Low Frequency Noise Limits, Testing Parameters and Health Effects – July 2012

INTRODUCTION:

Low Frequency Noise (LFN) is becoming more prevalent in society as more and more industrial equipment is being installed, more vehicles are being used and other modes of transportation are provided. LFN is noise having a frequency range between 25 cycles per second and 500 cycles per second. The typical human's hearing range is above 500 cycles per second and up to 20,000 cycles per second frequency. Only about five percent of humans can hear below the 500 cycles per second frequency and almost no one can hear below the 200 cycles per second frequency level of sound. As a result, the population of humans is rarely aware that they are being affected by LFN. However, seventy per cent of persons exposed to LFN are being affected to varying degrees and in various body systems depending on the frequency and intensity of the LFN to which they are exposed.

Symposiums on LFN have been held annually in Lyons, France and Sydney, Australia. Medical professionals and research scientists from around the world have presented papers at these symposiums relating the noise effect on humans. Studies done at he Human Development center in Lisbon, Portugal, that include autopsies of persons who have died after exposure to LFN as well as studies on living persons show that different frequencies of LFN affect different body systems. The Portuguese have named these health affects Vibro-Acoustic Disease (VAD). A key finding in the Portuguese studies is that the pericardium of the heart becomes thickened when a person is exposed to LFN over time that may vary from one to 14 years. They have found that the echo-cardiogram test is the most appropriate test to determine the existence of VAD in humans.

In the United States, most noise studies' defined parameters and limits do not appropriately address Low Frequency Noise. This is because only sounds that can be heard are thought to harm the human body and that affect is only to the hearing system. The U.S. has not participated in the international LFN symposiums until 2010 and that participation has been minimal. Thus, noise meter scales typically are weighted to what a young person of 10 years of age can hear and is called the "A" scale, referred to as dBA, decibels on the "A" scale.

More recently, the "C" scale or environmental noise scale was developed for noise meters to detect and appropriately reflect the intensity and frequency of LFN as well as hearing range noise. The "C" scale meter reading is referred to as dBC, decibels on the "C" scale. The noise meter reading on the "A" scale drops off quickly at frequencies below 500 cycles per second, whereas the "C" scale reflects a five to 15 higher decibel reading as the frequency decreases

from 500 cycles per second to 25 cycles per second. Thus, the "C" scale must be used to determine noise in the environment. Whereas, the "A" scale is more appropriate for hearing exams. It is generally accepted that each five decibel increase is a doubling of intensity for either scale.

NOISE LIMITS:

General Discussion:

Noise limits for the United States of America were determined after passage of the 1972 Noise Control and Abatement Act. The U.S. Environmental Protection agency (USEPA) determined appropriate noise levels requisite to protect the public health that were published in 1974. These noise parameters only addressed the intensity level in decibels using the "A" scale (dBA). The noise frequency was not addressed.

In 1982, the USEPA closed its Noise Control Office as a cost cutting measure, delegating their authority to state and local governments. As of June 2012, only six states in the U.S. have enacted a state noise law: New York, California, Maine, Massachusetts, Illinois and recently Colorado. Cities located in states without a state noise law have developed ordinances on noise levels that generally reflect what industry will agree to. The USEPA rules have not been applied nor has the frequency measurement been included as a requirement.

For interstate facilities (those facilities serving more than one state such as natural gas compressors on pipelines serving two or more states), the Federal Energy Regulatory Commission (FERC) had established noise control limits based on the USEPA guidelines. The FERC requires that noise testing be conducted at the facility boundary of the facility generating the noise while that facility is operating at capacity. No noise frequency is addressed in the FERC limits.

LFN Limits: (25 cps to 500 cps frequency):

> To properly establish the presence of LFN, a frequency analysis must be performed during noise testing for decibels to identify whether LFN exists and to allow abating or eliminating those frequencies.
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> Low Frequency Noise must be addressed separately from normal hearing range noise because of its effects on various systems in the human and animal bodies. Generally, LFN should be zero dBC. However, there may be circumstances where a LFN noise level not to exceed 30 dBC may be allowed, according to studies performed in Denmark.

If the distance from the noise source is five miles or greater to an occupied structure or land that may be developed for an occupied structure; then, the 30 dBC limit may be allowed.

LFN can travel five to eight miles. **The LFN limit of zero to 30 dBC must be adhered to by abatement or elimination of the LFN at the source.**

Hearing Range Noise (HRN) Limits (500 to 20,000 cps Frequency):

The USEPA guidelines show that at 70 dBA hearing loss will begin to occur and hearing protection is required. No time length of exposure was provided.

USEPA limits for Hearing Range Noise (HRN) is 55 dBA for any frequency within the hearing range. A frequency analysis must be performed to identify any offending frequency so that it may be abated or eliminated.

45 dBA is the noise limit for HRN at indoor areas such as schools, etc.

Night time HRN must be less than 35 dBA for residential areas.

TESTING PARAMETERS:

Noise Meter Capabilities:

Have a frequency range of 25 cycles per second (cps) frequency up to 20,000 cps frequency

Power Supply: A.C. or Battery, preferably both

Noise Scales: Both “A” and “C” scales

Decibel Range: Zero to 125, dBA and dBC scales

Operating Site Testing:

At property line of noise generating site, nearest to noise receiver property boundary line.

Noise Generating Site operating at capacity during testing at any location; operating site or receiver site.

Noise Receiver Site Testing: Test at nearest property line to operating site boundary while Operating Site is operating at capacity.

Ambient Conditions During Testing:

Wind Speed less than five miles per hour

No Rain, sleet, hail or snow occurring during testing

No talking by test personnel

No vehicular traffic within ½ mile or airplanes within two miles

HEALTH EFFECTS OF LFN:

There are numerous health effects of LFN from veins hurting to vertigo to death. The time period of exposure for these to occur can be from minutes to years. Following are a few health effects observed within minutes during LFN exposure and testing and at specific LFN frequencies:

25, 31.5, or 40 cps frequency – Constriction of blood vessels in legs causing numbness and pain in legs at 55 dBC or higher intensity.

125 cps – Head hurting and neck veins hurting at 55 dBC. Severe head hurting at 65 dBC and higher. Brain damage can occur.

Combination of 25, 31.5 and 40 cps at same time – Pain inside the back above the waist. Feels like a kidney infection hurting.

Symptoms observed from frequent and intense LFN exposure: Ruptured ear drums, reduced visual acuity, enlarged aorta of the heart, vertigo, veins in abdomen hurting and stinging, numbness in hands, loss of bladder and/or bowel control. Referenced documents include more symptoms for LFN exposure.

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