inter-noise 83

POWER PLANT COAL CONVERSION NOISE ANALYSIS

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National energy policies and fuel cost increases have intensified consideration for using fuels other than petroleum in utility boilers. Coal is a prime candidate for replacing petroleum, especially in the United States because of its abundance and lower cost. However, when power plants having the capability to burn coal are located in populated areas, environmental noise impacts from unloading and handling coal are of concern to pollution control officials. Therefore, environmental impact assessments must demonstrate that noise control measures will be adequate to achieve environmental noise standards and that the new noise will not become a source of community annoyance. Techniques for evaluating environmental noise from coal handling, both for barge and train delivery systems, are discussed in this paper.

Environmental noise assessments generally include a comparison of the expected noise emissions with local limits and a comparison of current community ambient sound levels with the expected sound levels after the plant change is completed. Thus, coal conversion noise impacts represent incremental changes in community noise levels resulting from the expected coal handling operations. Methods for measuring existing ambient sound levels around operating power plants, which include both the noise from power plant operations and community generated noise from sources such as vehicular traffic, air conditioners and aircraft, are well documented [1, 2]. However, the literature contains virtually no comprehensive information of predicting noise from coal handling operations.

A coal handling equipment noise data base was obtained for equipment that can potentially impact the community, such as coal unloaders, transportation vehicles, coal pile management mobile equipment and coal transfer equipment. The sound emission characteristics of each source (Table 1) were obtained from several sources, including studies of coal unloaders at several power plants [3], utility industry reports [4] and guides [5], government regulations [6], and sound measurements of similar types of equipment at existing power plants [7]. The three environmental noise descriptors calculated from this data are: (a) short-term equivalent sound level (Leq), which can be used for comparing the noise emissions with local regulations; (b) long-term equivalent sound level, which can be used to calculate the day-night level (Ldn) for assessing community reaction, and (c) the maximum equivalent sound level which is the maximum level that would occur for short periods of less than one-hour. The three noise descriptors represent differences in the operating characteristics or duty cycle (temporal pattern) of each piece of equipment, which appear to be power plant specific.

The sound levels in the community from coal handling operations are calculated at specific locations by summing the noise emissions from each significant noise source operating at the power plant site. This was done using the coal handling equipment data base, the inverse square law for sound divergence, and the attenuation provided by local conditions such as barriers, trees or local meteorology [4]. The short-term equivalent sound level is equal to the sum of the maximum sound level from each piece of equipment modified by a "power factor" that represents the percent of time the equipment operates at full power (time at full power ÷ total time equipment operated). Similarly, the long-term equivalent sound level is calculated by modifying the short-term equivalent sound level by the "use factor" or percent of time the equipment actually operates during specific time periods (time equipment operates ÷ total time available).

Calculations of the three descriptors were made for both daytime (0700 - 2200 hours) and night-time (2200 - 0700 hours). Thus, the long-term equivalent sound level for a specific piece of equipment is defined as the following:

$$Leq = \sum [L(max) + 10 \log (\text{power factor}) + 10 \log (\text{use factor})] . \quad (1)$$

Previous studies [5, 8] have shown that this equation can be used to predict the equipment sound level from various types of construction activities. Since coal handling uses equipment that is similar to that used for construction activities, the equation for estimating long-term equivalent sound levels should also provide a reasonable prediction of expected coal handling sound levels in the community.

When the long-term equivalent sound level is calculated for both daytime and night-time coal handling operations, the day-night sound level can also be calculated as described in Reference 9. The expected community response to the estimated day-night sound level can be obtained from the data in Reference 10.

Using the above procedure, noise impacts were estimated for two large power plant (800–1000 MW) coal conversions: one receiving coal by barge and the other by random railcar delivery. At the plant using barge delivery, the coal handling sound emissions were calculated to range from 59-64 dB(A) at 180 meters from the barge depending on the noise abatement treatment selected. Coal handling noise at this plant will be emitted from three sources: coal barge unloader, transfer tower and breaker house. This plant does not have on-site coal storage, which would otherwise have been a major noise source. The maximum long-term and short-term equivalent sound levels were considered to be virtually equivalent, since coal unloading would occur throughout the day and there are no coal storage piles that require maintenance.

For the plant with railcar coal delivery, calculating the expected noise in the surrounding community was more complex, since several pieces of mobile equipment are needed to manage the active and storage coal piles. At this station, expected daytime equivalent sound levels in the surrounding community depended on the operating characteristics of the coal handling equipment. For example, the maximum community sound level from the proposed coal handling operations (Table 1), which is 150 meters from the rotary car dumper, would be 72 dB(A). The short-term equivalent sound level would be 65 dB(A) and the long-term level would be 62 dB(A). These estimated levels are site specific and are influenced by the equipment use and equipment location relative to the community.

In summary, the proposed procedure provided a basis for calculating & assessing the noise impact of proposed power plant coal conversion. Should the analyses have shown that expected emissions would cause a contravention of local laws or the expected incremental emissions adversely impact the community, the relative contribution of each noise source could have been determined and appropriate noise mitigating measures implemented.

REFERENCES

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[3] "Noise Assessment of Coal Handling Facilities," Stone & Webster Engineering Corp. (February 1980).

[4] "Electric Power Plant Environmental Guide", Edison Electric Institute (1978).

[5] "Power Plant Construction Noise Guide", Empire State Electric Energy Research Corp. (May 1977).

[6] "Background Document for Proposed Revision to Rail Carrier Noise Emission Regulations", U.S. Environmental Protection Agency Report 550/9-78-207 (February 1979)

[7] Consolidated Edison Company of New York Inc. Report 80125-1 (1980)

[8] Teplitzky & Alexander, "Noise Emissions From Underground Feeder Cable Construction", Proceedings of Inter-Noise 82 (1982).

[9] "Community Noise", U.S. Environmental Protection Agency Report NTID 300.3 (1971).

[10] "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety", U.S. Environmental Protection Agency Report 550/9-74-004 (1974).

TABLE 1

ESTIMATED EQUIVALENT SOUND LEVELS
FROM RANDOM COAL TRAIN DELIVERIES

Noise Source	Noise Emissions	Reference
Rotary Car Dumper	L_A = 96 - 21 log d*	3
Breaker House	L_A = 101 dB(A)**	4
Transfer Tower No. 1	L_W = 96 dB(A)**	4
Transfer Tower No. 2	L_W = 106 dB(A)**	4
Bulldozer	L_A = 85 dB(A) @ 15 m	5
Switch Locomotive	L_A = 85 dB(A) @ 15 m	8
Earth Mover	L_A = 87 dB(A) @ 15 m	5
Train Locomotive	L_A = 89 dB(A) @ 15 m	7

* d = distance, m

** Sound Power Level, dB, re: 10^{-12} watt