New Noise Impact Criteria for High Speed Ground Transportation Systems in the United States

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Abstract: New ambient based noise impact criteria have been developed by the U.S. Department of Transportation for the assessment of environmental impacts of high speed rail projects. Adoption of these criteria will assure a uniform treatment of noise impacts of new high speed rail systems throughout the country. The noise impact levels were developed based on well-documented criteria, and on comprehensive social survey data concerning annoyance due to transportation noise. Impact levels are based on the Schultz response curve and include consideration of the combination of project and ambient noise levels. Additional information is included to account for startle from fast rise times and effects on livestock and wildlife.

NOISE IMPACT CRITERIA

The noise impact criteria, shown in Figure 1, are intended for use on high speed ground transportation projects in the United States. The basic criteria are identical to the criteria developed for urban transit systems (1). Impact thresholds are defined by two curves which allow increasing project noise levels as ambient noise increases up to a point, beyond which impact is determined based on project noise alone. Below the lower curve, a proposed project is considered to have no noise impact since, on the average, the introduction of the project will result in an insignificant increase in the number of people highly annoyed by the new noise. The curve defining the onset of noise impact does not increase beyond 65 dB, a standard limit used by several U.S. government agencies for an acceptable living environment. Project noise above the upper curve is considered to cause Severe Impact since a significant percentage of people would be highly annoyed by the new noise. This curve flattens out at 75 dB, a level associated with an unacceptable living environment. Between the two curves, the proposed project is judged to have an impact, though not severe. In this region the change in cumulative noise level is noticeable to most people, but may not be sufficient to cause strong, adverse reactions from the community. At lower ambient noise levels, increases are limited to 10 dB and 15 dB for Impact and Severe Impact, respectively.

Three types of land uses are identified. Category 1 refers to lands where quiet is an essential element in their intended purpose, such as tracts of land set aside for serenity and quiet. $L_{eq}$ is the preferred descriptor here. Category 2 refers to buildings where people normally sleep, such as homes and hospitals, where nighttime sensitivity to noise is assumed to be of utmost importance. $L_{eq}$ is used. Category 3 refers to institutional land uses with primarily daytime activities. $L_{eq}$ during the hours of noise sensitivity is used. Note that the scale for this category includes a 5 dB offset from the other categories to compensate for reduced sensitivity of the land use.

It is important to emphasize that it is the increase in the cumulative noise -- when project is added to ambient -- that is the basis for the criteria. As the existing level of ambient noise increases, the allowable level of transportation noise also increases, but such that the cumulative amount of increase is reduced.

DEVELOPMENT

The noise criteria have been developed based on well-documented criteria and research into human response to community noise. The primary goals in developing these noise criteria were to ensure that
the impact limits be firmly founded in scientific studies, be realistically based on noise levels associated with high-speed rail projects, and represent a reasonable balance between community benefit and project costs.

The Noise Impact Criteria Curves are based on the following considerations:

- The Environmental Protection Agency (EPA) information that a community noise level of $L_{eq}$ less than or equal to 55 dBA is "requisite to protect public health and welfare with an adequate margin of safety".
- The Department of Housing and Urban Development definition of $L_{eq}$ 65 dBA as the onset of normally unacceptable noise.
- The conclusion by EPA and others that a 5 dB increase in $L_{eq}$ or $L_{we}$ is the minimum required for a change in community reaction.
- Schultz’ finding that there are very few people highly annoyed when the $L_{eq}$ is 50 dBA, and that an increase in $L_{eq}$ from 50 dBA to 55 dBA results in an average of 2 percent more people highly annoyed (2).

For the threshold curve, the change in noise level from an existing ambient level of 50 dBA to a cumulative level of 55 dBA caused by a project is assumed to be a minimal impact, considered to be the lowest threshold where impact starts to occur. Moreover, the 2 percent increment represents the minimum measurable change in community reaction. Thus the curve's hinge point is placed at a project noise level of 53 dBA and an existing ambient noise level of 50 dBA, the combination of which yields a cumulative level of 55 dBA. The remainder of the lower curve in Figure 1 was determined from the Schultz annoyance curve by allowing a fixed 2 percent increase in annoyance at other levels of existing ambient noise. As cumulative noise increases, it takes a smaller and smaller increment to attain the same 2 percent increase in highly annoyed people. While it takes a 5 dB noise increase to cause a 2 percent increase in highly annoyed people at an existing ambient noise level of 50 dB, an increase of only 1 dB causes the 2 percent increase of highly annoyed people at an existing ambient noise level of 70 dB. The upper curve delineating the onset of Severe Impact was developed in a similar manner, except that it was based on a total noise level corresponding to a higher degree of impact.

OTHER CONSIDERATIONS: STARTLE, EFFECTS ON WILDLIFE

The presence of a high-speed ground transportation system in close proximity to homes may result in a new noise unlike other existing sources of community noise. The sound signature at a position close to a high-speed train passby is characterized by sudden onset of high noise levels for a short duration. A typical time history from a high speed train can have the sound rising rapidly at 15 dB per second and falling again within a few seconds. Shorter trains, such as the two-car test train of the German TransRapid TR07, can have even faster onset rates and shorter durations. After questioning the application to guided surface transportation of research on startle from aircraft overflights, it was considered appropriate to include these effects as “additional information” in the impact assessment, rather than to include a penalty in the calculation of noise exposure itself.

Most studies of noise effects on wildlife have focused on identifying a noise level associated with disturbance effects, even if the type of noise event varied considerably from study to study. Many studies report levels in the vicinity of 100 dB as associated with an observable effect, without specifying which level metric is preferable. Until more definitive information on thresholds can be developed, an interim criterion of $SEL = 100$ dB will be used in the United States for disturbance by high-speed ground transportation.

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REFERENCES