NOISE EXPOSURE SURVEY IN A NUCLEAR GENERATING STATION

by

A. Behar, P.Eng. D.I.C.
Ontario Hydro
Safety Services Department
Pickering, Ontario

ABSTRACT

Measurement techniques and some results from the survey are presented. The concept of L_{Trade} as the best estimator for noise exposure is introduced. It was also shown how the use of dosimeters may help to localize noise sources (plastic suits in our case). Finally, the close cooperation between workers, supervisors and surveyors was found to be fundamental for the success of the survey.

SOMMAIRE

Les techniques de mesure et certains résultats de l'étude sont rapportés. Le concept de $L_{métier}$ est présenté comme la meilleure façon d'évaluer l'exposition au bruit. Il a aussi été démontré comment l'utilisation de dosimètres peut aider à localiser les sources sonores (survêtements en plastique, dans notre cas). Enfin, l'étroite collaboration entre les travailleurs, les superviseurs et les enquêteurs a été essentielle au succès de l'étude.

1.0 INTRODUCTION

Workers in nuclear generating stations are exposed to varying noise levels during the shift. Consequently, their daily noise exposure is unpredictable and its evaluation has to be performed using noise dosimeters. In this note, we will present some of the techniques and procedures used during the exposure survey performed at the Pickering Nuclear Station "A", where besides the individual we were also interested in obtaining average noise exposure of workers from each trade.

During a previously performed noise level survey, workers from five different trades were found likely to be at risk from noise exposure. Therefore, it was decided workers from these trades were to be included in the exposure survey. Their number was decided to be as large as to represent, yet not to interfere with, the normal activities performed at the station.

The selection of the individuals was done by station management. Each worker's exposure was measured during five consecutive days to account for the inevitable exposure variation between days. This procedure is also in accord with the new Ontario Health and Safety Act proposed Regulations (June 1981) where emphasis is on weekly rather than daily exposures.

Noise doses were measured during both normal operations and shutdown (when most of the maintenance work takes place) periods.

2.0 INSTRUMENTATION

Dosimeters GenRad, type 1954-9710 were used for this survey. They were preset to a threshold level of 80 dBA, criterion level of 85 dBA and exchange rate of 5 dBA.

Doses were read on a Reader GenRad, type 1954-9720, which was also used as battery tester and calibrator.

A sound level meter B&K type 2215 was used for spot checks of high noise level areas as a coarse means of controlling dosimeter readings.

Dosimeters were calibrated at the beginning and at the end of each shift according to manufacturer's instructions. In addition, on several occasions another test was performed, where dosimeters were exposed to noise of constant level, controlled with a Sound Level Meter. The measured dose was then compared to that calculated from the SLM readings, so to reassess dosimeters performance in a real-life situation. (This procedure is now performed in our laboratory by using a reverberant diffuse enclosure where microphones of all dosimeters are exposed to 90 dBA pink noise.)

3.0 MEASURING PROCEDURE

At the beginning of the study each participant was briefed on the purpose of the test and his cooperation was sought to obtain meaningful results. Participants were asked to assist in switching dosimeters on and off and filling forms detailing types of jobs and areas they were working in during the day.

At the beginning of the shift a technician calibrated all dosimeters and checked their batteries. Then he handed them to the workers, who switched the instruments on and placed them in their shirt pockets. Microphones were attached to shirt collars and positioned upwards. Workers were instructed not to remove dosimeters during the whole shift.

At the end of the shift, the workers had to switch off the dosimeters and to return them to the technicians. Each individual filled in the above-mentioned form. The technician then performed the readings and checked the calibration and the batteries of each dosimeter. He also discussed measurement results with the workers, trying to relate dose readings to jobs being performed during the shift.

4.0 CALCULATIONS

With the information of dose and exposure duration, the daily L_{OSHA} was calculated for each individual using a computer program. Then the mean weekly noise exposure for each individual was obtained as:

$$\overline{L}_{OSHA} = 16.61 \log \frac{1}{n} \Sigma \, 10^{L_i/16.61}, \quad \text{dBA}$$

where n = number of readings (usually 5)
L_i = daily L_{OSHA}

Noise exposure for each trade was obtained from the $\overline{L}_{OSHA}$ of individuals from the trade, using the equation

$$\overline{L}_{Trade} = \frac{\Sigma \overline{L}_{OSHA}}{\eta}, \text{ dBA}$$

where η = number of individuals (see Table 1).

5.0 RESULTS AND COMMENTS

Two sets of results, from normal operation and shutdown conditions were obtained. Student's T test showed that their differences were not statistically significant. Thereafter all $\overline{L}_{OSHA}$ from each trade were pooled and $\overline{L}_{Trade}$ obtained. They are shown in Table 1, together with the range of the individual's $\overline{L}_{OSHA}$ and standard deviation.

To perform tasks in some areas workers must wear plastic suits that are complete coveralls, where the air is supplied through a hose connected to a source of approximately 620 kPa (90 psi) air. The air flow acts as an additional source of noise. During the survey it was noted that noise dose readings were constantly higher when plastic suits were worn.

To test how significant was the contribution of the noise generated in plastic suits, daily $\overline{L}_{OSHA}$ from workers wearing suits were separated from these of the rest. Mean $\overline{L}_{OSHA}$ and standard deviations were then calculated from both populations.

Results shown in Table 2 indicate that $\overline{L}_{OSHA}$ is much higher when using plastic suits and that the difference between both means is statistically significant. Independent sound level measurements confirmed the above findings.

High noise levels in plastic suits could be due to several factors such as suit design, high air pressure and damaged parts of the suit. A much quieter suit of new design is now gradually being introduced so L_{Trade} of trades currently wearing these devices is expected to be reduced in the near future. This study shows how an additional benefit such as assessing a noise source may be obtained from the exposure survey.

This survey proved to be a satisfactory experience resulting from the close cooperation between workers, supervisors and surveyors. Not a single dosimeter was damaged during the survey period that lasted for over four months, nor were abnormally high or low $\overline{L}_{OSHA}$ values recorded, thus confirming worker's positive attitude toward this exercise.

Because of the sampling technique used and because of possible changing working environments (noise levels in some parts of the station are also related to power output) exposure surveys should be repeated periodically every two to three years.

Table 1. Noise Exposure by Trade

Trade	Number of Workers		$\bar{L}_{Trade}$, dBA		
	On Site	Tested	Mean	St. Dev.	Range
Operators*	330	18	88	5.4	79-97
Mechanical Maintainers	160	24	90	3.8	81-97
Service Maintainers	40	2	82	-	77-85
Chemical Technicians	25	3	80	3.9	76-84
Control Technicians	125	8	92	5.2	81-96

*First operators excluded because they are exposed to noise levels below 80 dBA.

Table 2. Noise Exposures of Workers With and Without Plastic Suits (L_{OSHA}, dBA)

Trade	In Plastic			No Plastic			
	n*	Mean	St. Dev.	n*	Mean	St. Dev.	Mean Increase
Operators	9	95.1	9.84	57	86.4	5.62	8.7
Control Techn.	9	98.1	7.96	26	89.4	9.60	8.7
Mech. Maintainer	11	95.5	8.64	104	89.0	7.00	5.5

n* = number of readings