

probability of a collision by at least 40 percent) in order to compensate for this 66.8 percent increase. For example, if a select group of 1,000 crossings is expected to have 100 collisions per year with train horns being sounded, this same group of crossings would be expected to have 167 collisions per year once the train horn is banned if no other safety measures are implemented and other factors remain unchanged. Conversely, if these same crossings were experiencing 167 collisions per year while the horn was banned, it would be expected that this number would reduce to 100 once use of the horn is re-instituted. This would equate to an effectiveness of 67/167, or .40.

FRA is aware this figure is an average, but it has the benefit of reflecting the broadest range of exposure available to the agency. FRA is willing to consider well founded arguments that train horn effectiveness is heightened or reduced under specific circumstances. However, any such argument would need to be grounded in sound data and analysis. This could potentially create significant difficulty in administration of the rule, since historic collision patterns over a small number of crossings are not, by themselves, meaningful predictors of future exposure.

Much of the data available today to evaluate the effectiveness of SSMs reflect the reduction in violation rates, not collision rates. (Collisions are rare, and determination of a collision rate reduction for any one SSM requires long term data collection.) Only one study (in Los Angeles) has contrasted collision rates with violation rates, and out of necessity (until additional data are available), this finding is used in these analyses. In the Los Angeles demonstration it was noted that a carefully administered and well publicized program of photo enforcement reduced violation rates by 92 percent, while collisions were reduced by only 72 percent. This ratio, 72:92 or .78, is being used to adjust violation rate reductions in order to estimate resultant reductions in collision rates for law enforcement, education/awareness and photo enforcement options described in Appendix B. Violations that result in collisions constitute a small subset of all violations. It is reasonable to infer that education and legal sanctions may lack effectiveness for several segments of the population, including those who do not become aware of the countermeasures (e.g., because they are not residents of the area, do not follow public affairs in the media, or are difficult to reach because they are not fluent in English or other principal languages in which

information is disseminated) and those who are particularly inclined to violation of traffic laws. As such, for law enforcement, education/awareness and photo enforcement options the rate of violations must be reduced 78 percent in order to determine the effectiveness value for the ASM.

In contrast, engineering improvements such as those described in Appendix A appear to work in synergy with existing warning systems to condition and modify motorist behavior, reducing both the number of violations and the number of very close calls (violations within a few seconds of the train's arrival). Four-quadrant gates installed to date, for instance, appear to have been almost completely successful in preventing collisions. Although we would not expect this extraordinarily high level of success to be sustained over a broader range of exposure, excellent results would be expected. Accordingly, for engineering improvements contained in Appendix A, this rule adopts estimates of success drawn from carefully monitored studies of individual crossings.

#### 1. Temporary Closure of a Public Highway-Rail Grade Crossing

This SSM has the advantage of obvious safety and thus will more than compensate for the lack of a locomotive horn during the periods of crossing closure. The required conditions for closure are intended to ensure that vehicles are not able to enter the crossing. In order to avoid driver confusion and uncertainty, the crossing must be closed during the same hours every day and may only be closed during one period each 24 hours. FRA believes that such consistency will avoid unnecessary automobile-to-automobile collisions in addition to avoiding collisions with trains. Activation and deactivation of the system is the responsibility of the public authority responsible for maintenance of the street or highway crossing the railroad. Responsibility for activation and deactivation of the system may be contracted to another party, however, the appropriate public authority shall remain fully responsible for compliance with the requirements of this section. In addition, the system must be tamper and vandal resistant to the same extent as other traffic control devices.

*Effectiveness:* Because an effective closure system prevents vehicle entrance onto the crossing, the probability of a collision with a train at the crossing is zero during the period the crossing is closed. Effectiveness would equal 1. However, traffic would need to be redistributed among adjacent

crossings or grade separations for the purpose of estimating risk following the silencing of train horns, unless the particular "closure" was accomplished by a grade separation.

#### 2. Four-Quadrant Gate System

A four-quadrant gate system involves the installation of gates at a public highway-rail grade crossing to fully block highway traffic from entering the crossing when the gates are lowered. This system includes at least one gate for each direction of traffic on each approach. A four quadrant gate system is meant to prevent a motorist from entering the oncoming lane of traffic to avoid a fully lowered gate in the motorist's lane of traffic. Because an additional gate would also be fully lowered in the other lane of the road, the motorist would be fully blocked from entering the crossing.

FRA is requiring that all four-quadrant gate systems conform to the standards contained in Part 8, Section D.05 ("Four-Quadrant Gate Systems") of the MUTCD. These standards were added by FHWA to the MUTCD subsequent to publication of the NPRM. Because four quadrant gates would be used at crossing where horns are not sounded, FRA is requiring the following in addition to the MUTCD requirements.

a. When a train is approaching, all highway approach and exit lanes on both sides of the highway-rail crossing must be spanned by gates, thus denying to the highway user the option of circumventing the conventional approach lane gates by switching into the opposing (oncoming) traffic lane in order to enter the crossing and cross the tracks.

b. Crossing warning systems must be activated by use of constant warning time devices unless existing conditions at the crossing would prevent the proper operation of the constant warning time devices. FRA has been made aware that constant warning devices may not work properly under certain circumstance such as in electrified territory. If conditions exist that would not allow constant warning time systems to work as intended, other appropriate types of control circuitry may be used. Constant warning time devices are not required to be added to existing warning systems in Pre-Rule Quiet Zones. However, if warning systems in Pre-Rule Quiet Zones are upgraded, or new warning systems are installed, constant warning time devices are required.

c. Crossing warning systems must be equipped with power-out indicators. Power-out indicators are not required to be added to existing warning systems in Pre-Rule Quiet Zones. However, if