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# Noise Control Of Radiological Monitoring Equipment

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R. D. Rubick, W. W. Stevens, and L. L. Burke  
Argonne National Laboratory - West  
P.O. Box 2528  
Idaho Falls, Idaho 83403

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## Abstract:

Although vacuum pumps on continuous air monitors (CAMs) do not produce noise levels above regulatory limits, engineering controls were used to establish a safer work environment.

Operations performed in areas where CAMs are located is highly specialized and requires precision work when handling nuclear materials, heavy metals, and inert gases. Traditional methods for controlling noise such as enclosing or isolating the source and the use of personal protection equipment were evaluated. An innovative solution was found by retrofitting CAMs with air powered multistage ejectors pumps. By allowing the air to expand in several chambers to create a vacuum, one can eliminate the noise hazard altogether. In facilities with adequate pressurized air, use of these improved ejector pumps may be a cost-effective replacement for noisy vacuum pumps. A workplace designed or engineered with noise levels as low as possible or as close to background adds to; increased concentration, attention to detail, and increased production.

## Introduction

Although vacuum pumps on continuous air monitors (CAMs) do not produce noise levels above the American Conference of Governmental Industrial Hygienist's Threshold Limit Value (TLV) of 85 dBA (1994) or the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit (PEL) of 90 dBA (1996), engineering controls were be used to establish a safer

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work environment. This article specifically addresses the sound levels of beta gamma CAMs at Argonne National Laboratory - West (ANL-W). CAMs are designed to measure and record airborne radioactivity levels and to warn personnel when an established acceptable level has been exceeded.

CAMs are cart mounted and contain a vacuum pump, a radiation detector, an air flow controller, a recording device, and an alarm system. These units are equipped with a positive displacement electric motor driven blower with immersion lubricated gearboxes. The airflow is controlled by a motor controlled bypass valve located between the blower outlet and inlet. The flow may be set at any level between 0.5 and 4.0 standard cubic feet per minute (SCFM). The noise level produced by these monitors generally is 75 dBA at the operator's hearing zone, when standing 3 feet from the unit. Often, the units are located side-by-side which increases the noise level to 79 dBA at 3 feet.

Although the noise levels are below the TLV of 85 dBA, they are of sufficient magnitude to cause increased physical / psychological stress, fatigue, and distraction. Usually, the operations performed in areas where these CAMs are located is highly technical and required precision work when handling nuclear materials, heavy metals, and inert gases. CAM noise also causes communication problems which creates further safety concerns.

## **Methods**

CAMs draw ambient air through a filter to collect particles. A radiation detector monitors the

filter for radioactivity, records the value, and alarms if preset values are exceeded. The CAMs come from the manufacturer equipped with 1- horse power electrical motor running a conventional rotary lobe positive displacement blower. It is this motor that creates the concern for noise control.

The first attempt to lower noise levels was to enclose the electric motor and the vacuum pump using a noise absorbing material. The noise was reduced several decibels; however, it was still annoying to most individuals. The enclosure also resulted in reduced ventilation and air circulation causing a potential for the electric motor to overheat.

Another solution was to require employee use of hearing protection. From the start, this control was viewed as being unacceptable since it did not control the problem at its source.

Another option at was to move CAMs into unoccupied areas and to remotely monitor air activity levels. Numerous modifications were required to place the alarm indicators in areas where employees were stationed. This option was not feasible for a majority of the CAMs. Problems included space limitations, lack of adequate air flow, and unacceptable particulate loss in sample lines.

Finally a new technology was used to reduce noise levels for this and similar applications. This solution involved removing the motor and blower assembly and retrofitting the CAM with a multistage ejector pump. The principle operation of this pump is expansion of air in controlled steps through a series of nozzles within several chambers. This pump requires the use of

compressed air, which was readily available in most facilities at ANL-W. The required air flow through each CAM was set at 3.5 to 4.0 SCFM. The compressed air capacity needed to operate a multistage ejector pump to maintain this flow was 2.0 CFM at 25 psig.

Other advantages of this pump design, in addition to reduced sound level, are elimination of moving parts, high efficiency, and lower energy consumption. Conventional pumps are run by electrical motors which generate undesired heat and have many moving parts requiring maintenance. Maintenance on the electric motor driven blower includes frequent oil changes, which results in waste oil disposal problems. Since CAMS are operated in areas that contain radioactive material the oil has the potential for becoming radiologically contaminated which complicates disposal. These additional concerns were eliminated through the multistage ejector pumps.

## **Results**

Sound level measurements of a CAM with the multistage ejector pump indicated that the noise levels are at background levels. Abnormalities in the instrument function were not noted during the testing. Other types of radiological air sampling units, such as alpha air monitors and stack samplers, are presently being evaluated for retrofitting with the multistage ejector pumps.

## **Discussions**

Various attempts were made to control the noise source. Traditional industrial hygiene methods

require that "Exposures to chemical or physical agents must be controlled, first by the application of engineering principles - supplemented when needed by administrative control or the use of personal protective equipment"(NSC, 1979). Enclosing the hazard was evaluated. Isolation of the hazard was evaluated. The use of personal protective equipment was considered. Finally, the noise hazard was eliminated by re-engineering the system.

### **Conclusions**

In this day of corporate efficiency, safety and health professionals must use all resources available to provide employees with a safe and healthy workplace. Engineering controls are the best long term solution to the occupational noise problem (AIHA, 1996). Many noise sources are overlooked because they do not produce noise levels above the TLV or PEL. This noise needs to be abated because of annoyance and distraction problems. A simple modification to the CAMs produced a safer, more productive, and pleasant work area. A workplace with designed or engineered noise levels as close to background as possible adds to increased personnel concentration, attention to detail, and increased production.

### **References**

American Conference of Governmental Industrial Hygienists: Threshold Limit Values and Biological Exposure Indices for 1994-1995, pp. 104-105. Cincinnati, Ohio.

U.S. Department of Labor. Code of Federal Regulations. Washington DC: U.S. Government

Printing Office; 29 CFR Part 1910.95, 1996, pp. 195-196

National Safety Council: Fundamentals of Industrial Hygiene, Second Edition, National Safety Council, 1979, pp. 614

American Industrial Hygiene Association: Noise and Hearing Conservation Manual, AIHA, 1996, pp.11