

# EFFECTS OF LOW FREQUENCY NOISE ON HUMANS

P.A. Sloven (Piet, 1953). PSL@DCMR.NL

DCMR Environmental Protection Agency, Section Noise. The Netherlands.

**Preface** The size of this contribution is restricted. To save space, no references are stated. There is however, alliance with a more extensive article that will be published in the Journal of Low Frequency Noise, Vibration and Active Control.

**Framework.** Here, LFN is noise with frequencies dominant to annoyance below 200 Hz. Frequency range of LFN can be divided into three areas. 1) infra-LFN (16 Hz octave and below), 2) centre-LFN (31 and 63 Hz), 3) audio-LFN (up to 125 Hz). In dependent of duration one can describe three types of LFN. This contribution deals with type LFN-Q that causes such complaints as if LFN was appearing continuously (**q**uasi-continuous). LFN-R is **r**epetitive, for instance passing of trains and a single-event with short duration causes type LFN-S.

**Characteristics of LFN** In comparison with normal noise, A-weighting of LFN underestimates annoyance and effects can be unexpectedly more serious than in cases of 'normal' noise. The arithmetical united expression "*A-weighted equivalent dB*" usually does not link up with human perception of noise. In practice, typical LFN-annoyance in houses is usually accompanied with less than 25 dB(A).

Although the word *noise* is used in the term LFN, LFN-complaints are seldom linked to unbearable levels of noise. At rising sound levels however, the loudness of LFN increases two fold of the strength of 'normal noise'. Amplitude modulations can easily reinforce effects.

**What sufferers report and show** Descriptions of the LFN-character are: humming, rumbling, pulsating, thumping. Sensations are: hearing the sound, pressure on ears and in the head, quivering abdomen, shakey field of vision, vibration of chest. Reported reactions of the body: constricted throat, swallowing problems, more difficult breathing, salivary flooding, itchy testicles. Time and again, subjects are disproportionally tired after LFN-exposure.

Symptoms which are frequently stated: pain in the head or neck, pressure on ears, pulsation in the ears, undue fatigue, feelings of irritation, unease, stress and sometimes nausea, pressure on throat or breast, heavy head and prostration. Other investigators mention symptoms which I cannot confirm from my practice in dealing with complainants, such as digestive disorders, heart palpitations, disorientation, fainting and vomiting. Nevertheless I agree with the reporting on feelings of arousal.

In experiments, subjects indicated strange feelings in their ears, head and neck. Regarding these sensations, feelings of pressure dominate (many frequencies), vibrations (10 & 20 Hz), tinglings (20 Hz) and hearing (up to 20 Hz).

LFN-disturbed people remark that the sound is not always experienced as loud or noisy, but morely it is unpleasant and uneasy, bothersome, difficult to ignore and intruding; it interferes with activities and dominates the environment. Some at first, judge it to be harmful and they

fear LFN.

The most prominent and clearest effect is not when LFN is present but when it vanishes.

**Medical survey** In laboratory, effects of noise on heart rate, blood-pressure and stress-hormones cortisol and catecholamines in blood were examined. Cortisol level was more pronounced.

In The Netherlands, a tunnel has been pile driven at a distance of 30 m from dwellings. Inhabitants complained about strange feelings in their homes during the pile driving activities. Initial research showed that only LFN could cause this. In this unique LFN-survey in a practical situation, various tests were carried out. Several times were determined: blood pressure, heart rate, stress (cortisol level from saliva) and questionnaires were used to assess emotional impact. Causal relation between complaints and LFN is concluded as highly acceptable.

**Influence on personal development** Chronical exposure to noise in general, leads to forgetfulness and development of proficiency of reading. However, even short LFN-exposure deteriorates apprenticeship.

Using noise with - and without extra centre-LFN in a test situation, subjects declared noise which includes LFN is more disturbing. It caused lowering of performances.

Once inhabitants have to deal with LFN for longer time, there will be side-reactions. Chronic insomnia is the best known and will cause many other supplementary effects. For example loss of concentration, tiredness, excitability.

More insidious is the increasing sensitivity to LFN. Once recognized LFN in the mixture of environmental sounds, many complainants are not able to liberate themselves from LFN.

**Stages of LFN-effects** Individuals are not immediately conscious of the existence and there are three phases: discoverance, psychological - and physical reactions.

(1) Alarm (days). After the first disturbance and awareness of LFN, the sufferer becomes uncertain. (2) Seeking adaption (weeks) with changes in emotional life. (3) Exhaustibility (months) and even disablement.

LFN plays a role too in psychological phenomena triggering, time-lag effect and chunking.

**Conclusions and recommendations** Exposure to LFN causes many effects. Causal relation is likely, although it is hard to distinguish first - and secondary effects.

Sensitivity of people to normal noise is no predictor for sensitivity to LFN. Neither it is the other way about. Medical investigations reveal that there is little chance to 'prove' severe annoyance of noise in that medical way.

Complainants have - or perhaps get - a lesser range between hearing and acceptance of LFN.

Authorities has to deal with LFN-problems. Nuisance and health-threatening as social influences, has to be weighed. On that balance some annoyance will be admissible.

Nevertheless it is a sign of negligence to ignore LFN by saying, that it is just a problem for a small group. That would be comparable with ignoring aids because a 'special' group includes more sufferers.

In fact, in acoustics, LFN should be compared with the environmental problem of Persistent Organic Pollutants (POP's). Which are either directly recognisable, have severe weakening and no immediate damage.