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ACOUSTICS BULLETIN

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Institute of Acoustics

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Contents

Front cover photograph: A Proven Energy micro wind turbine in a domestic setting, here bringing electricity to a remote island location. Similar machines are used in urban and suburban applications, as envisaged in the Government's proposals to change the planning controls.

The deadline for material for the November/December 2007 issue is 12 October, and for the January/February 2008 issue is 7 December.

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Brüel & Kjær

Dear Members

It is the summer at last. Parliament is in recess and it is the silly season in the newspapers, and so I have amused myself by reading a splendid book called ***Hubbub: Filth, Noise and Stench in England.*** *This is a serious history of the seedier aspects of life in the 15th and 16th centuries and it was, of course, the word 'noise' in the title that attracted my attention. There is a whole chapter devoted to noise and I was surprised to find that the regulation of noise featured prominently some five hundred years ago. Many of the issues also bear a striking similarity to those we deal with today.*

The first recorded case of noise nuisance was heard in 1378 when the Nuisance Assize considered the case of a noisy armourer who had set up a forge in his house which shook the party walls. There was no concept of industrial zones and craftsmen often established their workshops in their homes, causing considerable noise nuisance to their neighbours. In the 15th century coopers were the subject of many actions, while in 1611 a smith was forced to remove a forge that he had erected in a residential street. A century later, coppersmiths were the trade regularly appearing in court to answer noise nuisance charges.

Neighbour noise was also a significant problem just as it is today. In 1595 a bylaw in London prevented any man from causing a sudden outcry after nine at night: offences listed included singing, making an affray, and beating a wife or servant. I would hope that some of that at least is now obsolete. Modern day building acoustics also has its origins in these times, with the emerging middle classes being able to afford improved party wall and floor constructions. After the Great Fire of London an Act was passed which specified materials and thicknesses for party walls. Odd, then, to find that some 340 years later we had to invent Robust Details Ltd.

Traffic noise was also a real problem in towns and cities. In 1586 an Act was passed in London whereby fines were imposed for any coach or cart heard to creak or 'pype' through want of oil.

My real reason for sharing the above with you all is that I do find it surprising that with this rich history of noise nuisance and management, government consultation documents are issued which suggest that we abandon much of the experience built up over the centuries. In my last letter I noted that the Institute had responded to the consultation document on micro-generation technologies and we considered that their proposals for unfettered installation of these noise sources in residential areas would be unworkable. This month we have contributed to the consultation on reforming the planning process for major infrastructure schemes. While we accept that there is a need to speed up the planning procedures for major projects such as airports and motorways, the mention of noise only twice in 220 pages does suggest that we may be turning the clock back. I hope that our Institute has helped to influence these policies for the better.

Colin English

PRESIDENT

IOA Consultation on changes to permitted development

Dr Nigel Cogger. Consultation Paper 1: Permitted development rights for householder micro-generation

This review has been prepared on behalf of the Institute of Acoustics (IOA) in response to the invitation to comment on the *Changes to Permitted Development: Consultation Paper 1: Permitted Development Rights for Householder Micro-generation*, published by the Department for Communities and Local Government (DCLG) in April 2007. The comments are a consensus based on the views of members of the Institute who attended a meeting held on 1 June 2007 at The Arden Hotel, Birmingham where there were seventy delegates. In order to help inform the views of the Institute, the delegates also included a representative of the National Society for Clean Air (NSCA) and representatives of manufacturers of micro wind turbines. Members of Council of the IOA gave their approval of the comments before publication.

Executive summary

The Institute of Acoustics has reviewed the proposals for an extension to permitted development rights for micro-generation and specifically the issues relating to noise and vibration from wind turbines. The IOA agrees that the planning system should not need to regulate development that has no impact beyond the host property, but considers that the proposed criteria to limit noise from micro-turbines are unworkable for the following reasons:

- the factors controlling noise and vibration generation, propagation and assessment are too complex to be compatible with the Permitted Development Rights scheme;
- the Consultation Paper does not determine where the responsibility should devolve for ensuring that the installation complies with the proposed criteria;
- the developer is unlikely to know whether the proposed installation will meet the criteria specified;
- the developer has no right of access to neighbouring properties and would not, therefore, be able to determine whether the specified criteria have been met subsequent to the installation;
- the impact of the development will be dependent on existing ambient noise levels and the proposed noise limits could exceed those levels and lead to disturbance and the risk of statutory nuisance;
- there is insufficient control over cumulative effects and no criteria for acoustic character, such as tonality.

The IOA concludes, therefore, that permitted development rights should not be extended to micro-turbines and, for similar reasons, to air source heat pumps.

Changes to Permitted Development: Consultation Paper 1

The Government is currently reviewing the scope of 'permitted development rights', which enable householders to undertake certain development works on or to residential properties, without requiring an application to the relevant local authority for planning consent. A part of this review, *Consultation Paper 1*, relates to extending permitted development rights to the installation of micro-generation devices for the domestic generation of heat and power. These devices include solar power, heat pumps, wind turbines, biomass boilers and combined heat and power (CHP) systems.

The Consultation Paper builds on the draft Planning Policy Statement (PPS): *Planning and Climate Change*, which was published for consultation on 13 December 2006. One of the key principles of the draft PPS is that planning should be a positive force for change, helping to create an attractive environment for innovation and enabling the private sector to bring forward investment in renewable and low-carbon technologies and supporting infrastructure. The DCLG recognises that any extension to permitted development rights could lead to adverse impacts and that clear and robust arrangements should be in place so that the interests of neighbours, the wider community and the environment are sufficiently protected from such impacts. The consultation paper recommends, therefore, that permitted development rights for micro-generation be restricted as summarised in Table 1.

Table 1

System	Normal buildings	Buildings in conservation areas and World Heritage Sites
Solar, on building	Permitted for the roof and walls unless it protrudes more than 150mm above roof plane	Permitted as normal, except on principal elevation fronting a highway
Solar, stand alone	Permitted if less than 4 metres height, at least 5 metres to any boundary, maximum area of array 9m^2	Permitted as normal except in front of principal elevation
Ground source heat pumps	Permitted	Permitted
Air source heat pumps	Permitted if internal noise <30dB, external noise <40dB, 'garden' noise <40dB	Permitted as normal except on principal elevation fronting a highway
Water source heat pumps	Permitted	Permitted
Wind turbines, on building	Permitted if <3m above ridge (including the blade) and diameter of blades <2m; also internal noise <30dB, external noise <40dB, 'garden' noise <40dB; up to 4 turbines on buildings >15m (as with antennas); vibration <0.5mms^{-1}	Not permitted
Wind turbines, stand alone	Permitted if <11m (including the blade) high and diameter of blades <2m; at least 12m from a boundary; also internal noise <30dB, external noise <40dB, 'garden' noise <40dB; vibration <0.5mms^{-1}	Permitted as normal except in front of principal elevation
Bio-mass	Permitted: flue height limited to 1m above ridge	Flues permitted as normal except on principal elevation fronting a highway
Combined heat and power	Permitted: flue height limited to 1m above ridge	Flues permitted as normal except on principal elevation fronting a highway
Hydro	No change	No change

IOA Response to Consultation Paper 1

Constraints

The functions of the IOA are limited to those concerning acoustics, noise and vibration, and its response to the Consultation Paper, therefore, addresses only those aspects of the proposals that have noise or vibration implications or both. In practice, the only micro-generation systems that potentially have significant noise or vibration implications are wind turbines and air source heat pumps and the response is consequently limited to the consultation proposals relating to these systems.

Basis of the response

The IOA and NSCA arranged a one-day meeting, *Permitted Development for Micro Wind Turbines*, to canvass the views of members on the Consultation Paper. Whilst the meeting concentrated on noise from micro wind turbines, the principles and views developed are equally applicable to the noise and vibration issues relating to air source heat pumps. The format of the meeting comprised three formal presentations, introducing the relevant aspects of the document and associated nose and vibration issues, followed by an open discussion, based primarily on the questions included in the consultation paper. The formal presentations were:

An Introduction to the DCLG Proposals for Permitted Development of Micro Wind Turbines: *G Mapp, Bureau Veritas;*

An Introduction to the Acoustic and Mechanical Issues Associated with Small and Micro Wind Turbines: *A Mackinnon and P Jones, TUV NEL Ltd;*

The Application of BS EN 61400-11 to Micro Wind Turbines: *Dr A McKenzie, Hayes McKenzie Partnership Ltd.*

Gwyn Mapp provided the background to the Consultation Paper, including its policy context, an introduction to the review undertaken by Entec and the development of the objective noise and vibration criteria. Mackinnon and Jones discussed the classification of wind turbines, factors affecting the performance and testing of micro wind turbines and the generation and propagation of noise and vibration, including static and dynamic loads on building structures. Dr McKenzie introduced the British Standard BS EN 61400-11: 1998: *Wind turbine generator systems - Part 11: Acoustic noise measurement techniques*, which provides a detailed noise measurement and assessment methodology to ensure that the noise emissions from a wind turbine can be measured in a consistent and accurate manner. The Standard is not restricted to any specific size or type of turbine, although for the purposes of quantification and comparison, the wind speed is quantified at a height of 10 m, not the hub height.

The open discussion was centred on the proposed criteria for noise and vibration taken from Annex 2 of the Consultation Paper and the questions relevant to noise and vibration issues taken from Annex 5. For convenience, these are summarised below:

Annex 2: Detailed noise and vibration proposals

Proposal 1: The design and installation of a MWT [micro wind turbine] should cause the internal noise level, due to noise from the MWT alone, in any mode of operation not to exceed a level of 30dB $L_{Aeq,5min}$ when measured 1m from any acoustically reflecting surface within a habitable room with windows closed of any dwelling within the same structure upon which the MWT is mounted;

Proposal 2: The design and installation of a MWT should cause an external noise level, due to noise from the MWT alone, in any mode of operation not to exceed 40dB $L_{Aeq,5min}$, measured 1m from the façade at the window to a habitable room of any neighbouring residential property;

Proposal 3: The design and installation of a MWT should cause the external noise level due to noise from the MWT alone, in any mode of operation not to exceed 40dB $L_{Aeq,5min}$, measured under free-field conditions, over an area of not less than 50% of a private outdoor space not solely associated with the host dwelling; and

Proposal 4: The design and installation of a MWT should cause the vibration level from the MWT alone, in any mode of operation, not to exceed a level of 0.5mms^{-1} (PPV), in the vertical (z-axis) direction, when measured on the floor towards the centre of any habitable room of any dwelling within the same structure upon which the MWT is mounted.

Annex 5: Summary of relevant questions

Question 1: Do you agree with the principle of an impact approach for permitted development?

Question 4: Do you agree that the impact of noise should be dealt with by specific noise restrictions based on decibel levels at/in neighbouring dwellings in the way proposed in Annex 2?

Question 5: If not, what alternative approach would best address this issue?

Question 7: Do you agree that local planning authorities should be able to restrict permitted development rights for micro-generation where the benefit from the technology is outweighed by its impact?

Question 16: Do you agree that the likely impact of noise from ASHPs should be dealt with by specific noise restrictions in the same way as proposed for domestic wind turbines?

Question 17: Do you agree with the recommendations for wind turbines?

Question 18: Do you agree that the likely impact of noise from turbines should be dealt with by specific noise restrictions in the way proposed?

In practice these questions may be grouped into three fundamental topics and the response of the IOA is, therefore, presented under these three topic headings.

Impact approach to permitted development (questions 1, 4, 5 and 7)

The Institute is familiar with and favours an impact approach to the assessment of noise and vibration and agrees with the view that the planning system should not need to regulate development that has no impact beyond the host property. It is, however, necessary to provide a definition of impact. In the Institute's view, whilst assessment against absolute criteria may be appropriate in some circumstances, the impact of a development should normally take account of the *change* from the pre-existing situation that results from the development at some location. In terms of noise, this is generally the difference between the noise level resulting from the development and the pre-existing noise level, often expressed as the background noise level (the noise level exceeded for 90% of a representative time period or $L_{A90,t}$), or as the energy average of the ambient noise level (the $L_{Aeq,t}$). An example methodology for such an assessment is provided in BS.4142: 1997, *Method for rating industrial noise affecting mixed residential and industrial areas.*

The use of an absolute value, such as the limit of 30dB L_{Aeq} for structureborne noise and 40dB L_{Aeq} for external noise does not define an impact. In areas where background noise levels are low, this could represent a significant change in the environment at the receiver location and, hence a significant adverse impact. The specific noise limits proposed, therefore, do not address the matter of ensuring that the permitted development has no significant impact beyond the host property.

In the Institute's view the impact of noise and vibration can only be developed by relative criteria that address the change in noise level resulting from the development. In fact, the noise policies of many local authorities require that the noise level resulting from any new noise generating development should be less than the pre-existing background noise level (usually by 5 or 10 dB) to ensure that the impact is not significant and that there is no perceptible change in the ambient noise levels.

From the text in the Consultation Paper, question 7 is presented in the context of visual impact, but clearly also relates to noise and vibration. In a quiet area, the permitted noise impact at neighbouring properties could be significant and may not be offset by the relatively small power

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output generated for the benefit of the host property. This could only be overcome by ensuring that the *change* in noise level beyond the host property, resulting from the permitted development, is not significant – that is, the noise criterion should be based on relative, not absolute, values.

There is no reference in the Consultation Paper as to who is to assume responsibility for determining whether there is any impact beyond the host property. Is this to be the local planning authority, the installer, or the occupant, or owner who proposes to install the device at the host property?

Specific noise restrictions for wind turbines (questions 4, 17 and 18)

Noise levels within dwellings

The noise restrictions proposed have been based primarily on the World Health Organisation recommendations to avoid sleep disturbance presented in section 3 of the Executive Summary and section 3.4 of the main text of the Guidelines for Community Noise (WHO, Geneva, 1999). The WHO proposed that continuous noise levels in bedrooms at night should not exceed 30dB(A), to avoid negative effects on sleep. This is then equated to an external level of 45dB(A) on the basis that a façade with a window opened for ventilation provides attenuation of 15dB.

The criterion for structureborne noise is equal to the internal noise level criterion proposed by the WHO and would appear to be based on the assumption that any room would be likely to be affected by only one turbine.

The external noise criterion of 40dB(A) at 1 m from a façade is based on the sound attenuation of a façade incorporating a window opened for ventilation and on the assumption that the façade could be affected by more than one turbine. Thus, to achieve no more than 30dB(A) internally, the total external facade noise level would be limited to 45dB(A) and the contribution from any one turbine to this level would be 40dB(A). An allowance of 5dB has then been included to allow for the cumulative impact that may accrue if there are several turbines in the area.

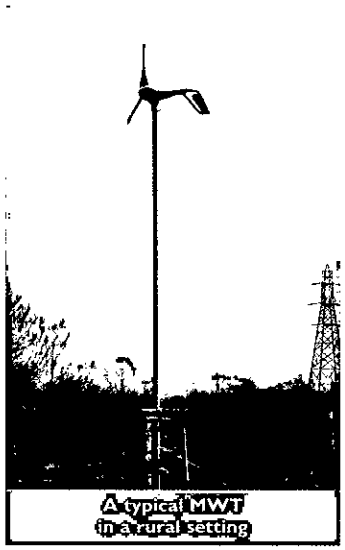
Noise levels in gardens

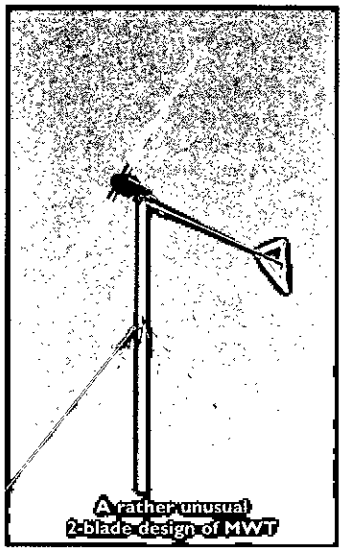
The free field noise level of 40dB(A) proposed for 50% of a garden or other outdoor space is, effectively 3dB higher than the noise level that would be permitted to be incident on a façade, but broadly similar to the lower limit of 37 to 42 dB L_{Aeq} (equivalent to 35 to 40 dB L_{A90}), as set in the ETSU document ETSU-R-97 *The Assessment and Rating of Noise from Wind Farms*.

There are several issues that arise from the proposed approach based on absolute limits:

1 Whilst the internal noise limits may be satisfactory from the rationale of limiting the risk of sleep disturbance (arguably the most critical health-related effect of noise), ambient noise levels within residential accommodation in quiet urban, suburban and, particularly rural areas can be significantly lower than 30dB(A). The proposed limit could, therefore, result in a perceptible change in the internal noise environment, which could be sufficient to result in an impact. Similarly, the ambient noise in a garden can be well below the free-field criterion of 40dB(A) and a perceptible deterioration in the noise environment could occur as the result of the installation of one turbine.

2 The proposed limits for internal noise assume that the contribution from other wind turbines is limited to 43dB(A), or that the external ambient noise from sources other than wind turbines is sufficiently high for the turbine not to increase the overall noise level (an external ambient level of approximately 50dB(A)). The increase in noise level for multiple sources is 10 times log *N*, where *N* is the number of sources. Thus, four equidistant turbines, each generating 40dB(A) at the receiver would give rise to a contribution of 46dB(A), 1dB above the WHO criterion, while ten equidistant turbines, each generating 40dB(A) at the receiver would give rise to 50dB(A), 5dB above the WHO criterion. These values relate only to the contribution of the turbines and take no account of the existing ambient noise from other sources.


A typical MWT in a rural setting


A rather unusual 2-blade design of MWT

3 Where the ambient noise is already at the 45dB(A) below which recommended to avoid sleep disturbance, one turbine would increase this level to 46dB(A), while eight turbines (eg two sets of four on two buildings more than 15m high, equidistant from the receiver) would result in a total level of between 50 and 51 dB(A). Whilst a 1dB change may not be perceptible, it can be seen that the cumulative effects would, again, result in a perceptible change in the noise environment, to a level above the WHO criterion to limit sleep disturbance.

4 There is no requirement to determine tonality, or any other audible character in the emissions. The importance of aural character is recognised in, for example, BS.4142, where a weighting of 5dB is applied if a source displays any distinguishing aural character and in ETSU-R-97, where a penalty is imposed for tonal noise. The Institute's view is that the effects of tonality on disturbance should be recognised and an appropriate strategy adopted to take account of this. It is recognised that the ETSU approach is complex and, whilst suitable for a large scale development such as a wind farm, where specialist impact assessments are necessarily undertaken, would not be appropriate for small scale residential installations. A more pragmatic approach, such as that adopted for assessments in accordance with BS.4142, where a 5dB weighting is applied to the actual noise level to allow for tonality, or the simple, but more objective method given in BS.7445: Part 2: 1991, *Description and measurement of environmental noise, Part 2. Guide to the acquisition of data pertinent to land use* could be considered.

5 Where ambient noise levels are low in gardens, the cumulative impact of several turbines would clearly lead to a significant adverse change in both the internal and external noise environment. Whilst an absolute criterion is used for noise from a wind farm in the ETSU guidance in areas of low background noise, the rationale for this approach is not impact based, but designed to avoid placing undue restrictions on wind farm development, which is assumed to provide an overall benefit to the community at large by the generation of significant electrical power.

6 The adoption of a limit to 50% of a private outdoor space used for rest and relaxation appears arbitrary, because no rationale for the adoption of this proportion has been provided. To which 50% area of the outdoor space does the limit apply? It is certainly possible that an area of garden primarily used for rest and relaxation could fall outside this limit and not be not subject to the 40dB(A) criterion, giving rise to an adverse impact. The Institute believes this proposal to be unfair and unworkable and, if a limit is to be proposed, then the whole of the private outdoor space should be subject to the limit.

7 It is not clear who is to be responsible for determining whether the absolute criterion has been met. More importantly, there is no right of access to a neighbouring property to undertake measurements to check whether the criteria have been met. There is likely to be a particular difficulty in arranging to determine structureborne noise

levels. In practice it may also be necessary to assess the impact at several neighbouring properties.

8 Under what conditions are the measurements to determine compliance to be undertaken? Noise levels from turbines will vary with wind speed and the conditions under which the turbine emits its highest noise level may not occur within a reasonable time period for the installation. Diurnal variations in ambient noise may favour measurement at night, when ambient noise levels are generally at their lowest. This could place an unacceptable burden on occupants of neighbouring properties, particularly to determine whether the structureborne noise criterion has been met. It would not be possible to determine compliance if the noise from the turbine is less than approximately 3 to 5 dB above the ambient noise level.

9 It is most unlikely that the householder would have either the necessary equipment or knowledge to undertake suitable measurements and the cost of employing a specialist acoustical engineer could be out of proportion to the cost of the installation.

10 An absolute limit where wide variations in noise and vibration levels would be expected is unlikely to be enforceable. In practice, it may not be significant if the absolute limits were exceeded occasionally, although this would be a breach of the Permitted Development Rights scheme. Absolute limits should, under such circumstances be supplemented by a statistical assessment, such as the use of a confidence interval, such that manufacturers can be reasonably certain that the noise generated by the turbine would be within the manufacturers' specified levels under most commonly occurring conditions (for example, 95% of the time).

11 The use of sound power levels for defining noise emissions from plant and machinery is now well established and labelling in accordance with EU Directives on noise enables the consumer to select products on the basis of noise emissions. Under such circumstances, the manufacturer could provide guidance on noise levels of micro-turbines at specified distances and whether or not there may be a risk of exceeding any established noise criterion. Whilst it is recognised that reflecting surfaces may increase the received noise level and obstructions may reduce it, any increase is likely to be limited to approximately 3dB and advice on such matters can be provided in product information and the possible impact of the installation determined. Notwithstanding the methodology used to define noise emissions, the matters discussed in points 1 to 5 above regarding absolute limits would still be applicable and advice from a competent person may be required.

12 The measurement of vibration requires specialist equipment and it may not be practicable to record levels in a furnished and occupied building. Again, the right of access would be an issue. Vibration itself is a complex issue and the level of vibration would be a function of the turbine construction and design, the mounting on the building, the vibration response characteristics of the building structure on which the turbine is mounted and the responses of the elements of the building structure through which the vibration propagates, including the floor. There are also matters of structural integrity of the building - wind loads can be high and the transfer of these loads to the building structure needs to be considered. Part A of the Building Regulations 2000 may be applicable to the installation of a wind turbine on a building and the structural implications of the possible applied dynamic and loads should not be underestimated.

13 The long term aspects of a micro-turbine installation have not been considered in the Consultation Paper. Any mechanical deterioration could lead to an increase in noise and vibration levels in time and thereby cause the turbine to exceed the specified criteria. It was suggested at the IOA meeting that an accredited maintenance regime, with renewable certification might be appropriate to ensure that long term deterioration in the installation does not give rise to an unacceptable impact.

14 The noise and vibration generated by a micro-turbine are strongly dependent on the installation and the view expressed at the IAO

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meeting was that accredited installers were likely to be required to ensure that noise and vibration issues were addressed effectively.

Conclusions

While the Institute is fully supportive of the encouragement of sustainable power generation and appreciates the rationale for simplifying the planning system to facilitate promotion of sustainable resources at a domestic level, it is unable to endorse the proposals for controlling the noise and vibration impact of micro-turbines as presented in the Consultation Paper 1: *Permitted Development Rights for Householder Micro-generation*. The noise and vibration implications of micro-turbines, particularly those mounted on buildings, are, in the Institute's view, too complex to be compatible with the Permitted Development Rights scheme.

The overriding objection to the proposals is that confirmation that any installation meets the proposed limits for noise and vibration is unlikely to be practicable because:

- there is no right of access to the neighbouring property to undertake either external or internal measurements;
- suitable operating conditions and ambient noise levels may not be available for testing;
- testing would require specialist knowledge of noise and vibration measurement techniques and specialist equipment;
- the absolute limits do not take account of the wide variation in operating conditions and use of statistical parameters, such as a confidence interval would be necessary to avoid occasional and insignificant non-compliance.

Noise and vibration effects at any neighbouring property will be the outcome of a complex chain incorporating:

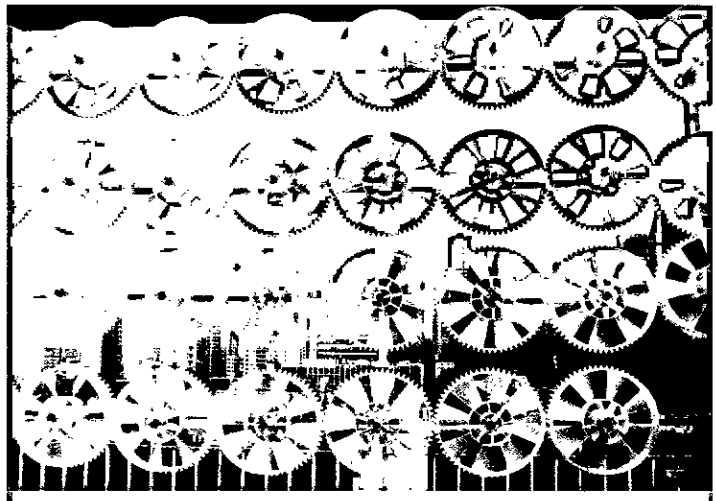
- the noise and vibration characteristics established by design and manufacture;
- the effects of the location and mounting/installation of the turbine;
- the response of the building to the vibration loads imposed by the turbine and its mounting;
- the propagation path, including weather conditions, intervening screening and acoustically reflecting structures;
- pre-existing ambient noise and vibration levels;
- cumulative effects of several installations.

The householder would be unable to resolve these issues and would not be in a position to know whether or not a selected turbine is capable of meeting the criteria when installed and the manufacturer and installer can only be responsible for specific links in the chain. The Consultation Paper does not determine where the responsibility should devolve for ensuring that the installation complies with the proposed criteria. It is, therefore, difficult to see how the proposals can be enforceable. However, the provision of sound power data and advice on distance and the effects of reflections could be provided to assist the consumer to make an informed choice of a micro-turbine to meet any noise limits specified.

It is our view that the absolute criteria specified are not compatible with the fundamental principle expressed at paragraph 34 of the Consultation Paper that permitted development rights should be *informed primarily by their potential impact on others and that the planning system should not be there to regulate development that has no impact beyond the host property*. The limits proposed could potentially result in an impact in those areas where background noise levels are more than approximately 5dB lower than the criteria specified. Additionally the impact on the wider community may not be offset by the relatively small power output generated for the benefit of the host property.

The issue of tonality and other aural characteristics has not been adequately addressed, even though these can result in a higher level of disturbance than would be implied by the overall A-weighted sound level alone.

The issue of vibration has been dealt with too simplistically and account has not been taken of the dynamic loads that may be imposed on a building structure not designed to withstand such loads.



An experimental multi-MWT installation on top of a rail building

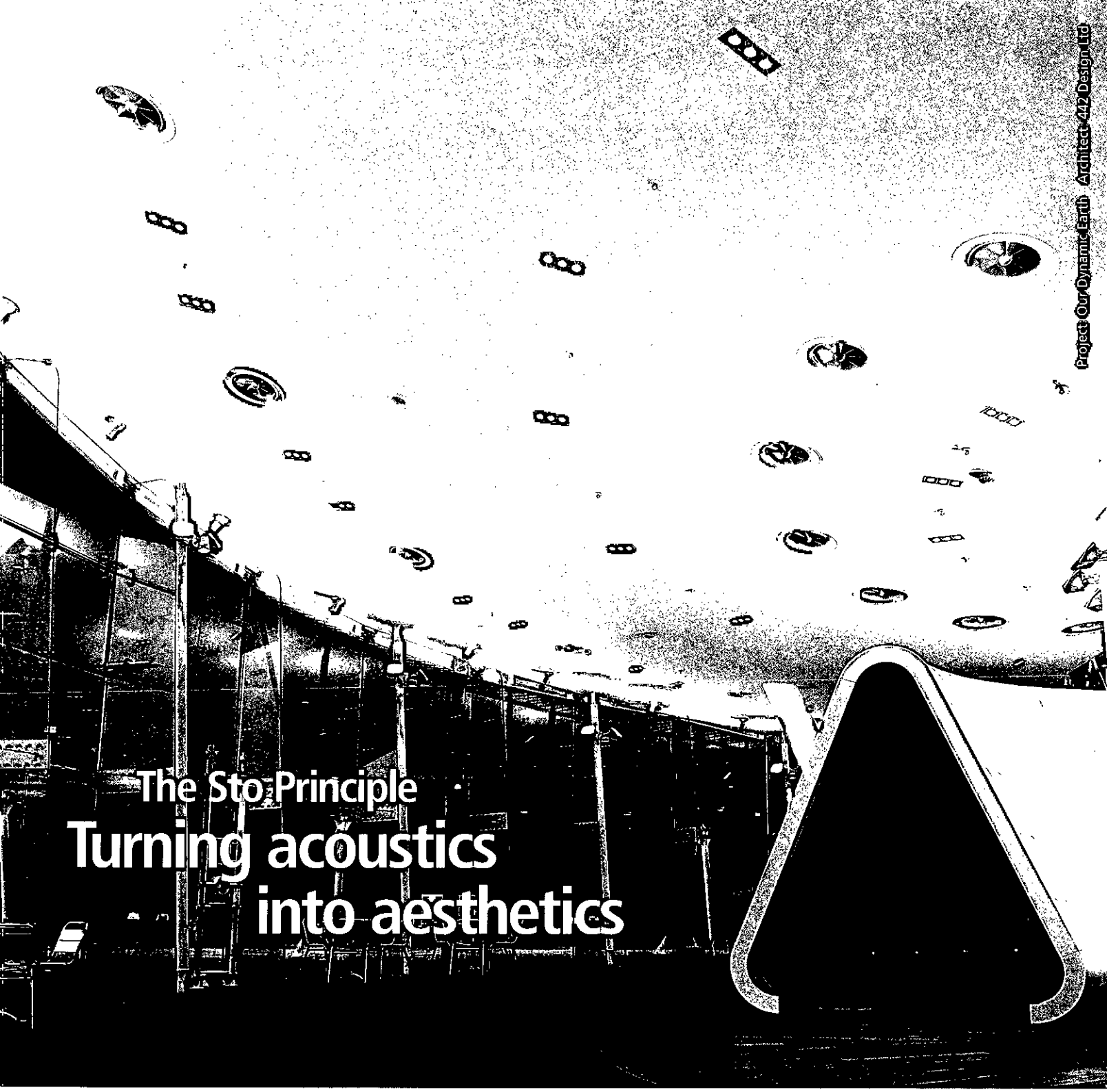
Micro wind energy on a local government office (photo courtesy South Northants Council)

The quality of installation of the turbine will have a significant influence on the generation and structureborne propagation of noise and vibration and it is considered that an accreditation scheme for the installation and maintenance of micro-turbines will be necessary to ensure that the principle of no significant impact at non-host properties, that is the foundation of the Consultation Paper, can be achieved.

The Institute concludes that the noise and vibration proposals in the Consultation Paper are not practicable and further research is needed to determine how the impact of micro-turbines can be defined and expressed in such a way that manufacturers, installers and the householder can be confident that the impact on non-host properties will not be significant. The application of Permitted Development Rights to micro-turbines without a full knowledge of the likely impacts is, therefore, considered premature.

Whilst a detailed assessment of noise from air source heat pumps has not been undertaken, it is considered that the same principles and conclusions would be applicable.

Dr Nigel Cogger CEng FIOA



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Speech and Hearing Group

Helen Nichols. Recent Developments

A call for papers is addressed to those concerned with providing optimal conditions for speech and hearing in schools and other learning establishments. A one-day conference has been scheduled at the Kohn Centre, Royal Society on 29 January 2008. Its mission is to promote understanding, appreciation and development of high calibre solutions for speech and hearing - within their specific physical contexts - and especially with regard to educational environments.

By way of background, the newly reformed national Speech and Hearing Group recently visited two leading educational establishments on the south coast to investigate:

- what happens when theory meets reality?
- what is involved in putting that theory into practice?
- what and who is involved in achieving successful acoustical environments for learning?

Headteachers David Cassar of St Mary's School, Bexhill and Deborah Carter of Ovingdean Hall, Brighton are leaders who put theory into practice within the broader perspective of their multi-disciplinary advisory teams. They are experts in interpretation and application of theory to meet individual special needs of their pupils. This holistic approach to the support of communication difficulties produces environments equipped to enhance learning and teaching experiences for all who attend.

The group was guided by headteachers through sequences of general teaching, specialist (practical) teaching and therapy spaces, communal teaching and social spaces, and spaces for whole-class, for small groups, and one-to-one. As both schools were in session the importance of designed choice for room performance and intelligibility was vividly illustrated.

St Mary's-on-Sea, Bexhill is a non-maintained special school focussing on child-centred development for pupils aged 7-16 and latterly through to 19. It teaches the National Curriculum using an inspired range of facilities and an integrated approach to therapy. The school caters for both day and residential pupils.

Our visit and cross-departmental meetings involved senior management and staffs from therapy, speech and language, audiology, education, pastoral care and social care, together with representatives from facilities management and the husband-and-wife architect team involved in the evolution of the school over 15 years.

Ovingdean Hall, Brighton is a maintained school with a nationwide catchment catering for the severe and profoundly deaf plus additional needs. It supports pupils from nine to 19-plus including high achievers, using a combination of teaching techniques developed over 150 years and the latest audio technology. The school's reputation is for empowering pupils, for proactive work in performing arts and drama, and for standards development in audiology equipment.

These professionals have a complex task: they are dealing with pupils specifically identified for their speech and hearing difficulties. Overlaid on this is a range of conditions from the wider special needs spectrum including secondary physical difficulties, learning, social and emotional difficulties. Over 40% of children with hearing impairment have other difficulties. In the autistic spectrum (ASD), particular distractions can cause a mismatch between presented and received information.

Practical truths emerging from these visits include the following.

- Auditory perception and speech recognition (discrimination) are not the same.
- Cross-departmental meetings pay dividends in terms of benefits for teaching and learning.
- Use of sound field systems is very successfully received, but qualified success is enabled by informed and interested continuing engagement of senior audiology staff who regularly monitor standards and performance.
- The use of 'new' classroom equipment is embraced, but its practical use can tell a different story. For example, the adjustment mechanism for headphones; and the use of PowerPoint presentations deaf awareness training causing the teacher to face the board, *ie'* not face pupils.
- Management is receptive and is prepared to discuss and try new ideas.
- Two-way communication with the manufacturers of equipment pays dividends
- Continuing engagement over 15 evolutionary years had sensitised architects to the appropriate and proven acoustic methods and vocabulary.
- Effective (and active) policy and practice in management of people (users) and space is the key.
- A highly developed use of passive management techniques such as 'quiet zones' is supplemented by proactive pastoral intervention.
- Optimum strategic relationships in terms of space configuration are used as foundation for effective provision.

Speech and Hearing Group at St Mary's School

One-to-one art therapy space

Main hall with 'tack board' ceiling panels

HT introduces the pool hall

The recommended approach to a successful acoustic environment for special needs is a multi-disciplinary approach. Arguably this integrated approach will produce enhanced conditions to support the range of need across the learning and teaching spectrum.

Helen Nichols - Helen is a director of an independent specialist design consultancy for education *'Effective Learning Environments'*. She is an associate member of the Institute Of Acoustics, a chartered architect and an accredited project manager. **www.eleuk.com**

Meeting Notice

IOA Autumn Conference to discuss sources of noise and vibration problems

Whether the problem is health and safety at work or low noise design, understanding the source of noise and vibration problems is critical to identifying effective solutions.

This year's Autumn Conference, organised by the Institute of Acoustics' Noise and Vibration Engineering Group, will cover the broad area of problem solving in noise and vibration engineering, from diagnosis through to the resulting engineering solutions, especially those with a focus on new measurement methods and innovative ideas.

The Conference will return to its successful meeting place, the Oxford Hotel in Oxford and will take place on Wednesday 17 October and Thursday 18 October 2007. An impressive line-up of papers will discuss the control of workplace noise, noise from industrial machines or domestic appliances, and noise, vibration and harshness in the automotive and transportation industries.

One of the highlights of the conference will be the presentation by Trevor Baylis OBE, the inventor of the wind-up radio, of the Institute's prestigious medal, the Young Persons' Award for Innovation. He will also give a presentation on protecting intellectual property. The award is sponsored by IAC Ltd.

The Conference is a must for engineers, designers and safety officers wishing to keep abreast of developments in measurement methods and solutions to practical noise and vibration problems.

For the programme and registration please visit
www.ioa.org.uk/viewupcoming.asp
For further information phone Judy Edrich on **01727 848195**, email: **judy.edrich@ioa.org.uk**

Meeting Report

Jim Smith. North West Branch

DEFRA research into human response to vibration in residential environments april 2007

David Hiller (Arup Acoustics) and Colin Cobbing (Temple Group Limited) jointly presented an overview of their paper 'Research into Human Response to Vibration in Residential Environments', which had been part of the recent Rumble in the (Urban) Jungle meeting. The research was undertaken by Arup Acoustics and Temple Group Limited, with their respective subconsultants Transport Research Laboratory and the Institute of Sound and Vibration Research.

The work, essentially a pilot study commissioned by DEFRA, was intended to provide advice on how best to progress towards a vibration exposure-response study and ultimately allow a more detailed investigation of dose-response relationships.

The research included the development of a bespoke survey questionnaire carefully tailored to elicit the most objective data in response to vibration effects occurring beyond residents' control and to assess confounding factors such as noise. Alongside this, appropriate measurement protocols were developed to allow exposure to vibration to be quantified.

A pilot study was undertaken which trialled the questionnaire and measurement protocol for over a 100 questionnaire and measurement pairings and included measurement locations alongside the East Coast Main Line (railway) north of London and a construction (impact piling) site. Analyses of the results was undertaken as a basis for assessment of the proposed methods.

It was concluded that the Pilot Study demonstrated that the approaches developed and trialled were very successful, providing a robust basis for undertaking a future exposure-response study.

The event was well attended and provoked a stimulating question-and-answer session.

Acoustics engineers help students box clever with sound

Acoustic Ambassadors at Tring School

Getting their message across loud and clear is the aim of acoustical engineers from the Institute of Acoustics, who believe that not enough young people have heard about this exciting business area.

On 11 July 2007, with this in mind, Acoustics Ambassadors (all members of the Institute of Acoustics) Richard Collman from Acoustical Control Engineers, Paul Goring and Gary Timmins from NHBC, David Watts from AIRO Ltd and Ralph Weston from RJD Acoustics joined forces with Setpoint Hertfordshire to present an interesting and fun-filled session with Year 9 students at Tring School in Hertfordshire. The idea of the session was to investigate aspects of sound transmission and insulation through a practical project aimed at raising awareness of the nature of engineering, and in particular, acoustics.

The task was part of a project to teach pupils the basic concepts of acoustics and sound insulation and how to find the best materials to come up with a soundproof and cost-effective solution.

The challenge was for pupils to hold a band practice without disturbing the neighbours. In the guise of members of a band, and using a metal box with simulated drum kit and bass guitar, pupils enthusiastically got to grips with how to use various materials to soundproof the box. The box represented a bedroom in which their band could rehearse on the understanding that they did not make too much noise. An MP3 player and a fan masqueraded as drum kit and bass guitar.

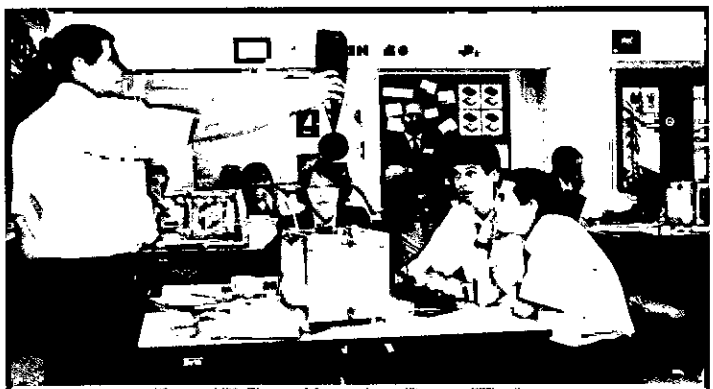
A fictitious grant was up for grabs and students, in teams of three or four, had to compete to find the best way of deadening airborne and structure-borne sound using the test rig with simulated drum kit and bass guitar. Each group had the flexibility to develop its own unique solution. The results were presented by the groups and then tested using a sound analyser to determine the levels of sound escaping from the box. .

Richard Collman from Acoustical Control Engineers, who was instrumental in designing the project, said that science, engineering and specifically acoustics could be fun, and were a good career option. This project introduced several important acoustic concepts such as insulation, absorption and vibration as well as more general ideas such as testing a prototype, evaluating it and refining the design.

Deputy headteacher Lynne Casson added that it was a new experience for the students, one which opened up their eyes to a different career. The project also helped them learn how to communicate and work in a team.

The workshop was organised by Setpoint Hertfordshire in association with the Institute of Acoustics. One of the main aims of the IOA, according to Kevin Macan-Lind, Chief Executive of the IOA, was to promote acoustics to young people and raise awareness of this important sector of industry. The Institute was grateful to Setpoint Hertfordshire which has helped to create Acoustics Ambassadors under their Science, Engineering and Technology Ambassador scheme.

The IOA would like to extend the Acoustics Ambassadors scheme to other parts of the country. If anyone is interested in taking part in the scheme, please contact judy.edrich@ioa.org.uk.



Richard Collman, Acoustical Control Engineers, conducts a test on the winning project

The winning group (the Sound Stoppers), with Harry, Dan and Jamie

IOA appoints Membership and Publications Officer

Nezi Yusuf

The Institute of Acoustics is pleased to announce the appointment of Nezi Yusuf to the newly-created position of Membership and Publications Officer. Nezi will be responsible not only for managing and implementing a membership development plan and a publications strategy, but also for providing support to administrators in the areas of engineering and publicity.

Nezi brings to the Institute a wealth of customer care experience at the highest level working in the travel and airline industries, and most recently for one of the world's top airlines at VIP level. On the relevance of her experience would be to her new position, Nezi said that understanding people's needs were, she believed, essential to generating customer satisfaction, as was a good relationship. She saw her appointment as an exciting opportunity and a challenge to build and develop a good relationship with existing members and to recruit and help maintain the Institute's growth. She aimed to assist and guide members to make full use of the many benefits currently available to them and to add some more tangible benefits for the whole membership to enjoy. She was especially looking forward to learning and understanding the other divisions of the IOA and to working with the Regional Branches.

Nezi's appointment is part of the Institute's continuing strategy to raise its profile. Her experience will be invaluable in improving services to current members and recruiting new members and she will provide much-needed assistance to other members of the team.

Nezi Yusuf

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Sound Insulation and The Code for Sustainable Homes Conference

(6 months into the Code)

Wednesday 24 October 2007
Austin Court, Birmingham

6 months after The Code for Sustainable Homes has been published, how are housebuilders, architects, accousticians, building control, manufacturers and many other professions meeting the challenges? This conference aims to address some of the key regulatory issues, acoustic design and cost factors to maximise your credits.

For more information or a booking form contact:
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One-Day Conference
Austin Court, Birmingham, 23 October 2007

Sound Insulation Measurements in Residential Buildings
Three years to a 97% pass rate

The current requirements for resistance to the passage of sound in residential dwellings under the Building Regulations came into force in England and Wales on 1st July 2003.

The most notable change was the introduction of pre-completion sound testing and for this the Association of Noise Consultants established a scheme for registering selected employees of the Association's Member Companies to undertake the required measurements.

To date 280 individuals from 64 Member Companies have been registered and since 2003 over 85,000 measurements of airborne or impact sound insulation have been made under the Scheme at over 13,000 sites.

This one-day conference provides an opportunity for all involved with pre-completion testing including acousticians, architects, building control officers and builders to exchange experience gained so far and to explore the most pressing issues.

On the following day HBMedia are holding a one-day conference at the same venue on noise aspects of the Code for Sustainable Homes.

Provisional Programme

- Sound Insulation, PCT and the ANC Registration Scheme
- ANC Round Robin Exercise & ISO 140
- ANC/BRE/RDL Research Project
- ANC Good Practice Guide
- Role, Training and Responsibilities of the Acoustic Consultant
- Selected ANC Registration Scheme Statistics
- Common Causes of Failure
- The Role of Building Control
- UKAS Accreditation

Web site: www.anc-pct-conference.com

Further Information:
Cathy Mackenzie Management Services
Tel 0151 638 0181 email anc@cmrl.demon.co.uk

A two-day international conference

to address process of accurate detection and identification of underwater targets

The accurate detection and identification of underwater targets continues as a major issue, despite, or as a result of, the promise of higher resolution underwater imaging systems. With the additional threat of terrorist activities as well as traditional warfare-based applications the problem has now expanded.

With the increasing deployment of autonomous underwater vehicles for mine countermeasures applications, the automated processing of the large volumes of data gathered by these vehicles to detect and classify targets has become a critical task. Numerous techniques have been proposed for computer aided detection (CAD) to detect all possible mine-like objects, and computer aided classification (CAC) models to classify whether the detected object is a target or not. The question remains as to whether the perfect technique can be found for all applications, or if the answer lies in collaboration and data fusion.

The detection of objects is hampered in environments such as shallow water or in regions of complex cluttered seabeds with rock outcrops or seaweed. The design of targets is also becoming more sophisticated to hamper detection, with cladding to disguise the shape of the target or attenuate the reflection. One of the most complex to detect is a buried target, and the problems of detecting these using conventional systems suggests that a novel approach is required using new sensors, signals or multi-static deployment techniques.

The Institute of Acoustics will be holding a two-day conference on 18 and 19 September 2007 to address the entire process of detection and identification, encompassing the design of sensors (both acoustic and others) to aid detection, deployment strategies, signal design and target scattering, as well as CAD/CAC processing algorithms. It will also encompass diver detection, harbour surveillance and marine mammal detection as well as the detection of mine-like targets. The conference is organised by the Underwater Acoustics group of the Institute of Acoustics and will take place at Heriot-Watt University, Edinburgh. It is sponsored by QinetiQ and the Edinburgh Research Partnership in Signal and Image Processing.

Judith Bell from Heriot-Watt University, organiser of the conference says that it is aimed at researchers in the underwater acoustics community as well as developers of sonar equipment. It would be an exciting conference attracting delegates from across the world. It would be the first time a conference of this nature had been organised in the UK and an extremely interesting meeting was anticipated.

Further details and the programme can be found on the IOA website at **http://www.ioa.org.uk/viewupcoming.asp** or telephone Judy Edrich at **01727 848195**, email: **judy.edrich@ioa.org.uk** .

Missing Kit

Network Rail sound measurement equipment was stolen from Elstree & Borehamwood Station some time between Wednesday 1 and Monday 6 August 2007.

The equipment was a Norsonic type 118 sound level meter, serial no.28281, a Gras type 41AL outdoor microphone, serial no.33658, and a large black Peli case containing batteries and associated cabling.

If you are offered instrumentation in unusual circumstances, or have any information as to the whereabouts of this equipment, please contact Simon McHugh, Acoustic Design Engineer, for and on behalf of the Temple Group for Network Rail, on **0207 0233 196**, mobile **07920 588291**, email **Simon.McHugh@networkrail.co.uk** . Any help would be greatly appreciated and all information will be held in the strictest confidence.

IOA certificate pass list

Certificate Name: Workplace Noise Risk Assessment
Exam Date: 23 March 2007 - Pass Candidates

Colchester Institute
Jackson A
King J
Sherred R
Smith N
Street T

University of Derby
Abram M J
Edwards D R
Harpham R
Joy P R
Short A C
Smith D
Stokes J G
White J

EEF East Midlands & Mid Anglia
Graham C A
Martin J
Sangwine D W

EEF Sheffield
Allwood R
Church D J
Kittle R
Morris M P
Rayns M C
Thompson A

Institute of Occupational Medicine
Little J
McKeown S
Miller D
Rogers L M
Stern D

NESCOT
Costa L P
Monk-Steel A D

Rapid Results College
Barker A
Debnam W
Nichol C A
O'Higgins M
Roulston M G
Tonks D
Willis L J

University of Ulster
Doyle L
Macphee I C T
Quinn G
University of the West of England
Conway C G
Harris C
Petty F
Powell A RA
Shaddick R S

Certificate Name: Hand-arm Vibration
Exam Date: 24 April 2007 - Pass Candidates

EEF Sheffield
Armstrong C E
Dixon L A
Johnson J

Institute of Naval Medicine
Currie G
Hall T J
Smith I W
Smith J D
Williams M J

Certificate Name: Environmental Noise Assessment
Exam Date: 18 May 2007 - Pass Candidates

Bel Educational Noise Courses
Buchanan L
Connolly H
Doherty J
Duffy D
Jorgensen G
MacNiven M K
Matassa P
McClung J
McCoull L J
Patterson S
Shepherd H
Slater G
Sturrock R M

University of Birmingham
Ellis T J
James R L
Jenkins A
Murray R J
Williams R

Colchester Institute
Burke A M
Cheong M A
Conner M A
Corthorn P J
Dearing M P
Durup N D
Greenhalgh J
Khan A
Morris K
Reed N L
Shearman A J

University of Derby
Varley A F

EEF Sheffield
Campuzano A
Frary I
Holdsworth P J
Kierek-Bell A
McDonald R
McGilp S D
Nattrass R H
Paynter B
Smith R A

Leeds Metropolitan University
Alexander I J
Bryce L M M
Neatis M J
Newham J
Russell S

Liverpool University
Adamson J L
Baker S J
Bradshaw S
Dixon S
Garnett M P
Magadia T D
McCloskey S
McClymont J D
McDonald F L
Morgan A D
Oakes I L
Pearson D
Watt L

NESCOT
Bayles D S J
Beattie S
Chan N Y C
Dando M H
Gallagher G C
Horwood D
Jordan P J
Ko I
Oxborough E
Phillips J J
Smith R
Stone K N
Sudi Z D
Talbot M P
Valpondi P
Webb C
Webb S A
Wilson J

University of Strathclyde
Hardaker D I
Hyslop J
Mann A
McGhie M S
McIntyre S
Mowat R G
Mulders A J
Stevenson K R
Sutherland C D

University of the West of England
Allday K A
Bird R M
Hammond J
Southby H R
Widdecombe C

Sound insulation design of modular construction housing

David Yates

Introduction

This article attempts to provide an insight into the acoustic issues of modular housing using the Verbus system of construction. It briefly summarises the history of the development of Verbus modular housing and the acoustic design considerations of the process. Results are presented from two sound insulation tests conducted during the course of the project. The results are discussed in terms of compliance with Approved Document E[1] and increased performance standards such as EcoHomes[2].

Background to Verbus

Verbus Systems is a supplier of prefabricated modules designed primarily for use in the construction of residential developments. The system is designed to reduce construction time, reduce environmental impact and speed up fit-out.

The Verbus system aspires to provide sustainability to the building design. The system has the ability to be recycled, refurbished, relocated and resized, which can provide cost savings that are then available to improved internal environments in energy efficient systems and internal finishes. Verbus aspires to meet best practices in sustainable building design and construction, such as EcoHomes and BREEAM.

A Verbus unit is a monocoque steel structure built with shipping container technology from corrugated sheet steel and rolled steel sections. Units can be stacked vertically up to 16 storeys high to form the structural frame of a building.

The units are pre-fitted at the production stage with thermal insulation and plywood lining. Electrical, mechanical and plumbing services can be pre-fixed to the units, with the possibility of installing plasterboard finishing and prefabricated bathroom pods. The completed Verbus frame is clad on site using standard cladding systems to give the finished appearance of a conventional building.

The aim of Verbus is to produce a design solution that would be easily repeated and constructed, and hence in terms of acoustics it would achieve a 'robust detail' status.

Initial acoustic issues with design of Verbus System

Compliance with standards

The minimum standards for acoustic compliance for residential or dwelling rooms are stated in The Building Regulations Part E (see Table 1). Hotel operators often refer to their own criteria which can be more onerous. Increased sound insulation performance criteria can be found in the Building Research Establishment's (BRE) Guide BR406 'Specifying dwellings with enhanced sound insulation'[3].

New building developments are often required to meet certification standards which include improved sound insulation performance between living spaces. As an example the EcoHomes certification provides minimal points for meeting Approved Document E but awards extra points for achieving a 3dB or 5dB increase in airborne sound insulation and a 3dB or 5dB decrease in impact sound insulation values set in Approved Document E.

Façade design for a Verbus System building has to be assessed on a site-by-site basis owing to variance in external noise levels from location to location. Typically the combined cladding and modular construction will be specified to meet World Health Organisation internal ambient noise level standards[4] or a similar criterion.

continued on page 18

Sound insulation design... - *continued from page 17*

Design considerations for the modules

Verbus containers are constructed from a lightweight steel structure, which without proper detailing could provide a weak resistance to sound propagation for both airborne and impact sound. The added factor of small self-contained units might cause an uncomfortable environment in terms of quality and perception.

The level of airborne sound insulation the existing module container could achieve was unknown at the early stages of design. A construction using 2 x 9mm plasterboard sheets, connected to 10mm plywood, supported on 75mm L-section brackets with 40mm of mineral wool in the cavity, was expected to provide the required airborne sound insulation. The void between the 1.4mm thick steel walls of the container varies between 20mm and 55mm (Figure 1).

Floor construction designs are similar to the wall constructions, replacing the plasterboard with plywood for the floor finish. These were to include a resilient pad or layer between the bracket and the plywood, to control impact noise (Figure 2).

Owing to concerns regarding flanking paths, the support pads for the modules were designed to include a resilient layer to reduce the transmission of structure-borne noise through the connectors. The design specified a resilient material with a constant bulk modulus which would alter in area to achieve the required stiffness. The required stiffness or resilience between modules in a multi-storey development (effectively a multi-degree-of-freedom system) varies with height. The location of the resilient material also provides protection against noise due to thermal movements.

Connection of the modules is based on variations of standard module connectors for shipping containers (Figure 4). The connectors potentially provide flanking paths directly between neighbouring modules.

The initial design proposed two solutions that included resilient material to reduce the structure-borne noise transfer. In practice the thickness of the resilient material that could be used in the connectors is limited owing to the small tolerances involved in the design of the connectors. The proposed design of resilient materials in the connectors provided excessive friction in the locking mechanism and therefore could not be used.

Vertical circulation such as stairwells and lifts can be accommodated in an independent module, thereby providing isolation and reducing structure-borne noise transfer.

Prototype development

A prototype of three units of Verbus System modular housing was available for sound insulation tests in February 2005. The prototype was specified and constructed to represent a possible single dwelling containing living areas, a bedroom, kitchen and bathroom.

An unexpected practical problem occurred in the prototype modules. Transportation of the container required the application of a dry, airtight seal to the module. Once opened and subjected to humidity, the floor construction buckled. This was resolved on subsequent developments by not completely de-humidifying the container at pre-shipping stage.

It was noticed after module assembly that the connectors for each module were left without the resilient material and no provision had been made to control the flanking path for structure-borne noise transfer via the connector. The acoustic tests therefore reflected 'worst case' flanking conditions.

As the prototype was a single dwelling, there were no possible horizontal partitions to perform SI testing and therefore the results at this stage solely reflect the vertical airborne sound insulation properties.

Trapped air pockets gave issues of vibration and panel resonance of the floors. On the prototype the perimeter of the module between the ground and first floor modules had been sealed to provide thermal insulation. The air trapped between the modules was found to be stiff enough to cause increased vibration transfer through the floor when excited by heavy impacts (for example, a person jumping). This did not affect impact noise results directly but the phenomenon requires further investigation.

Design Development

Testing

The first building to use the Verbus system for construction and available for acoustic testing, was an extension to the Travelodge on the A36 Warminster

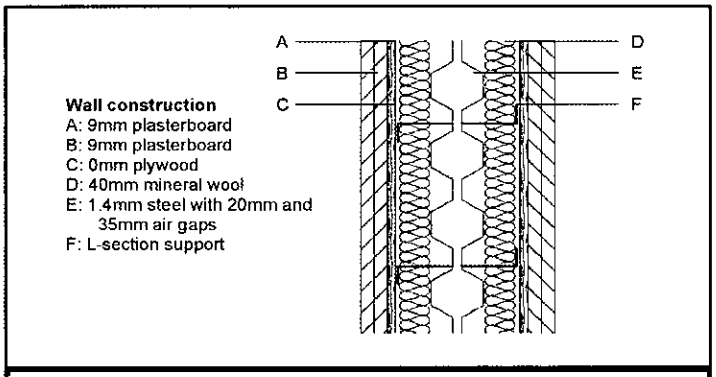

Figure 1

Typical wall construction of Verbus module

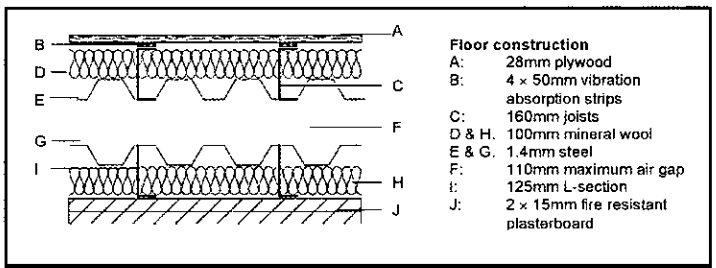

Figure 2

Typical floor construction of Verbus module

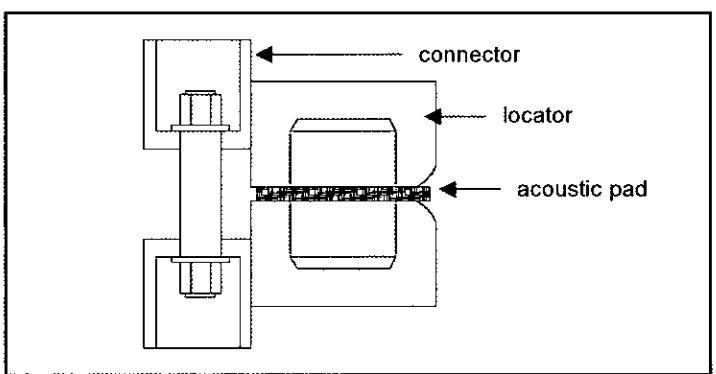

Figure 3

Detail of connector and locator with resilient material between vertical units

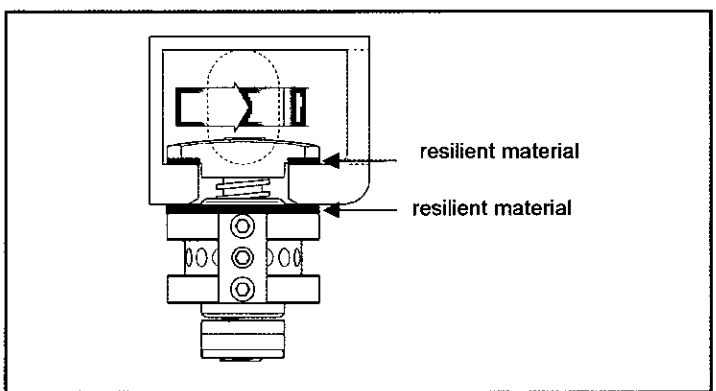

Figure 4

Detail of the initial design of connector

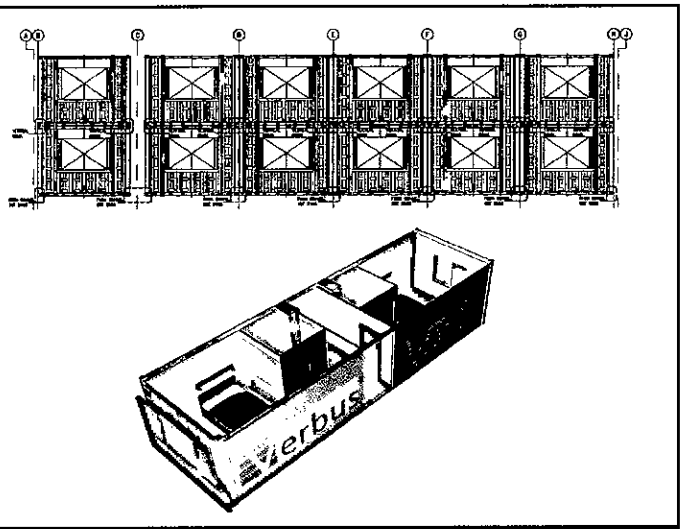

Figure 5

Elevation of Travelodge Warminster, and layout of a typical unit

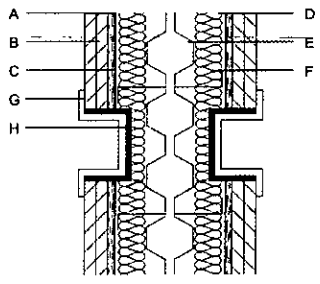

Figure 6

Wall construction detail for Travelodge Warminster

Figure 7

Construction at Travelodge Warminster:
(a) locator and resilient pad; (b) locator, connector and resilient pad

bypass. The extension consists of two Verbus units vertically and six units horizontally, adjacent to the original Travelodge building. There are two bedrooms in each module, with a corridor running down a central spine. A prefabricated bathroom pod is located within each bedroom (Figure 5).

The building was tested for compliance with Part E and to Travelodge's own requirements. The tests included three full sets (airborne wall test, airborne floor test, and impact floor test) to ensure that over 10% of rooms had been tested. All tests were conducted in accordance with ISO 140-4:1998 *Field measurement of airborne sound insulation between rooms*[5] and ISO 140-7:1998 *Field measurement of impact sound insulation of floors*[6].

This construction did include the resilient pads between modules (Figure 3), although the primary reason was to control potential noise due to thermal movements. These were only intended to eliminate the direct metal-to-metal contacts between units, not to reduce flanking noise, so they could be bridged to increase structural integrity.

Travelodge fit-out requirements have changed since this project was built, but at the time, back-to-back recessed sockets were called for in each room. The electrical sockets were recessed through the plasterboard and plywood inner wall linings, although they remained within the steel container module forming each room.

It was agreed that relying on the plastic sockets with thin steel on either side of the rooms would not be sufficient, and proprietary putty pads were used to seal round the back of the recessed sockets for additional protection (Figure 6).

It was not possible to box-in the backs of the sockets with plasterboard, as there was limited space between the rear of the socket boxes and the steel module wall.

Figure 6: Wall construction detail for Travelodge Warminster

Results

The results of the tests on the prototype can be seen in Tables 3, 4 and 5. The EcoHomes targets are included for comparison.

Based on the results from Warminster Travelodge, the Verbus module system is compliant with the minimum standards set out in Approved Document E. Besides achieving these minimum levels, the results verify the partition's high level of performance for airborne sound insulation and impact sound insulation, with the majority of tests achieving the maximum EcoHomes rating. The results also comply with standards for Scotland[7].

The results confirm that the required standards can be achieved without resilient material in connectors and locators.

Figure 9 is a typical D_{nT} curve for a horizontal test on a Verbus partition, and Figure 10 is a typical D_{nT} curve for a vertical test.

Figure 11 and Figure 12 show the D_{nT} curves for room 6a impact tests, with and without carpet.

Future work

Future work will include an assessment of the trapped air pocket between two units stacked vertically, discovered at the prototype stage. This effect has only occurred between one pair of units.

Proposed design changes to Verbus modules include alternatives to the resilient layers used between modules in the Warminster Travelodge, and different wall constructions. Investigations are under way on various types of plastic material which will reduce the coefficient of sliding friction between module connections, as this material does not specifically have to be resilient. Changes are being made to the wall construction linings, for reasons of fire safety.

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Sound insulation design... - *continued from page 19*

It would be interesting to see the overall effect of the proprietary putty pads used to seal behind recessed sockets, especially in order to find out if the pads significantly affected the acoustic performance of the partition. It may be possible to omit them, as a cost saving.

Summary

The Verbus modular system can successfully meet sound insulation standards for dwellings or rooms for residential purposes. The standard module will comply with the performance requirements in Approved Document E.

The modules provide sufficient sound insulation to meet increased performance standards. The first full construction has shown that the modules are capable of gaining maximum credit under the EcoHomes certification rating.

The Verbus system is undergoing a continuous design process. Knowledge gained through amendments to the design will be included in the further development of constructions using the Verbus system. Further investigations into the design, and the increase in the number of developments using the method will, it is hoped, allow the system to be adopted as a 'robust detail'.

This article is based on the paper presented by David Yates, Buro Happold Ltd, London, at the Institute's 2007 Spring Conference, co-written by L Hughes, Buro Happold Ltd, Newcastle-on-Tyne, and A Campbell, WSP, Bristol

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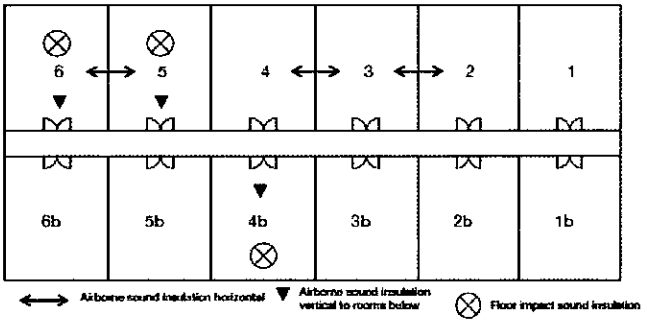

Figure 8

Plan view of test arrangement

		airborne sound insulation $D_{nT,w} + C_{tr}$ dB (minimum values)	impact sound insulation $L'_{nT,w}$ dB (maximum values)
dwelling-houses and flats	walls	45	
	floors and stairs	45	62
rooms for residential purposes	walls	43	
	floors and stairs	45	62
enhanced sound insulation (BR406)	walls	50	
	floors	52	55

Table 1

Sound insulation values for compliance with Part E and BR406

measurement direction	Part E $D_{nT,w} + C$ (dB)	result $D_{nT,w} + C$ (dB)	Part E $L'_{nT,w}$ (dB)	result $L'_{nT,w}$ (dB)
ground floor bedroom to first floor	43	62		
first floor to ground floor bedroom	43	60	62	30

Table 2

Verbus prototype testing results

Horizontal airborne sound insulation test				
measurement direction	Part E $D_{nT,w} + C_{tr}$ (dB)	EcoHomes maximum credit rating, $D_{nT,w} + C_{tr}$ (dB)	result $D_{nT,w} + C_{tr}$ (dB)	compliance
2a → 3a	43	48	50	pass
3a → 2a	43	48	52	pass
3a → 4a	43	48	53	pass
4a → 3a	43	48	52	pass
5a → 6a	43	48	49	pass
6a → 5a	43	48	47	pass†

† More than 3dB above Part E gives EcoHomes credit rating of 3 points

Table 3

Horizontal sound insulation test results from Warminster Travelodge

Vertical airborne sound insulation test				
measurement direction	Part E $D_{nT,w} + C_{tr}$ (dB)	EcoHomes maximum credit rating, $D_{nT,w} + C_{tr}$ (dB)	result $D_{nT,w} + C_{tr}$ (dB)	compliance
6a (1F) → 6a (GF)	43	48	55	pass
6a (GF) → 6a (1F)	43	48	54	pass
5a (1F) → 5a (GF)	43	48	57	pass
5a (GF) → 5a (1F)	43	48	55	pass
4b (1F) → 4b (GF)	43	48	54	pass
4b (GF) → 4b (1F)	43	48	64	pass

Table 4

Vertical sound insulation test results from Warminster Travelodge

Sound insulation design... - *continued from page 20*

Impact sound insulation test				
measurement direction	Part E $L'_{nT,w}$ (dB)	EcoHomes maximum credit rating $L'_{nT,w}$ (dB)	result $L'_{nT,w}$ (dB)	compliance
6a no carpet	62	57	54	pass
5a no carpet	62	57	55	pass
4b no carpet	62	57	55	pass
6a with carpet	62	57	26	pass
5a with carpet	62	57	28	pass
4b with carpet	62	57	27	pass

Table 5

Impact sound insulation test at Warminster Travelodge

Scottish Building Regulations			
measurement direction	BS EN ISO 717-1 and 717-2 mean value	mean result	compliance
walls $D_{nT,w}$ (dB)	53	57	pass
floors (airborne sound insulation) $D_{nT,w}$ (dB)	52	65	pass
floor without carpet (impact) $L'_{nT,w}$ (dB)	61	55	pass
floor with carpet (impact) $L'_{nT,w}$ (dB)	61	27	pass

Table 6

Arithmetic average of results compared with Scottish Building Regulations

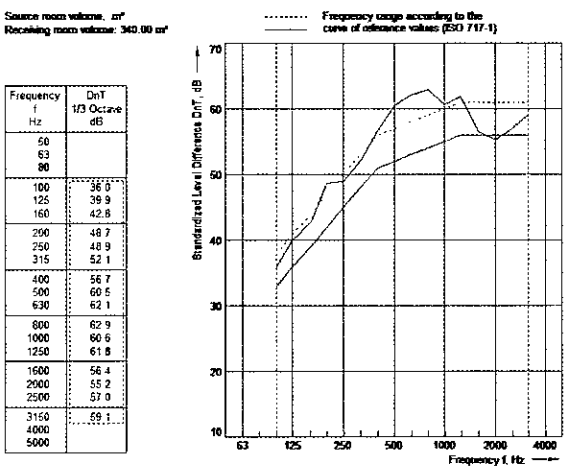

Figure 9

D_{nT} curve for horizontal airborne sound insulation test 3a to 2a

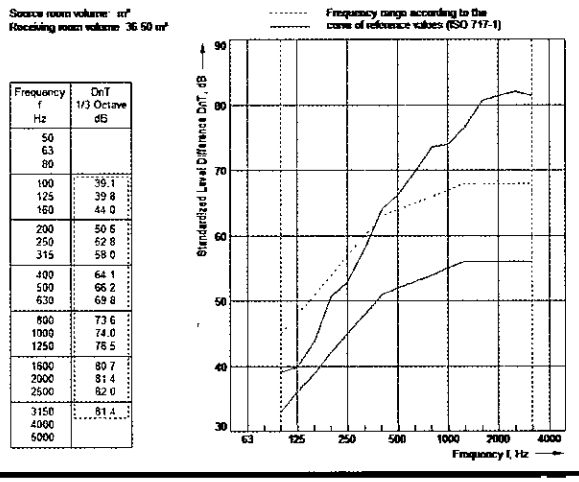

Figure 10

D_{nT} curve for vertical airborne sound insulation test for 6a first floor to ground level

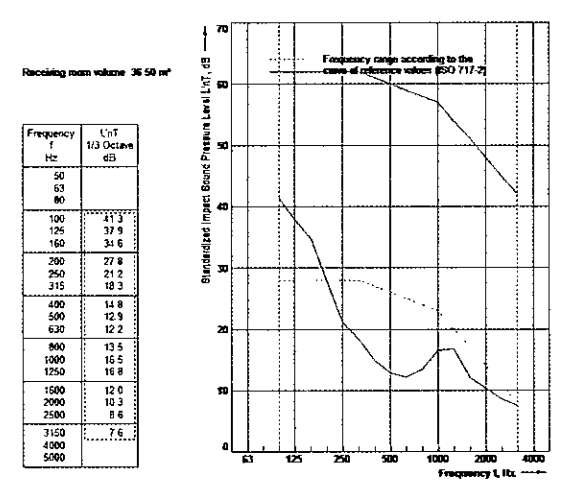

Figure 11

Typical curve for impact sound insulation with carpet

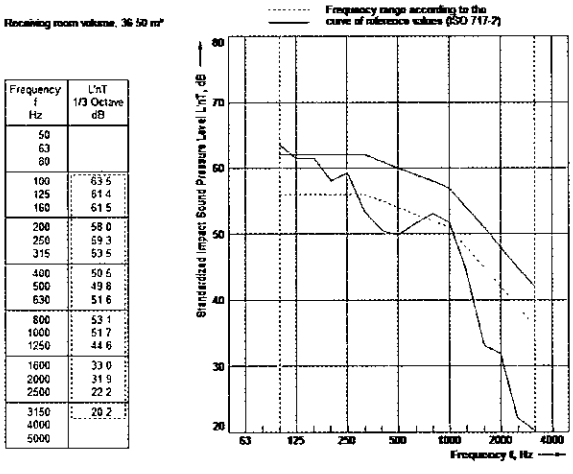

Figure 12

Typical curve for impact sound insulation without carpet

Marine environmental risk management

Colin Schofield

The potential impact from the operation of human-made systems on the wider environment, and in particular on animal life, is an area of increasing public awareness, scientific understanding and, also legislation. Assessing the potential impact of system operation by preparing an Environmental Impact Assessment (EIA) is a complex interaction between the system, the environment it is placed in and the species that may (or may not) be in that region. Performing this assessment by hand is a time-consuming and complex process requiring significant knowledge bases. Automating such assessments will be a major step forward in mitigating any potential impacts by allowing EIAs to be generated flexibly as the scenario unfolds.

The Environmental Risk Management Capability (ERMC) brings together a wide range of expertise across the acoustics arena including, sonar design, ocean modelling, marine biology and bio-acoustics to automate the production of EIAs for underwater noise. Initially, this work is being performed to assess the impact of Royal Navy sonar operations (trials, exercises and use) but the methods can also be applied to the assessment of other noisy underwater systems, and eventually to other 'pollutants'. This article describes how the research, data management and industrial community is working together to develop this capability and the methods being proposed.

Issues

The potential impact of the operation of human-made systems on the wider environment, and in particular other animal life, is an area of increasing public awareness, scientific understanding and, also legislation. The factors affecting Royal Navy (RN) operation of sonar systems in UK coastal waters serve as an example. The potential effects of these operations have been highlighted by the growing media and public concern that the use of active sonars has, in some cases, been linked to the stranding of marine mammals. Such RN operations in peacetime are assessed using the Environmental Impact Assessment (EIA) technique in order to provide evidence that the risk to marine species is as low as reasonably practical. EIAs have to assess:

- The characteristics of the sonars in question
- The nature of the operations to be conducted (timescale, purpose, location)
- The environmental conditions at that time of year (propagation effects)
- The density and behaviour of the various marine species in the surroundings (Figure 1)
- The sensitivity of each species, or group of species, to sound
- The legislation regarding protected areas and endangered species, which varies between countries and regions
- The security aspects of producing a publicly available EIA report concerning system and operations, which have secure aspects that cannot be detailed.

The assessment thus has to bring together systems knowledge, operational knowledge, environmental knowledge, biological knowledge and, last but not least, legal knowledge. In planning such operations, the collected body of this knowledge can be brought together. However, for flexible operations at sea the knowledge has be built into a system that is operable by the ship's staff, who may be experts in the system in question but will have very little knowledge of the biodiversity, its sensitivity and the legal protection status of the locality.

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Marine environmental risk management - *continued from page 23*

Although this article discusses the problem with reference to RN sonar operations, the same complexities and processes apply to commercial operations at sea; including oil and minerals exploration (seismic profiling) and construction works (eg offshore wind farms).

Legislation

The legislation in this area defines various species that have some level of protection, and regions of the seas and coastlines that have some protected status. Example conventions and legislation protecting cetaceans in the North West Approaches to the UK are shown in Figure 2.

However, no consistent source of legislation actually exists, with UK, European Union, and other nations' legislation all being different. Many learned bodies, such as the World Conservation Union (IUCN) have tried to classify the extent to which different marine species are endangered but the data about many are sparse and reaching consistent conclusions has proved difficult. However, if a species is endangered then generally its numbers are relatively low and its habitat well defined. In these cases, setting up exclusion zones around the habitat is a sensible approach. The difficult exceptions are those species that are relatively sparse and roam over wide areas, because it is difficult to estimate their populations, difficult to predict densities in a region and difficult to assess their sensitivity.

The RN is a global navy: operations may occur in UK, European, US, Mediterranean, Gulf, and Australasian waters, so the legislative cover and data cover has to be commensurate with this global capability.

The Global EIA

For the last few years, as the RN has been conducting trials and exercising sonars, a paper-based EIA process has been developed, primarily by QinetiQ. The so-called Global EIA for sonar system usage (particularly Sonar 2087) was published by the MoD on its web site[2] for all to see, as an example of how the risks are being assessed and mitigated in practice[3].

The EIA details the application of the MoD's environmental policy as captured in the JSP 418 Environmental Manual, which includes the following:

- The MoD and its Agencies are required to demonstrate compliance with the letter and the spirit of the Environmental Protection Act (EPA) and Environment Act (EA) which apply to all service and civilian personnel, and with all other existing environmental legislation
- Crown or defence exemptions from legislation may only be invoked where essential to maintain operational effectiveness
- The MoD recognises all international conventions to which the UK is a party
- The MoD supports the protection and enhancement of the natural environment in line with the Government's environmental strategy, and the principles of stewardship and sustainability, within overriding operational and financial constraints
- The MoD and its Agencies will strive to be good neighbours at home and abroad.

The EIA then details modelling of the potential effects of a sonar against a set of agreed thresholds based on the perceived risk to a 'generic' mammal whose audiogram lies below that of all measured marine mammals. The precautionary generic audiogram used is shown in Figure 3.

Assessments are performed using this audiogram to derive the regions of potential impact for:

- Diver aversion
- Permanent threshold shift (PTS) – a permanent loss of hearing sensitivity.
- Temporary threshold shift (TTS) – a temporary loss of hearing sensitivity.
- Beaked whales

For each of these assessments, a number of stand-off ranges (SORs) can be predicted which effectively represent the minimum clear region around the sonar or the minimum clear distance away from a protected region that must exist for safe operation of the sonar. To find the stand-off ranges the process is akin to that used in industrial situations but the question is reversed. In the industrial situation the noise exposure is predicted for the workplace to determine if (and what) hearing protection is required. In contrast, in this

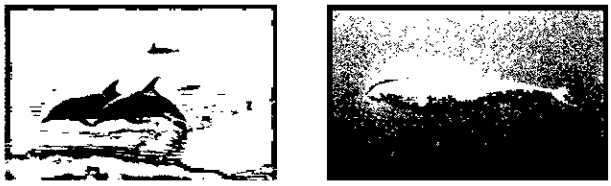

Figure 1

The potential impact of the operation of human-made systems on the wider environment, and in particular other animal life (such as dolphins and beaked whales), is an area of increasing public awareness, scientific understanding and legislation.

Common name	Cetacean legislation and conventions for NW Approaches						
	W & C	Bonn	Bern	Bio-Div	CITES	Habitat	IUCN
Harbour porpoise	V	II	II	P	II	II, IV	VU
Risso's dolphin	V	II	II	C	II	IV	DD
Common dolphin	V	II	II	C	II	IV	
Bottlenose dolphin	V	II	II	C	II	II, IV	DD
Killer whale or orca	V	II	II	C	II	IV	CD
Striped dolphin	V	II	II	C	II	IV	CD
Northern bottlenose whale	V	II	II	P	I	IV	CD
Cuvier's beaked whale	V	II	II	C	II	IV	DD
Sperm whale	V		III	P	I	IV	VU
Sowerby's beaked whale	V	II	II	C	II	IV	DD
Fraser's dolphin	V		III		II	IV	DD
Narwhal	V	II	III	C	II	IV	DD
Beluga whale	V	II	III	C	II	IV	VU
Minke whale	V		II	P	I	IV	NT
Fin whale	V		II	P	I	IV	EN
Sei whale	V		II	P	I	IV	EN
Humpback whale	V	I	II	P	I	IV	VU
Northern right whale	V	I	II	P	I	IV	EN
Blue whale	V	I	II	P	I	IV	EN

	Description
W & C	Wildlife and Countryside Act (1981) Schedule: V= protected species
Bonn	Convention on Conservation of Migratory Species of Wild Animals
Bern	Convention on the Conservation of European Wildlife and Natural Habitats Appendix: II: strictly protected endangered and vulnerable animals; III: protected animals
Bio-Div	UK Bio-Diversity Action Plan conservation status: P: Priority species, *ie* globally threatened or rapidly declining in the UK (50%+ in 25 years); C: species of conservation concern
CITES	Convention on the International Trade in Endangered Species Appendix: I: species threatened with extinction; II: vulnerable species
Habitat	Directive on Conservation of Natural Habitat and Wild Fauna and Flora Appendix: II: species requiring the designation of protected areas; IV: protected species
IUCN	IUCN Red Data List Designation: EN: endangered, VU: vulnerable; CD: conservation dependent; NT: near threatened; DD: data deficient.

Figure 2

Example conventions and legislation protecting cetaceans in the NW approaches (taken from Pooley (2000)[1])

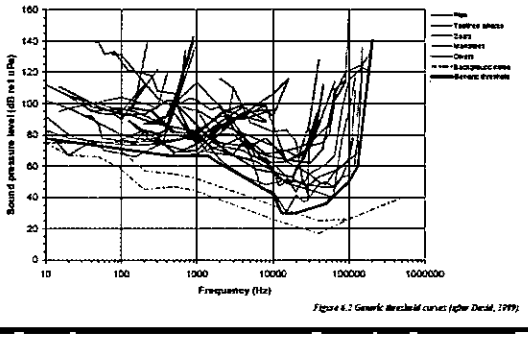

Figure 3

Generic threshold curve from the global EIA

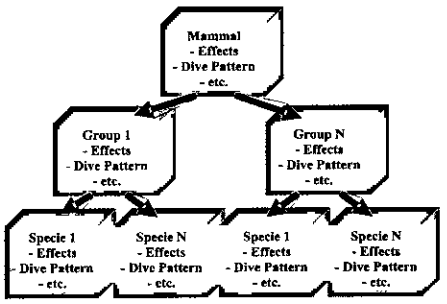

Figure 4

A hierarchical approach has been adopted. If data from a particular species are available they are used. If unavailable, data from other species in the same genus are used. In the worst case, any similar marine mammal or a precautionary generic marine mammal parameter is used.

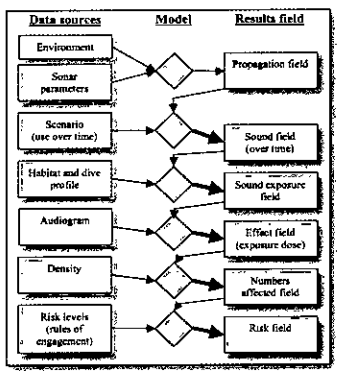

Figure 5

The sound exposure response modelling approach utilised within ERMC(S) uses a flexible set of modelling components that can be developed to appropriate levels of fidelity independently.

case the assessment is essentially deriving how far from the sound source the affected object must remain so as not to need any protection - hence the term 'stand-off range'.

Each stand-off range is calculated from an assessment of the noise exposure of the 'generic' mammal calculated in a way that parallels the personal noise exposure of an employee (HSE 1989)[3].

$$L_{EP,A} = 10\log_{10}\left\{\frac{1}{T_0}\int_0^{T_0}\left[\frac{p_a(t)}{p_0}\right]^2 dt\right\}$$

This equation is modified as follows to allow integration of sonar pulses over a day:

$$L_{EP,d} = 10\log_{10}\left\{\frac{1}{28800}\sum_{t=0}^{t=24hr} 10^{\frac{SPL-GTV}{10}}\delta t\right\}$$

Where SPL is the sound pressure level due to the sonar, GTV is the generic threshold value at the frequency of interest, and the summation covers a duration of 24 hours. What remains is to agree the sound exposure for mammals that results in a TTS or PTS. The values used are derived from work by David[3] where exposure levels of 75dB and 95dB above the reference threshold were the lowest levels that caused any observable TTS and PTS effect in fish, marine mammals or submerged human beings.

From these limits can be determined the maximum sound pressure level in the water that can be sustained (a PTS threshold and a TTS threshold based on the generic threshold value and the total duration of the sound, T). Hence, the distance from the sonar at which the sound level drops beneath these

Probability\Seriousness	Catastrophic	Critical	Marginal	Negligible
Frequent	A	A	A	B
Probable	A	A	B	C
Occasional	A	B	C	C
Remote	B	C	C	D
Improbable	C	C	D	D
Incredible	C	D	D	D

Figure 6

The risk classes A, B, C and D signify the level of risk associated with the probability of an event related to the seriousness of an event.

thresholds can be derived, which become the associated stand-off ranges.

$$PTSThreshold = GTV + 95 - 10\log_{10}\frac{T}{28800}$$

$$TTSThreshold = GTV + 75 - 10\log_{10}\frac{T}{28800}$$

The resulting ranges will depend upon the oceanographic environment in the locality, including the local water depths, temperature and salinity structure, sediment, *etc*, and also the deployment of the sonar (where in the water column the sonar transmitter is placed). In the global EIA a number of standard regions and environments are considered to try to cater for these variations.

Issues with a paper-based global EIA

Although the global EIA provides a good foundation, each operation and exercise of the sonar system can be expected to be different from that assumed at the global level. The environment and the sonar operation will not be quite that assumed, whilst the weather and other operational factors will change the actual usage of the system from that planned in unpredictable ways when the EIA is prepared so far in advance. Hence, associated with the global EIA, each specific exercise of the sonar usually needs a specific supporting EIA for the actual location and time of year concerned. Again this local EIA has to be performed ahead of time as it requires a significant amount of effort to plan and run the simulations required to develop the associated stand-off ranges. This process is time-consuming and expensive when repeated for each exercise and, if it were extended to cover all sonars on all RN vessels it would become almost prohibitive.

To counter these problems, an effective computer-based prediction system was required that could be used

- both during the planning stage and during the actual operation (to cater for the unplanned elements)
- for all RN sonars and also all supporting NATO sonars for joint exercises, and
- anywhere in the world, rather than just in a few predicted regions.

This desire resulted in the development of the Environmental Risk Management Capability (Sonar).

Environmental Risk Management Capability (Sonar)

ERMC(S) brings together the systems and acoustics knowledge of BAE Systems Integrated Systems Division (Insyte) with the marine biology and mathematical modelling of the Sea Mammal Research Unit (SMRU) and Centre for Research into Ecological and Environmental Modelling (CREEM), both at the University of St Andrews, to create a peer-reviewed operational tool that can provide EIA reports for any well-documented sound source anywhere in the world.

The tool relies on the validated global EIA approach but provides real-time assessment and supplementary complex sound-exposure-response (dose-response) models that provide a real assessment of the environmental risks incurred in the operation of the sonar.

The policies, processes, analysis and reporting within the system have been

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Marine environmental risk management - *continued from page 25*

subjected to peer review by working groups concentrating on the legislation, the operations, the modelling, the data supply and the openness of the system to ensure that the system provides a solid foundation that may, at some time, need to be relied upon in court.

Two methods are being implemented within ERMC.

- The first method is the implementation of the peer reviewed permanent and temporary threshold shift (PTS/TTS) algorithms from the global EIA. These algorithms calculate the in situ stand-off ranges based on acoustic threshold levels, the sonar parameters and the local environmental conditions. The stand-off ranges can then be compared visually against all local known mandatory protection areas to determine if any adverse effects will occur.
- The second methodology was developed by SMRU and CREEM and provides the next-generation environmental impact assessment process. The algorithms, called SAFESIMM (statistical algorithms for estimating the sonar influence on marine megafauna), provide a quantitative evaluation of the risks to marine mammals posed by sonar, whilst accounting for uncertainties in the knowledge of both marine mammal densities and the likely biological consequences of exposure to sound.

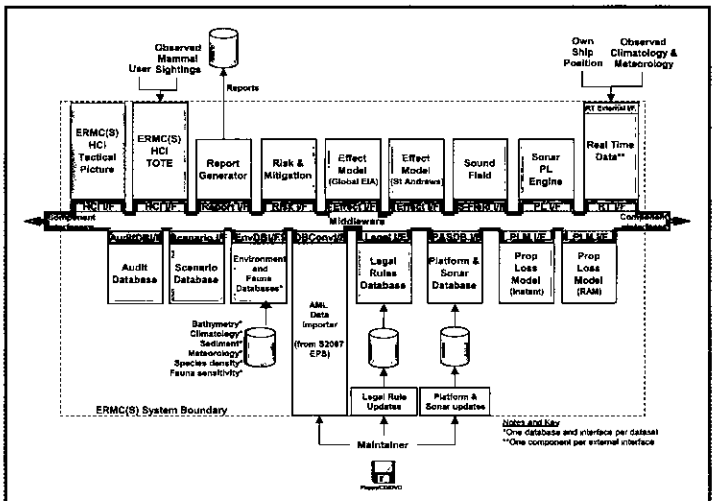

Figure 7

An 'open systems' architecture allows the components of ERMC(S) to be developed, adapted and enhanced at different rates and potentially to be provided from different sources. For example, extending the modelling to commercial noise generating systems could be a single new component within this architecture.

Data

The availability of data is the essence of the ERMC system and the adaptability and maintenance of such data is a key element of the system. The following categories of data are held and can be updated as new information becomes available.

- Sonar system parameters
- Environmental descriptors: water depth, sediment characterises, sound speed profiles
- Marine species: maps of species density, and species (or group) specific information on behaviour (*eg* dive patterns) and sensitivity to sound (audiograms)
- Areas and limits: coastlines, protected areas, fishing areas, national waters and boundaries.

Most of these datasets are now loaded from an extension to the IHO's S-57 electronic chart transfer format called Additional Military Layers (AML). AML format global chart-like and gridded datasets into portable file sets that can be created by onshore data repositories, distributed to users via various

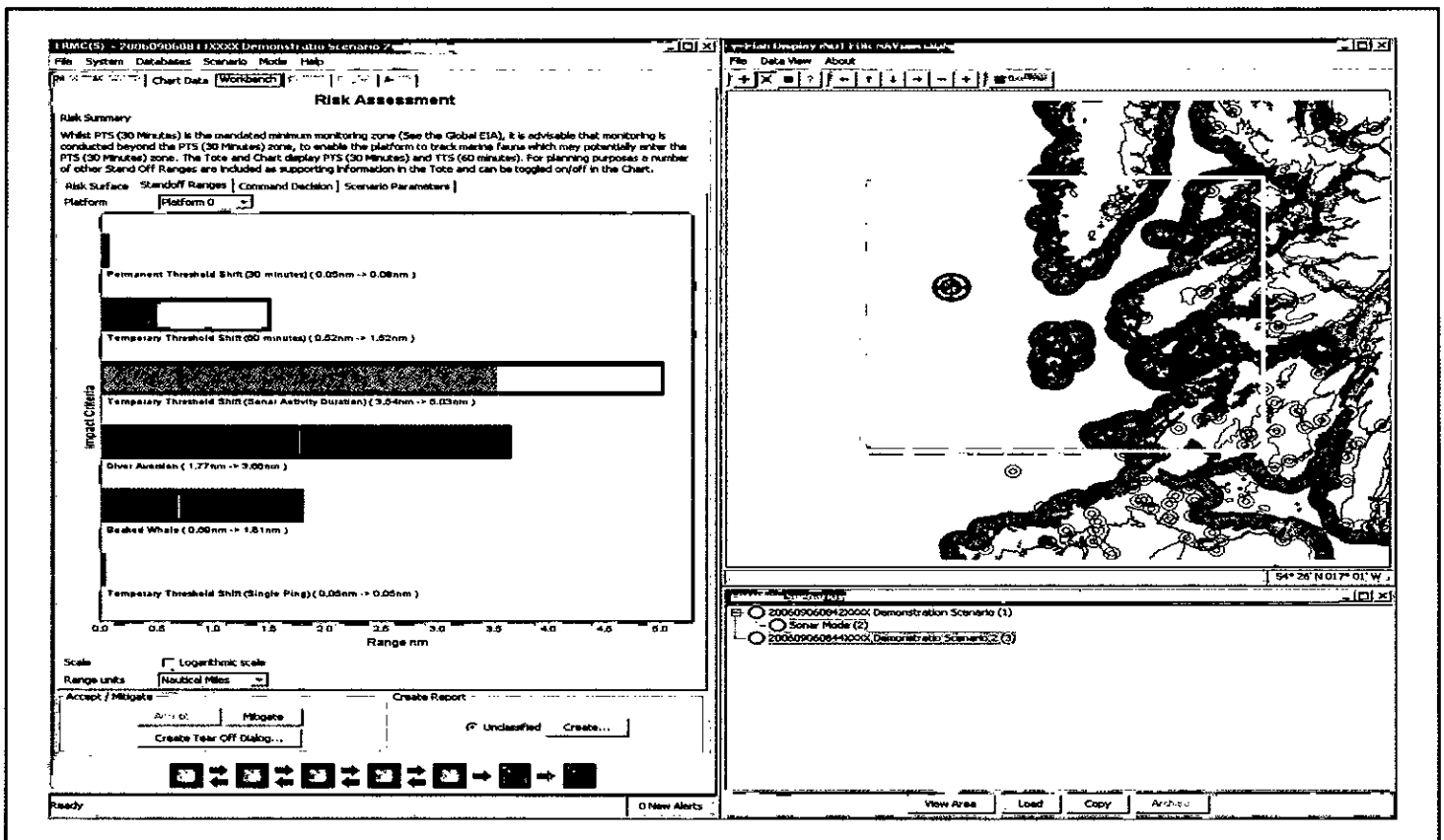

Figure 8

Stand-off ranges can be visualised as bar graphs for observation zones and as no-go areas in a chart view. The areas surrounded in blue are those in which recreational divers may be expected.

communications routes and loaded onto the systems at sea. For the purposes of the RN, the source of this data is the UKHO, though SMRU and CREEM are providing the marine mammal data in the first instance.

The marine mammal datasets are perhaps the hardest to generate as they are undoubtedly the hardest to measure. Species audiograms and thresholds are difficult to obtain and the behaviour of species under normal situations and when presented with stimuli in the wild is very difficult to monitor.

Models

One way of visualising the sound exposure dose modelling is shown in Figure 5, which shows the modelling chain used to reach a solution. The yellow rectangles (on the left) represent key sources of data utilised (already discussed above) whilst the blue diamonds (in the centre) represent an algorithm that combines data to produce another dataset (green rectangles on the right) in the chain.

In broad terms the calculation process is as follows.

- Step 1 generates a sound field from environmental data and scenario. Various validated acoustic propagation models could be used at this stage. At present the UK INSTANT model and the US RAM model are available. The simple process of adding other models has been successfully demonstrated.
- Step 2 applies biological knowledge to the sound field to determine the effect.
  GEIA, the global EIA, is applied by applying the suite of threshold algorithms to determine the range at which the sound level from the sonar drops beneath the threshold. This range will be different in the various directions around the sonar as the environment is not homogeneous; hence minimum and maximum ranges are determined based on 16 angular sectors around the sonar. These resulting ranges can then be applied as safety no-go areas around all known mandatory conservation areas and as the observation zone around the sonar.
  SAFESIMM is the St Andrews risk modelling algorithm. Essentially, SAFESIMM runs a stochastic model for each species in the region affected by distributing a large number of simulated animals in the ocean region, then simulating their swim and dive patterns through the predicted sound field. The simulation builds up the sound exposure level accumulated by that species. This data can then be used to determine the probabilities of TTS or PTS onset for the from the dose response model.

The easiest way to see how the risk is determined and assessed by the command is to compare it against the UK Defence Standards for human safety assessment (DefStan 00-56). This is based on an assessment of the likelihood of adverse effects and how critical is that effect (Figure 6) with a target that the impact is ALARP (as low as reasonably practical). The models are effectively calculating the probability of an effect, which may then be assessed for its seriousness and an associated risk class A, B, C or D inferred.

At present, seriousness is the most subjective element of the assessment as it implies some form of policy decisions about how serious effects are to different species. For example, PTS is presumed to be more serious than TTS: TTS to an endangered species could be considered more serious than TTS to an abundant species; the local rules of engagement might expect lower levels of seriousness to be acceptable in peacetime than in a wartime scenario. Such a policy is not currently laid down but it is left to the ship's command to determine what level of seriousness is appropriate for the operational circumstances, allowing the command to assess the risk and balance against the operational requirements and make an informed decision on the evidence presented.

System

The ERMC(S) system is being deployed on all UK RN sonar-equipped vessels over the coming year; initially on the type 23 frigates and then spreading out to other vessels. The system consists of a software application plus supporting data installation capable of running on a Microsoft Windows PC or laptop.

The system design conforms to open systems principles with the ability for the MoD customer to contract alternative suppliers for each component in

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Marine environmental risk management - *continued from page 27*

the system should they wish to do so. To implement the open systems design a CORBA 'middleware' solution is used with each system component being built independently and registering at run-time with the CORBA infrastructure (Figure 7). In this way, any component can be easily replaced by any other component if the published interface for that component is matched.

The operators use a work flow 'wizard' to guide them through setting up the scenario and modelling the results. The results are then presented in a number of forms, including a hardcopy output which can be approved by the command. If the results are not acceptable various mitigation measures can be modelled to reduce the perceived impact (eg reducing sonar output power or duty cycle) until an acceptable level is achieved.

As the system is still in final validation and initial use, and covers the use of real RN sonars, a real predicted risk surface from the SAFESIMM model cannot be shown. However, a simulated display appears in Figure 9. The command can use this information to make an educated decision about the level of risk incurred by the operational plans.

Additionally, in order to maintain a record for post-operation assessment, ERMC(S) maintains an audit log of all data and scenarios that have been undertaken. This log can be used to record both what happened in practice and any mammal observations noted by visual observers on the ship during the operation. If good data are recorded then a feedback route exists allowing the UKHO to update the underlying species databases and publish updated information for future use.

Summary

ERMC(S) provides the RN with a real-time assessment capability to meet its obligations under environmental legislation to minimise the impact of sonar transmissions on marine mammals. A flexible data loading technique is used to allow the latest authenticated data, such as updated audiograms[4] and improved population data, to be uploaded to ensure that the system remains current.

The system can also be adapted to cater for assessing commercial noise sources in the environment (eg geo-physical survey sonars, construction noise, fishing) and for alternative environmental impact assessments in the future (eg oil, chemical, pollutants).

Acknowledgements

The author acknowledges the assistance of the ERMC(S) development team in Insyte, Prof Ian Boyd and Carl Donovan (Sea Mammal Research Unit, Gatty Marine Laboratory, University of St Andrews) and Dr Catriona Stephenson (CREEM, The Observatory, Buchanan Gardens, University of St Andrews), and the ERMC(S) customer, UK Defence Procurement Agency's Sonar 2087 project team.

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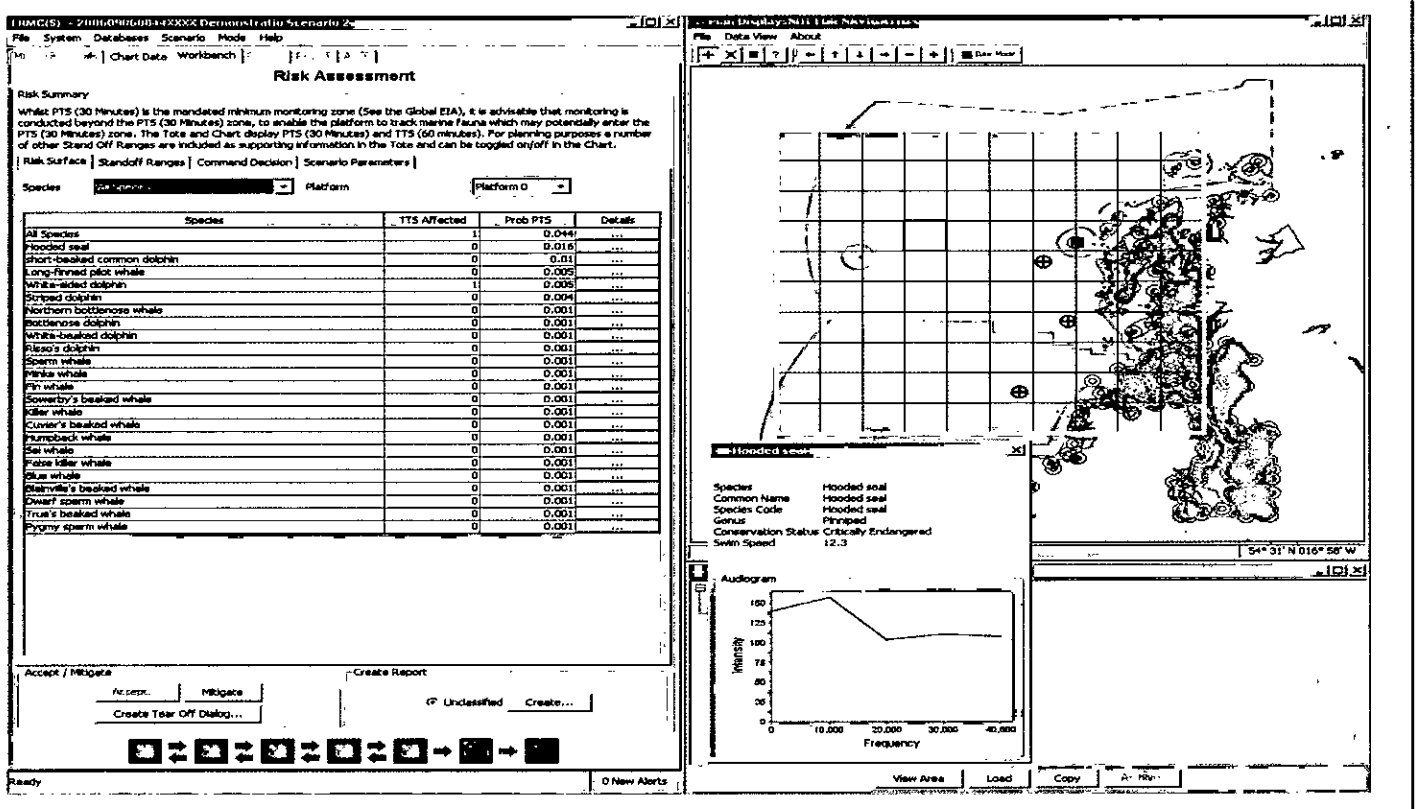

Figure 9

The risk assessment provides an analysis of the probability of adverse effects on local species and provides a colour coded risk surface around the operational area (simulated example shown).

An inevitable consequence: The story of Industrial Deafness - Part 1

Dick Bowdler looks at the history of occupational deafness in the UK

Instroducrion

One hundred years ago, in 1907, a British government committee, *The Departmental Committee on Compensation for Industrial Diseases* said "Boilermakers' deafness is unquestionably an injury due to employment" [1]. A year later The *Annual Report, Factories and Workshops* said "It is generally known that men employed in certain trades are liable to have their sense of hearing seriously impaired, if not entirely destroyed in the course of time, as a result of long continued exposure to loud noises. One well known instance is that of boilermakers' deafness, other occupations are the hammering of metal sheets and cylinders, use of pneumatic tools, beetling of cloth, engine driving and firing of guns." [2].

Yet it was to be more than 80 years before legislation was brought in to reduce the risk of damage to hearing at work. How could this have happened? How could millions of people have continued to be made deaf at work and no-one, or almost no-one, did anything about it.

Although the answer lay in the lack of action by government and employers, for half that time, they could not be accused of negligence. The story is rather one of changing attitudes and knowledge and of the development of the moral framework of society and technology.

One hundred years ago there was no general feeling in society that anything should be done about industrial injuries generally. Ten years before this time the Forth Rail Bridge was built. 71 workers are known to have died during the construction. It is indicative of the attitude at the time that it is widely believed that the figure was very much higher but such deaths were never properly recorded. The concept we now have that employers have a duty of care towards their employees was unknown. It was the attitude of both employers and employees that damage to their hearing was an inevitable consequence of their employment.

There was no legal obligation and no moral obligation in the context of the time for an employer to prevent his or her employees getting deaf. As Lord Justice Mustill said in the landmark case of Thomson and Smiths Shiprepairers in 1984 (about which we shall hear more) "...while an employer must keep up to date, the court must be slow to blame him for not ploughing a lone furrow".

Before 1900

There are references going back over several hundred years to the fact that some noisy occupations - in particular those involving the hammering of metal - will cause permanent deafness or tinnitus. Tinsmiths in the middle ages had "ringing in the ears". But the first authoritative reference was in 1831 when Dr Fosbroke, writing in *The Lancet*, stated that "Blacksmiths' deafness is a consequence of employment" [3].

Loud noise damages the inner ear irreversibly. It is insidious. It "creeps upon them gradually" as Dr Fosbroke wrote. It is cumulative which makes it more difficult to guard against. It is like tobacco. One cigarette will not kill you and one day at work will not make you deaf. Neither will two or three - but where is the line? It is easy to say "one more exposure is not going to make any difference". Fosbroke's article stood almost on its own for 50 years before any real work was done on the subject. In 1886 a Glasgow doctor, Thomas Barr, found that about 75% of the boilermakers that he examined were deaf to the extent that they had difficulty in hearing (or could not hear at all) a public speaker. He compared these boilermakers with some in other occupations and found, for example, that only 8% of letter carriers suffered deafness to the same degree. Dr Barr says "It is familiarly known that boilermakers and others who work amid very noisy surroundings are extremely liable to dulness (sic) of hearing. In Glasgow we would have little difficulty in finding hundreds whose sense of hearing has thus been irremediably damaged by the noisy character of their work." [4] So it was clear by this time that workers in certain industries would be made deaf by their employment. As far as I am aware Dr Barr's research was the first work of its kind anywhere in the world. The extent of this research was modest but the first scientific link between employment and deafness.

Enlightened Edwardians?

In 1908 Lloyd George as Chancellor suggested the introduction of a National Insurance Scheme that eventually became the 1911 National Insurance Act. It was the first contributory system of insurance against illness and unemployment. In this first decade and a half of the 20th century there was a growing awareness of industrial hygiene and industrial safety generally. It was well known that some workers were made deaf by their employment. Knowledge of this kind is disseminated throughout industry 'on the grape-vine'. It is passed from employee to employee and from employer to employer, often in casual conversation. It is inconceivable that employers and employees and their families in large boiler-making companies were not aware of this. It was known simply because there were such large numbers of employees who were so severely deaf that no one could doubt it.

Now that the original trade of boiler-making has ceased it is probably worth explaining what the process involved. Boilers were made for steam engines - particularly steam ships - but the trade of boiler-making extended to the construction of the steel ships themselves. The riveting process that joined metal plates together consisted of putting a red-hot metal dowel - a rivet - through a hole drilled through two plates. The riveter (on the outside) hammered the rivet flat with a 14-pound sledgehammer. In today's terms the peak linear noise level exceeded 150dB and the $L_{EP,d}$ was probably in the order of 110dB even if it were a lone riveter working outside. More commonly there would be hundreds of such riveters often working in a shed and the $L_{EP,d}$ probably approached or even exceeded 120dB. But it was the 'holder-on' or 'holder-up' who suffered the worst noise. This was the man stationed inside the boiler, or within the double hull of the ship, to hold the other end of the rivet in position. The holder-on was subjected to the noise of

perhaps tens or hundreds of sledgehammers on the outside, the nearest one within centimetres of his ear. His exposure would have been an L_{EPd} approaching 130dB. It is hardly surprising they were deaf.

But the 'inevitable consequence' attitude prevailed. *The Report of the Departmental Committee on Compensation for Industrial Diseases* in 1907, whilst admitting that boilermakers' deafness was due to employment added that 'It does not, however, prevent a man from continuing at his trade, and it cannot, therefore, give rise to claims for compensation...' [1]. The reason for compensation was not because a person was damaged but because he could not continue in employment. The idea that employers were responsible for the general health of their workers was a concept not yet born.

Technology

It is easy to criticise the attitude to industrial deafness in retrospect but if put into context it is more understandable. Little improvement could have been made at this stage, even by a pioneering employer, because of the lack of scientific technique and knowledge.

There was no accurate method of measuring hearing loss. Thomas Barr measured it by the distance at which a ticking watch, a whisper or a shout could be heard (still used by consultants but not as the main test). Dr Rodger measured for how long the subject could hear a tuning fork as its sound faded away, sometimes using his own hearing as a norm for comparison [5].

There was no accurate and readily available way of measuring the level of sound or its frequency. Frequency was measured subjectively. Dr Rodger describes in 1925 how he 'went down to the boiler shops in Leith with my pockets bulging with tuning forks' in order to estimate the predominant frequencies of boiler-making noise [6].

Because accurate, objective measurements of the degree of deafness and the level of sound could not be made, no quantitative relationship between the two could be established. That is to say that it was not yet possible to predict the risk of deafness in a trade by knowing its noise level. There was research into deafness amongst cotton weavers in Lancashire in 1927 when 24% of workers were found to have some degree of deafness but otherwise little appears to have been done [7]. In most ways Thomas Barr's work in 1886 remained the best scientific study concerned with noise-induced deafness in Britain for 50 years.

Rolling cotton wool in Vaseline was about the only material that could be used to act as ear protection, and this could not have been very effective. It was originally proposed by Yearsley in 1848 but, oddly enough, as an aid to hearing rather than protection against noise. How this worked is not clear, although perhaps the Vaseline softened any wax in the ear. However, the idea that the same material could both improve hearing and protect against noise suggests it was not very effective at either job. In any case doing this in industrial conditions of the time was unlikely to have produced a very hygienic ear plug. The cotton-wool-in-Vaseline technique was probably put forward as an answer to many things because it was commonly used at the time for protecting the ears whilst bathing.

In 1882 another doctor, Ward Cousins, described an ear plug used by bathers but it was also. recommended for persons working in loud noise 'such as artisans in factories, soldiers and sailors during the discharge of cannon, and all who were painfully affected by noise'. It was a vulcanite (hard rubber) plug shaped like a rifle bullet. Such plugs were made by Dr Cousins presumably only for his patients' use [7]. The first commercial ear plug was produced in 1914 - the Mallock-Armstrong [8], spurred by the need for protection against gunfire in the 1914-18 war, but the simpler home-made variety was probably more common. Some time later in 1933 a paper to the British Association still proposed the use of cotton wool and paraffin wax for riveters [9].

Progress at last

There has never been a public debate on the effects of noise on hearing except for brief periods and specific issues. In the 1970s there was a brief debate on the dangers of loud noise on the hearing of young people in discotheques. Leeds City Council introduced a bye law limiting the noise in discos but this was quietly dropped when it turned out to be largely unenforceable. The public debate on noise has always been driven by its nuisance effect (or, in the 1950s by its alleged effect on the efficiency of workers). People understand nuisance. They experience it or think they experience it every day. It is immediate whilst loss of hearing is insidious. People do not know that they are getting deaf until one day they realise they cannot hear what people are saying to them. By then it is twenty years too late.

So it was in the 1930s that one of the driving forces was the number of motor cars that appeared in the streets and roads. It is doubtful that the large numbers of horse-drawn vehicles were much quieter, but the relatively sudden change of character of the noise probably gave an increased awareness. As always with noise, it was probably used as a proxy for other fears. The Anti-Noise League - later to become the Noise Abatement Society - was the leading group in the campaign against environmental noise. It had on its council, and associated with it, many eminent figures including doctors and scientists [10]. It will be of interest to those now working in the field that the first Noise Map of London was produced in the 1930s at a scale of four inches to the mile by consulting acoustician C W Glover. It was a map of the 'whole County of London' and shows areas where 'street noise is consistently excessive'.

Deafness sometimes became a peripheral issue - some people thought that people in cities would go deaf because of the noise of

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An inevitable consequence... - *continued from page 31*

the motor car - but rarely was it concerned with those in industry. One exception to the focus on environmental noise at this time was the Industrial Welfare Society. Founded in 1918 it was 'an association of firms, corporations and persons, concerned with working conditions, beyond statutory requirements, as they affect the security, happiness and health of workers...'. The Council consisted of representatives of trade unions and employers associations as well as those representing individual companies and the Patron was the King [11].

At the same time as the motor car spurred interest in noise, the radio and telephone industries provided the technical knowledge to develop measuring equipment and audiometry. In the Second World War the advances in electronics which were necessary to produce modern fighting machines enabled such measuring equipment to develop. The first sound level meters of the 1930s had been *subjective noise meters*. They produced a noise which the operator could vary in level in one ear and compare with the noise being measured in the other [12]. A few *objective noise meters*, which were the forerunners of the present sound level meters, were produced in the mid 1930s. At the Anti-Noise League's Noise Abatement Exhibition in 1935 two 'objective noise meters' were on display. One was produced by the National Physical Laboratory and the other by the Western Electric Company Ltd. But equally on display were subjective meters [10]. It was not until about 1940 or 1941 that the first commercial sound level meters became available. One of the first was the General Radio Company's sound level meter. It should be noted that the term 'sound level meter' was applied to an instrument specifically designed to make measurements which approximated to loudness, rather than the pressure level of a sound and was similar to a modern meter measuring A-weighted decibels. By the late 1940s sound level meters became more common. British Standard 1479, *Memorandum on the Use of Sound Level Meters* was issued in 1948 [13].

The other tool necessary to establish a quantitative link between noise level and degree of deafness was the audiometer. This measured the degree of hearing loss. Again by the mid-thirties there were some basic types available. The forerunner at the time was the Western Electric audiometer available in the 1930s [11,14]. But again it was the development of electronics in the early 1940s which established audiometers in the commercial field. In 1948 the Amplivox audiometer was available commercially [15].

Following Sabine's work researchers had by now started to make measurements of the acoustic properties of materials. The electronic equipment to do so was similar to that later commercially available but at this time was confined to research establishments. Measurements of absorption coefficient were made by the National Physical Laboratory [16]. Methods of sound insulation were more widely known. These developments had first come about prompted by the need to improve the acoustics of concert halls and theatres [10]. Noise reducing materials were produced commercially in the 1930s and 1940s such as anti-vibration mats (including typewriter mats), acoustic plaster and sound insulating walls [11,17,18]. Various 'silenced' devices were produced including circular saws, motors, turbines, typewriters and railway carriages some of which were forerunners to today's technology. Others proved less enduring such as rubber blocks to build roads and rubber horseshoes.

Ear protection became commercially available. Already at the Anti-Noise League's Noise Abatement Exhibition in 1935 there was on display a variety of ear protectors including the Mallock-Armstrong, Luxon ear protectors, some plastic and rubber plugs, impregnated cotton wool such as Ohropax and Quies, the Auroprotector ear defender, and Antiphones. There were advertisements for Soundex vulcanite plugs by Ardente [10,11]. These were all plugs of variable effectiveness and it was not to be until the 1950s that effective ear muffs would be readily available.

There was an improving attitude with the development of the welfare state and the introduction of free medical treatment in the late 1940s. People generally began to believe they had a right to good health and that the state and others responsible for them had a duty to provide it. By this time it was well known within the medical profession that exposure to loud noise, particularly for prolonged periods, would damage hearing. Established companies with noise levels in the workplace in the order of 100dB(A) or more were probably now negligent in common law because not only did they know that their employees hearing might be damaged but they could have found the means to measure and reduce noise, to measure hearing loss and to obtain ear protection.

The concluding part of this article will deal with the actual knowledge that some employers had, the Codes of Practice, the litigation that was necessary to move things on, and the regulation finally brought about at the instigation of the European Union.

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Acoustical monitoring prevents downtime at Shapfell Lime Quarry

S J Lacey

Corus Northern Engineering Services (CNES) is an engineering support organisation with bases in Teesside, Scunthorpe and Rotherham. Part of the Corus Group plc, the company uses a 'toolbox' of techniques to help customers of all sizes, and from every industry sector, maintain their output, efficiency and profitability, by providing a detailed and accurate assessment of their plant assets. CNES uses a range of non-intrusive techniques, including acoustic monitoring, thermographic imaging, vibration monitoring, laser alignment, lubricant technology, and remote visual inspection. Corus is Europe's second largest steel producer with crude steel production of 18.2 million tonnes in 2006, primarily in the UK and the Netherlands. Corus is a subsidiary of Tata Steel

By carrying out regular condition monitoring checks on critical rotating plant and machinery, CNES helped a limestone quarry in Cumbria maintain its output, efficiency and profitability. The condition monitoring team has been working closely with Shapfell Lime Quarry for more than 12 years, providing monthly patrol monitoring at the site using a range of condition monitoring equipment and techniques, including hand-held acoustic monitoring devices and vibration monitoring systems.

On a recent patrol monitoring visit, a CNES engineer discovered unusually high readings on the primary crusher at the site, which raised concerns. Through further investigation using acoustic and vibration analysis systems, it was discovered that the unusual noise levels and irregular readings were related to a fault on one of the primary crusher's main bearings, which had been running for more than 30 years. Significant wear and damage were found on the inner raceway of the bearing.

By analysing the results, CNES was able to advise Shapfell's maintenance team when it should plan to replace the bearing. The maintenance fitters were mobilised and the bearing was replaced during a scheduled plant shutdown without causing any major disruption to the crushing process. Had the bearing problem not been spotted, and a failure occurred during operation, the plant would have lost at least two weeks' production while the bearing was replaced and the required manpower and lifting gear were mobilised on site.

At Shapfell, the first stage in the production of lime is the quarrying of the limestone itself. The quarrying of the limestone takes place on a 47-hectare site, one mile east of the lime works. Drilling and blasting in the quarry are undertaken by sub-contractors, under the strict control of the Shapfell quarry management. The typical face is 18 metres high, and between 10,000 and 30,000 tonnes of stone are blasted out at any one time. The shot stone is loaded and transported by dump trucks through a series of internal roads to the crushing plant.

Here, limestone is crushed in a primary jaw crusher, screened and then

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Acoustical monitoring prevents downtime... - *continued from page 33*

transported to the secondary roll crusher. Further screening takes place, with the small material being used primarily in the iron making process or sold locally as stone products. The larger limestone, suitable for the kilns, is transferred to an outdoor stockpile. Limestone from this pile is fed into a washing plant, where scrubbers, screens and thickeners are used to remove contamination and produce a clean raw material for burning in the kilns.

Paul Wright, engineering manager at Shapfell Limestone Quarry commented that CNES had helped the company considerably over the last ten years or so. By understanding which condition monitoring technique was appropriate for maintaining each piece of machinery or bearing, the output, efficiency and profitability of the plant could be maintained at all times. The company's own maintenance team had also been able to learn from CNES engineers.

The blower systems at the site are also being monitored and maintained. These supply combustion and cooling air to the lime kilns, and are critical to the process. If they were to seize up because of excess dust particles building up on the surface of the rotor blades, the equipment could break down, causing downtime and disruption to production. Patrol monitoring of the blowers, using vibration monitoring and acoustical techniques, again means that faults can be predicted before they cause serious damage to the blowers, and consequent losses in production.

Other companies in the quarrying, mineral processing and cement manufacturing sectors are using CNES' technical expertise and subcontract manufacturing services to monitor critical plant, and also to refurbish existing equipment. Starting out as a supplier of rolled steel kiln sections to these companies, complete overhaul services and a full range of condition monitoring, plus asset management services, are now offered. CNES has the workshop facilities to carry out a complete range of overhaul services to quarry screens, crushers and asphalt coating drums for the quarrying sector. Screens can be removed from site, dismantled and inspected in the workshops. A typical contract includes welding and refabricating the decks and main frames, replacing shake-proof fasteners, overhauling exciter units or refurbishing eccentric shafts and bearing housings. Completely overhauled screens can be reinstalled and commissioned at the customer's site, together with fixed condition monitoring systems as required. CNES also carries out complete overhauls of jaw or gyratory crushers, the manufacture of cones, bowls or shafts, and the overhaul of mobile crushing plant. Asphalt coating drums can also be inspected, overhauled and recommissioned to suit tight schedules.

David Scatchard is marketing manager with Corus Northern Engineering Services

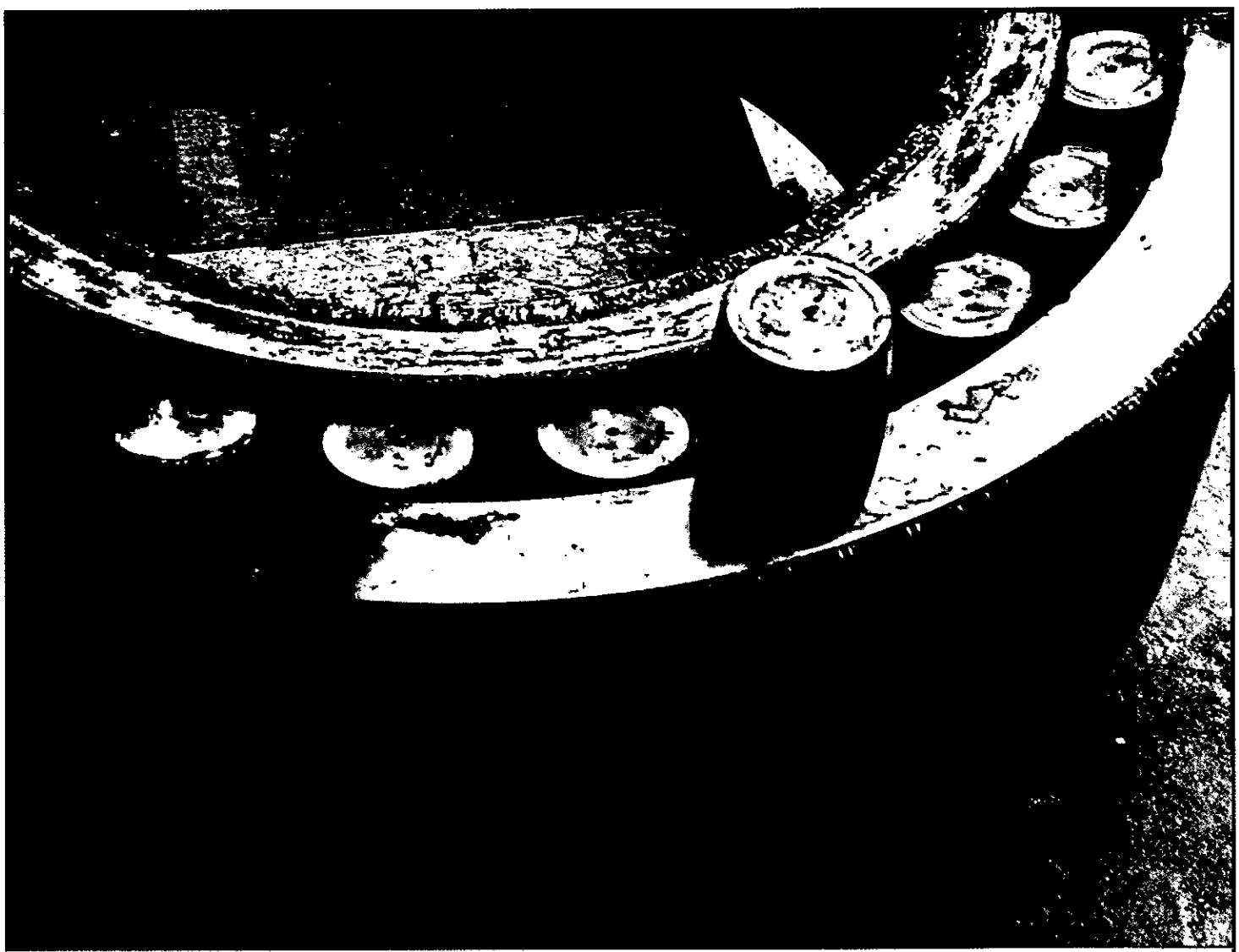


Figure 1

Catastrophic failure of a large bearing

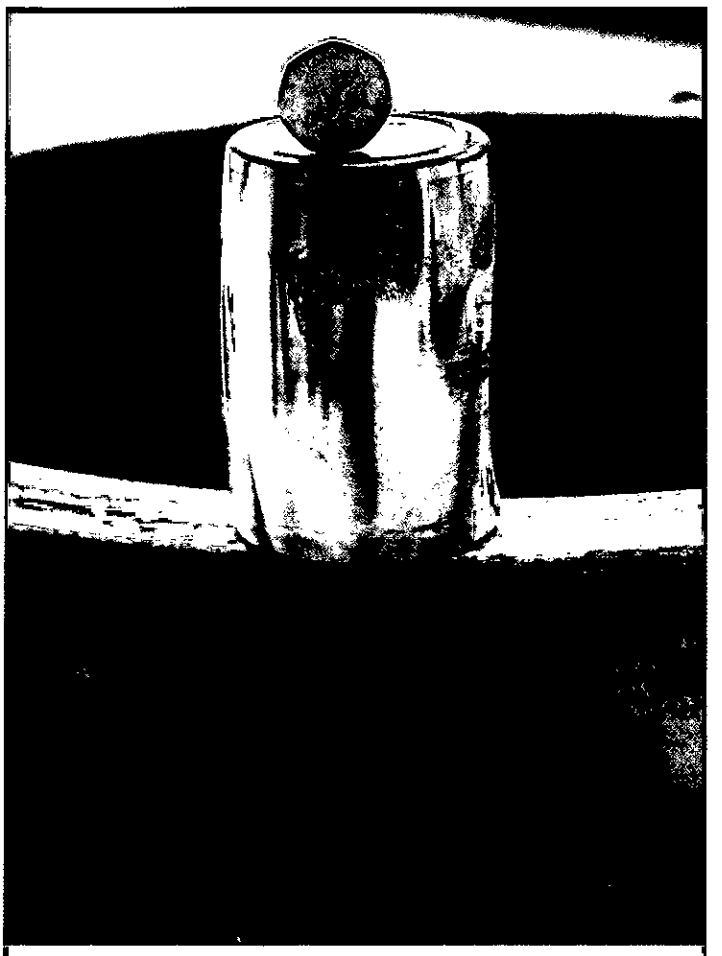


Figure 2

Detail of damage to inner raceway

Errata and apology

A brief history of the speed of sound

The above article, which appeared in *Acoustics Bulletin* Vol.32 No.4, was credited to Lindsay Hannah. The author acknowledges that a majority of the fully referenced text as published, excluding the values for sound speed in various other media given in the table, was reproduced from the paper by Michael Delany entitled *Sound propagation in the atmosphere: a historical review*. This paper was originally published in the referenced NPL Report in the 1970s, and subsequently in Acustica 38 (4) 201-223 1977, and Proc.IOA 1 32-72, 1978. The author wishes to apologise to Michael Delany for not having identified the origin of the article more clearly.

There were discrepancies, incorrect tabulated values, and confusing statements in the article, which were reproduced in good faith from the New Zealand Acoustics version. Many readers will have noticed that the Latin for 'speed' is celeritas, that the velocity of sound is not an 'effect', that Newton's famous opus is entitled *Philosophaiae Naturalis Principia Mathematica*, and that the symbol γ is defined as the ratio of specific heats at constant pressure and constant volume (not temperature).

The speed of sound in a solid depends upon its geometric form, and I have it on good authority that within a very large volume of steel it is approximately 5900ms^{-1}, in a thin flat steel plate it is approximately 5270 ms^{-1}, and in a steel bar it is approximately 5060ms-1.

The editor apologises for any confusion, and for these and other errors he should have been able to spot.

AcSoft

drops 01dB product line

AcSoft Ltd has announced that it will no longer be supplying environmental noise instrumentation from French manufacturer 01dB-Metravib in the UK.

After a very successful year in 2006, with turnover increasing by more than 20%, it has been decided to rationalise the company's product offering, to minimise overlap and increase the quality of products and services.

AcSoft's MD, John Shelton, commented that the company had worked with 01dB right from the beginning, and had developed their market presence in the UK over more than 12 years. In that time, PC-based instrumentation had moved from a niche into the mainstream, and 01dB developed into a significant supplier in the international market.

AcSoft represents Svantek, HEAD acoustics, Dytran, Listen, GRAS and Acoustic Camera in the UK & Ireland. With such a wide product offering, several overlaps have inevitably developed, and with the release of the new 95x instruments from Svantek, the company had decided to focus on that supplier's range, to satisfy the needs of its customers in environmental noise, noise at work and human/ground vibration. Existing customers would continue to be supported, and after-sales and application support would be provided as normal. For the moment, multichannel solutions from 01dB-Metravib would still be offered to the automotive and industrial market.

Svantek now offers a complete catalogue of instruments for noise and vibration measurement, with advanced features such as real-time third-octave and FFT analysis, and building acoustics features such as RT60. Signals may also be recorded to a standard plug-in USB stick, for later processing and playback on a PC.

For long-term environmental noise monitoring, AcSoft will shortly be introducing a new concept from Azimut Monitoring in France, with solar-powered web-based logging and presentation of noise and air quality data.

John Shelton added that although it felt a wrench to drop one of their seminal suppliers, his team was confident that the newly-optimised catalogue of products and software would continue to offer excellent performance and value for money.

AcSoft Ltd
Tel: **01296 682686** fax: **01296 682860**
email: **jshelton@acsoft.co.uk**

BBA certification for Glasroc products

British Gypsum

British Gypsum's award winning Glasroc paperless gypsum boards have received new certification from the British Board of Agrement (BBA), the UK's leading independent approval body for construction products.

Glasroc FireCase s, the market-leading steel encasement board, and Glasroc MultiBoard, a high performance multi-purpose lining board, are manufactured by a unique patented process that provides an ultra-smooth plaster-like surface, unlike traditional plasterboards which have a paper lining to both faces.

In the absence of appropriate British Standards, BBA certificates provide architects and other construction industry professionals with the assurance of an independent assessment of the fire, acoustic and structural performance of the products, based on actual test evidence.

The new certificates for Glasroc FireCase s and Glasroc MultiBoard also include up-to-date information on the physical properties, weights, densities and dimensions of the products, and the latest Building Regulation Approved Documents, as well as new fire resistance testing information and Hp/A tables, as appropriate.

Glasroc boards were developed by British Gypsum almost 20 years ago and are today used for a wide range of applications from fire protection to structural steel beams and columns, to high performance firewalls and fire, moisture and impact resistant wall and ceiling linings. Glasroc MultiBoard, owing to its exceptional flexibility, is also widely used for lining modern curved wall and ceiling structures.

Now in their third and fourth editions respectively, the fully revised certificates are available to download from the BBA website **www.bbacerts.co.uk** . Further information and dimensions for Glasroc products are available from **www.british-gypsum.com**

Remote concert noise tests reduce council costs

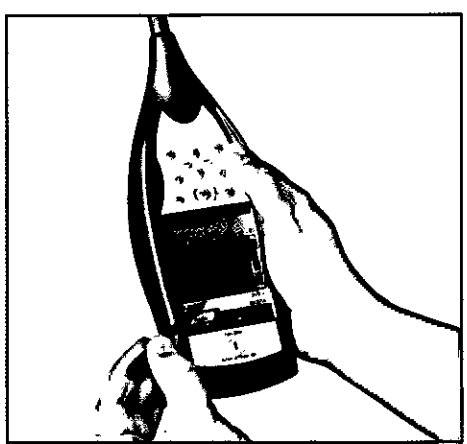
Brüel & Kjær

In July 2007 the London Borough of Richmond became the first council to use Brüel and Kjær's sound testing equipment with a wireless link to monitor concert noise levels, and reduced the number of staff it usually needs at this type of event.

This system, which has a direct cost benefit to the local authority and residents, was set up by Richmond's Environmental Health Officers (EHOs) using Bruel and Kjaer UK's state- of-the-art measuring equipment to create a link from inside the stadium to a monitoring point near a local residential area, ensuring the concert did not exceed the permitted music noise levels for the stadium.

The equipment used, Bruel and Kjaer's type 2250 sound level meter, provided concurrent measurement of 1-minute and 15-minute LAeq values. If the 1-minute value indicated that the 15-minute LAeq was likely to exceed the stadium's licence, it allowed EHOs to send an advance warning to the sound engineer controlling the music levels.

The wireless link system



The B&K 2250 is the heart of the system

A spokesman from Richmond Council said that the beauty of the system was that it allowed officers to be at the mixing desk and see what the noise level was outside the stadium, where local residents could be disturbed. If noise levels rose in excess of the permitted figure, they could instantly feed this information back to the sound engineer so that he could reduce the level accordingly.

Brüel and Kjær is a world-leading manufacturer and supplier of sound and vibration solutions for use in a wide range of applications including environmental noise measurements, building acoustics, vibration measurements and quality control for use in the automotive, aerospace and consumer industries, as well as by local authorities. Today Brüel and Kjær has 900 employees and sales offices in 55 countries. Brüel and Kjær is a subsidiary of UK-based Spectris plc.

For more information: Heather Wilkins,
Bruel & Kjaer UK Ltd
Telephone: **01438 739 000**
Email: **heather.wilkins@bksv.com**
www.bksv.co.uk

Sound Solutions wins regional award

Arts & Business First Time Sponsor of the Year Award

Sound Solutions, Acoustic Associates Sussex Ltd, has won the Arts & Business First Time Sponsor of the Year Award sponsored by University of Portsmouth and CIBAS for their partnership with artist Rowena Easton. The Awards, held at Aspex Gallery in Portsmouth, are to celebrate the best corporate and cultural relationships in the south-east region.

The First Time Sponsor of the Year Award is presented in recognition of the most innovative first time sponsor. 'Machines for Singing' is an architectural sound installation that 'plugs in' to a building to record the subsonic life of its fabric. It was developed by artists Rowena Easton and Mike Blow in partnership with acoustic consultancy team Barbs and Peter Attwood of Sound Solutions. It was piloted at the Gardner Arts centre during Architecture Week 06. Sound Solutions is keen to raise the profile of acoustics in the public perception, to encourage an increased awareness of sound in the physical environment, particularly among those setting out on their careers.

More than 200 people saw Sound Solutions and their fellow winners, Givaudan, Rolls Royce Motor Cars, Southern Vectis, Henmans LLP and Southern Co-operatives, take awards. Barbs Attwood commented that she and Peter were extremely pleased to have won this prestigious award, a mark of excellence which acknowledges Sound Solutions' successful partnership in the project 'Machines for Singing'. They believed that it was an inspired example of the cross-pollination of ideas between arts and business, and in their case, the science of architectural acoustics. They were looking forward to enabling the project in its further development.

Jane Chambers, Regional Director, Arts & Business South-east congratulated all the winners in the 2007 Awards. She was delighted that the south-east boasted so many strong examples of culture and commerce working together to achieve their ambitions. She wished the partnerships every success, and was looking forward to hearing how they grew and developed in the future.

(L to R) Peter Attwood, Rowena Easton (artist), Colin Tweedy (CEO Arts & Business), Chris Jones (B&K), Barbs Attwood (artist & Sound Solutions), Mike Blow (Technical Director)

All-England Lawn Tennis and Croquet Club

PA with the roof off

The Centre Court atmosphere at this year's Wimbledon Tennis Championships was a very different one due to the absence of a roof! This very different environment called for a very different loudspeaker system.

It was clear to Tim Speight and Jon Berry, of sound contractor RG Jones Sound Engineering (suppliers of sound systems for the Club), that installing a distributed system would not be a viable option, as the limitations on possible loudspeaker positions and cable routes would have compromised the performance of a distributed system enough to render it useless. A more innovative approach was required.

The designers started thinking about the possibilities for a point source system, but designing a point source system that was capable of 'throwing' sound 100m across the bowl, whilst at the same time containing the sound within the bowl to prevent noise nuisance to neighbouring courts and residents, was not straightforward. After their experiences at St Paul's Cathedral with Duran Audio's DDS beam steering technology, the AXYS Target/Intellivox ranges were considered.

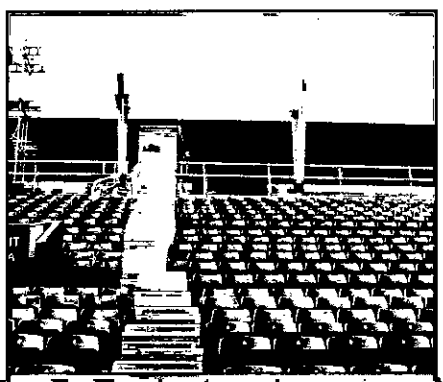
The 3D predictions convinced Tim and Jon that the method would be a viable option for a temporary installation.

Tim Speight went on to explain that they demonstrated to the All England Lawn Tennis and Croquet Club, its umpires, and the BBC ahead of the championships, to collect their views on the final design of the system. The demonstration took place in Court Number 1. It was a success and all parties agreed that this should be the solution for Wimbledon 2007.

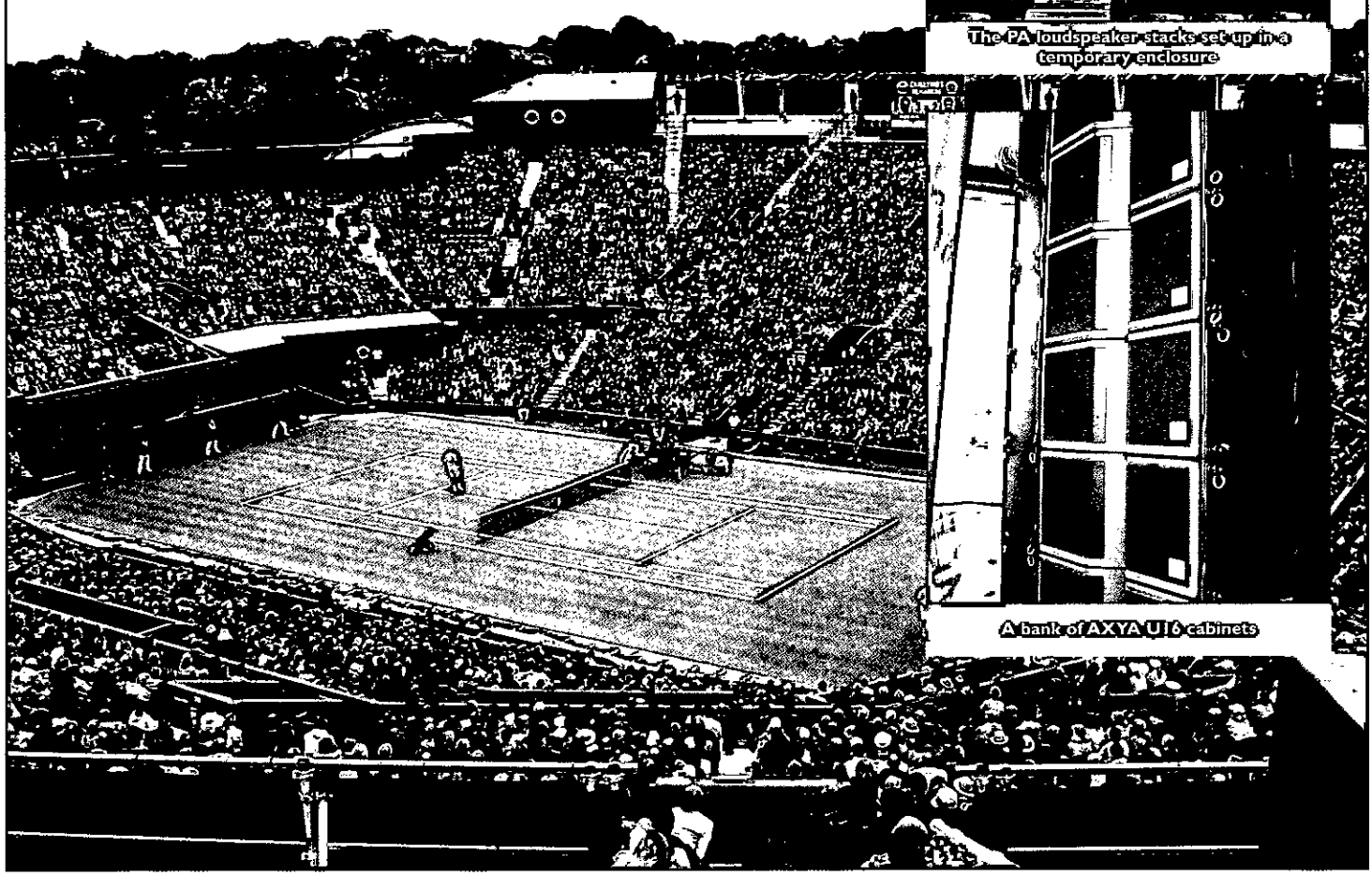
For the installation a total of thirty AXYS Target U16 mid/hi units and four AXYS Intellivox DS1608's were installed. The area taken up by the loudspeakers was very compact (helped by the built in DSP and amplification) and the system was invisible to the untrained observer. The fact that the U16's were effectively ground stacked at the back of the east stand made the rigging very easy; all that was needed was a small enclosure to protect the units from the inevitable rain. The result was very impressive and there were several comments from officials that this was the best sound that had ever been achieved in Centre Court.

The great thing about the Target and Intellivox units, according to Jon, was that they maximised the throw obtainable from a conventional line array whilst minimising unwanted spill and reflections. This meant that the three major design goals for the system could be achieved: (1) to keep as much sound as possible away from the umpire's microphone and the playing surface; (2) to minimise the reflections from the press boxes opposite the arrays, and the spill to other courts and residents; and (3) to ensure, most importantly, that all spectators heard the announcements reproduced clearly.

For more information:
www.duran-audio.com
www.rgjones.co.uk



The PA loudspeaker stacks set up in a temporary enclosure



A bank of AXYA U16 cabinets

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We are looking for enthusiastic people with experience in all aspects of acoustics and vibration who also have a good working knowledge of current standards and procedures. You must be computer literate with excellent spoken and written communication skills. If you have the drive and energy to develop our business, you will be commensurately rewarded with an excellent remuneration package.

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Parliamentary reports

From Hansard

Commons Written Answers

15 June 2007: Turbines - Health hazards

Mr Cox: To ask the Secretary of State for Trade and Industry pursuant to the answer of 14 May 2007, Official Report, on turbines: health hazards, what qualifications Hayes McKenzie possessed in relation to infrasound emitted by wind turbines; and what role medical experts played in the production of the report.

Malcolm Wicks: The Hayes McKenzie report for DTI *'The measurement of Low Frequency Noise at three UK wind farms'* investigated the levels of low frequency noise and infrasound emitted by wind turbines, it was not within the remit of the study to undertake new medical analysis.

However the study did refer to the document prepared for the World Health Organisation 'Community Noise' which states that there is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects. It also referenced work undertaken for DEFRA on low frequency noise and its effects.

Dr Andrew McKenzie and Malcolm Hayes are acoustic experts with between them over 45 years' experience. They have conducted work in relation to wind turbines at over 400 proposed, consented or completed sites in the UK and overseas.

Mr Cox: To ask the Secretary of State for Trade and Industry what research his Department has carried out on the numbers of individuals and households adversely affected by infrasound emitted by wind turbines.

Malcolm Wicks: DTI and DEFRA have recently commissioned a report by Salford University, one of the objectives of which is to establish the levels and nature of the noise complaints received across the UK relating to noise issues from wind farms, both historic and current, and determine whether Aerodynamic Modulation (AM) is a significant effect.

This report will be published later this summer.

21 June 2007: M1 motorway

Mr Greg Knight: To ask the Secretary of State for Transport when the carriageways of the M1 motorway between junctions 26 and 27 are next scheduled to be resurfaced.

Dr Ladyman: The M1 motorway between junctions 26 and 27 forms part of the M1 J21 to J30 widening contract 1. As part of this widening programme, all the carriageways will be re-surfaced providing a new low noise surface. Subject to the satisfactory completion of statutory procedures and approved funding, Contract 1 work is planned to start in late 2007.

21 June 2007: Aviation: Noise

Chris Grayling: To ask the Secretary of State for Transport how many UK airports with over 50,000 movements per year have produced strategic noise maps.

Gillian Merron: Under the Environmental Noise Directive, airports with over 50,000 movements per year are required to submit noise maps to the Department by 30 June 2007. To date, 12 airports have submitted maps. Outstanding maps for other airports are expected by the end of June. Airports have been encouraged to publish these maps on their web sites.

25 June 2007: Lorries - Noise

Mr Arbuthnot: To ask the Secretary of State for Transport if he will estimate the change in noise level adjacent to an *(a)* A class road and *(b)* motorway arising from an additional traffic volume per day of (i) 400, (ii) 600, (iii) 800 and (iv) 1,000 heavy goods vehicle movements.

Dr Ladyman: The method used in the UK for calculating road traffic noise requires a baseline volume of traffic. The change in road traffic noise, including from heavy goods vehicles (HGVs), is calculated from the change in the baseline traffic level. A change in traffic noise level cannot be calculated with only absolute increases in traffic volumes.

If all the other factors that influence road traffic noise remained unchanged, a 10 per cent. change in HGVs is approximately equivalent to a one decibel noise change.

25 June 2007: Transport - Noise

Mr Evennett: To ask the Secretary of State for Transport what steps his Department is taking to address noise generated by *(a)* road traffic, *(b)* trains and *(c)* aviation.

Gillian Merron: On aircraft noise, the Government's objective is to strike a fair balance between the local and national benefits that can be gained from airport expansion and the local environmental costs that might be imposed on people who live nearest to airports.

One of the aims of The 2003 Future of Air Transport White Paper was that the number of people in the UK significantly affected by aircraft noise should be limited and, where possible, reduced. In helping airports deliver this aim, the Civil Aviation Act 2006 strengthened airport operators' powers to control noise at airports.

The Environmental Noise Directive requires the production of strategic noise maps for large urban areas, major roads, major railways and major airports. The maps will be used to prepare noise action plans during 2008 setting out how environmental noise, including that from transport sources, will be managed. To inform the development of these plans, the Department for Transport will work closely with DEFRA and transport stakeholders in reviewing how transport noise is currently managed and what additional mitigation measures might be needed.

In assessing the impact of new road proposals on the environment, noise annoyance is taken into account in scheme appraisal. Road construction projects will include high standards of environmental mitigation to ensure that, so far as reasonably possible, the impact of noise is minimised in accordance with this policy.

Mr Evennett: To ask the Secretary of State for Transport what representations he has received on noise nuisance generated by *(a)* aviation and *(b)* road traffic.

Gillian Merron: The Department regularly receives representations regarding noise generated by aviation and road traffic. The views are used in developing measures to address noise nuisance from transport.

27 June 2007: Noise

Mr Evennett: To ask the Secretary of State for Environment, Food and Rural Affairs when he expects to implement section 84 and Schedule 1 of the Clean Neighbourhoods and Environment Act 2005 relating to noise.

Mr Bradshaw: Section 84 and Schedule 1 of the Clean Neighbourhoods and Environment Act 2005 came into force in relation to England on 1 October 2006. We have revised the directions for permitted noise levels and an approval for devices measuring noise levels.

However, these cannot be brought into force until a stand-still period required under the Technical Standards and Regulations Directive 98/34/EC has expired.

A statement will be published on the DEFRA website when we are able to confirm the exact date.

Mr Evennett: To ask the Secretary of State for Environment, Food and Rural Affairs what his Department's policy is on neighbourhood noise.

Mr Bradshaw: The Government take the issue of neighbourhood noise seriously, and has given new powers to local authorities to deal with noise-related problems under the Clean Neighbourhoods and Environment Act 2005.

27 June 2007: Noise - Greater London

Mr Evennett: To ask the Secretary of State for Environment, Food and Rural Affairs how many environment protection officers there are responsible for noise in each London borough.

Mr Bradshaw: My Department does not hold the information requested. Staffing levels in individual London boroughs are a matter for the relevant local authority.

27 June 2007: Noise - Pollution Control

Mr Evennett: To ask the Secretary of State for Environment, Food and Rural Affairs if he will provide an update on a proposed National Ambient Noise Strategy.

Mr Bradshaw: The Government plan to publish a combined national noise strategy for England, covering ambient and neighbourhood noise, by the end of 2007.

28 June 2007: Aviation - Noise

Justine Greening: To ask the Secretary of State for Transport which noise monitors in (a) Wandsworth, (b) South West London and (c) West London have provided data used in noise pollution modelling as part of the Project for the Sustainable Development of Heathrow; where those noise monitors were situated; and if he will make a statement.

Gillian Merron: Modelling to estimate future aircraft noise exposure at Heathrow is being carried out using the Civil Aviation Authority's Aircraft Noise Contour Model (ANCON). The model is validated against information obtained from 10 fixed monitors under the departure tracks at Heathrow, supplemented by additional mobile noise monitors. Since 2000, monitoring has included data from mobile monitors in Fulham, Barnes, Richmond, Isleworth and Twickenham. The methodology is set out in ERCD Report 0307 and the location of fixed and mobile monitoring sites is shown in ERCD Report 0406, both of which are available on the CAA website **www.caa.co.uk**

70th Birthday

Roy Bratby

Roy Bratby (Chief Executive 1996 to 2006) celebrated his 70th birthday on Monday 13 August. Doreen organised a surprise visit (for Roy) to HQ so that he could indulge his passion for chocolate cakes. In the absence of Kevin and Linda, Peter Wheeler presented Roy with even more chocolate, and Hansa, Joanne, Pat and Judy (taking the photo) joined in the celebration. Roy seems to be as busy as ever - enjoying his retirement!

(L to R) Pat, Hansa, Doreen, Roy, Peter, Joanne

Obituary

Terry Hallett

Partners past and present, and colleagues of the Walker Beak Mason Partnership were saddened by the death of partner Terry Hallett at the early age of 51 from cancer.

Terry joined the firm in 1995 on the strong recommendation of Professor Peter Lord of Salford University, who encountered Terry when he was completing an MSc in acoustics at the University of the South Bank. Terry proved a very able and willing addition to WBM and was invited to become a partner in 2001 as Dr Angus Walker retired from partnership. He led many key projects in the building and room acoustics field of work, taking over the leadership of the Bedford office as Colin Beak retired in 2004.

Regrettably, Terry was diagnosed with cancer at the beginning of 2005 but faced it with such a positive attitude that he continued to work as much as he could in spite of his illness, until he was forced to reduce his workload by the combined impact of the cancer and its treatment.

The Terry we knew, and will remember, was cheeky and cheerful, with a ready smile and a humorous response for any verbal openings we were foolish enough to give him. They were always given in jest and Terry had the courtesy to make sure we knew.

Terry leaves behind his widow Maureen and all his friends and colleagues at WBM, who will miss his humour and smiles.

Terry at the WBM Christmas party at the end of 2005

Hepworth Acoustics

New appointments

Hepworth Acoustics continues expansion with key appointment in Bristol and new office in East Midlands

Hepworth Acoustics is one of the largest independent acoustics consultancies in the United Kingdom. The head office is in Warrington and the company operates from seven regional offices. The company specialises in environmental and building acoustics as well as noise mapping. It is continuing its policy of expanding its network of offices with a new opening in the East Midlands and the key appointment of Graham Bowland at its Bristol office.

Peter Hepworth, managing director of Hepworth Acoustics, says that East Midlands is the company's seventh regional office, and there are more in the pipeline, ensuring that clients are provided with a tight network of offices around the UK. In Bristol, bringing Graham on board adds breadth to the professional services offered in the region and ensures that potential and existing clients are fully supported.

The East Midlands region is now serviced by a Hepworth Acoustics office in Castle Donnington, which is headed by principal consultant Richard Housley. The office will provide consultancy on all aspects of environmental and building acoustics.

Hepworth Acoustics is also developing its client base in South West England and Wales with the appointment of acoustics specialist Graham Bowland to head the firm's regional office in Bristol, which opened last year. He joins from WSP Group, where he handled planning assessments and building acoustics, especially in educational and public buildings.

Hepworth has built up an impressive client base since it established the office and there are opportunities to expand on this, according to Graham. His experience is complementary to the firm's portfolio of acoustic consultancy services and he is looking forward to making a significant impact on Hepworth business in the South West and Wales.

Contact Peter Hepworth on **01925 579100** or email **peter.hepworth@hepworth-acoustics.co.uk** for more information.

Richard Housley

Graham Bowland

'Sound and Structural Vibration – Radiation, Transmission and Response (Second Edition)'

Frank Fahy and Paolo Gardonio

The first edition of this book, written by Frank Fahy in the early 1980s, was one of the standard reference texts on the analysis of audio-frequency vibration in coupled solid-fluid systems. However, since that time major advances have taken place in the field of vibro-acoustics. One significant development has been the widespread adoption of powerful computational tools for the numerical analysis of sound radiation from vibrating structures. These tools are now widely used within industry and academia. A second major development since the early 1980s has been the rapid advance in structural materials and signal processing systems. This, in turn, has led to the introduction of active control measures to reduce structural vibration and the associated sound radiation.

The second edition of 'Sound and Structural Vibration – Radiation, Transmission and Response', co-written with Paolo Gardonio, incorporates these two major developments. The analytical based material of the first edition has been greatly extended and now includes the theoretical basis of modern numerical analysis. In addition an entirely new chapter is included on active control of sound and vibration. Thus, the second edition is a greatly expanded book, with 633 pages compared with the first edition's 309 pages.

Chapter 1 introduces a mathematical description of vibrational waves in various ideal structures such as beam, plates and cylindrical shells, and Chapter 2 addresses the concept of structural impedance for the above type of ideal structural elements. The mechanics of sound radiation from vibrating surfaces is explained in Chapter 3 and the problem of evaluating the fluid loading applied by the fluid on the body is considered in Chapter 4. Chapter 5 details the sound transmission characteristics of various types of plane partitions including single-leaf, double-leaf and non-uniform designs. Chapter 6 considers the vibrational response of structures to incident sound fields with the principle of vibro-acoustic reciprocity being strongly emphasised. The subject of Chapter 7 is coupled system behaviour in situations where the structure wholly or partially encloses the volume of fluid. Chapter 8 introduces the principles of numerically based analysis of fluid-interaction problems: Finite Element Analysis and Boundary Element Analysis. Finally, Chapter 9 considers recent approaches to diminishing sound radiation by actively controlling the vibration of the radiating structure.

It is pleasing to see that the extensive physical explanations, which were such a successful feature of the first edition, have been retained and have been complemented with examples from modern numerical analysis. The experimental data relating to the theoretical content have also been revised to include more recent examples of vibro-acoustic interaction. These changes have made this book an easily readable and more up-to-date reference text than the first edition. The second edition is, therefore, a welcome successor to the original.

Stephen Walsh

Hepworth's latest noise database for Defra gives quarries valuable noise data

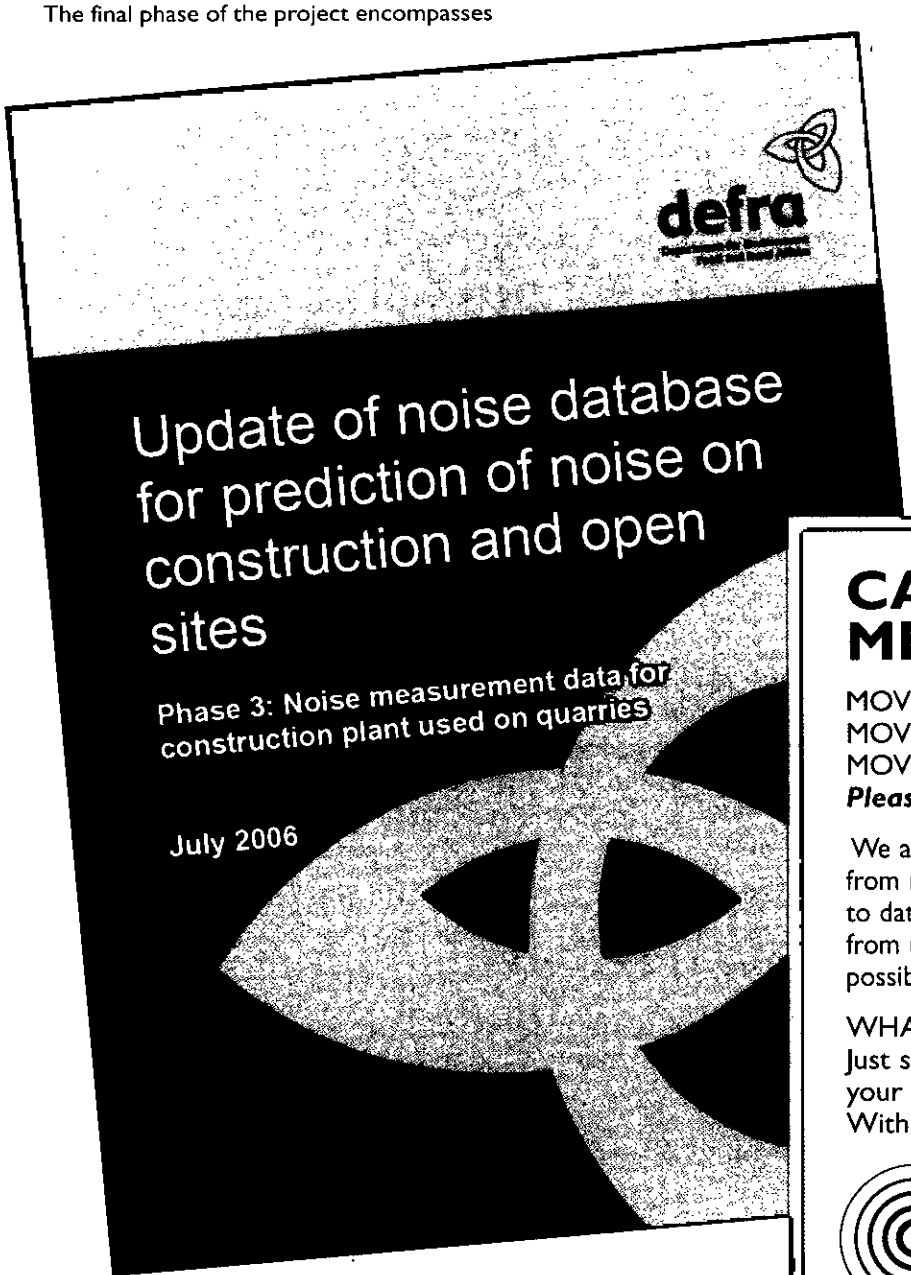
Hepworth Acoustics

Noise data for construction-type plant used on construction and open sites has until recently relied on data that was either gathered in the 1970s or is provided by equipment manufacturers. In 2004 Defra commissioned Hepworth Acoustics to produce a database of noise emissions that was based on actual measurements from the plant in use. The first part of the database, relating to construction, demolition, opencast coal sites and waste disposal sites was published in 2005 and can be viewed at **http://www.defra.gov.uk/environment/noise/research/construct-noise/constructnoise-database.pdf** .

The final phase of the project encompasses quarries. The report has recently been published by Defra and can be found at **http://www.defra.gov.uk/environment/noise/research/pdf/noise-database-phase3.pdf** .

The central objective of the Construction Plant Noise Database is to provide accurate source data to enable operators of open sites, quarries and landfill operations to evaluate the potential impact of noise from the proposed operations. The noise data is suitable for use with BS5228 but reflects current practice and plant. To complete Phase 3, Hepworth Acoustics carried out surveys of quarries in Cheshire, Derbyshire and North Wales. Approximately 300 individual measurements of plant noise were taken and the results are presented as un-weighted octave band sound pressure levels together with A-weighted activity sound pressure levels.

The value of the study lies in the fact that where it is not practical to measure noise levels from the exact type of plant being used, the database can provide greater accuracy than relying on 'type test' noise emission data from manufacturers, according to Peter Hepworth. The database helps operators to evaluate the potential noise impact of their sites with more accurate data, thus enabling them to take appropriate steps to mitigate the impact and assisting their use of BS.5228.



Vacancy

Robust Details Ltd has a vacancy for an Inspector in the Yorkshire area. The territory covered includes the following postcodes: OL, HX, HD, BD, HG, WF and LS.

The successful candidate must be either UKAS accredited or ANC Registered for field testing of the airborne and impact sound insulation of separating walls and floors in accordance with the relevant parts of ISO 140, ISO 717 and Approved Document E (2003) of the Building Regulations.

It is expected that all candidates will be able to demonstrate not only a significant level of ADE testing but will have substantial diagnostics experience. The ability to conduct non-invasive investigations into the causes of poor sound insulation and to demonstrate supportable conclusions is considered essential. Experience of invasive investigations is also desirable.

In the first instance please send your comprehensive CV, demonstrating how you satisfy the above key criteria, to:

Mr P R Dunbavin
Inspectorate Chairman
Robust Details Ltd
Davy Avenue
Knowlhill
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Candidates should be qualified in building acoustics or related subjects, to a bachelor degree or post graduate level, and have a minimum of three years consultancy experience. Skills in instrumentation, organization, mathematics and English speaking and writing are a prerequisite. Candidates must be able to demonstrate their ability to work in a team as well as manage multiple projects and tasks independently.

Salaries and benefits are negotiable and commensurate with qualifications and experience.

Interested candidates should email or fax a CV/resume and covering letter containing details of current salary and benefits to:

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Fax: +971-4-321-7274
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www.pmkconsultants.com

An accelerometer for all occasions

Brüel & Kjær

Brüel and Kjær has launched a new range of versatile DC response accelerometers suitable for testing dynamic acceleration effects on a number of applications, from automotive to aerospace.

Designed to be incredibly robust, the new Micro-Electro-Mechanical-Systems (MEMS) DC response accelerometers can withstand high mechanical shocks of up to 10,000G and have been gas-damped, making them resistant to temperatures ranging from -54 to +121°C.

Ideal for measuring low frequency motion and the tilt of objects under constant force, the DC accelerometers can be used for studying acceleration effects within many industries, such as aerospace - to test aircraft, missiles, helicopters and satellites - and automotive manufacturers for testing airbags and seats.

The accelerometers are also suitable for railways, ground transportation testing, structural testing and even studies on whole body motion.

Currently available in 36 variants, accelerometers are individually calibrated to provide a specified frequency range and offer two operating temperature ranges to suit customer requirements.

For additional information: Heather Wilkins,
Brüel & Kjær UK Ltd
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email: **heather.wilkins@bksv.com**
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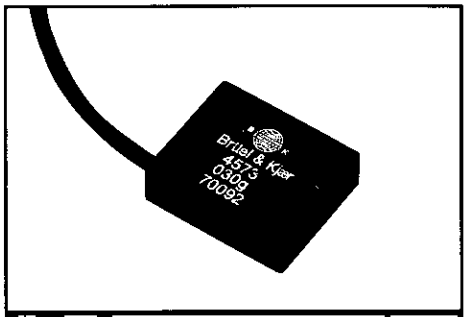


Micro-Electro-Mechanical-Systems (MEMS) DC response accelerometer

CHARM

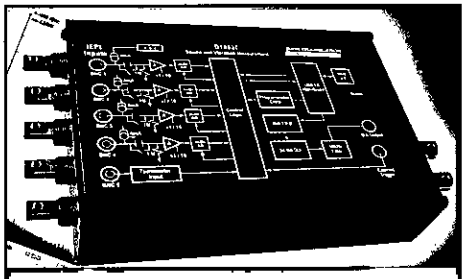
Bay Systems

Hand-arm vibration levels can be calculated from time histories and spectral data using nVision's CHARM module (Calculate Hand Arm RMs). The advanced NVH PC software accepts data from most sampling and analysis systems including wave cards and USB systems. The new CHARM module enables the vector-summed hand-arm vibration level (x + y + z directions) to be calculated. It uses standard drag-and-drop techniques to load the data, and the user simply selects the channels and presses 'process'. The result appears immediately as a html document and appended to the original data object.

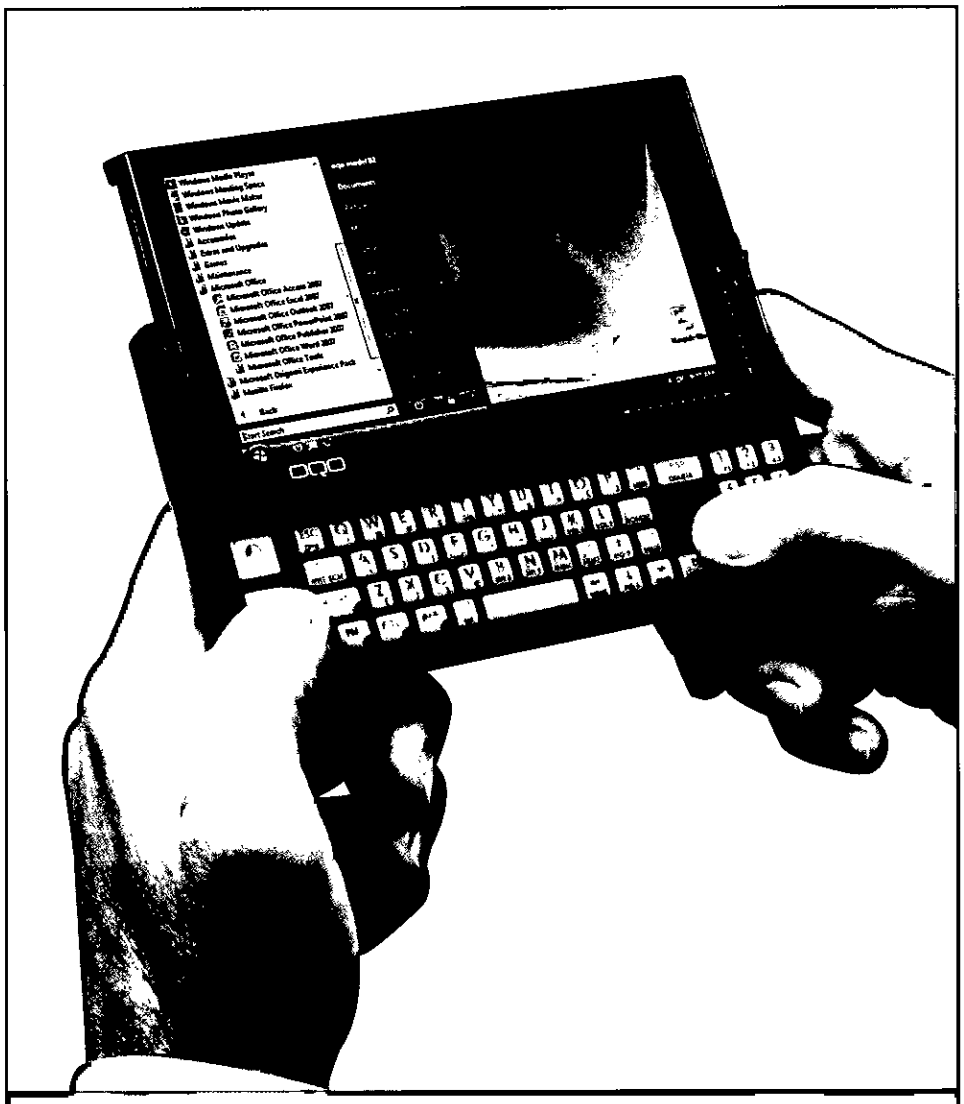
A major advantage of the nVision-based system is that any hand-arm or whole-body set of response curves can be loaded, making the system 'future-proof'. Data can be acquired using an ultra-portable full-function PC such as the Micro VAIO, shown in the picture, with the DT9837 USB-powered four-channel acquisition card and IEPE-powered accelerometer. If field work is not necessary, data can be gathered using a standard PC.

As a special introductory offer, customers can have a triaxial accelerometer, Micro VAIO pC, five-channel acquisition system and some very versatile sortware for a very competitive price.

Contact Alan Bennetts at Bay Systems, tel **01458 860393**, or email **sales@baysystems.ltd.uk**



Charm 9837



Micro VAIO PC

Brüel & Kjær

announces 'low noise' tapping machines

More accurate sound insulation measurements to help constructors meet strict noise regulations are now available, following the launch of Bruel & Kjaer's updated standard tapping machine – with reduced external noise.

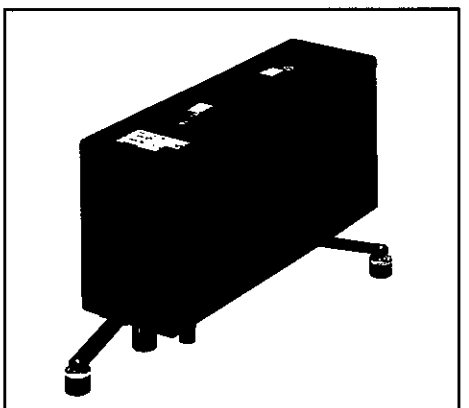
The inherent mechanical noise a typical standard tapping machine produces, particularly on poorly insulated floors, can be picked up during use and distort the results. Bruel and Kjaer significantly reduced the internal noise (and hence external noise) of its standard tapping machines by using vibration insulation inserts and bushes.

For the design and performance of standard tapping machines, manufacturers must follow the international standards ISO 140-6, ISO 140-7, ISO 140-8 and ISO 140-11. Measurement procedures for drum noise (noise from footsteps) are on the research level, but currently no international standard has been issued.

The tapping machine is placed on to the floor covering and measurements are made of the resulting impact noise inside the room below. Each machine has five hammers, which lift and drop on to the floor twice a second: this creates some inherent mechanical noise from the motor, gearbox and lifting mechanism. With Brüel & Kjær's improved model only the floor acoustics are recorded and users are provided with more precise measurements.

Measurement of sound insulation is also governed by international standards (ISO 140 and ISO 3382) which require the construction industry to obtain reliable results by certain methods. To meet these standards the results must have been produced by an omnidirectional sound source radiating noise evenly in all directions. Brüel & Kjær provides a complete system for the accurate measurement of building acoustics, which includes two omnidirectional sound source loudspeakers, an amplifier and the improved standard tapping machine.

For additional information: Heather Wilkins, Marketing Coordinator, Brüel & Kjær UK Ltd
Telephone: **01438 739 000**
email **heather.wilkins@bksv.com**
www.bksv.co.uk



Brüel & Kjær's updated standard tapping machine – with reduced external noise

Knauf Gypsum Parge Coat set for more Part E solutions

Knauf Gypsum Parge Coat application

Knauf Drywall's Gypsum Parge Coat, a key solution for Part E compliance in residential masonry separating walls, has gained further approvals that allow its use in a wider range of applications. After extensive on-site acoustic testing, Knauf Gypsum Parge Coat has achieved Robust Detail status for use on cavity separating walls of dense aggregate blocks (1850 to 2300 kgm^{-3}) and Besblock Star Performer general purpose cellular blocks. This follows earlier Robust Detail approval for its use with medium density aggregate blocks (1350 to 1600 kgm^{-3}).

The latest approvals mean that housebuilders and drylining contractors can ensure Part E compliance without pre-completion testing by using a parge coat on separating walls of types E-WM-3 and E-WM-5, in addition to the common E-WM-4 type approved previously. This makes the product suitable for use in houses, flats and all other residential buildings where masonry separating walls of these types are specified.

Knauf Gypsum Parge Coat is used in place of traditional sand-cement renders to seal masonry before finishing with Knauf plasterboards. As a gypsum product it is easy to mix and to apply, by hand or machine, and its fast drying time of only two hours is a boost for site productivity as wallboards can be direct bonded on the same day.

Part E of the Building Regulations requires that in new-build houses, separating walls must provide at least 45dB reduction of airborne sound on site. Robust Details provide conditions for constructions to comply with Part E, without pre-completion testing. With the new approvals, builders have three options for compliance using 100mm blocks with a 75mm cavity; each outer face is parge-coated and finished with 12.5mm wallboard on dabs of bonding compound.

Gypsum Parge Coat is available from builders merchants in 25kg bags, each covering 4.25m^2 at a minimum thickness of 6mm. Further details on Gypsum Parge Coat and other Knauf drywalls for Part E compliance in residential applications can be found in the design partner series housing brochure, available free from **08700 613700** or as a download from **www.knauf.co.uk** .

For more information: Knauf Drywall, tel: **01795 424499** email: **info@knauf.co.uk**

BarnOwl: Real-time directional noise monitoring

World first patented technology for multiple noise source detection and analysis

The manufacturers say that with BarnOwl it is possible to tell in real time not only how loud the noise is, but also where it is coming from. BarnOwl is an integrated system of three microphones, a precision engineered mounting plate, acoustical hardware and sophisticated signal processing and reporting software. It provides the world's only full-time, 360° real-time directional noise monitoring and control solution.

The benefits of the BarnOwl noise monitoring method over traditional techniques are:

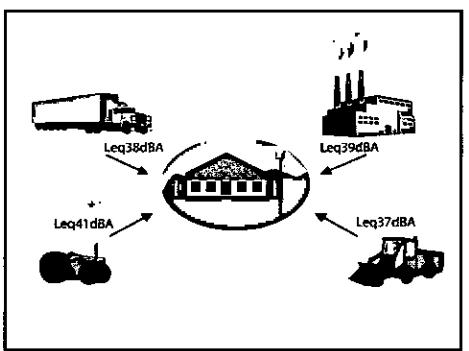
- It allows noise professionals to provide more accurate advice to their clients
- It gives quicker and more accurate resolution of noise issues, and allows industry to improve its operational efficiency
- Fairer negotiations can be conducted between industry and regulators, with a better outcome for affected communities.

BarnOwlTM achieves this by providing accurate measurements with true directional monitoring, thus eliminating debate over the subjective nature of attended measurements. Longer measurement durations can be studied, giving proper consideration to variable conditions such as the weather and operations on site. It provides fully automated and unattended monitoring that reduces the overheads associated with attended monitoring. This means that real-time noise data can be received and acted on by site personnel to reduce noise.

The accurate measurement of noise levels and direction gives both industry and regulatory authorities certainty as to whether noise from a site meets the required limits. The system can check compliance with consent conditions, without interference from other noise sources, and watch the movement of noise sources on a remote monitor in real time. It can track and report on the noise level from multiple sources over days, weeks or years, and exclude extraneous noise from measurement results. The source of intermittent, unpredictable noise can be positively identified.

Second by second noise monitoring gives operations managers a way to manage and control noise in real time. Multiple noise sources can be monitored ensuring the site's noise contribution is accurately presented alongside other sources such as road traffic. Alerts can be sent immediately when noise contribution exceeds a threshold, and real-time data reports and real time audio feeds are available immediately to a site controller. If required, immediate action can be taken by operational managers to rectify the potential problem.

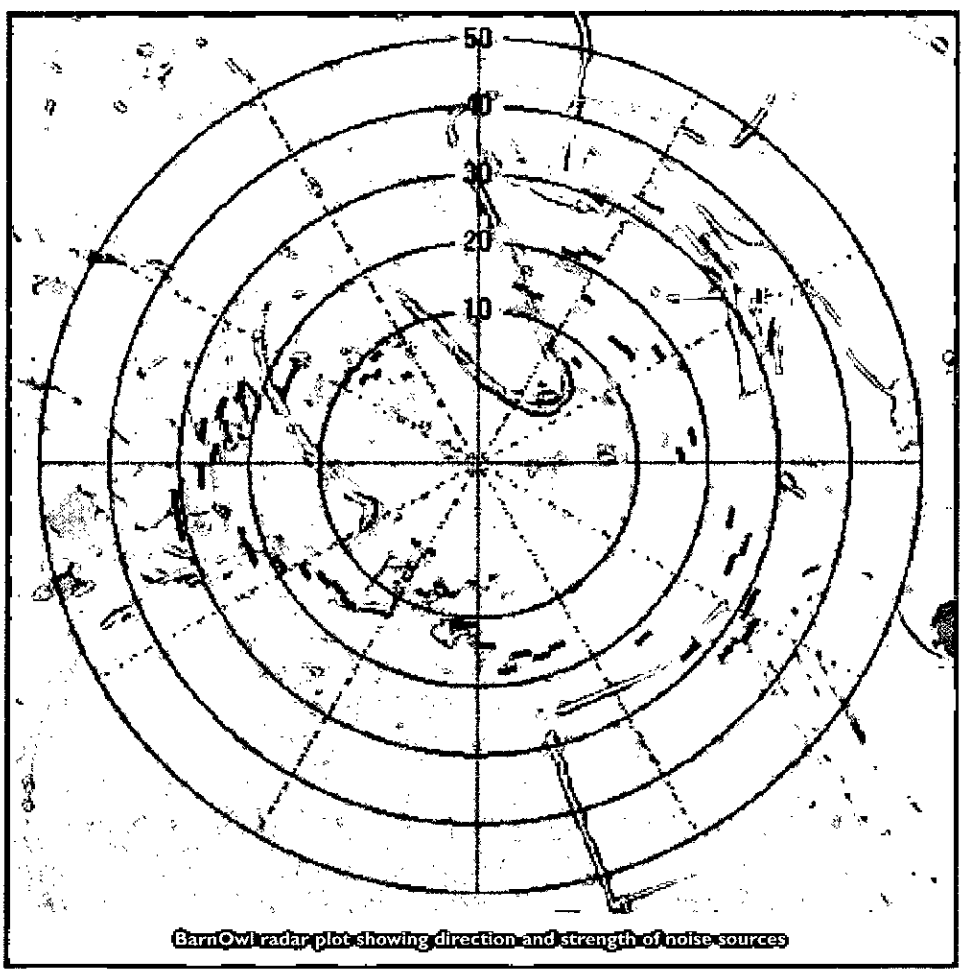
The features of the BarnOwl system include multiple noise source detection; automatic unattended real time noise detection (every second) from 72 directions; directional monitoring with low pass filter to eliminate insect noise; real-time graphical display and reporting of noise levels as L_{Aeq} and L_{A10} values; trigger and alert options for real time control; networked and wireless connectivity; configurable for access by SCADA or similar system; samples of audio signals recorded; direct real-time audio over network connection; automated microphone calibration, and archiving facility. There are both permanent and mobile power options.



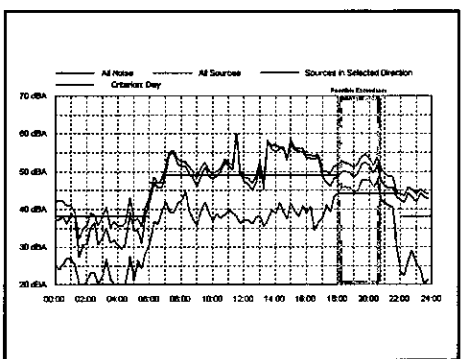
BarnOwl accurately measures noise levels from each source to determine industrial noise contribution


BarnOwl added as one component at a BHP Billiton environmental monitoring station

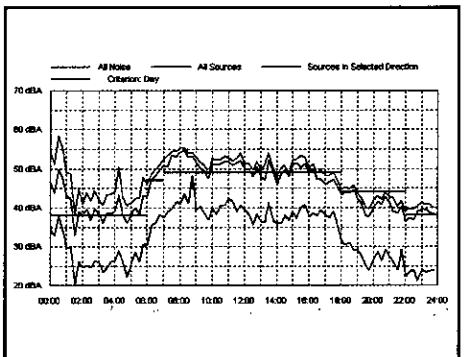
For more information: Neil Gross, Sound Science, tel: **+61 2 8116 6118**, fax: **+61 2 9437 4393**, email: **neilg@soundscience.com.au** **www.soundscience.com.au**



BarnOwl radar plot showing direction and strength of noise sources



BarnOwl real time report shows that there is a possible exceedance in the evening from the designated industrial source (red line)



BarnOwl real time report shows that sources other than the designated industrial site (red line) are causing the exceedance of the specified noise limit (black line)

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Committee meetings 2007

DAY	DATE	TIME	MEETING
Thursday	6 September	10.30	Membership
Thursday	13 September	11.00	Medals & Awards
Thursday	13 September	1.30	Executive
Thursday	20 September	11.00	Publications
Thursday	**27 September**	**11.30**	**Council**
Thursday	4 October	10.30	Diploma Tutors and Examiners
Thursday	4 October	1.30	Education
Thursday	11 October	10.30	Engineering Division
Thursday	18 October	11.00	Publications
Thursday	1 November	11.00	Research Co-ordination
Tuesday	6 November	10.30	CCENM Examiners
Tuesday	6 November	1.30	CCENM Committee
Thursday	8 November	10.30	Membership
Tuesday	13 November	10.30	ASBA Examiners
Tuesday	13 November	1.30	ASBA Committee
Thursday	15 November	10.00	Meetings
Tuesday	20 November	10.30	CMOHAV Examiners
Tuesday	20 November	1.30	CMOHAV Committee
Thursday	22 November	11.00	Executive
Thursday	29 November	11.00	Publications
Tuesday	4 December	10.30	CCWPNA Examiners
Tuesday	4 December	1.30	CCWPNA Committee
Thursday	**6 December**	**11.30**	**Council**

Refreshments will be served after or before all meetings. In order to facilitate the catering arrangements it would be appreciated if those members unable to attend meetings would send apologies at least 24 hours before the meeting.

Examination dates 2007

DATE	EXAMINATION
5 October	Certificate of Competence in Environmental Noise Measurement
19 October	Certificate in the Management of Occupational Exposure to Hand-arm Vibration
2 November	ASBA Examination
9 November	Certificate of Competence in Workplace Noise Assessment

Conferences and meetings:

Diary 2007-08

18-19 September 2007
Underwater Acoustics Group
Detection and classification of underwater targets
Edinburgh

26 September 2007
Measurement & Instrumentation Group
Perception, consideration and closure... a better way of dealing with noise from aircraft
Birmingham

17-18 October 2007
Noise & Vibration Engineering Group
Autumn Conference: Advances in noise and vibration engineering
Oxford

29-30 November 2007
Electroacoustics Group
Reproduced Sound 23 - Hall of sound: audio for live events
Newcastle-upon-Tyne

29 January 2008
Speech & Hearing Group
Speech and hearing in learning environments
London

16-18 September 2008
Underwater Acoustics Group
Underwater noise measurement, impact and mitigation
Southampton

10-11 April
Spring Conference 2008 - Widening Horizons in Acoustics Research
Reading

Further details can be obtained from Linda Canty at the Institute of Acoustics
Tel.: **01727 848195**
or on the IOA website: **www.ioa.org.uk**

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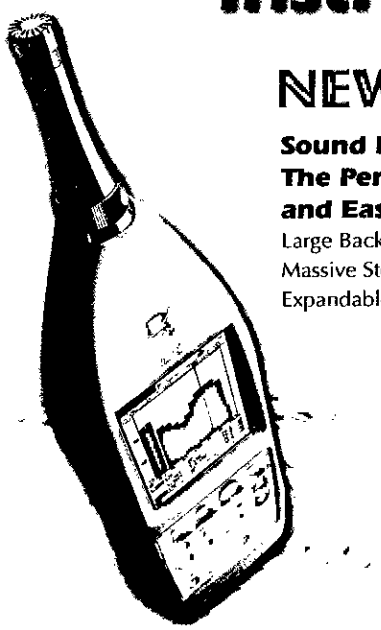

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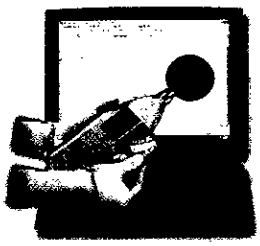

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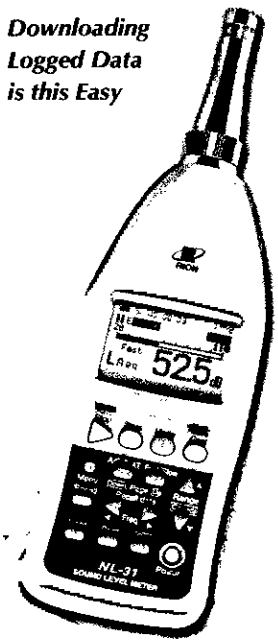

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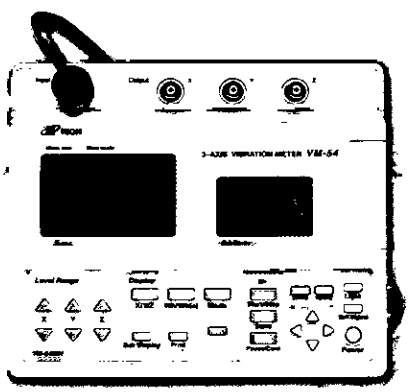

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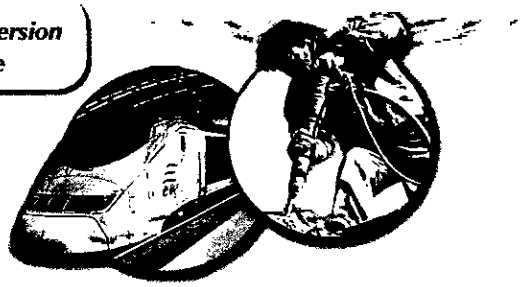

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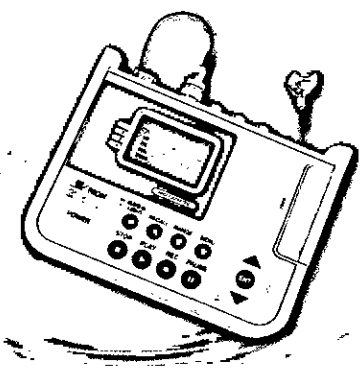

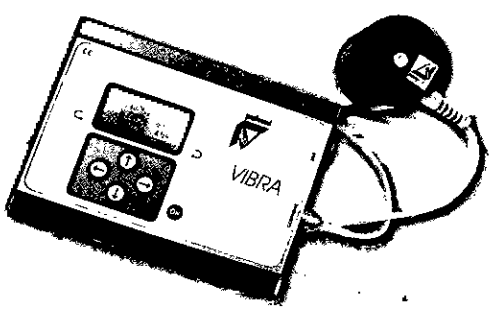

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