure of someone working on a production platform. Personnel working on FPSO's will have a slightly higher noise risk than those working on production platforms. It can also be seen that the risk is greatest for 1st generation installations with 3rd generation installations slightly worse than 2nd generation.

PLOT 4: INSTALLATION NEMS SCORE



The installation NEMS score counts the total noise exposure of the crew in multiples of the first action level noise dose. It can be seen from the median lines that drilling rigs have a much greater noise risk than FPSO's or production platforms and that the noise risk for an FPSO is greater than for a production platform. The overall installation risk has decreased with each generation. However, the upper quartile of 3rd generation installations is higher than that for 2nd generation installations. This suggests that some newer installations are actually worse with respect to noise.



SUMMARY OF THE NOISE AT WORK REGULATIONS - OFFSHORE INDUSTRY

Citation and Commencement (Regulation 1)

The Noise at Work Regulations (NAWR) apply to all workers in Great Britain. The NAWR were implemented offshore in February 1998 under SI 1197 No. 1993 "The Electricity and Noise at Work Regulations".

Interpretation of Employers Duties Under the Regulations (Regulation 2)

Within the Regulations, duties apply whenever exposures exceed the first action level. The requirements are more stringent when it comes to exceedance of the second and peak action levels. The noise exposure action levels are classified as follows:

- First action level = 85 dB(A) $L_{EP,d}$
- Second action level = 90 dB(A) $L_{EP,d}$
- Peak action level = 200 Pascals peak pressure (measured as 140 dB(C) peak).

For places of work which involve more than one employer e.g. multi-contractor sites like offshore installations, the regulations place duties on all employers involved and each will have a responsibility to their own employees and, so far as reasonably practicable, to anyone else at work that is affected by the work they do.

Dis-application of Duties (Regulation 3)

The duties imposed by the regulations do not apply to the crew of an aircraft moving under its own power or any other person on board who is at work in connection with its operation. However, the regulations do apply to the passengers, who are at work. In this instance the NAWRs are enforced by the CAA.

Assessment of Noise Exposure (Regulation 4)

Employers are required to carry out a noise assessment wherever an employee is likely to be exposed at or above the first or peak action level. The assessment should identify all workers exposed and provide enough information to enable the employer to decide what further actions to take. The assessments will need to be undertaken by a competent person.

The assessment should be reviewed whenever there are significant changes in equipment or work patterns that may invalidate the installation assessment.

SUMMARY OF THE NOISE AT WORK REGULATIONS

Assessment Records (Regulation 5)

The NAWRs require employers to maintain copies of all current assessments until a new one is made. However, it is recommended that records are kept longer than this to provide information on long-term trends.

Reduction of Risk of Hearing Damage (Regulation 6)

Regulation 6 states that, 'every employer shall reduce the risk of damage to the hearing of his employees from exposure to noise to the lowest level reasonably practicable'.

There is a quantifiable risk of hearing damage from exposures between the first and second action levels and a residual though small risk below 85 dB(A). Therefore, there is a general duty to reduce exposure. In practice this could mean the duty holder implementing good practice noise controls and having in place low noise purchasing policy.

Reduction in Noise Exposure (Regulation 7)

Employers must reduce exposure, as far as is reasonably practicable, (other than by the provision of personal ear protectors) when individuals are exposed to noise at or above the second (and peak) action level.

In practice this means planning and carrying out a programme of noise control measures with the aim of reducing exposures to as low a level as reasonably practicable, as well as putting in place systems to ensure that the control are used and maintained.

Ear Protection (Regulation 8)

Where employees are exposed between the first and second action levels employers must provide suitable hearing protection to employees who ask for them. Suitable hearing protection must be issued to, and worn by, all employees likely to be exposed to the second action level or above, or to the peak action level or above. Suitability of hearing protection should be checked in accordance with the method presented in the guidance notes (see reference No. 1, page 16).

For workers with a variable exposure to noise, the employer should make sure that the employee is provided with hearing protection adequate for the worst situation likely to be encountered and knows when and where to use them.

SUMMARY OF THE NOISE AT WORK REGULATIONS - OFFSHORE INDUSTRY

Ear Protection Zones (Regulation 9)

Employers are required to mark ear protection zones with signs showing where hearing protection must be worn, wherever reasonably practicable. (The signs will be required in all areas where employees are likely to be exposed at or above the second or peak action level.) Signs should be located at all entrances and at appropriate locations within the designated area. Hearing hazard-warning notices should comply with the requirements of the Health and Safety (Safety Signs and Signals) Regulations 1996 S.I. 1996/341. Likewise hearing protection signs should be used to cover noisy activities and/or use of hand tools (e.g. needle gunning etc).

Maintenance and Use of Equipment (Regulation 10)

Employers must ensure, so far as is practicable, that anything provided to control exposure to noise (except ear protectors where exposure is between the first and second action levels) is properly used and that all equipment is maintained. The NAWRs recognise the need for a planned programme of maintenance to inspect and carry out checks to confirm the effectiveness of noise control measures used (e.g. integrity of acoustic insulation/enclosures).

It is a requirement that hearing protection be maintained in good condition. Ear defenders should be replaced at set periods (or immediately if damaged) to avoid the use of sub-standard ear defenders. Availability of ear defenders must be maintained on site.

It is also the duty of the employee to use and maintain noise control hardware and personal protective equipment (e.g. ear defenders) in accordance with manufacturers instructions. Any defects should be reported in line with company procedures

Provision of Information to Employees (Regulation 11)

The NAWR requires employers to provide information and training to all persons exposed to noise above the first action level. The information should include:

- the likely noise exposure and the risk to hearing that noise creates;
- where and how people can obtain hearing protection;
- the employees duties under the NAWR;
- how to report defects in ear protectors and noise control equipment
- what the employee should do to minimise the risk, such as the correct use of noise control equipment and correct choice, use and maintenance of hearing protection, and where to use hearing protection.

Regulations 12 to 15 are not applicable to the offshore industry.

USEFUL REFERENCES

1. Reducing noise at work - guidance on the Noise at Work Regulations 1989. L108 HSE Books 1989 ISBN 0 7176 1511 1.
2. Sound Solutions Offshore, 1998. HSG182 HSE Books ISBN 0 7176 1581 2.
3. A guide to the integrity, workplace environment and miscellaneous aspects of the offshore Installations and Wells (Design and Construction etc) Regulations 1996. L85 HSE Books 1996 ISBN 0 7176 1164 7.
4. Noise at Work – Advice for employers. INDG362.
5. Sound solutions: techniques to reduce noise at work. HSG138 HSE Books 1995 ISBN 0 7176 0791 7.

The future availability and applicability of the references listed in this publication cannot be guaranteed.

ACKNOWLEDGEMENT

The information in this booklet was collated and analysed by BV Acoustic Technology, 36 – 38 The Avenue, Southampton, England, SO17 1XN, Tel: +44 (0) 23 8032 5000. The information used is based on the results of BVAT's Noise Exposure Management System (NEMS) software and associated surveys.

