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The Industrial Hygienist's Role in the Determination of an Employee's Enrollment in the Hearing Conservation Program

By

Tammy A. Lopez

Introduction

The Los Alamos National Laboratory (LANL) Hearing Conservation Program (HCP) Lead requested a noise exposure assessment for an employee (E1) to determine whether E1 needed to be kept on the HCP list. This list is maintained for employees who are exposed to high noise in their work areas and thus, evaluated yearly by audiometric testing through LANL's Occupational Medicine program. It has become increasingly important for noise data to be on file at Occupational Medicine for employees enrolled in the HCP; if there is a standard threshold shift in an employee's hearing and there is no data on record, it can be difficult to determine whether the shift is work related or is a result of other extracurricular activities. All work related standard threshold shifts are deemed recordable cases under the Occupational Safety and Health Administration (OSHA) recording and reporting criteria in 29 CFR 1904.7.

E1 is a safety compliance inspector whose job mostly consists of performing safety compliance inspections on construction sites. Therefore, he is exposed to loud, heavy equipment and machinery often and is a perfect candidate for a noise exposure assessment. However, at the time of assessment, there were no big construction projects occurring so E1 had a different area with high noise levels evaluated that he frequently inspects as a part of his job.

Process

In Building (Bldg.) 1, there is a mechanical room in which E1 conducts safety inspections approximately 8 times per month for a maximum time of 10 minutes each visit. This room has

large industrial-sized fans operating 24/7, therefore, there are high noise levels. There is also a slight wind from the fans in the room. Entry into the mechanical room by any personnel requires a hard hat, safety vest, and ear plugs, the latter of which is provided at the entry way. A map of the mechanical room was drawn to show the room layout and the nine different sampling locations where sound pressure level measurements were taken (see Map attachment). According to E1, he stands in location sample 1 the entire time he is in the room, however, E1 is there to do safety inspections so he may need to move around. Therefore, sound pressure level measurements were taken around the room and an overall sound pressure level was calculated (see Calculation attachment).

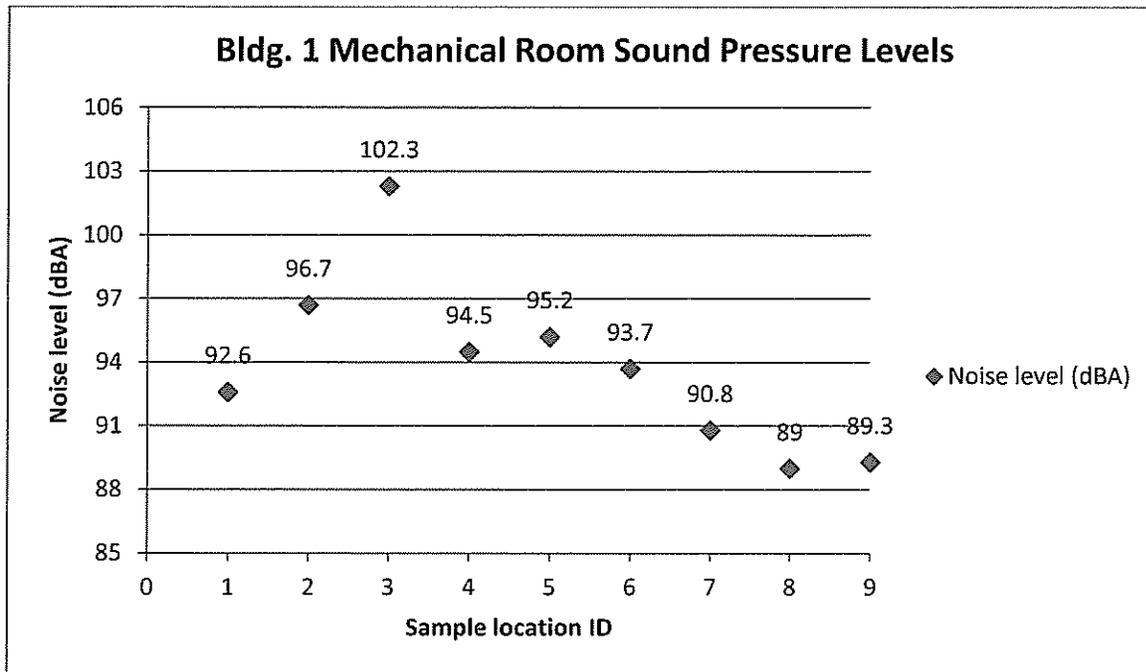
Methods and Measurements

A Quest Integrating and Logging Sound Level meter (Model 2900), which was calibrated with a Quest Model QC-10 Acoustic calibrator at 114 dBA, was used for this exposure assessment. Each location sampled, along with the measurements and the location description, are in Table 1 below. Graph 1 also portrays these measurements.

Table 1: Sampling locations and measurements

| Sample ID | Sample location | Type | Result | Unit |
|------------------|--|------------------|---------------|-------------|
| Sample 1 | E side of room and E of Fan 1 | continuous noise | 92.6 | dBA |
| Sample 2 | E side of room and E of Fan 2 | continuous noise | 96.7 | dBA |
| Sample 3 | S side of room and S of Fan 2 | continuous noise | 102.3 | dBA |
| Sample 4 | SE side of room, on top of an elevated slab | continuous noise | 94.5 | dBA |
| Sample 5 | middle of room between Fans 1 and 2 | continuous noise | 95.2 | dBA |
| Sample 6 | W side of room in area between Fans 1 and 2 where large ducts were connected | continuous noise | 93.7 | dBA |
| Sample 7 | NW side of room, W of HUS-17 unit and E of large duct that comes from fans 1 and 2 | continuous noise | 90.8 | dBA |
| Sample 8 | NW corner of room by NW side exit | continuous noise | 89 | dBA |
| Sample 9 | NE side of room | continuous noise | 89.3 | dBA |

Graph 1: Bldg. 1 Mechanical Room Sound Pressure Levels



Results and Discussion

All measurements exceeded 85 dBA, the action level that, if exceeded for 8 hours, can cause damage to hearing, according to the American Conference of Industrial Hygienists (ACGIH) 2005 Threshold Limit Value (TLV). (The ACGIH 2005 TLV booklet is the current standard reference that LANL is contractually obligated to use.) The sound pressure level range measured in this room was between 89.0 to 102.3 dBA.

However, E1 spends a maximum of 10 minutes per day in this room, 8 times per month, therefore, the TLV for 10 minutes, or a time close to it, must be followed. According to the ACGIH 2005 TLV booklet, 100 dBA is the TLV for 15 minutes of exposure time and 103 dBA is the TLV for 7.5 minutes of exposure time to high noise levels. The highest sound pressure level measured was at sample location 3, which is on the south side of Fan 2, at 102.3 dBA. This measurement exceeds the 15 minute TLV and is very close to the 7.5 minute TLV level. The

overall A-weighted sound pressure level was calculated for the entire room; this was 105.4 dBA, which exceeds both the 7.5 minute and 15 minute TLV levels (see Calculation attachment).

E1 wears 3M E-A-R Ultrafit Plus Corded Earplugs with a Noise Reduction Rating (NRR) of 26 dB. The NRR value is derived using a C weighted measure force so it must be converted to an A-weighted protected level. To determine if the earplugs are adequate to reduce the exposure below the ACGIH TLV, the effective noise reduction level was calculated using the OSHA A-weighted protected level calculation method with a 50% margin of safety. (An ACGIH method was unavailable.) The earplugs reduced E1's exposure to 95.9 dBA, which is below the ACGIH TLV 7.5 and 15 minute levels (see Calculation attachment). Therefore, this is appropriate hearing protection for E1 when he is in the room for 10 minutes per day, 8 times per month.

Conclusion and Recommendations

An overall sound pressure level exposure for the entire room was calculated at 105.4 dBA; therefore, it is recommended that E1 stay enrolled in LANL's HCP, since the overall sound pressure level exposure exceeds both the 7.5 minute and 15 minute TLVs. If employees are exposed to levels exceeding the limits, feasible engineering, administrative, and protective protection equipment (PPE) controls must be implemented. Currently, budget will not allow for reconfiguration of the room or installation of sound barriers, therefore, engineering controls are not feasible. An audiogram will be conducted annually as a result of E1's HCP enrollment; this is an administrative control. E1 is also using 3M E-A-R UltraFit Plus Corded Earplugs which have a NRR of 26 dB. The noise reduction level for these earplugs was calculated to be 95.9 dBA. E1 is recommended to continue use of this PPE while in this room because they reduce the noise exposure level to below the ACGIH TLV for 7.5 and 15 minute exposures.

Calculations Attachment

Overall Sound Pressure Level Calculation:

$$92.6/10 = 9.26 \rightarrow \text{antilog}(9.26) \rightarrow 1.820 \times 10^9$$

$$96.7/10 = 9.67 \rightarrow \text{antilog}(9.67) \rightarrow 4.677 \times 10^9$$

$$102.3/10 = 10.23 \rightarrow \text{antilog}(10.23) \rightarrow 1.698 \times 10^{10}$$

$$94.5/10 = 9.45 \rightarrow \text{antilog}(9.45) \rightarrow 2.818 \times 10^9$$

$$95.2/10 = 9.52 \rightarrow \text{antilog}(9.52) \rightarrow 3.311 \times 10^9$$

$$93.7/10 = 9.37 \rightarrow \text{antilog}(9.37) \rightarrow 2.344 \times 10^9$$

$$90.8/10 = 9.08 \rightarrow \text{antilog}(9.08) \rightarrow 1.202 \times 10^9$$

$$89.0/10 = 8.9 \rightarrow \text{antilog}(8.9) \rightarrow 7.943 \times 10^8$$

$$89.3/10 = 8.93 \rightarrow \text{antilog}(8.93) \rightarrow \underline{8.511 \times 10^8}$$

$$\Sigma = 3.47974 \times 10^{10} \rightarrow \log(3.47974 \times 10^{10}) \times 10 = 105.4$$

Overall sound pressure level = 105.4 dBA

**Noise Reduction Level using the OSHA A-weighted Protected Level Calculation Method
with a 50% Margin of Safety (for 3M E-A-R Ultrafit Plus Earplugs with a NRR of 26 db):**

$$\text{A weighted protected level} = \text{dBA} - (\text{NRR} - 7) / 2$$

$$= 105.4 \text{ dBA} - (26 \text{ dB} - 7) / 2$$

$$= 95.9 \text{ dBA}$$

Map of Bldg. 1 Mechanical Room Attachment

