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BROADCASTING AND THE NOISE AT WORK REGULATIONS

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SUMMARY

This paper considers some strategies and options in implementing the Noise at Work Regulations 1989 in a broadcasting environment. It is to some extent a personal view and every item in it should not be taken as representing official BBC policy. It must also be noted that no policies or practices mentioned have been approved or agreed by the HSE, or tested in court.

INTRODUCTION

The BBC has known for many years that the ordinary day to day work of broadcasting might expose some staff to high sound levels. When the Noise at Work Regulations 1989 [1] - here called, for short, the Regulations - came into force, the BBC already had some noise control measures in place. These had gradually been introduced following the code of practice on industrial noise of 1972[2]. Despite this experience we found it far from plain sailing when we came to implement the Regulations. In this paper I will look at some of the problems. I cannot give all the answers: in some cases the BBC's policy is still the subject of internal debate or problems remain to be resolved.

Music or Noise: The Old Chestnut

When an acoustic or safety consultant first discusses with managers the question of noise control on speech and music, the starting point will inevitably be the old chestnut of whether the sound that you want to hear is as damaging as unwanted sound. Of course one can simply say that the law (or at least, the HSE, which is much the same thing in practice) says music and noise are the same, and that's the end of it.

However, more pragmatically, you can be fairly sure that managers will not be committed to enforcing health and safety measures unless they themselves believe that a real risk exists. The very idea that there may be danger from something enjoyable, which gives no pain or obvious symptoms, and which is a major leisure activity of much of the population, seems obvious nonsense to some. Opposed perceptions can lead to mutual distrust, and in trying to overcome this, it can be useful to remember that most people have literally no idea of how their ears work. High intelligence and a good education seem no bar to an un-articulated belief that noise induced hearing loss is a psychological rather than a physical phenomenon. A little information can go a long way to help matters.

What is "likely"?

The next step is to make noise assessments; and this will not be straightforward. Studio engineers and production staff tend to have a wide range of activities, listening to loudspeakers and on headphones in various places on different types of programme material. The Regulations are of course based on a single day's exposure, and according to the HSE, if the exposure is variable one should base the assessment on the "worst likely" exposure[3].

This can lead to the apparently odd result that the assessment, which is presumably intended to be a guide to the risk, may bear little relation to it. For example, anyone who regularly works on outside broadcasts might be required to work in the pits at a motor race, where the day's exposure might be over 100dBA. Whoever actually does the work should of course have appropriate training and instruction and ear protection equipment as the law demands. So unless you are prepared to restrict who does what, there is a good argument that everyone who might do the job should have the same assessment, even though many of them might work on nothing noisier than golf tournaments.

There is an argument, possibly equally good, that the assessment is meant to bear some relationship with risk, and therefore only those who have actually been exposed to high sound levels should have a high assessment, whatever might be considered their "worst likely" exposure. Provided that all staff get the necessary training and equipment, the latter seems a reasonable course. However it can be hard to escape a feeling that neither the regulations nor the HSE's guidance are well framed to cope with people with only a moderate probability of occasional high exposure.

Assessment and Self-control

Having dealt with this conceptual difficulty, you can begin analysing work patterns and measuring the exposure acquired during various activities. You will soon run up against a fundamental problem: many of the exposures are governed by the position of a volume control, set in some cases by the employee you are trying to assess, and in others by a colleague of his or hers.

Of course you can try to be reasonable about this: in BBC Radio we found that in studios dealing exclusively with speech, daily noise exposures from loudspeakers would not be a hazard unless the volume was turned up so high that the neighbours (i.e., the next door studios) complained. However, if the exposure can approach anywhere near one of the action levels, (and in studios dealing with any sort of popular music this is not unlikely) how can you be sure that the levels you measure are representative for all staff?

There are two fundamentally different possible approaches. Either you can

do a lot of measurement and some statistical analysis in an attempt to assess the "worst likely" exposure. This has the considerable advantage that it will tell you what is actually happening. However the measurements will not predict the future: the next new recruit might just happen to like it louder. Also you may well find that the "worst likely" assessment is above the first action level, and some further action will then be required.

Alternatively you may decide that listening conditions vary so much that measurements can give only a general indication of the likely dose. Instead you can try to put in place limiters to control the exposure positively, or warning signals that will allow staff to control it themselves. This may give greater security, but may require considerable investment in technical modifications.

How to be Unpopular

The idea of controlling the maximum sound level that monitoring loudspeakers can produce, does not go down well with the audio practitioners. The sound engineer and producer will be most concerned at the idea of any device connected in the loudspeaker feed, that can make what they hear in any way different from what they are sending to the listener at home. On hearing something not quite right, they will, they say, immediately start to worry about whether it was a technical fault or merely the protection circuit operating. If this distracts them, or makes them miss some vital thing that they should have heard, the programme will suffer. For many engineers who do music recording the very idea of interposing any alien equipment into the system that they are using to assess the delicate adjustments by which their professional competence is judged, is anathema.

Dose Control or Level Control?

When you are considering how exactly to control the exposure without unduly annoying the "golden-eared", some helpful person will probably point out that the quantity which the Regulations require to be controlled is not level, but dose - the total A-weighted sound energy over the working day. It is tempting to try to control this quantity directly, because the daily exposure to sound from loudspeakers will often be for a period less than eight hours, and not all the time at the highest level; so a correspondingly higher maximum could often be permitted.

Against this must be set a number of factors. Firstly, staff would have to stop work when their dose reached the relevant action level - which could be awkward in the middle of the 9 o'clock news. Secondly, an individual's daily noise dose may be acquired during a number of different activities in different places, so the only valid check would be to give everybody an individual dosemeter. The initial cost, additional administration and cost of maintenance and calibration, as well as the well known problems of getting reliable dosemeter readings, make this impractical.

Finally, dosemeters would not measure exposure from headphones. Overall, the seemingly attractive option of controlling total dose gives more problems than it solves.

However, since maximum level is so manifestly the "wrong" thing to measure and control, it is also often suggested that it is better to control or indicate $L(A)_{eq}$ over a fairly short time such as five or ten minutes. Unfortunately, in practice the effect of integration is such that, after a period of high level that does not quite operate the circuit, what finally nudges it over the edge may well be a relatively low level item. This makes such a system incomprehensible to the non-technical user, and infuriating to everybody.

In BBC Network Radio we are continuing with the system that has been used for many years, of high sound level warning lights in control rooms where it has been found that there is a reasonable likelihood of exceeding the first Action Level of exposure. (In practice these are exclusively rooms dealing with popular music.) The lights are sensitive to maximum A-weighted level as this gives immediate feedback to the operator on the effect of changing the level.

This system has the advantage that the high sound level detection and warning system has no electronic connection with the rest of the studio equipment. A microphone set into the ceiling or suspended above the operator's position detects the sound, and is calibrated with reference to the level at a typical listening position. Amber "warning" and red "action" lamps are provided, with operating levels separated by 5dB. Similar systems are commercially available.

This does put the onus on the individual operator to take notice of the lamps and reduce the volume when the appropriate lamp flashes. However this is in principle little different from requiring a machine operator to ensure that the appropriate guards are in place when the machine is running.

HEADACHES FROM HEADPHONES

Headphones pose their own special problems. It has been found that it is difficult to judge sound level from headphones, and many people will set the level higher than they realise. Listening is private: there is no immediate evidence that the level is high, and the neighbours will not be disturbed.

Most headphones have high overload points, so that a small innocuous-looking pair of "cans" may potentially give greater noise exposures than a pair of large rock music monitor loudspeakers, depending only on the amplifier to which they are connected. Low impedance headphones often need only a small voltage to give high sound levels. Unless care is taken, it is by no means impossible to produce systems in which it is pos-

sible to exceed not only the first and second action levels of the Regulations, but even, where there can be loud clicks from switching, the peak action level of 200 Pascals.

Headphones: Problems of measurement

Measuring sound exposure from headphones is itself not simple. Annex 1 to the Regulations, in defining the sound pressure that is to be used in calculations, refers to:

> ... the time-weighted value of A-weighted instantaneous pressure in pascals in the undisturbed field in air at atmospheric pressure to which the person is exposed ... or the pressure of the disturbed field adjacent to the person's head adjusted to provide a notional equivalent undisturbed field pressure.

One cannot sensibly measure sound level from headphones as "undisturbed field", so the "disturbed field" (i.e., in the presence of a head) must be measured and the result "adjusted". There is no published guidance on how one should measure and suitably adjust the result, although the HSE specialists can give useful advice. (The advice in the HSE's Noise Guide no. 3[4] may mislead some, as it refers only to the use of a miniature microphone under a headset, whereas the use of an "ear simulator" may in many cases be the best method.)[5]

To do the job properly requires unusual equipment, and will be beyond the capabilities of a person whose only specialist acoustic training is a standard "Competent Person" course lasting a few days. In other words, it will not be cheap.

In television, the widespread use of insert earphones, and their high sensitivity and potential for giving high sound levels, demands a method of measurement that will cope with them. Some form of coupler or ear simulator is essential and considerable correction of the results will be necessary.

Headphones: Controlling Levels

In a very small broadcasting organisation, it may be possible to standardise on one type of headphone and to modify all possible outlets into which headphones can be plugged to limit the maximum drive voltage. Even in this easiest of situations, this strategy will lead to continuing difficulties; for example when the chosen type of headphones becomes obsolete and you end up with a mixture of different types, and when some equipment is inevitably found difficult to modify. Nowadays much listening takes place in offices, and often on domestic equipment, so a comprehensive policy must include all the headphones used by production staff.

In a large broadcasting organisation, the quantity, variety, and rate of

change of equipment into which headphones can be plugged, is so enormous that no strategy based on modifying headphone outlets is practical. The BBC realised this a long time ago, and developed sound level limiters[6] that can be fitted to the headphones themselves. However if others wish to follow this path, there is at the time of writing no trade supplier of broadcast equipment that will supply headphones or earphones with a limiter set to achieve a given maximum dose, and with enough documentation on calibration to make reasonably sure that the legal requirements are met.

Headphones: Problems in use

It must be admitted that until recently, only a fairly low percentage of BBC headphones has been fitted with limiters. This is mainly due to the problems outlined below. However the situation is rapidly changing; for example the fitting of limiters to over 1000 pairs of headphones used in the Network Radio directorate, is scheduled for completion early in 1994.

For the headphone users, high sound level limiters present several practical difficulties. Firstly there are problems associated with the programme material itself. When editing, it is often necessary to listen to quiet items next to loud ones - for example, a quiet intake of breath or faint rustles preceding the start of a piece of music, or the end of a musical die-away. Attention to such detail is fundamental to quality editing. Yet constantly adjusting a volume control is awkward and slows down what people have learnt, over many years, to do as a smoothly flowing process.

Headphones: Noisy Environments

Secondly there are the problems of listening on headphones when the background noise is high. The circumstances may vary, from, for example, a junior engineer "tidying up" a track at the back of a control room while his senior colleague records the band's next number, to a commentator in the pits at the Formula One Grand Prix at Silverstone. Noise excluding headphones can help. However, in the first case the engineer also needs to know what is going on in the control room and cannot be completely isolated. In the second case even very good noise excluding headphones barely keep out enough sound to allow listening to the cue programme at a level that will not itself cause excessive exposure.

The second example is extreme, but background noise is a problem in many outside broadcasts and, if listening critically, in many other situations. Active noise cancelling headphones may provide some answers to this, by reducing break-in of low frequency sound that is most effective in causing masking, but at present they are very expensive and unsuitable for most broadcasting applications. Television camera operators have a particular problem of needing to hear the programme sound together with a continuous stream of instructions, often in very noisy circumstances such as a "Top of the Pops" recording.

Other safety aspects must not be forgotten: a person using noise excluding headphones to work in an open-plan office must still be able to hear the fire alarm.

Headphones: Foldback to Musicians

Thirdly, there is a specific problem associated with live music recording. Musicians in bands often require "foldback" on headphones to enable them to play together, either with others in different parts of the studio or with prerecorded material. The band sometimes provides this foldback from their own resources, but studio equipment is very often involved. Foldback to a brass group or a drummer may have to be very loud to be audible. This is perhaps a grey area legally - the broadcasting organisation may not employ the musicians directly, but it is difficult for it to abdicate all responsibility for sound levels provided via its own equipment. In the BBC, the studios which do most of this type of work are equipped with headphones attached to boxes which carry high sound level warning lights and warning signs. It has been found that a strictly engineered limitation on level in these circumstances, results in no recordings. Of course if we implemented such a limitation, the recordings would still be made - but in non-BBC studios.

Headphones: DJs

Fourthly there are the DJs, more formally known as self-operating presenters on popular music programmes. These are of course performers employed for their personality and ability to project a particular image. All DJs listen on headphones much of the time, and those who deal in rock and pop music often require high sound levels. I have no doubt that DJs use these high levels to enable them to generate the required atmosphere of excitement. They are also used to hearing their own voice (which, since it is their living, is naturally of prime importance to them) in their ears at this high level, and often in headphones of their own choice which they will carry from one job to another. Any attempt to restrict the maximum sound level to less than they want will make them most upset.

I think there are two things needed to overcome this problem. Firstly, good and convincing education in the causes of hearing damage; and secondly a common approach by all who use DJs, not only broadcasters but also clubs and discos. Until this happens, any attempt to control headphone levels will lead to continued arguments that DJs are allowed what level they like in other places. The BBC does not have a final answer to this problem, but because many DJs are so wedded to their own headphones, we are investigating methods of giving warnings of high sound levels, that can be automatically set to be correct for any pair of headphones that may be plugged in.

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Portable Cassette Players

Finally on headphones, there is the problem of "Walkman" type portable tape cassette players. These are widely used by production staff for listening to tapes submitted by would-be performers and keeping up to date with broadcast programmes. Many of these machines are capable of providing an excessive sound level under the Regulations, although the law permits them to be sold freely for non-work uses. They are usually provided with a fig-leaf in the form of a warning about high sound levels in the instruction manual. Your guess as to the chances of a professional user reading this is as good as mine.

The BBC has solved the technical problem of designing an effective limiter which will work with the low impedance, high sensitivity headphones that personal cassette players use. However the fitting of such a limiter may well quadruple or quintuple the cost, not just of the headphones but of the whole outfit. There is considerable resistance in any organisation to such a relatively expensive move, particularly when millions of the same devices are in use by the general public without protection, and one's competitors do not seem to be concerned.

CONCLUSION

This survey has not been exhaustive, but shows some of the problems likely to be faced by anyone attempting to formulate and implement noise control policy in broadcasting. (I have not even touched on the noise exposure of musicians from their instruments, as in Britain the BBC is the only broadcaster that employs musicians on salary or long term contract. However any organisation that employs both orchestras and acoustics engineers cannot escape some responsibility in this field, which deserves a conference session of its own.)

The overall conclusion is that in many areas solutions are possible, although in some they involve considerable expense and effort. In some areas the solutions are still not clear.

Those who work at the programme production "coalface" of broadcasting are in general highly committed to achieving the best possible product, and believe strongly that they need to use particular working practices. If they see noise control as getting in the way of their productions, it will not be easy to introduce it effectively. In overcoming this barrier, education and persuasion is vital. Although it is civil litigation and thus not directly applicable to the Regulations, the case of Berry v. Stone Manganese Marine Ltd (1972)[7] may be relevant. Here the judge made the point that because noise hazard is not self-evident, mere enforcement of wearing ear protection is not enough, but it is the duty of employers to take steps by persuasion and propaganda to ensure that ear protection is used.

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