1973 WL 7313 (Ill.Pol.Control.Bd.)

Illinois Pollution Control Board

State of Illinois

IN THE MATTER OF NOISE POLLUTION CONTROL REGULATIONS

#R72-2
July 31, 1973

OPINION OF THE BOARD

*1 This opinion supports the noise pollution control regulations adopted by the Board on July 26, 1973 [1].

The provisions of the Environmental Protection Act with respect to limitations on noise are somewhat meager and contain no provisions which are susceptible to execution without the promulgation of regulations by the Pollution Control Board; as distinguished from statutory provisions with respect to air pollution and water pollution. There are no inherent prohibitions which proscribe noise pollution or impose any limitations on persons as to what they shall not do in the emission of noise.

Section 23 provides:

> "The General Assembly finds that excessive noise endangers physical and emotional health and well-being, interferes with legitimate business and recreational activities, increases construction costs, depresses property values, offends the senses, creates public nuisances, and in other respects reduces the quality of our environment."

Section 24 provides:

"No person shall emit beyond the boundaries of his property any noise that unreasonably interferes with the enjoyment of life or with any lawful business or activity, so as to violate any regulation or standard adopted by the Board under this Act." (Emphasis supplied).

Section 25 provides:

> "The Board, pursuant to the procedures prescribed in Title VII of this Act, may adopt regulations prescribing limitations on noise emissions beyond the boundaries of the property of any person, and prescribing requirements and standards for equipment and procedures for monitoring noise and the collection, reporting and retention of data resulting from such monitoring."

Accordingly, it will be seen from the foregoing statutory provisions that there is no capability of control of noise emissions by virtue of the Statute alone. Furthermore, contrasted with earlier regulations available for the control of air and water pollution, there are no pre-existing regulations that have been promulgated by predecessor agencies of the Pollution Control Board.

Case SU-17-11



SLG
EXHIBIT
11

The foregoing statutory provisions can be implemented only by the adoption of new regulations respecting noise emissions. Therefore the Board adopted this comprehensive Regulation on July 26, 1973.

Perhaps the most appropriate point of departure in considering the history and sequence of events leading up to the final adoption of the Noise Regulation is the petition filed by Community Action Program (CAP) proposing adoption of airport noise regulations. This proposal was filed by the citizens' group pursuant to Section 28 of the Environmental Protection Act. The Board concluded initially that the proposal had sufficient merit to justify hearing and hearings were held on February 11, 1971 and February 12, 1971. At the conclusion of the hearings, the Board, although not taking official action on the specific proposal, proposed that the entire subject of noise, not only limited to airport noise, be studied by the Institute for Environmental Quality. Hearings were suspended on the subject of noise pollution control pending receipt from the Institute of its report and recommendation. Shortly thereafter, a noise pollution control Task Force was formed under the aegis of the Institute. This Task Force was composed of the following members:

| | |
|---|---|
| John J. Desmond | Associate Director, Engineering Experiment Station, Chairman |
| Harlow W. Ades | Professor of Electrical Engineering, of Physiology and Biophysics and of Psychology |
| Duane H. Cooper | Associate Professor of Electrical Engineering and of Physics; Research Associate Professor in Coordinated Science Laboratory |
| Roger W. Findley | Professor of Law |
| John S. Moore | Manager, Division of Noise Pollution Control of the Illinois Environmental Protection Agency |
| John J. O'Neill | Professor of Speech, Chairman of Speech and Hearing Science |
| Sheldon J. Plager | Professor of Law |
| Paul D. Schomer | Visiting Assistant Professor of Electrical Engineering |
| Roger R. Yoerger | Professor of Agricultural Engineering |
| Adam R. Zak | Professor of Aeronautical and Astronautical Engineering |
| Larry Blackwood | Research Associate, Office of Environmental & Planning Studies, College of Law |

*2 All of the foregoing individuals are or were on the faculty of the University of Illinois excepting John S. Moore.

Bolt, Beranek and Newman, Inc., originally consultant to the Task Force, terminated their consultant role and George Kamperman, a noise abatement engineer of Kamperman Associates, Inc. became a consultant to the Task Force.

On February 16, 1972, the Institute for Environmental Quality submitted its document #TF-2, entitled "Control of Noise From Stationary Sources", being the report of the Task Force created by the Institute for Environmental Quality. This report contained a proposed regulation for the control of noise from stationary sources which served as the basis for the hearings conducted and the regulations ultimately adopted. Part 1 contained a definition section, prohibited noise pollution, set forth procedures for measurement, and contained a non-degradation provision later deleted. Part 2 set up land use designations based on the Standard Land Use Coding Manual, U.S. Department of Transportation,

1969 (SLUCM) and classified all lands into Classes A, B, and C, which corresponded generally to residential, business, and manufacturing uses. A provision was also included for non-developed land. Part 3 provided for maximum noise levels emitted to abutting Class A, B, and C properties based on the classification, in turn, of the emitter. The initial proposed regulation measured the emissions at the property line of the emitter. Separate daytime and nighttime limits were established for Class A receivers. Special provisions were contained providing for limits of noise emitted to non-abutting property, discrete frequency noise, and certain exemptions limited initially only to signal and warning devices and bells and chimes.

Following the text of the regulation was the Standard Land Use Coding Manual classification which designated the multitude of uses into numerical categories which, in turn, were incorporated by appropriate numerical specification in the regulation as A, B, or C land uses.

Hearings were held on the proposed regulation as follows:

| Date | Location |
|---|---|
| June 22, 1972 | Chicago |
| June 23, 1972 | Chicago |
| June 26, 1972 | Rockford |
| June 28, 1972 | East St. Louis |
| June 30, 1972 | Peoria |
| August 17, 1972 | Chicago |
| August 18, 1972 | Rock Island |
| October 11, 1972 | Chicago |
| November 9, 1972 | Chicago |
| November 10, 1972 | Edwardsville |
| November 11, 1972 | Rockford |

*3 In addition to the presentations made by the Task Force witnesses and representatives of the Environmental Protection Agency, which will be commented on in more detail below, testimony was received from interested witnesses. While this testimony often related to matters that were the subject of the proposed regulation, such as industrial operations, motor race tracks, mining operations, motor freight terminals, and railroad switching facilities, the testimony also related in some degree to matters that were not subject to control by the present proposed regulation, namely, railroad whistles from moving trains, trucks, and aircraft noise emissions. Testimony was also received from utility companies, oil refineries, mining operators, manufacturing concerns, pipeline companies, and representatives of the Illinois Manufacturers' Association and the Illinois State Chamber of Commerce and others.

As a result of the initial series of hearings conducted on the proposed regulation, it became evident that it would be necessary to make several major modifications in the regulations as proposed. Accordingly, the Agency and the Task Force made several revisions to the regulations, based on the hearings conducted and submitted them to the Board for consideration. This revised proposal appeared in Newsletter #62, which set forth both the new proposed regulations and indicated the modifications that had taken place since the original February, 1972 proposal. Incorporated were earlier

revisions made and presented by the Agency and Task Force in the course of the hearing process in response to the evidence offered by citizens and industry. Since this opinion will detail the changes made between the original proposal and the regulation as finally adopted, no effort will be made to specify all intermediate changes, some of which were not retained. The modified regulation published in Newsletter #62 on March 19, 1973 incorporated all provisions and modifications and reflected the status of the regulation as it stood on that date. As in previous revisions, the proposed regulation included the SLUCM Code which was unchanged in its application to the specific class designations.

This revision changed the structure slightly from the original proposal. A major modification related to the point where noise measurements would be made. The original proposal had determined noise emissions at the property line of the emitter. The new proposed regulation determined allowable emissions at the point of reception and at least 25 feet from the emitter. There were several other significant changes. Among these were the following:
1. Rule 208(e) exempted existing industry from the residential nighttime limits and thus allowed a 10 decibel leeway for continuous noise sources which would meet certain other qualifications.

2. There was a modification of the standards in terms of safety valves as noted in the definitions and Rule 208.

3. Prominent discrete tones were allowed under certain specified circumstances.

*4 4. The forging and mining industries and railroad marshalling yards were given delayed compliance dates.

5. Certain definitions were deleted, added or modified.

Subsequent to the close of the hearings on November 11, 1972, the Board received a substantial amount of written documentation from the Agency and industry. These exhibits were introduced into the record at later hearings and were made available for examination at the Board's offices.

On the basis of the proposal of the Agency and Task Force reflecting major changes that had been effected in the Regulation and further, because the Board at that time did not feel that it was in a position to promulgate a proposed final draft, an additional series of hearings was scheduled. In announcing the hearings, the Board solicited response with respect to the following issues posed by the proposed regulations:
1. What priority is followed when heterogeneous land uses result simultaneously in different allowable noise emission levels for a single source?

2. What changes, if any, should be made in the groupings of SLUCM land uses into the Class A, Class B or Class C categories?

3. On what basis is compliance measured for industries with a delayed compliance date in the framework of changing land uses?

4. Should a procedure be specified to provide equal protection to an industrial area from the sudden presence of a residential neighbor? Should the proposed regulation be coordinated with local zoning?

5. Is a non-degradation rule for new industry based on the $L_{90}$ value for the area appropriate in terms both of industrial planning and protecting the people of Illinois?

6. How do we assure that the industries given delayed compliance dates will use the time to develop the technology necessary for noise control? Can the time required to develop useful technology be specified?

Hearings were again conducted throughout the State, as follows:

| Date | Location |
|---|---|
| May 7, 1973 | Edwardsville |
| May 8, 1973 | Champaign |
| May 14, 1973 | Rock Island |
| May 15, 1973 | Chicago |
| May 21, 1973 | Rockford |

All correspondence, exhibits and written documentation received by the Board since the close of the hearings were incorporated in the record as composite Ex. 129 and 164. At the new series of hearings, essentially the same type of witnesses, representing the same interests as previously, appeared and testified. On June 15, 1973, after the conclusion of the second round of hearings, the Board approved for publication a proposed final draft which was published in Newsletter #68, dated June 22, 1973. The final version of the proposed regulation did not differ greatly from the original proposal in terms of the numerical limits imposed on noise emitters; the major difference was in the applicability of the numerical limits to various noise situations. The changes between the original proposal received from the Task Force and the proposed final draft were specified in the Newsletter and are summarized below.

*5 1. Noise measurements are made on the receivers' property but not closer than 25 feet to the property-line-noise-source, instead of at or beyond the emitters property line as originally proposed.

2. Existing property-line-noise-sources are exempted from the nighttime limits of Rule 203.

3. Undeveloped land is not classified and thus not subject to the numerical limits.

4. The non-degradation rule is deleted.

5. Farmlands are reclassified as Class C use instead of Class B use.

6. A rule regulating impulsive sound is included.

7. The rule governing nonabutting property is deleted.

8. The definition and regulation of prominent discrete tones is revised so as to include fewer noise sources.

9. Exemptions from the numerical limits are broadened to include lawn care equipment, agricultural farm machinery, equipment used in construction and certain types of land use.

10. Delayed compliance dates of at least 12 months for existing sources are included with up to a 3 year delay for blasting noise, railroad car coupling noise and forging hammer impact noise. New sources would have to comply immediately with the numerical limits.

Comments were invited until July 15, 1973. On the basis of the comments received, several additional modifications were made as follows:

1. Definitions

Definitions 101(e), 101(k) and 101(s) were modified to specify the reference pressure in the preferred units as 20 micronewtons per square meter rather than as 0.0002 microbars.

2. Automobile and Motorcycle Racetracks

Rules 201(b) and 201(c) are modified to move SLUCM land use 7223 used for automobile and motorcycle racing from the B category to the C category. SLUCM class 7223 includes all race tracks so it is necessary to specify automobile and motorcycle racing. Rule 209(j) is added to give a two year compliance date for racetracks used for motorized racing. Fairground motor racetracks are similarly treated.

3. Refineries

Rule 209(i) is added to give a two year compliance date for SLUCM Code 291 (petroleum refining) land uses.

4. Modified Compliance dates.

Rule 209(a) is modified to include new rules 209(i) and 209(j), providing a two-year compliance date for oil refineries and for automobile and motorcycle racetracks.

5. A new section 201(d) was added which provided in substance that where agricultural or undeveloped land is adjacent with land classified as "B" or "C", such agricultural or undeveloped land could be classified as a Class B or C land by a municipal government having zoning jurisdiction over such land; which classification would remain after development until it was removed by the zoning authority. This provision was designed to reassure developers of "B" or "C" prope ties that they would not be subjected to development of adjacent properties that could entail noise restrictions beyond that originally contemplated at the time of original development.

***6** The regulation adopted retains the basic structure that was originally proposed by the Task Force in February of 1972. A noise pollution prohibition is provided which would enable abatement of noise nuisances irrespective of numerical limits. The nondegradation rule is deleted principally because of administrative difficulties and not because of any indifference to this concept. The basic land use treatment and designation are retained although certain changes have been made within the respective A, B, and C use classifications. Rules relating to prominent discrete tones and impulsive sounds have been included and improved. The earlier proposal distinguishing between abutting and non-abutting land has been deleted. Exemptions have been provided for a wider range of activities than originally proposed and compliance dates for existing sources have been extended beyond the one-year provision in the case of certain emitters of prominent discrete tones, impulsive noise, loud low frequency noise, automobile and motorcycle racetracks, oil refineries, blasting noise, railroad coupling and forge impact noise. It must be emphasized, however, that new sources must comply with the regulation upon its effective date in most cases.

The balance of this opinion will consider the concept of noise generally, a discussion of some of the technical aspects such as frequency, octave band, sound pressure levels and prominent discrete tones. The psychological and physiological need will be considered, together with an analysis of the justification for the decibel limits employed in the regulation. Explanation will be made of the types of emissions such as impulsive and fluctuating sounds.

Analysis will next be made of the technical feasibility and economic reasonableness of the regulations promulgated, giving recognition to the means of abatement available for the particular noise sources, the cost likely to be incurred in their abatement and the time necessary to achieve compliance. With respect to the foregoing areas of discussion, analysis will be made of various special problems that exist with respect to the entire subject of noise abatement such as those relating

to prominent discrete tones and the somewhat unique characteristics relative to noise emission and abatement identified with specific uses and operations such as oil refineries, motor racetracks, forging operations and blasting operations.

Concept of Noise

Noise is often defined as unwanted or undesired sound. It is undesired sound that, for example, interferes with one's reception of desired sound or imposes sound when none is wanted at all. Sound is a fluctuation in air pressure that stimulates the nervous system through the ear, eardrum and connecting nerves. Several characteristics of these pressure fluctuations determine their impact on the individual. These include the magnitude of the pressure fluctuations, the speed or frequency of these fluctuations, the variation of the fluctuations with time, and the spatial characteristics.

*7 The ear senses loudness by the magnitude of the pressure fluctuations against the eardrum. For this reason, the unit of sound magnitude is the decibel (dB) which is a non-dimensional measure of sound pressure level (SPL) in terms of a standard reference pressure. The reference pressure Pref. is 20 micronewtons per square meter and the relation between the sound pressure, P, and its dB value is given by $dB=10 \log (P^2/Pref.^2)$. For multiple sound sources, the total sound pressure is related to the individual pressure by $p^2$ total $= P_1^2 + P_2^2 + P_3^2 + \ldots$ In mathematical terms, therefore, doubling the sound sources increases the dB reading by 3. However, in subjective terms, it takes a 10 dB increase in sound level before the sound seems twice as loud. Representative decibel levels of sounds encountered are listed in the following table:

| | |
|---|---|
| 0-10 | hearing threshold |
| 20-30 | quiet bedroom |
| 45 | living room |
| 55 | medium size office |
| 85 | train at 50 feet |
| 90 | 8 hour OSHA limit |
| 120 | pain threshold |

Frequency refers to the rate at which the pressure level oscillates with time. The frequency is therefore expressed as the number of pressure cycles per unit time, cycles per second or the newer unit, Hertz (Hz). The frequency of a sound is often referred to as the "pitch" so that low pitch means low frequency, similarly for high pitch sounds. Numerically, A above middle C on a piano has a frequency (or pitch) of 440 Hz and the typical human ear can hear sounds having frequencies between 20Hz and 15,000 to 20,000 Hz.

Although the frequency range for audible sounds is continous, for ease of measurement and description, it has been customary to divide the frequency range into intervals. The basic interval used is the octave band, which is defined as the frequency interval having the upper frequency limit equal to twice the lower frequency limit. For example, if the lower limit equals 100 Hz, than the upper limit of the octave band equals 200 Hz and this band has a width or range of 100 Hz. For an octave band having a lower limit of 500 Hz, the upper limit is 1000 Hz and this band has a range of 500 Hz. Using the octave band as the interval; the audible spectrum breaks up into slightly more than 9 octave bands. Other intervals used include 1/3 octave bands and 1/10 octave bands. The frequency intervals are today represented by their center frequencies which, mathematically, are the geometric means of the limits of the bands. For example, the octave band between 100 Hz and 200 Hz has a center frequency of 141 Hz and the octave band between 500 Hz and 1000 Hz has a center frequency of 707 Hz. Recently, a set of preferred frequencies has been established which establishes the center

frequencies of octave bands as the identifying quantity. The band frequency limits are then determined mathematically. These preferred center frequencies are set out in ANSI Standard S1.6-1967 and are listed below along with the octave band limits.

| Preferred Frequency - Hz | Octave Band Limits - Hz |
|---|---|
| 31.5 | 22.4-45 |
| 63 | 45-90 |
| 125 | 90-180 |
| 250 | 180-355 |
| 500 | 355-710 |
| 1000 | 710-1420 |
| 2000 | 1400-2800 |
| 4000 | 2800-5600 |
| 8000 | 5600-11,200 |

***8** The human ear does not hear all frequencies of sound with equal sensitivity; low frequencies being not heard as well as high frequencies. Thus, a sound having an SPL of 60 dB at 1000 Hz would be much louder than a sound having an SPL of 60 dB at 50 Hz, so that it is necessary to know both the sound pressure level and the frequency before the subjective loudness can be evaluated. Several methods for incorporating the sensitivity or frequency response of the human ear have been established, the one most often used is the A-weighting scale. The A-weighting scale is an approximation of an equal loudness judgment for sound of different frequencies, the use of the scale resulting in a single number equivalent for a complex sound having many frequency components. The following table lists the A-weighting corrections that should be applied in order to simulate the ear's sensitivity. (EPA Ex. 63)

| Sound Frequency | A-Weighting Decibel Correction |
|---|---|
| 31.5 Hz | -39.5 |
| 63 | -26.1 |
| 125 | -16.2 |
| 250 | - 8.0 |
| 500 | - 3.3 |
| 1000 | 0 |
| 2000 | + 1.2 |
| 4000 | + 1.0 |
| 8000 | - 1.1 |

Once the corrections are made, the weighted octave band values are combined to give a single A weighted decibel level for the sound.

Until now, the sounds under discussion were considered to be steady and continuous, that is, the magnitude and frequency distribution did not vary with time. Many sounds, however, are non-steady and either the magnitude or frequency vary with time, examples of which include sirens (varying frequency and magnitude) and punch presses (varying magnitude). These types of sounds are subjectively more annoying and bothersome than steady sounds having the same magnitude and frequency distribution, (EPA Ex. 110) especially for hammering and blasting type noise, and, therefore, should be evaluated separately from steady sound.

Sound is emitted and received as pressure fluctuations in the atmosphere. The fluctuations travel from the emitter to the receiver and the physical relation between the emitter and receiver determines the alteration of emitted sound and thus, the characteristics of the received sound. Two major spatial factors determine this alteration: distance and direction. Distance between emitter and receiver determines the amount of atmospheric diffusion or attenuation of sound energy and thus, the decrease in SPL between emitter and receiver. In theory, doubling the distance between the emitter and receiver decreases the SPL received by 6dB while halving the distance increases the SPL received by 6dB. For example, if a motor emits 60 dB at 100 feet, at 200 feet, the reading would typically be 54 dB. Since the noise regulations are based on sound levels measured on the receiver's property, opportunity is available for the atmospheric attenuation of the sound emitted. The directional aspect refers to the orientation between the sound radiating surfaces and the receiver. The pressure fluctuations are often generated by vibrating surfaces so that "seeing" the surface results in more sound received than if the vibrating surface is shielded. Intervening objects such as buildings or barriers block and disperse the sound so that the amount received is lessened.

Effects of Noise

*9 The effects of noise on people can be broken down into two major categories: physiological and psychological. The testimony of Professors Ades and O'Neill introduced into the record discusses these subjects in length. (Exhibits 50 and 61). The physiological effects include damage to the ear and permanent or temporary hearing loss; while the psychological effects include interference with speech communication, annoyance and loss in physical or mental efficiency.

The physiological effects of noise (EPA Ex. 50) include both physical damage and hearing loss. At sound pressure levels exceeding 120 dB, the ear can suffer physical damage, primarily in the area of the inner ear. It might be noted, however, that extreme impulsive noises such as blasts can rupture the ear drum itself. The damage to the inner ear is postulated to result either from rupturing cells and nerves because of excessive vibration or by causing the cells to exhaust themselves because of noise induced excessive metabolic rates. Photomicrographs have shown the decay and destruction of the inner ear structure caused by excessive noise.

At noise levels lower than those causing physical damage, the ear can still suffer hearing loss. This loss is represented by the threshold shift, that is, the shift in sound level at which a tone is first detected. For example, if a tone is first detected by an individual at a sound level of 10 dB and following exposure to noise, the tone is then detected at a sound level of 20 dB, the individual is said to have a noise induced threshold shift of 10 dB. The shift can be thought of as a decrease in the ears' sensitivity to sound and means that all levels of sound would appear quieter than before the shift occurred. The amount of threshold shift depends on the frequency, duration and magnitude of the noise producing the shift. This threshold shift (hearing loss) can be either temporary or permanent. Temporary shifts decrease with time and the ear returns to its former sensitivity. More severe noise exposures can result in a residual shift after the temporary portion has subsided. Estimates of threshold shift based on test data show that sound levels as low as 70 dB for durations of several hours can produce temporary threshold shifts following single exposures to noise. The amount of shift is proportional to the logarithm of the exposure time (EPA Ex. 53). Typical threshold shifts as related to sound level and duration are listed in the following table:

| | | Exposure Time | | (Minutes) | | |
|---|---|---|---|---|---|---|
| | | 12 | 23 | 45 | 100 | |
| | 85 | 3 | 5 | 7.5 | 12.5) | |
| Sound | 90 | 9 | 14 | 19 | 23 ) | threshold |
| Level | 95 | 16 | 21 | 27 | 31 ) | shift (dB) |
| (dB) | 100 | 20 | 26 | 33 | 42 ) | at 4000 Hz |

***10** The time required for the temporary shift to decay is also proportional to the sound level and duration; when the time required is in excess of several weeks, the shift can then be considered permanent. Permanent hearing loss can be caused by a single exposure to intense noise but is usually caused by repeated exposures over an extended period of time. In considering permanent hearing loss, consideration of presbycusis is required. Presbycusis is the hearing loss due to aging processes; however, it has been suggested that exposures to noise during a person's lifetime may contribute significantly to this "aging" process. Studies of permanent hearing loss have been conducted, primarily of workers engaged in noisy occupations. The following table shows the permanent threshold shift resulting from occupational noise exposure as a function of noise level and time on job. The levels have been adjusted for the effects of presbycusis and the data at 10 years has leveled off. (EPA Ex. 53)

| | | Time on Job | (Years) | | |
|---|---|---|---|---|---|
| | | 1 | 5 | 10 | |
| Industrial | 83 | 2 | 5 | 12 ) | |
| Noise | 92 | 2 | 19 | 27 ) | threshold shift (dB) |
| Level | 97 | 22 | 37 | 46 ) | at 4000 Hz |
| (dBA) | | | | | |

It must be remembered that occupational exposure occurs usually 8 hours per day, 5 days per week with 16 hours per workday for recove whereas environmental exposure occurs for periods up to 24 hours pedays, 7 days per week for housewives, retirees, and children. Thus environmental exposure to noise would be expected to result in more severe hearing loss than industrial exposure to the same noise leve

To put the threshold shifts in proper perspective, Figure 12 f EPA Exhibit 53, listed below, gives the relation between threshold shift at the speech important frequencies and the ability to understand speech.

| Degree of handicap | Range in Threshold Shifts - (dB) | Ability to Understand Speech |
|---|---|---|
| Not significant | 0-25 | No difficulty |
| Slight | 25-40 | Difficulty with faint speech |
| Mild | 40-55 | Difficulty with normal speech |
| Marked | 55-70 | Difficulty with loud speech |

| | | |
|---|---|---|
| Severe | 70-90 | Can only understand shouted speech |
| Extreme | 90 and up | Cannot even understand amplified speech |

*11 The psychological effects of noise include interference with speech, annoyance and the mental and motor performance of an individual. Of these effects, speech interference and annoyance are the most important.

Speech interference to the listener caused by noise is manifested in several ways; the relative sound level of the speech is reduced, the speech sound may be distorted and become unrecognizable, or the noise may distract the listener. To the speaker, the presence of noise may cause him to raise his voice level. In terms of frequency, noise concentrated in the range of 500 to 3,000 Hz is most effective in masking or interfering with speech. For this reason, attempts to relate difficulty in communicating to various levels of noise have focused on the noise in this frequency range.

One commonly used measure is the speech interference level (SIL) defined originally as the arithmetic average of the sound pressure levels in the 600 to 1200, 1200 to 2400, and 2400 to 4800 Hz octave bands. Recently, the speech interference has been expressed in terms of the preferred frequencies as the arithmetic average of the sound pressure levels of the three octave bands having the geometric mean center frequencies of 500, 1000 and 2000 Hz. This preferred speech interference level (PSIL) is related to required voice levels and distance between speaker and listener by the following table (EPA Ex. 7, Table 18.1).

| | PSIL (db) | | | |
|---|---|---|---|---|
| distance between | voice effort | | | |
| speaker and listener (ft) | normal | raised | very loud | shouting |
| 1 | 68 | 74 | 80 | 92 |
| 2 | 62 | 68 | 74 | 86 |
| 6 | 52 | 58 | 64 | 70 |
| 12 | 46 | 52 | 58 | 64 |

The voice levels required according to the above table are for average male voices and are based on 60% reliable communication. The speech interference for female voices is approximately 5 dB more severe.

For example, for two males to converse over a distance of 6 feet at normal voice levels means the ambient PSIL can not exceed 52 dB. For two females to converse at the same conditions means the PSIL can not exceed 47 dB.

Another criterion for estimating the effects of noise on communication is the preferred noise criterion (PNC) curves (EPA Ex. 108). These curves apply to interior broad band noise and rate octave band sound levels in terms of room suitability for various activities. They result from updating the noise criterion (NC) curves originally developed from noise questionaires and surveys in military and office buildings and used for design and evaluation of room suitability for communication. The following table lists the octave band sound pressure levels at the preferred center frequencies for typical PNC curves.

| | Sound pressure level (dB) at octave band | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | center frequency (Hz) | | | | | | | | |
| PNC Curve | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25 | 60 | 49 | 43 | 37 | 31 | 25 | 20 | 18 | 18 |
| 30 | 61 | 52 | 46 | 41 | 35 | 30 | 25 | 23 | 23 |
| 40 | 64 | 59 | 54 | 50 | 45 | 40 | 35 | 33 | 33 |
| 50 | 70 | 66 | 62 | 58 | 54 | 50 | 46 | 43 | 43 |
| 60 | 76 | 73 | 69 | 66 | 63 | 59 | 56 | 53 | 53 |

***12** Typical room suitability for various activities is related to the PNC curves in the following table. (EPA Ex. 108)

| PNC Curve | Type of space and acoustical requirements |
|---|---|
| 25-40 | Bedrooms, sleeping quarters, hospitals, residences, apartments, hotels, motels (for sleeping, resting, relaxing). |
| 30-40 | Living rooms and similar spaces in dwellings (for conversing or listening to radio and TV). |
| 35-45 | Large offices, reception areas, retail shops and stores, cafeterias, restaurants (for moderately good listening conditions). |
| 40-50 | Lobbies, laboratory work spaces, drafting and engineering rooms, general secretarial areas (for fair listening conditions). |
| 50-60 | Shops, garages, power-plant control rooms (for just acceptable speech and telephone communication). PNC levels above 60 are not recommended for any office or communication situation. |

The technique in using the above tables is to compare the noise being rated at each octave band center frequency with the PNC curves; the PNC rating then being the highest PNC curve that is intersected by the noise at any octave band center frequency. Since the PNC curves are indoor ratings, the attenuation of walls must be considered in rating the receiving land noise levels.

Annoyance

The next major psychological effect of noise is annoyance, especially as it relates to interference with relaxation or sleep. The annoying value of a particular noise depends on several factors (EPA Ex. 61):
(a) The type of community - residential or industrial.

(b) Time of day and activity of residents - noises which appear acceptable during the working weekday may be objectionable during the evening or on a weekend.

(c) Community acceptance-annoyance may be effected by the relationship of noise source to community welfare.

***13** (d) Noise background - annoyance of a particular noise may be related to the customary ambient noise in the environment.

(e) Initial effects - new noise may be initially objectionable, with subsequent diminution of complaints.

(f) Geography and climate-noises may be more objectionable under conditions where people are outdoors a large portion of the time.

Since annoyance is an unfavorable reaction to a stimulus, one might suggest that measurements of annoyance should always be done in terms of complaints and that the lack of complaints indicates a lack of annoyance. This type of correlation, however, includes factors for two separate stages of response to a noise stimulus. The first stage is the personal level where the individual is or is not annoyed, depending on factors of the type listed above. Assuming he is annoyed, the second stage is the community level where the individual may or may not complain, depending on his status in the community, the degree of annoyance, and the results he feels his complaint will achieve. Therefore, even though a person might suffer annoyance, he may not complain. This was proven out in European studies which showed that few people actually register a formal complaint concerning noise. In Great Britain, only 20-23% of individuals who felt that they had a serious local problem even felt like calling or writing to an official. Only about 2-4% actually followed through on their complaints. Therefore, a regulation based on complaints would ignore the vast number of citizens who do not complain. To solve this problem, a regulation should be based on the likelihood of complaint, that is, based on the personal reaction to a noise independent of a person's status or influence.

A recent method developed for rating community response to noise pollution is ISO R 1996 "Assessment of Noise with Respect to Community Response" (EPA Ex. 100). This relates the excess noise, in dBA, to anticipated community response: the excess noise being that noise in excess of the adjusted community noise level. Included in the method are adjustments for the noise being rated, depending on the impulsive, prominent discrete tone or fluctuating characteristics; and on the community rating depending on the time of day and type of neighborhood. The basic relation between excess noise in dBA and the expected community response is given in the following table:

| | | **Expected community response** |
|---|---|---|
| **Excess noise in dBA** | **Category** | **Description** |
| 0 | none | no observed reaction |
| 5 | little | sporadic complaints |
| 10 | medium | widespread complaints |
| 15 | strong | threats of community action |
| 20 | very strong | widespread community action |

***14** This method can be in-directly applied to the Illinois noise regulations, since it depends strongly on the character of the community, whereas the present regulation depends only on the noise emitter and noise receiver in terms of limits on noise. The impact on the noise receiver under the regulation is, however, a function of the surrounding community since the limits apply to each noise emitter. For example, a residence in an industrial setting might be surrounded by four equally loud industries and have a total sound level 6dB greater than a residence in a less industrialized setting with only one industry emitting noise. In terms of the numerical limits the regulation imposes, hypothetical communities ranging from industrial to residential, if exposed to the C/A daytime limits (equivalent to 61 dBA), would have an expected community response ranging from sporadic to widespread complaints, as will be shown later.

Special types of sounds

Up to this point the sounds discussed could be characterized as steady, broad band sounds. These sounds occur continuously and do not contain clearly identifiable tones of a given pitch or frequency. Types of sounds characterized as steady broad band would include noise from process plants, noise from a properly maintained air conditioner or fan. In terms of annoyance or nuisance, these sounds would have the lowest intrinsic values if compared subjectively to non-

steady or non-broad band noise. This can be seen from the various noise rating criteria e. g. ISO R. 1996, where 5 dB(A) penalties are put on noises characterized as impulsive (non steady state) or as having prominent discrete tones (audible tone components).

Impulsive sounds can be considered as that sound having less than a seconds duration. Typical examples of this type of sound include blasts, hammering, impact of drop forges, and punch presses. When compared subjectively to continuous noise, impulsive noise is adjudged to be more annoying (EPA Ex. 110). According to ISO R 1996, a 5 dB(A) penalty for impulsive noise levels with respect to continuous noise is necessary in assessing the annoying value of noise. In addition, the community noise equivalent level (CNEL) rating scheme, used by the State of California in monitoring noise sources, has been shown to correlate well with community reaction to noise if a 5dB decrease in the sound levels of impulsive noise was included. Thus, it appears that impulsive sound levels should be 5dB less than continuous sound levels if the same subjective reaction is to be maintained in both instances.

The short duration of impulsive sounds does not allow the determination of octave band sound levels using portable measuring equipment consisting of a sound level meter and octave band analyzer. More costly and sophisticated equipment, including a precision tape recorder and spectrum analyzer would be required and would not permit easy use in the field. In addition, it appears that impulsive noise levels, measured in dBA, correlate sufficiently well for all types of impulsive sound emitters so that the octave band levels are not required.

***15** Prominent discrete tones refer to sounds which have easily identifiable frequency or pitch components, examples of which include whistles, transformer hum, motor noise, and musical instruments. These tones in terms of noisiness are more annoying than sounds not having these tones (EPA Ex. 63, p. 289) so that again a penalty should be imposed on sounds having these prominent discrete tones.

The first problem to deal with is the classification of sound as having or not having prominent discrete tones. The ANSI Standard S1.13-1971 "Methods for the Measurement of Sound Pressure Levels" (EPA Ex. 44) suggests that a prominent discrete tone would typically be present, based on a panel of listeners if the tone were from 5 to 15 decibels higher than the level at which the tone would just be audible in the presence of broad band noise. They go on to set 10 dB as the level for the establishment of prominent discrete tones. However, the ear's sensitivity to discrete tones has been shown to vary with frequency according to Fletcher and Munson, and others. Therefore, the definition of a discrete tone as being prominent should be a function of frequency. Using the Fletcher and Munson concepts along with the 10 dB criterion from Ex. 44, the following table gives for # octave bands, the decibel differentials for the # octave discrete tone and the adjacent # octave bands required for a prominent discrete tone to exist, as a function of frequency (EPA Group Ex. 117 plus 10 dB criterion):

| **# Octave Band Center frequency (Hz)** | **Excess SPL required for prominent discrete tone (dB)** |
|---|---|
| 100 | 16.0 |
| 200 | 10.7 |
| 400 | 7.2 |
| 800 | 4.8 |
| 2000 | 3.5 |
| 4000 | 3.3 |

8000 4.9

Once a sound is determined to have these prominent discrete tones, the next problem is to rate these sounds in terms of annoyance with respect to sound devoid of these tones. As mentioned previously, the ISO R 1996 recommendation would penalize prominent discrete tones by 5 dBA in assessing their relative annoyance. In addition, Kryter, in his book, "The Effects of Noise on Man", establishes the following correction factors to be applied in estimating noisiness from sound pressure level readings in octave bands. The factors depend both on frequency and on the excess sound pressure level of the prominent discrete tone as described previously.

| Excess Sound Level (dB) | Frequency (Hz) | Correction Factor (dB) |
|---|---|---|
| 8 | 400-1600 | 4 |
| 5 | 400-1600 | 3 |
| 5 | 1000-4000 | 5 |
| 5 | 4000-8000 | 3 |

***16** Thus, it appears that a correction factor of around 5 dB based on the ISO and Kryter material seems appropriate in terms of equating qual noisiness between sounds with prominent discrete tones and those without.

One last type of sound is fluctuating sound, where the sound pressure level varies with time. Some sirens emit noise that could be classified as fluctuating and there is also machine and process noise that varies regularly in sound level with time. Little information is available to determine its relative annoyance to non-fluctuating noise.

Need for a Noise Regulation

The need for the regulation was demonstrated during the sixteen hearings by the appearance of many citizens who complained about unreasonable nuisances resulting from noise emissions. The complaints covered a wide range of sources including forges, railroad switch yards, fans and blowers, machinery, transformers, racetracks and truck terminals.

The Agency investigated some of the complaints and made noise measurements on the complainant's property. Although the majority of noise sources for which complaints were received did violate the proposed numerical limits, not all did. For example, a Mr. Bodeen testified on May 14, 1973 in Rock Island about a nuisance caused by an electrical transformer substation that was located adjacent to his property. He characterized the noise emissions as "unbearable" (5/14/73, R. 335), and although the utility did respond by constructing a temporary barrier made of wood, the noise received was still a nuisance. The Agency made noise level measurements on the Bodeen property (EPA Ex. 149) and found the levels to comply with all proposed numerical regulations, including the prominent discrete tone rule, Rule 207. (5/14/73, R. 343). Relief available to Mr. Bodeen would still be possible, however, under the nuisance rule, Rule 102.

There were many instances of citizens being subjected suddenly to the presence of nearby noise sources. The residents of Coffeen, Illinois, for example, were awakened one night at 3 A.M. by the start-up of a mine air shaft exhaust fan (5/7/73 hearing). The fan emits a highpitched whine, inhibits conversation and interferes with the residents' sleep. Sound level measurements made by the Agency on the residential property a quarter mile away from the fan (EPA Ex. 133) showed the noise levels exceeding the C to A daytime standard by as much as 28 decibels and also showed the presence of prominent discrete tones.

Local officials also appeared at the hearings and testified to their inability to enforce local noise ordinances and the need for a state-wide noise regulation. The problem apparently is that the methods for enforcement have not been established and the manpower is not available, especially in the smaller communities (5/7/73 R. 30-43).

The Agency's own files support the need for the regulation. The Illinois Manufacturer's Association statement of December 8, 1972 (Group Ex. 129) includes a summary of the Agency noise complaint file for the period of July 1, 1970 to November 27, 1972 and finds that 12% of the complaints involved factory sources. However, in terms of all sources covered by this Regulation we find that approximately 46% of the sources complained about would be regulated. The other significant area of complaints are transportation sources (43%) based on the IMA summary.

Protection Offered by the Regulation

***17** As a preface to the following material it might be well to identify those areas not covered by the regulation. The following noise sources are not covered by this Regulation: airport noise, construction noise, and transportation noise.

The regulation is designed to protect people in the State from the unreasonable exposure to environmental noise burdens. It is not designed to cover only those instances when serious physiological damage will result. This is achieved by setting maximum limits on the noise levels received from each individual noise emitter. The regulation does not control all environmental noise emissions; transportation noise, airport noise and construction noise will be subject to future noise regulations.

In regulating environmental noise pollution, the regulation is designed to protect people 24 hours a day, 365 days a year. It, therefore, is significantly different from noise regulations designed to protect the worker in an industrial setting where the exposure to noise is typically 8 hours a day, 5 days a week and where the noise control is designed to minimize hearing loss. In addition, personal noise control devices such as earplugs are often used. In regulating noise emissions, the regulation is designed to protect people not only from physiological damage due to noise, but also from unreasonable nuisances such as interferences with communication or sleep. The protection covers all people, both the very young and very old, in good health and poor, and thus includes those not usually covered by industrial hygiene noise limits.

The protection provided by the regulation depends on the classifications of the noise emitter and of the receiver. For example, a residential receiver is protected more than an industrial receiver, while, on the other hand, an industrial emitter is allowed to emit more noise than an institutional emitter to the same class of receiving land.

The specific sound levels of Rules 202 through 205 adopted in the Regulation are justified using three rating criteria. The criteria consist of (1) expected response of a community to various noise levels, (2) speech interference caused by noise, and (3) noise ratings of rooms used for different activities. Although the rating criteria apply to total environmental noise levels and the regulation applies to each noise source individually, the conclusion to be drawn is that the regulation allows a moderately noisy environment to occur. For example, the noise levels permitted by industry emitting to residences would allow speech at normal voice levels for males at a maximum distance of 6 feet and would result in a room suitability rating of fair listening conditions or worse using the rating criteria discussed previously. An analysis of the specific regulations adopted follows.

Rule 101: Definitions

This rule is self-explanatory except for a few definitions where the intent needs to be expanded.
(c) Daytime hours: Some consideration was given to expanding the limits so that the duration was increased from 15 hours to 16 hours in order to allow two 8-hour shifts of operation under the daytime rules. However, many industries have second shifts lasting until 11 or 12 P.M. when many people are normally asleep, and since the reason for dividing the

day into daytime and nighttime hours is to offer greater protection during sleeping hours, it was not deemed appropriate to expand the daytime hours definition.

***18** (f) Existing property-line-noise-source: The definition is designed to make clear the distinction between new and existing sources. It is not intended that the installation of a new or different piece of equipment at an existing property-line-noise-source would change the classification of the source from the existing category to the more strict new category. The property-line-noise-source is, in general, being regulated, not individual pieces of machinery that may comprise the source. To be considered as existing, substantial progress in the construction or establishment must have occurred.

The issue was raised primarily by Edison in terms of replacing or upgrading power transformers at existing transformer sites. The intent of the definition is to enable Edison or another power utility to replace transformers at a site without placing the site in a new category. The last sentence of the definition refers to sources whose use classifications change. It is intended to cover situations where a new or different land use moves into an existing structure. An example of this would be fans or blowers attached to a building used originally as a commercial business, class B, which subsequently is used for manufacturing purposes, class C. Even though the sources of noise, the fans or blowers, were in existence, the reclassification of the property-line-noise source from class B to class C would put it in the new property-line-noise-source category.

(h) New property-line-noise-source: This definition works in conjunction with definition (f), existing property-line-noise-source. The key word in the definition is establishment, the intent is to prevent existing sources that make minor alterations or equipment modifications from being reclassified as new property-line-noise-sources.

(n) Prominent discrete tones: Subdividing the definition into 3 steps as a function of frequency is intended to account for the ears sensitivity to these tones. Prominent discrete tones can be both low frequency such as transformer hum or high frequency such as a whistle or screech of bearings; and the ear more easily identifies discrete tones as being prominent at high frequencies than at low frequencies. An earlier definition proposed dividing the frequency band into only two steps but based on testimony from industry, a three-step definition is adopted. The result is to more closely approximate the subjective annoyance reaction to prominent discrete tones. To industry, it represents a slight loosening of the regulations by eliminating more noise from the definition and thus regulation of prominent discrete tones, while to the receiver, it represents an insignificant change in terms of exposure to noise.

(o) Property-line-noise-source: The definition makes the point that we are concerned with the totality of equipment and machinery that contributes to the noise emission from a property-line-noise-source rather than with individual pieces of machinery. It is this total noise emission that is to be regulated rather than noise from individual machines. An exception to this would be forging operations where by Rule 209(h), it is proposed to regulate forge impact noise separately from other noises emitted by the operation.

Rule 102: Prohibition of Noise Pollution

***19** This is a standard nuisance-type regulation comparable to that appearing in the statute with respect to air and water pollution, that could apply irrespective of compliance with or violation of any regulation based on numerical limits. Although our jurisdiction would cover disputes between residential neighbors, we feel that the local authorities may be better suited in terms of providing an immediate solution to the problem.

Rule 103: Measurement Techniques

This rule establishes the basic techniques to be used in measuring sound levels by reference to specific published standards such as those of the American National Standards Institute, Inc. (ANSI). Much testimony appears in the record, mainly

from industry, urging that the techniques be specified in more detail as part of the regulation. This was felt to be impractical given the uniqueness of each measuring location in the state and the periodic development of new and more advanced techniques. Filing the techniques with the Secretary of State before applying them should give sufficient notice of their nature and provisions to interested persons. Application of the measurement techniques to specific situations must be done on an individual basis and could be a subject to challenge in an enforcement proceeding.

Rule 104: Burden of Persuasion

The burden of persuasion rests with the person who would benefit from the exception. The role of the Agency is not to provide assistance in terms of measuring noise levels but rather to be helpful to people in explaining the regulation.

Rule 105: Severability

This is a standard severability rule.

Rule 201: Classification of Land According to Use

This rule provides the basic differentiation between land uses of varying noise sensitivity, classifying land uses both as potential noise emitters and noise receivers. The classes in order of decreasing noise sensitivity as receivers are roughly divided by use as follows: Class A-residential and institutional; Class B - commercial and business Class C - industrial.

The classification of land is dependent on the actual use being made of the land, rather than on anticipated or planned use such as could occur if the classifications were based on zoning. This is not to say that zoning is not a factor in these regulations because it is, in implicit terms. Zoning largely determines land use which, in turn, determines the applicable noise regulation. Thus, the application of the regulations is based indirectly on local zoning decisions, and a conflict in land uses from a noise standpoint relates back to the zoning decision that determined the conflict.

Actual land use is an appropriate basis in that the regulation is designed to protect people where they actually live and work, rather than protecting vacant property in anticipation of people living and working there. There was much discussion during the hearings of the problems of industrial planning in the face of changing land uses and thus, changing regulations. Industry was concerned about a single residence moving into an industrial area, forcing sudden expenditures of funds to comply with the more strict residential requirements, subsequent to which the residential use may be eliminated and the expenses then wasted. However, many citizens in residential areas testified during the hearings to the sudden presence of a noise source near their property. This is, in part, resolved by the inclusion of Rule 201(d). In both instances, it probably was local zoning decisions that caused the problems. The regulation would, in essence, add a new consideration, i. e. potential for noise pollution, to the other considerations that results in zoning decisions, rather than circumventing these decisions.

***20** Classes of land use are divided into three categories employing, as a useful means of categorizing the multiplicity of possible land uses, the Standard Land Use Coding Manual (SLUCM) 1969 reprint, published by the U.S. Department of Transportation, which is incorporated in the regulation. The choice of three classes is a compromise which is intended to acknowledge the different noise requirements of different types of land use without creating an unduly complex regulation. Several industries, but primarily Shell Oil, suggested that the class C category be divided into light industry and heavy industry with different numerical limits for each sub-category. This would, in their opinion, take into account the great disparity in sizes between the various types of industries included in class C. Shell's situation is unique in that not only is it a very large refinery, but abuts the residential community of South Roxana, allowing only the width of a street for noise attenuation. Rather than basing a regulation on this unique situation, this could be handled in a variance proceeding. The rule that exempts existing noise sources from the nighttime limits also serves to reduce Shell's problems in complying with the regulation. Additionally, an extended two-year compliance date has been provided for oil refineries.

It is important to recognize that land use is not necessarily co-extensive with land ownership. A good example of this is a farmer's piece of property. The portion of land used as farmland would be classified as a "C" use while the farmstead itself would be classified as an "A" use. Another example includes multiuse buildings such as high rise apartments, where the apartments themselves are class A uses, while ground level businesses are class B uses. Still another example is an industry located on a large tract of land owned by the industry. That portion of the land where the industry is situated is a class C use while the remaining land, if not used, is not classified and thus, neither regulated nor protected.

Discussion of the Numerical Regulations

The next series of rules, 202 through 207, is the heart of the regulations based on numerical limits. These rules establish limits on the amount of noise received on a particular class of land use from a noise source also classified by land use. In applying the regulations, several conditions must be met:

1) The noise limits apply to each individual property-line-noise-source rather than to the total environmental noise level. This concept was misunderstood during the earlier hearings where much time was spent discussing background noise levels. The limits apply individually to each source so that one source is not penalized for the emissions of its noisy neighbor. The total noise level received therefore is not regulated, but is dependent on the total number of nearby noise sources. For example, a residence receiving noise from a single industry at the allowed limits is subjected to less noise than a residence surrounded by four equally noisy industries, each emitting at the allowable limits. This is appropriate because in the second case, the residence is clearly in an industiral area (in the first case it is not) and thus not entitled to the same protection from environmental noise.

***21** 2) Both the noise emitter and noise receiver must be among the land uses classified by Rule 201. Land not included in the classes of Rule 201 such as undeveloped land is not protected from noise.

3) The sound pressure levels must be measured within the receiving property but not closer than 25 feet to the property-line-noise-source. This represents a significant departure from the original proposal which measured sound pressure levels at the emitters' property line. Since the regulation is intended to protect people from noise pollution, it is appropriate to measure the levels on the receiving property. This also is to industries' benefit in that it allows some atmospheric attenuation of noise. Originally, the measurements were to be made on or beyond the emitter's property line which, as brought out in the initial hearings, created problems of abutting compared with nonabutting property. The 25 foot provision is intended to set a lower limit on the available atmospheric attenuation. A good example is a utility pole transformer located on an easement, classified as a Class C noise emitter, adjoining residential property. In applying Rules 202 through 207, sound pressure level measurements cannot be taken closer than 25 feet to the transformer.

4) Finally, the particular noise emitter is not exempted elsewhere in the regulation.
Rule 202 governing sound emitted to Class A land during the daytime hours received the most discussion during the hearings, being the most stringent limit on noise emissions from existing sources not covered by the impulsive or prominent discrete tone rules. The rule establishes separate levels of noise emissions from Classes C, B and A property-line-noise-sources with C emitting to A (C/A) being the least restrictive and A emitting to A (A/A) the most restrictive. The additional noise emissions permitted for Class C property is an attempt to weigh the benefits accrued with the costs for noise reduction.

The regulation establishes sound pressure level limits for nine octave band center frequencies. The nine octave bands cover an overall frequency range of 22.4 Hz to 11,200 Hz. The overall frequency limits represent the typical hearing range of people.

The characteristic shape of the sound pressure level limits i.e. higher dB levels at low frequencies, lower dB levels at high frequencies is in recognition of the variation of an ear's sensitivity to sounds of varying frequency. In this regard, the limits follow to a certain extent the A-weighting scale, with the addition that the low frequency levels are further limited by the potential for the vibration of structures. The levels also correspond roughly to the Stevens weighting criteria, which is based on subjective loudness or annoyance. (EPA Ex. 2). Thus, more factors are taken into account than would be the case if the regulation was based solely on A-weighted sound pressure levels.

The specific octave band limits, if weighted using the A scale, are equivalent to the following limits: C/A 61 dBA, B/A 55 dBA, A/A 55 dBA. Suggestions were made that the C/A limit be set at 70 dBA based on preventing physiological damage to the ear; but this level was not felt to be proper based on the criteria of annoyance, speech interference and expected community reaction. The use of A-weighting was also not considered appropriate since the characteristics of all possible noise sources is so varied that the correlation between A weighted sound levels and subjective reaction does not always hold true. (EPA Ex. 2).

*22 In discussing the numerical regulations, it is often convenient to talk in terms of the A-weighted equivalents to the octave band sound pressure levels. The Board does not feel that a regulation based on dBA levels offers sufficient protection to the citizenry but as a rough measure of noise emission levels, dBA measurements may be helpful in assessing, on a preliminary basis, a potential noise problem.

The following table summarizes the numerical regulations 202 through 205 in terms of the dBA equivalents.

| | | Emitting Land Use | | | |
|---|---|---|---|---|---|
| | | C | B | A | |
| | | C | 70 | 62 | 62) |
| receiving | | | | | equivalent |
| land | B | 66 | 62 | 55) | dBA |
| use | | | | | levels |
| | | A(day) | 61 | 55 | 55) |
| | | A(night) | 51 | 45 | 45) |

Based on the previous discussion of physiological and psychological effects of noise, the protection to the citizen resulting from the regulation of the numerical limits of Rules 202 through 205 can be specified. As a general statement the levels are below those causing noise induced hearing loss although the C to C limit of 70 dBA is at the threshold. (EPA (Ex. 53). Instead, protection is against unwarranted annoyance and speech and sleep interference. The protection to be discussed is based on a single noise emitter operating at the limits, the presence of more than one emitter will decrease the protection provided. In addition, special consideration of Rules 206 (Impulsive Noise) and 207 (Prominent Discrete Tones) is necessary since they regulate special types of noise.

The three rating criteria used in establishing the levels of protection are the preferred noise criterion (PNC) curves of EPA Ex. 108, the preferred speech interference level (PSIL) curves of Table 18.1 of EPA Ex. 7, and ISO R1996 (included as part of EPA Ex. 100). It should be noted that the ISO document is suited to residential lands impacted by noise and cannot be properly applied to emissions to class B or class C land. The protection listed below follows the format in EPA Ex. 107 "Rationale for Suggested Levels" but with different results based on correspondence with the Agency (Comments in Response to E.H. Hohman, Dec. 21, 1972; Group Exhibit 129). In particular, the PNC curves apply

indoors so that the octave band levels of Rules 202 through 205 were decreased by 10 dB to approximate the attenuation of walls having open windows.

Rule 202: Sound Emitted to Class A Land During Daytime Hours

Class C Emitter

*23 Moderately fair listening conditions. Normal voice level speech is possible at 6 feet for males, 4 feet for females. Raised voice level speech is possible at 12 feet for males. Widespread complaints could result from these levels.

Class B or A Emitter

Fair to moderately good listening conditions. Normal voice level speech is possible at 13 feet for males, 8 feet for females. Sporadic complaints could result from these levels.

Rule 203: Sound Emitted to Class A Land During Nighttime Hours

Class C Emitter

Moderately good listening conditions, for conversing or listening to radio or T.V. Normal voice level speech is possible at 20 feet for males, 12 feet for females. Widespread complaints could result from these levels.

Class B or A Emitter

Moderately good listening conditions, for conversing or listening to radio or TV. Normal voice level speech is possible in excess of 20 feet for both males and females. Sporadic complaints could result from these noise levels.

Rule 204: Sound Emitted to Class B Land

Class C Emitter

For just acceptable speech and telephone communication. Normal voice level conversation is possible at 3 to 4 feet for males, 2 ft. for females. Raised voice level conversation is possible at 7 feet and very loud voice level conversation at 13 feet for males.

Class B Emitter

For just acceptable speech and telephone communication. Normal voice level speech is possible at 6 feet for males, 3 feet for females. Raised voice level speech is possible at 12 feet for males.

Class A Emitter

For moderately fair listening conditions. Normal voice level speech is possible at 13 feet for males, 8 feet for females. Raised voice level speech is possible in excess of 20 feet for males.

Rule 205: Sound Emitted to Class C Land

Class C Emitter

For work spaces where speech or telephone communication is not required. Normal voice level speech is possible at 2.5 feet for males, 1.5 feet for females. Very loud voice level speech is possible at 10 feet for males.

Class B or A Emitter

For just acceptable speech and telephone communication. Normal voice level speech is possible at 6 feet for males, 3 feet for females. Raised voice level speech is possible at 12 feet for males.

Rule 206 Impulsive Sound

Rule 206, (Impulsive sound) establishes sound emission limits, in dBA, that are 5 dBA more strict than the corresponding Rules 202 thru 205. This penalty is based on the information presented earlier concerning the relative annoyance of impulsive versus non-impulsive sounds based on the work of Kryter, (EPA Ex. 110) and the ISO Recommendation. By imposing the 5 dBA penalty on impulsive sounds, the same protection is achieved as in Rules 202 through 205.

Rule 207 Prominent Discrete Tones

Rule 207, (Prominent Discrete Tones) establishes on a # octave basis, a penalty equivalent to 5 dB for sounds containing prominent discrete tones. This again is based on the relative annoyance values discussed earlier. It appears from the regulation that a 10 dB penalty is being imposed, however, the band width for Rules 202 thru 205 is an octave and for the prominent discrete tone measurement, the band width is # octave, so that the difference in band widths alone results in approximately a 5 dB difference. Thus the penalty imposed is actually 5 dB and results in the same protection being achieved as by Rules 202 thru 205.

***24** Much more could be said about this Rule, considering the problems in interpretation evidenced during the hearings. However, the Bodeen case showed that prominent discrete tones such as transformer hum can be annoying and should be regulated. The complexities involved in the definition of prominent discrete tones and their regulation result from firstly, the problem of defining the response of the ear to prominent discrete tones and secondly, the equating of subjective reaction to these tones.

This rule is actually a compromise since the prominent discrete tones are not regulated with respect to the overall noise emission, but instead to the maximum levels permitted at the various frequencies and land use classes. This benefits low level noise emissions containing prominent discrete tones which could otherwise be required to meet levels much lower than the regulation.

It is obvious from the above discussion of Rules 202 thru 207 that noise levels are not unduely limited in terms of interference with normal existence. The Regulations do not eliminate the presence of environmental noise and the limits could justifiably be tightened further in consideration of the adverse impact upon the receiver if it were not for the resulting economic burden that would be imposed on the noise emitter.

Rule 208 Exceptions

This rule contains exceptions to the application of the numerical limits of Part 2. The exceptions result from evidence submitted by the Agency and industry and recognize both the beneficial emissions of noise in certain instances as well as those areas of noise pollution best handled by local authorities or perhaps not at all.

Rule 208(a) exempts noise emissions from the following SLUCM land uses from Rules 202 through 207: 110 - household units, 140-mobile home parks, 190 - other residential NEC, 691 - religious activities, 7311 - fairgrounds not used for automobile and motorcycle racing, 7421 - playlots or tot lots, 7422 - playgrounds, 7423 - playfields or athletic fields, and

7429 - other playground and athletic areas NEC. The exceptions for SLUCM codes 110, 140, 190 and 691 indicate noise emission situations that can be better handled by the local authorities. If no relief is available, the Board through Rule 102 of this regulation could act. The exception for fairgrounds recognizes an activity occurring for only short periods of time during the year. It is important to note that not covered by this exemption are automobile and motorcycle races that may occur on fairground property. Although one could argue that automobile and motorcycle races on fairground property are already covered under SLUCM code 7223 (racetracks), the term fairground to many people implies a variety of activities. The exceptions 7421, 7422, 7423 and 7429 are intended to apply to noise emissions from people actively participating in sports activities or play. Typical noise emissions could include those of children playing or a sandlot baseball or football game. The noise emissions from spectator sports is not included in this exception but instead is covered under SLUCM code 722 (sports assembly) which includes stadiums, racetracks, and field-houses. In this case, the noise is not from the participating athletes (except for racetracks) but instead from the crowd, public address systems and promotor equipment such as organs and whistles.

***25** Rule 208(b) exempts warning and safety devices from the numerical limits. This was done because the social benefits far outweigh any annoyance and because the noise emissions occur infrequently and usually for short durations. It should be noted that the exception would also cover the periodic maintenance and testing of these devices. Not covered by the exception would be devices which may in some ways be similar but which are used routinely in the course of operation such as circuit breakers used for switching electrical power.

Rule 208(c) exempts lawn care equipment and farm machinery from the numerical limits when they are used during the daytime. A farmer would still be subject to the nighttime limits during nighttime hours and would have to schedule his nighttime operations so that they occur in the interior of this property; any activities near his property line would have to occur during the daytime.

Rule 208(d) exempts noise emissions from equipment being used for construction. This recognizes that specific regulations covering these noise sources will be proposed in the future to the Board. The exemption refers to the use of the equipment so if similar equipment is used for different activities, for example, surface mining, the exemption would not apply. It is intended that blasting activities related to construction, for example, sewer construction, would be exempt from the numerical limits but would be covered both by Rule 102 plus future regulations covering construction noise.

Rule 208 (e) exempts all existing noise sources from the nighttime limits of Rule 203. This exception is in response to arguments from continuous 24 hour a day operations such as refineries that do not have flexibility of operation to regulate noise emissions based on the time of day. By adding this exception, the economic impact of the regulations is lessened by an amount equivalent to a 10 dB reduction in noise control requirements. New sources can design their operation and position their noisy equipment to meet the nighttime as well as the daytime limits.

Rule 209 Compliance Dates

Although the Regulation becomes effective 10 days after filing with the Secretary of State's Office, Part 2 becomes effective for existing noise emission sources only after a minimum period of 12 months and in certain cases only after 3 years. The delay in compliance allows industry to assess their particular noise emission situation and if not in compliance, to take such voluntary action as they may desire. It must be recognized that the field of noise pollution control, while practiced already by many industries, is new to some and thus time should be allowed for voluntary compliance rather than to allow the Agency immediate enforcement capabilities with respect to numerical limits for existing sources. New sources are in general required to comply immediately with the numerical regulations since noise control can be designed into the facility and does not have to be retrofitted. The compliance dates are based largely on specific problem areas testified to during the hearings and in some cases apply to both new and existing sources.

*26 Rule 209 (a) sets an immediate compliance date for most new sources since these sources have some flexibility of equipment location and operation so as to meet the noise limits. However, by Rules 209 (f), 209(g), 209(i), and 209(j), new sources with these particular noise problems are given delayed dates for compliance.

Rule 209 (b) sets a 12 month delay in complying with Part 2 for existing sources. It is felt that the 12-month delay will allow noise sources time to assess their problems and to take action as may be required. The record indicates the availability of consultants, noise control materials, and noise control techniques (EPA Exhibits 125, 126, 127). The time frame of one year seems to be reasonable based on the testimony of Dr. Dietrich (8/17/72 R. 278) that only 5 percent of business and industry in Illinois would not be able to comply with the daytime limits within a one year period. In addition, there is the information presented at the May 14, 1973 hearing (EPA Exhibits 148 k, 148 1) where a corn milling facility quieted many different noise sources using a variety of techniques so as to reduce the noise levels measured at the property line by as much as 26 dB. The program cost $132,000 for a $30,000,000 facility and was completed within a year. A longer delay in compliance for existing sources was not deemed necessary except for special cases covered by Rules 209(c) through 209(j).

Rule 209(c) allows an eighteen month delay in compliance with Rules 202-205 for low frequency noise emissions more than 10 dB above the numerical limits. The amount of noise reduction achieved with certain techniques depends on the frequency of the noise being attenuated. In particular, the transmission loss (sound decrease) afforded by walls is lower at low frequencies than at high frequencies (EPA Ex. 122) so that it is more difficult to control low frequency noise than high frequency noise using this technique. Therefore an extended delay in compliance is justified

Rule 209(d) allows an eighteen month delay for existing sources to comply with the impulsive noise regulation, Rule 206. Impulsive sounds, such as those from punch presses are more difficult to control at the source and are often emitted at high sound levels. In addition a penalty equivalent to 5 dBA is placed on these emissions so that additional reduction is required. For these reasons an additional delay in compliance is justified.

Rule 209(e) allows an eighteen month delay in compliance for existing sources which emit prominent discrete tones. Because of their extra annoyance potential these tones are regulated more strictly than broad band noise so that added noise reduction is required of the emitter. Thus a longer compliance delay is justified.

Rule 209(f) sets a 3 year delay in compliance for blasting noise from coal mining and mining and quarrying of non-metallic minerals. Testimony was received from mining interests that Examples of the application of these techniques to typical noise sources are given in EPA Exhibits 123 and 128, and are discussed in the following section of this opinion. The examples cover a wide range of noise emitters, including those frequently found in the property-line-noise-sources covered by this regulation.

Economic Reasonableness

*27 The Illinois Pollution Control Board, in adopting this regulation, determined that the sound levels approved are necessary to protect the people from unreasonable exposure to noise, which is both annoying and which interferes with communication and sleep. The Board also concludes that the record demonstrates the economic reasonableness of the regulation. This conclusion is based on the testimony at the 16 hearings held by the Board which developed a significant amount of data on the economic reasonableness of the Regulations, both as to the capability of limiting noise emissions from particular property-line-noise-sources, and also of abating or minimizing noise emissions from specific facilities, processes and equipment.

The record includes extensive input with respect to noise generated by utilities, manufacturing plants, oil refineries, mining, and forging sources, just to name a few. Additionally, the Agency has made a detailed analysis of specific noise sources, the methods of abatement and the costs incurred in their achievment (EPA Ex. 123, 128). The methods used

and the costs incurred can be extrapolated to virtually every source of noise emission and sustain the conclusion reached by the Board that the Regulations, in consideration of the demonstrated need for the numerical limits employed, the time available for compliance, the technology available and the demonstrated cost for achieving compliance, are both technologically feasible and economically reasonable.

Prior to a discussion particular to individual industries, a review of noise control costs is necessary. The Agency in Exhibits 123 and 128 presented case histories of 44 instances where significant noise reductions were achieved at low costs and include those typically found in property-line-noise-sources. The techniques employed included both modifying the noise emitter and shielding the noise from the receiver. The case histories range in complexity from controlling a single machine to controlling an entire complex and show the wide ranging noise control that has been and is being achieved. The following table summarizes the types of noises controlled, the costs for control and the results achieved (EPA Ex. 123, 128).

largely open on the sides to achieve good natural ventilation and it is admitted that by sealing up the plant the environmental noise can be abated (5/15/73 R. 125, 170). This could, however, increase the interior heat levels unless a forced ventilation system was installed. The 5 year plan by the forging association would result in compliance with the Illinois Noise Pollution Control Regulation (5/15/ R. 185). On examination, we learned that this noise program is an effort on the part of industry to deal with its total noise problems (5/15/73 R. 186), is funded, however, only at a rate of one fiftieth of one percent of the total capital investment of industry (ibid R. 195), that the 3 year r & d phase could be accelerated by 6 or 9 months by additional manpower (ibid, R. 196), and that the 2 year implementation period is an estimate which could be initiated before the 3 year r & d phase were over (ibid R. 199). The Board therefore concludes that the 3 year compliance delay is reasonable in light of the impact of forging noise on the citizens and on the possibilities for expedited results from this effort on the part of industry to solve its own problem.

***28** Rule 209(i) gives a two year delay in compliance to petroleum refineries. There are twelve refineries located in the State of Illinois of which Shell Oil, located in Wood River, provided the major industry input during these hearings. The Agency as a result of measurements of the 9 major refineries taken by its surveillance section concluded that 4 were presently in compliance and 5, including Shell, were out of compliance (EPA Ex. 155). The degree of noncompliance for Shell was as much as 24 dB for the 2000 and 4000 Hz octave bands while the others were from 5 to 13 dB out of compliance. The question of compliance was determined with respect to the nearest class A receiving land, that is, based on the most stringent land use. Shell's testimony was that it would take a minimum of 5 years for compliance (5/21/73 R. 76) due to the large number of noise sources to be controlled. The Shell refinery at Wood River is twice the size of any other refinery in the state and in fact until recently its capacity exceeded the total combined capacity of the other refineries in Illinois (5/21/73 R. 111). A delay in compliance for all refineries using the Shell information does not seem warranted based on its unusually large size, so that the two year delay, in recognition of the numbers of noise sources and their unshielded nature, is established.

Rule 209(j) allows a two year delay in compliance for automobile and motorcycle racing. The racing issue as far as the owners, racers and other enthusiasts were concerned did not surface until the very last hearings although there was significant input from citizens who complained about race track noise (over 15% of the total citizen witnesses who complained about specific nuisances). The Board recognizes that noise control has not been a concern of racing interests so that little has been done to develop noise control for motorized racing. For this reason an extended compliance date of two years will allow for this development and its application to racing. A lengthy discussion of racing appears later in this opinion.

Technical Feasibility of Noise Control

The Agency and Task Force in exhibits 122, 125 and 126 and at the November, 1972 hearings presented basic information on noise control techniques and noise control materials and their costs.

In controlling noise one can either quiet the source directly, block the noise transmission paths either at the source or at the point of reception, or protect the individual with devices such as ear plugs. For environmental noise control only the first two methods are suitable and while quieting the noise source directly is preferred, it is often not possible so that blocking the noise transmission path becomes the technique used in many instances.

In order to discuss noise control techniques it is first necessary to understand the means by which noise is transmitted. The noise emitting from a source eventually reaches the ear as pressure fluctuations in the air. These fluctuations may have travelled directly from the source through the air to the ear, or indirectly from a source then through a structure and finally through the air to the ear. For example vibrating machinery may transmit noise into the floor and to the walls, and then into the air from the walls and floor so that blocking just the direct airborne noise transmission would not reduce the noise being transmitted to the floor and walls and thence into the air.

***29** Materials used for noise control can be subdivided into four classes (EPA Ex. 125):
a) sound absorbing materials - porous materials that convert sound energy into heat

b) sound barriers - dense, limp masses that reflect most sound and transmit little sound

c) vibration isolation - resilient materials that do not transmit vibration

d) vibration damping - materials to inhibit vibrations.

These materials can then be used in four general classes of noise control systems.
a) mufflers and silencers - for gas flow silencing of fans, compressors or high pressure gas discharges

b) barriers - to block sound transmissions, for example partitions or enclosures

c) sound absorption - acoustical tile, curtains

d) vibration isolation - pads, cushions between source and structure to reduce structureborne sound transmission.

the impulsive blast noise can exceed 100 dBA and cannot be easily controlled. This testimony, the statement of the Illinois Aggregate Association at the November 9, 1972 hearing, is that they cannot operate without blasting and they cannot blast under the regulations--even when the receiving land use is Class C; since the C to C limit of Rule 206 is 65 dBA. It should be noted, however, that the current state of the art of blasting is unlikely to reflect much serious consideration of possible means to reduce environmental noise emissions, since their reduction has never before been required. For the same reason, the possibilities for fragmenting rock by other, quieter means have probably not received adequate study, although the use of blasting mats to contain the explosion of rock or dust in some situations may result in noise reductions. Also the acquisition of land to allow for atmospheric attenuation may be possible but can be expensive. Assuming, therefore, that no way is currently known for blasting operations to meet the noise emission limits, the fairest course of action for the Board is to set a compliance date for them, with respect to Rule 206 daytime limits, further in the future than the date for operations for which solutions are now known; e.g., three years from adoption of the regulations instead of the usual one year. This approach simultaneously recognizes the difficulties faced by the quarrying industry and avoids relieving it of all responsibility, which would be unfair to other industries.

Rule 209(g) gives a three year delay in compliance to the impact noise of railroad car coupling in railroad marshalling yards. Impact noise is one of the major annoyances associated with marshalling yards (10/11/72 R50) and because of the moving nature of the noise source, the couplers, as more and more cars are joined, localized noise reduction is restricted

to the couplers themselves. Another major source of annoyance, the retarders, are at fixed locations in the yard and so barriers or shields at the retarders can be used to reduce the noise. Thus for coupler noise the control techniques, such as cushioning materials, have to be developed for application to the source itself. Three years appears to be an adequate time to develop the technique.

*30 Rule 209(h) gives a three year delay in compliance to the impact noise of forging hammers. The Board received evidence from the forging industry as to the noisy nature of their operation at several of the hearings and also citizen testimony as to the annoyance caused by forging operations (see testimony of Horton - 11/11/72 and 5/14/73, Nance - 11/11/72, Ney, 5/21/73). The Forging Industry Association at the May 15, 1973 hearing asked for a 5 year compliance delay so that a 5 year plan, approved by industry one week earlier and consisting of 3 years of research and development and 2 years of implementation could be accomplished. The program will address both the in-plant noise problem and the environmental noise problem acknowledged by industry (5/15/73 R127, 128) and of ficially began in June 1973. Because of the heat generated, forge plants are

In order to analyze costs for compliance, it is convenient to put the various size transformers into three classes: distribution (pole, plus small and medium compartmental), small power (small and medium power), and large power.

Out of 14 distribution transformers measured, none violates the prominent discrete tone rule and one violates the C to A (daytime) rule so that the likelihood of non-compliance based on Edison's data is 7.1 per cent. In terms of the 337,000 distribution transformers in the Edison system, 7.1 percent or 24,100 might be in violation. Edison purchases about 22,000 of these types of transformers annually so that slightly more than 1 year's purchase of quieter transformers would result in 100 percent compliance.

The added cost to Edison to replace the distribution transformers is based on testimony and exhibits submitted by E. C. Edwards of Edison. The annual purchase cost for the 22,000 new transformers normally purchased is $13.8 million (6/23/72, Edwards Ex. C). To replace the 24,100 existing transformers that might be in violation with 6 dB quieter models at a cost increase of 27 percent (Edward's Exhibit C) would, therefore, cost Edison $19.2 million. And adding on labor costs claimed by Edison of $250 per transformer, the total cost to Edison to bring all distribution transformers into compliance is $25.2 million.

Two comments should be made concerning these distribution transformers. Firstly, Edison's own data does not show any of these transformers in violation of the prominent discrete tone rules. This successfully rebuts a major Edison argument concerning the rule and shows the accommodations that have been made to a complicated rule in an effort to weigh the benefits with the costs. Secondly, the cost figure of $25.2 million to achieve compliance is a significant reduction (89 percent) from the approximately $230 million cost claimed by Edison (Edward's Ex. C) and a more realistic figure, we believe, than the zero cost claimed by the Agency.

Turning now to the small power transformers, 3 units were tested of which none violates the prominent discrete tone rule and 1 violates the C to A daytime rules (the actual receiving land use for this case is not known). Using this data, as many as 1 out of 3 or 33 percent of the 5000 transformers may be in violation and again, using Exhibit C of the Edwards testimony, the added cost to replace the units with 6 dB quieter ones is approximately $14 million. The cost figure is based on an average per unit replacement cost, including labor, of $8400. It may well be cheaper to build barriers for noise attenuation of these transformers but we do not have sufficient information to make the calculation. For the large power transformers, barriers are significantly cheaper as will be shown next.

*31 Data from the large power transformers used in power substations and major distribution and switching sites shows that one of the four tested violates the prominent discrete tone rule, and another one violates the C to A daytime rule. On this basis, 50 percent of the large power transformers may require replacement or site modification in order to come into compliance. Edison bases its cost data on replacing every large transformer with a quiet unit and calculates a cost

for compliance of $192 million. The calculation is based on providing barriers for the 50 percent that may be in violation and the cost is reduced by over 95 percent.

The Agency in their Exhibits 123 and 128 presented case histories of 4 locations where transformer noise was reduced using barriers. At least three of the four sites contained transformers in the large power class, so the information is applicable to the present instance. The best example is the Baltimore Conastone site where six transformers were quieted in the neighborhood by 13 dB using concrete block barriers. The barrier is 500 feet long and 35 feet high and the total barrier cost, including firewalls, was $230,000 to shield transformers costing $2,600,000. The added cost to purchase quieter transformers would have been $390,000 so that a $230,000 barrier was the successful alternative to replacing the transformers with quieter units at a total cost of $2,990,000, a cost savings of 92.3 percent.

Using the information from Exhibits 123 and 128, the costs of barriers to reduce noise emissions from the large power transformers have been calculated. Exhibit G to the testimony of J.J. Quorollo of Edison lists approximately 1500 existing large power transformers, half of which would require noise attenuation according to Edison's data. If one assumes 3-sided barriers would be required for each transformer and, depending on the size of the transformer, sized the barriers accordingly, he would find barrier total costs per transformer varying between $3000 and $54,000 for transformers costing between $44,000 and $550,000 per unit, not including installation. Therefore, to quiet 50 percent of the large power transformers using barriers, would cost Edison $6,000,000, a cost reduction of 97 percent when compared to the Edison cost figure for transformer replacement of $192 million according to Quorollo's Exhibit G.

In summary, to bring every transformer site owned by Edison into compliance would cost approximately $45.2 million, which when compared to Edison's estimated cost of $492 million, represents a cost reduction of 91%.

Gas turbine peaking units are also a major cost item claimed by Edison. These units consist of electrical generators driven by gas turbine engines and emit noise primarily from the turbine intake and exhaust, and the turbine and generator themselves. Of the two major noise sources, the turbine inlet emits mainly high frequency noise while the exhaust emits mainly low frequency noise.

***32** Edison has 86 peaker units located at 9 sites within their system. Data for the Lombard (6 peakers) and Rockford Sabrooke (8 peakers) sites was presented at the June 23, 1972 hearing (Testimony of E.W. Lacey) but unfortunately was not measured at the receiving property. The Lombard data was projected to the south property line and shows sound levels in excess of the C/A daytime limits with the silencing. The south property line presently abuts a park (Fancher 5/7/73) so the receiving land would probably be Class A and therefore the Lombard site probably does not comply with the regulation. The Saybrooke site, if the contingency plan consisting of barriers is installed, would meet the C/A limits both at the property line and at the nearest residence. Without the barriers, the noise levels at the nearest residence would slightly exceed (by 2 or 3 dB at the low frequencies) the C/A limits at the nearest residence (Lacey Ex. E).

It is obvious that gas turbine peakers are noisy pieces of equipment and when located near populated areas would require noise attenuation. As for the 7 sites for which data is not available, one can only conjecture as to the necessity for abatement equipment. Edison costs for noise attenuation for their 36 peakers comes to $9.3 million (Lacey Ex. G) including additional silencing at the Sabrooke and Lombard sites. In terms of capital investment, the total direct cost to Edison for their peakers comes to $169.1 million so that the cost of silencing is approximately 5.5 percent.

The third major cost item cited by Edison is the reduction of noise from their eleven base load generating station locations. The major source of noise is the fans which supply combustion air to the furnaces. Data provided (Lacey Ex. F) shows the noise from fans at Joliet units 7 and 8 to comply with the C/A daytime regulations. These units have some noise attenuation and according to Edison, emit noise that is typical for fans at other locations (Lacey 6/23/73).

The costs of compliance for the generating stations are shown on Lacey exhibit H. The costs are based on the nighttime limits which do not now apply to existing sources. Therefore, the costs are lessened since 10 dB less attenuation is required to meet the daytime limits. A rough approximation of the costs based on the daytime limits can be obtained by eliminating all costs for the stations where the level of noise reduction required is less than or equal to 10 dB, since these sources would probably comply with the daytime limits. The costs for compliance for most other stations would be reduced since the level of control required is actually 10 dB less. By ratioing the costs of Exhibit H with the degree of control actually required according to Edison's exhibit and the regulation as adopted, we find actual costs to Edison to be $4.0 million as opposed to their figure of $10.2 millio

In summary, the costs to Edison to comply with the regulation have been reduced significantly due to the modifications made to the original proposed regulation and we feel justify the regulations as being economically reasonable.

Shell Oil Company

*33 The Shell Oil refinery located at Wood River is the largest refinery in the state. It abuts the community of South Roxana to the south and as a result, little noise attenuation through distance is available.

The refinery is a very large facility consisting of hundreds of noise producing sources such as furnaces, compressors and fans. Noise data taken around the plant boundary were used by Shell to estimate noise reductions required for various equipment to meet the regulations as proposed. The result was that compliance would barely be possible through an expenditure of up to $30 million and 6-10 years times ($10-14 million if just the major noise sources, furnaces and compressors, could be controlled sufficiently to meet the regulations).

The Agency response was in part to revise the proposed regulations, including the exemption of existing sources from the nighttime limits. The impact is to decrease Shell's anticipated costs and problems with compliance. In particular, Shell could probably comply by decreasing the noise coming from a small number of major sources such as furnaces (EPA Ex. 128), the techniques for which are technically feasible and just might consist of external barriers and mufflers. The cost would be significantly less than the minimum $10-14 million stated by Shell.

Shell suggested that the regulations should include a limit of 70 dBA at the property lines of the oil refineries in Illinois. Data submitted by the Agency indicate that the noise reduction required by Shell is not typical of other major oil refineries in the State (EPA Ex. 155). In addition, the reports submitted by Shell Oil Company during the November, 1972 hearings indicate that the mean noise level associated with complaints of noise from major oil refineries was approximately 56 dBA (11/10/72, Koopman testimony, Reference 5). Thus, a sound level limit of 70 dBA for oil refineries based on this report seems too permissive.

It has been suggested by Shell and others that the manufacturing class of land should be subdivided into two classes of industry: heavy and light, with refineries being classified as heavy. The limits adopted for Class C lands are already based upon heavy industry noise emissions using for comparison the sound level limits established by the City of Chicago (EPA Exhibit 1). In the future, it may be best to subdivide industry into two categories in order to impose more stringent limits upon light industry; however, until sufficient data and experience are available, it is best to allow light industry to emit sound levels that are controlled by limits established for heavy industry noise emissions.

Automobile and Motorcycle Racing

Automobile and motorcycle racing have presented several problems involving difficulties in reconciliation. A substantial number of citizen witnesses presented testimony that such activities, when located in or near residential areas, possessed serious noise nuisance attributes which interfered with sleep and conversation and generally affected the quality of life (R. 5/15/73 Pitelka, Gall, 5/21/73 Horrell, 6/23/72 Hoffman). In fact, over 15% of the complaints during the hearings

concerned noise from racetracks. Often those annoyances came from activities that were not subject to control by the present Regulation such as traffic to and from the racetrack and air pollution resulting from the exhausts of cars. However, more often, the noise complaint related to the noise being emitted from the racing itself, both from the automobile and motorcycle motors and from the loudspeakers that were used in conjunction with the racing activity.

*34 It is regrettable that the racing industry did not fully avail itself of the hearing process to make its position known to the Board. After the hearings were completed, the Board did receive several thousand letters and petitions, urging the Board not to "ban automobile and motorcycle racing in Illinois". This, of course, has never been the issue. The Board has neither the desire nor the jurisdiction to shut down any business in the State. The objective of the Board as to all activities covered by its Regulations, is to limit controls to those necessary to fulfill the Board's statutory mandate. The justification for the regulatory numbers employed has been discussed in detail previously. Accordingly, the objective in the control of any enterprise is to determine what controls can be imposed consistent with achieving the objective, and at the same time assure that compliance will not impose an unreasonable constraint, consistent with technological feasibility and economic reasonableness. For some racetracks located in remote and sparsely-populated areas, the proposed sound limits measured at the point of reception and not emission, should present little difficulty in compliance. For example, those located adjacent to agricultural or industrial property would only have to meet the C/C limit of 70 dBA and by Rule 201 (d) if the local authorities desire, could obtain permanent zoning to classes B or C. For others, located in built-up areas and in proximity to residential sections, compliance may represent a more difficult problem.

Contrary to other activities and industries where noise reduction is a primary objective, at motor racetracks both for participants and spectators, motor noise is deemed a necessity. While some limited efforts have been made to control it, complete elimination has never been sought or desired. In this context, we must accept the premise that a middle ground must be achieved in noise control from this source. On the one hand, we could give an across-the-board exemption of the numerical limits to motor racetracks as suggested by the Environmental Protection Agency, leaving them subject to control only by the nuisance provisions. On the other hand, we could have left motor tracks in the "B" use category as in the case of other sports activities which would have limited motor racing to the 55 dBA maximum inherent in the B/A regulation. Neither approach appeared realistic or appropriate.

To equate automobile and motorcycle racing to the noise limits imposed on other sports activities where noise is not a necessary ingredient and the sports activity itself is not the principal source of noise emissions seemed equally unrealistic. Instead, the Board chose a middle ground classifying auto and motorcycle racetracks as a "C" use and giving two years in which to comply. This treatment would equate automobile and motorcycle racing to industrial operations and provide it with the maximum noise emission rate possible provided by the Regulations. Also, in providing a two-year compliance date, the Board has given a substantial period for each track to analyze the regulations and determine first, whether or not it is in compliance and if not, what must be done to achieve compliance. To those for whom the time is too short or the limits too stringent, the variance route is available upon a showing of hardship.

*35 One communication received since the close of the hearings is a letter dated July 16, 1973 from the firm of Burditt & Calkins on behalf the Citizens for Illinois Motor Sports (CIMS) (Group Ex. 169). While opposing the application of the Regulation to motor racing in the form proposed at the time the letter was written, which classified motor racing as a "B" use and imposed a B/A limit essentially of 55 dBA, we assume the same objections would apply to the new treatment as a "C" use with a two-year compliance date. Indeed, such an attitude was indicated in the July 25, 1973 letter from the same firm.

While we recognize the views expressed in the letters are in opposition to the Regulation as adopted, the contents are of particular interest because they represent the only significant effort on the part of the industry to demonstrate the character of abatement methods that could be employed with a view of lessening noise emissions. These include walls or barriers, modifications of engines, the employment of mufflers and the concept of doming. While these methods were all alleged to be impractical or unduly expensive, they do demonstrate that technological feasibility is available and point

the way to areas of investigation we hope the motor racing industry will explore during the two-year period before the regulations become mandatory. Of particular interest is the Maryland experience commented on, where the erection of a 20 foot plywood wall produced a 5 dBA reduction at what does not appear to be an exorbitant cost. If plywood alone can produce such results, we would expect experimentation in more substantial materials to produce an even more dramatic result.

SAMUEL. T. LAWTON, GR. and GACOB D. DUMELLE

Footnotes

1 The Board acknowledges the valuable assistance rendered in this proceeding by Edward H. Hohman, Engineering Assistant to the Board.

1973 WL 7313 (Ill.Pol.Control.Bd.)

End of Document

© 2018 Thomson Reuters. No claim to original U S. Government Works.