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PRACTICAL NOISE CONTROL IN LARGE POWER PLANT.

P J E BARRY & H F J SCRASE

CENTRAL ELECTRICITY GENERATING BOARD, SOUTH EASTERN REGION.

INTRODUCTION:

In the Autumn of 1972, it was decided to adopt a noise control policy which would ensure that the Region conformed, as soon as practicable to the "Code of Practice for reducing the exposure of employed persons to Noise" which had just been published by the Department of Employment.

Subsequently, two seminars were held to train Power Station and Electrical District Noise Control Officers in the use of sound level meters and to acquaint them with the forms of CEGB-approved personal ear protection available.

The Noise Control Officers then carried out preliminary noise surveys at their respective sites to establish the nature and approximate magnitude of any problem, reporting their findings to the Regional Scientific Services Department. It was agreed that where high noise levels were found or the total integrated dose seemed likely to exceed the criterion laid down in the Code of Practice, the results of these surveys would also be communicated to the Regional Medical Adviser for consideration and to recommend appropriate action.

RESULTS OF PRELIMINARY SURVEYS:

The results of these surveys revealed that at no power station could the noise situation be regarded as being entirely satisfactory. There were many instances where plant operating and maintenance personnel had to reside in areas where the noise levels exceeded 90 dB(A). An analysis of the reports received indicated that the ranges of sound levels present in those areas where staff commonly spent the greater part of their working day were as follows:

RANGE OF BACKGROUND NOISE LEVELS FOUND IN POWER STATION OPERATIONAL AREAS BEFORE COMMENCING THE NOISE CONTROL PROGRAMME.

Area	Noise level range dB(A)
Turbine Hall (steam turbine sets)	87 - 100
Turbine Hall (gas turbine sets)	94 - 117
Turbine Hall (basement)	86 - 108
Boiler House Operating Floor	78 - 103
Boiler House Basement	80 - 105

As far as the Electrical Districts were concerned the problems were found to be less severe, being confined in general to such items of equipment as air compressors and air-blast circuit breakers.

ASSESSMENT OF HEARING DAMAGE RISK:

It soon became apparent from these initial surveys that considerable engineering work would be necessary in the long run to ameliorate the noise problems at a number of power stations. In the meantime, however, it would be necessary to take steps to eliminate the possibility of hearing damage to staff having to enter the problem area.

Although areas of high noise level had been identified, proper assessment of the hearing damage risks to staff required the collation of more detailed noise contour measurements and their dwell times. Accordingly, the stations produced noise contour maps of their operational areas which were then used when calculating the equivalent noise levels to which personnel were subjected. Difficult situations were, in some cases, resolved by the use of personal dosemeters.

Clearly, with the great variety in the sizes and types of power stations in the South Eastern Region, there have been many areas where these assessments have shown that the noise levels are insufficient to yield a high probability of hearing damage risk. In addition, there are also those low-merit stations where any such risks are further reduced by the loading patterns.

Where critical conditions have been identified, however, the procedures to be followed have been laid down in a Memorandum on Noise Control. The Noise Control Officers or other staff designated to act have to ensure that barriers are erected and notices posted restricting access to these areas and the Regional Medical Department have the responsibility of recommending the type of hearing protection (if any) to be worn by operators working there.

REMEDIAL TREATMENT:

From the outset, it was recognised that it would be unreasonable to expect staff to wear ear protection for their complete work periods and that, wherever possible, noise problems should be eliminated at source.

The nature of the remedies has depended upon the offending item of plant and any operational peculiarities it has possessed and perhaps the best method of illustrating the amount of work which has been involved is by taking a case history from one of the power stations. For this, a medium sized, middle-aged, coal-fired station has been selected which had noise problems typical of those to be found throughout the Region. This station has an output of some 308 MW (E) produced by four 52.5 MW and two 60 MW turbo-generators. The alternators of the four smaller generating sets are air cooled whilst the two larger machines are hydrogen cooled. Steam for the turbines is produced at a temperature of 496C and a pressure of 66 Bar (6.6 MPa) by eleven pulverised-fuel fired boilers, each having a rated throughput of 40 kg/s.

The early surveys at the station highlighted noise problems in the boiler house operating area, the turbine hall, the coal milling areas and in the ash plant chamber. In addition, staff operating the mobile coal-handling equipment and certain pneumatic tools were also subjected to unacceptable noise levels. The order of magnitude of these problems may be judged from the noise contours measured in the turbine hall, for example, and reproduced here in part in Figure 1(a).

Further investigation showed that the noise sources in the boiler house all arose from steam leaks, whereas, in the turbine hall, there was a considerable contribution from the machines installed there as well as from a multiplicity of steam leaks. The turbo-generators, particularly the four smaller sets, were especially noisy as were certain electrically-driven feedpumps. The overall situation was not helped by the fact that the fabric of the turbine hall was tiled brick with a tiled floor and concrete roof which produced an extremely reverberant noise field.

These investigations enabled priorities to be assigned to the remedial work required. Since measurements have shown that steam leaks can raise the local background noise levels by as much as 300% and influence the overall levels for distances of up to 100 m. away, the highest priority was apportioned to their abolition. Theoretically, this was a fairly straight-forward task, merely requiring valve glands to be re-packed, gaskets to be renewed or holed pipework to be made good. In practice, however, it was a far from simple task; one couldn't necessarily shut down electrical generators purely to repair steam leaks. Besides the economic penalties this would have incurred, there was not always alternative generating capacity available. Thus, where repairs could not be carried out immediately, temporary palliatives were effected by muffling the leaks, using a technique developed within the Board (1). As time went on, it became apparent that steam leaks were recurring on certain small valves which had previously been repaired. To combat this, it was decided that, wherever possible, these valves would be replaced by glandless bellows type units.

The repair and/or muffling of all steam leaks meant that the boiler house could be removed from the list of noise areas and went a long way towards diminishing the noise levels in the turbine hall. The remainder of the noise sources in the turbine hall were, in the main, caused by windage from rotating machinery such as alternators, exciters, ventilation fans and feedpump motors. These were dealt with by covering the exciters completely by contoured enclosures, encasing the exposed portions of the alternator shafts with absorptive material, enclosing alternator ventilation fans and their driving motors, fitting silencers to the cooling-air intakes and outlets of feedpump driving motors and by lagging certain pipework. The success of these measures may be assessed from the later set of noise contours shown in Figure 1(b).

In the coal milling basement and ash pump chamber, the problems were much more difficult to surmount because of the low-frequency nature of the noise spectrum. Some reduction in noise level was achieved by enclosing transmission drives, but these still remained zones where it was necessary to restrict personnel access. Fortunately, this posed no great operational dilemma as these areas are normally unmanned.

The noise produced by the mobile coal-handling plant (e.g. bulldozers) was largely abated, in collaboration with the manufacturers, by affixing proprietary damping material to engine bulkheads, absorptive linings in the cabs and by installing more efficient silencers to exhausts and cooling systems. The problem of engine overheating had to be considered and this was circumvented by redesigning the engine covers.

With regards to the pneumatic tools, there was a limit to the degree of noise reduction which could be attained. Even after fitting excellent absorptive muffs to the air discharge passages, there still remained the actual impact noise of the tool contacting the workpiece. Again this was an instance where we

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had to insist on operators wearing hearing protection.

NEW PLANT:

Nowadays, whenever new plant is being purchased or modifications to existing equipment are being contemplated, noise considerations form an integral part of the design and specification procedure. For example, a specially designed air-compressor house was built to contain new machines and steam drains vessels were recently equipped with new outlet diffuser-type silencers whose design was based upon research work carried out within the Region (2).

CONCLUDING REMARKS:

The points discussed above give an idea of the amount of work which was involved in achieving an acceptable noise environment in a power station. To ensure that it remains acceptable demands constant vigilance and good maintenance.

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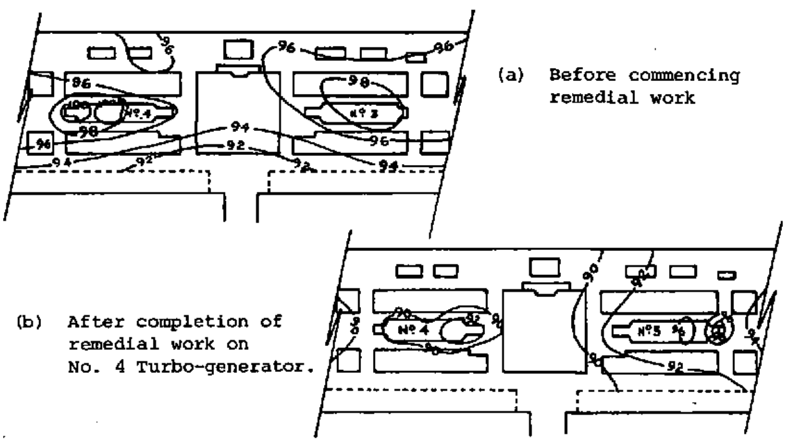

(a) Before commencing remedial work

(b) After completion of remedial work on No. 4 Turbo-generator.

Fig.1 PLAN VIEW OF PART OF TURBINE HALL SHOWING NOISE LEVEL CONTOURS
All levels given in dB(A)