Appendix II

Status of Current Programs

A. Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)

Most of the funds for crossing improvements come through the Federal Highway Administration (FHWA). In 1973, Congress established and funded a categorical Highway Trust Fund program for improving highway-rail crossing safety. The crossing safety program has been funded continuously since then. Most recently, through passage of the ISTEA, the Congress authorized to states over $3.4 billion in Fiscal Year (FY) 1992 and nearly $4.1 billion per year for surface transportation programs in FYs 1993 through 1997. Of this amount, ten percent is set aside for safety programs, including crossing safety.

1. ISTEA, Section 1007

Of the ten percent set-aside for safety programs, states must spend $149 million on highway-rail crossing improvements. At least 50 percent of these funds must be spent on the installation or upgrading of warning devices, and the remainder may be spent on additional warning devices or on other means of eliminating crossing hazards. The specific amounts received by each state are determined by a Congressionally mandated formula which considers the number of crossings, highway route miles, geographical area and population. (Significantly, the numbers of crossing accidents and casualties do not enter into this formula.) States also receive over $116 million in the set-aside amount which can be spent on hazard elimination at crossings or on highways. Optional amounts for each state range from $0 to $10.6 million.

All public highway-rail crossings are eligible. Projects may include the installation of train-activated warning devices (traditional lights and/or gates), signs and pavement markings, crossing closures, signal circuit upgrades, illumination (street lights), crossing surfaces, the building of grade separations (bridges), sight-distance improvements and other highway approach modifications.

2. ISTEA, Section 1010

This section authorized $30 million over six years for the elimination of hazards at both public and private highway crossings in up to five high speed corridors. The five corridors include: The Northwest (Vancouver, British Columbia to Eugene, Oregon via Seattle and Portland); California (San Diego to the Bay Area via Los Angeles and the San Joaquin Valley with a connection to Sacramento); Chicago (with spokes to Milwaukee, St. Louis and Detroit); Florida (Tampa to Miami via Orlando); and the Mid-Atlantic (Washington to Charlotte, North Carolina via Richmond).

Corridor	**Length in Kilometers (miles)**	**Estimated Number of Crossings**
California	1,054 (655)	600
Chicago Hub	1,041 (647)	815
MidAtlantic	769 (478)	585
Northwest	747 (464)	475
Florida	576 (358)	315

The initial $5 million has been obligated and the second year funding requests are under review by FRA and FHWA. States are developing long range plans for treatment of corridor crossings and initiating projects to specific crossings. Projects being undertaken involve both existing and advanced technologies. For example, four quadrant gates will be installed and evaluated, as will an arrestor net system designed to safely restrain vehicles from entering the crossing when a train is approaching.

Two other high speed rail corridors exist or are being developed under other authorities. These include completion of the Northeast Corridor from New York City to Boston, MA and the Empire Corridor from New York City to Schenectady, NY via Albany, NY.

3. ISTEA, Section 1036

Section 1036(c) calls for a technology demonstration program which will facilitate the establishment of high-speed rail service. Of four

projects selected for demonstration to-date, three address highway-rail crossings. These are:

Installation of an obstacle detection system with four-quadrant gates at a highway-rail crossing. The Connecticut Department of Transportation will demonstrate an advanced crossing protection system using four-quadrant gates with a transponder-based system which will detect an obstacle between the gates and will notify the locomotive engineer should the warning devices not work or if the crossing is blocked, enabling the train to stop in time to avoid an accident. Two or three Amtrak locomotives will be retro-fitted with the necessary cab signals to receive signals from the new vehicle detection system. The new system will overlay the existing warning system and will relay information to the engineer via cab signals.

A consortium of four firms, a university and Virginia's Center for Innovative Technology will demonstrate a "friendly mobile barrier" (FMB). The FMB is a crash attenuation device that rises from a vault in the roadway behind crossing gates after the gates have come down. The FMB will block access to the tracks for approaching highway vehicles and will stop a passenger car or light truck while averting both fatal injury to occupants and damage to the barrier. The FMB will also prevent a large truck from gaining access to the tracks at truck speeds up to 80 kph (50 mph), though damage to both the truck and barrier could be severe.

The Florida Department of Transportation (FL DOT) will demonstrate a low cost grade separation structure and process. Total cost and time of construction is expected to be approximately fifty percent less than the time and cost of a traditional pile supported, concrete wall and beamed structure. The proposed structure will use either a culvert style approach or "two vertical walls of reinforced concrete covered by a deck (to be designed by the FL DOT)." The FL DOT will "compete" the options.

4. ISTEA, Section 1072

Section 1072 requires the Department to coordinate field testing of a Vehicle Proximity Alert System (VPAS) to determine feasibility for use by priority vehicles (emergency, police, school buses, hazmat) as an effective highway-rail grade crossing safety device. A special public announcement on 26 July 1993 solicited information for any existing designs for possible test and evaluation (T&E). Eleven formal responses involving different technologies were received and evaluated. Four systems, representing three basic design concepts, were tentatively selected.

The current program effort is to provide a test site(s) (currently the Pueblo Transportation Test Center), test plan, data collection and evaluation for the selected systems that have operational prototypes. The test and evaluation will include a representative design from each of the three design concepts. Those systems that successfully pass initial testing and have promise will receive a thorough field operational evaluation to verify the reliability and overall performance in real-life conditions.

The cost for testing and evaluation should be under $1,000,000, and FHWA has identified approximately $1,000,000 of IVHS (Intelligent Vehicle Highway System) funds which have been transferred to VPAS for the T&E effort. The FRA Office of Railroad Development (High Speed Rail Corridor Project) will have funds available in FY 1995 to help support the T&E effort.

5. ISTEA, Section 1077

Section 1077 required revision of the Manual on Uniform Traffic Control Devices (MUTCD) to grant states and local governments the discretionary authority to install STOP or YIELD signs at any highway-rail grade crossing without automatic traffic control devices with two or more trains operating across the highway-rail grade crossing per day. To implement Section 1077 the FHWA published on November 6, 1992 a Final Rule 92-11 in the Federal Register (57 FR 53029). This Final Rule incorporated standards into Section 8B-9 of the MUTCD.

The rule was effective upon issuance. In addition, on December 30, 1992, the FHWA issued an interpretation which defined "two or more trains a day" to mean: an average of two or more trains operating over the crossing each day for a period of one year prior to the installation of the STOP or YIELD control sign.

FRA and FHWA have developed a list of considerations to assist in the selection of crossings where it would be most appropriate to install such signs first. We have encouraged states, communities and railroads to develop a rational program for the installation of STOP or YIELD signs.

The following factors are suggested for consideration when reviewing a crossing for possible STOP or YIELD sign installation:

a. Will local law enforcement officials enforce the traffic control message?;

b. Volume, type and speed of highway traffic;

c. Frequency, type and speed of trains;

d. Number of tracks and the intersection angles;

e. Adequacy of stopping sight distances;

f. Need for more active control devices; and

g. Crossing accident history.

Crossings which should be considered first for STOP sign installations should be those where most of the following factors are met:

a. Local and/or state police and judicial officials will commit to a continuing program of enforcement.

b. The highway is secondary in character with low traffic counts. Recommended maximum of 400 Annual Average Daily Traffic (AADT) in rural areas, and 1,500 AADT in urban areas.

c. Highway traffic mix includes buses, hazardous materials carriers and/or large (trash or earth moving) equipment.

d. Train speeds exceed 30 mph and/or train movements are 10 or more per day, 5 or more days per week.

e. Rail line is used by passenger trains and/or a significant incidence of hazardous material lading.

f. Crossing is multiple track and/or approach is at a skewed (other than 90 degree) angle.

g. The line of sight from an approaching highway vehicle to an approaching train is restricted.

h. Installation of a STOP sign would not occasion a more dangerous situation than would exist with a YIELD sign.

STOP or YIELD signs shall not be used at crossings with active traffic control devices. STOP AHEAD or YIELD AHEAD Advance Warning Signs should also be installed. The placement of a STOP or YIELD Sign at a crossing shall conform to the requirements of MUTCD Section 2B-9 Location of STOP Sign and YIELD Sign.

The FRA has developed software and made available lists which group "passive" crossings, i.e., those without active warning devices, into categories based on information taken from the U.S. DOT/AAR (Department of Transportation / Association of American Railroads) National Highway-Rail Crossing Inventory and the objective criteria from the foregoing factors. The top categories include those crossings which should be reviewed and considered first for STOP signs (i.e., those most likely to realize a safety benefit). Several states and railroads have acquired these listings.

B. High Speed Rail

The FRA's Office of Safety has established guidelines for crossings on high speed rail corridors.

If rail speeds are to exceed 200 kph (125 mph), no at-grade (level) crossings, public or private, will be permitted across the rail right-of-way. All crossings in such high speed rail corridors must be closed or grade separated (a bridge built).

1. Public Crossings:

Where trains will be operating at speeds between 176 and 200 kph highway-rail crossings must be equipped with impenetrable barriers capable of precluding intrusion onto an operating track, i.e, stopping highway vehicles short of fouling the operating track(s). Such a barrier must be operated in conjunction with intrusion detection and train stop technology. This implies track circuits of sufficient length that logic circuitry can verify and communicate to the locomotive that: 1) the barriers are closed; and, 2) the crossing is clear of vehicles, while the train is still a sufficient distance from the crossing that a full service brake application (non emergency) would bring the train to a stop before reaching the crossing if either indicator was not favorable. (See requirement for "grade crossing **protection**" in the context of operating speeds above 110 mph (49 CFR 213.9(c)).)

In this context, the term "grade crossing **protection**" is separate and distinct from conventional "warning devices." Warning devices, which are defined by the Manual on Uniform Traffic Control Devices (MUTCD), are intended to warn motorists of the presence of a crossing and of impending rail activities for the purpose of highway traffic control at and over the crossing. Concerns for the safety of the motorist and the efficiency of highway traffic flow are the motivating factors, and the FHWA has taken the lead in establishing requisite standards. However, these concerns pale in comparison to concern for the safety of the rail operation (for passengers, crews and trains) where rail speeds exceed 176 kph.

Conventional warning devices do not **protect** the integrity or safety of the rail movement at any speed, and this failure would be catastrophic at speeds above 176 kph. Thus, "protection" is defined to mean an effective barrier, i.e., one which precludes intrusion onto the rail right-of-way. The closest parallel to this situation currently addressed within the MUTCD is the reference to "resistance gates" for closing roads on approaches to movable bridges. See MUTCD Section 4E-13. The role of "highway traffic control" in such a setting is to alert the highway vehicle driver that an obstruction or barricade lies ahead, i.e., that the road is temporarily closed. The MUTCD currently defines the necessary elements for properly closing and/or barricading a road.

For new service on designated corridors at or above 128 kph (80 mph) to 176 kph, FRA's guidelines call for the conduct of a corridor analysis leading to elimination of not less than 25% (50% as the target) of crossings, with separation or active warning devices, to include gates, at the remainder. Constant warning time upgrades would be required, where not present. As warranted at selected crossings, encourage use of median barriers, special signing (e.g., active advance) and/or four quadrant gates.

If lightweight train sets are introduced, additional protection might be required for rail movements.

2. Private Crossings:

Should be individually analyzed, closed as warranted, and at a minimum subject to manual gates (normal position being closed and locked), and safety measures comparable to public crossings in the same corridor.

For train speeds from 176 to 200 kph, accidental intrusion on the rail right-of-way must be absolutely precluded. This means that private crossings must be equipped with locked gates linked to the train signal and control system, along with telephones and a fail safe vehicle (obstruction) detection at the crossing. Gates should be substantially constructed, i.e., able to absorb a moderate speed collision from vehicles likely to be using the crossings without fracturing. If the gate/barrier is opened (e.g., to accommodate an emergency) it can not be done until track clearance has been received from the railroad and trains in the territory have been advised.

Where passenger trains are scheduled to operate at speeds from 128 to 176 kph, private crossings should either be closed, grade separated, provided with a secured barrier, or equipped with automatic visual and audible traffic control devices which provide a minimum of 20

seconds warning of the impending presence of a train to users of the crossing. The traffic control device should include a full barrier gate system (covering all lanes, approach and exit) on each side of the rail right-of-way. The barrier (gate) will normally be closed (down) and will open on request (manually or automatically), if no train is approaching, for a period of time sufficient for the crossing user to negotiate the crossing.

Rail Speed KPH (MPH)	Public Crossings	Private Crossings
128 (80) to 176 (110)	Eliminate all redundant or unnecessary crossings. Install most sophisticated traffic control/warning devices compatible with the location, e.g., median barriers, special signing (possibly active advance warning), four-quadrant gates. Automated devices should be equipped with constant warning time equipment.	Closed, grade separated, provided with a secured barrier or equipped with automatic devices. Device or barrier should extend across the entire highway on both sides of the track, should normally be closed and opened on request, if no train is approaching, for a period of time sufficient to cross the track(s).
177 (111) to 200 (125)	Protect rail movement with full width barriers capable of absorbing impact of highway vehicle. Include a fail safe vehicle detection capability between barriers. Notify approaching trains of warning device or barrier failure or of an intruding vehicle in sufficient time for the train to stop short of the crossing without resorting to emergency brake application.	Protect rail movement with full width barrier or gate, normally closed and locked, capable of absorbing impact of a highway vehicle. Gate lock or control should be interlocked with train signal and control system and released by a railroad dispatcher. A fail safe vehicle detection or video system should monitor the area between the barriers. The crossing should be equipped with a direct link telephone to the railroad dispatcher.
Above 200 (125)	Close or grade separate all highway-rail crossings.	Close or grade separate all highway-rail crossings.

C. Light Rail

Many metropolitan areas are addressing transportation needs by establishing light rail transit systems or reestablishing street cars or trolleys. Light rail transit systems currently exist in eighteen cities in the United States and Canada. New operations often share existing streets with highway traffic. Sometimes they use medians or closely parallel existing streets; operate in exclusive rights-of-way; or share a right-of-way, and sometimes track, with conventional rail operations. In some instances, light rail transit systems may employ a combination of these scenarios.

Most systems have some grade crossings. Not surprisingly these corridors generate relatively large numbers of crossing and pedestrian incidents and casualties. New operations have quickly discovered that the most prevalent safety problem, and the one that draws the most public concern, is light rail versus motor vehicle collisions.

Some communities have operated light rail and commuter rail systems for many years, e.g., New Jersey Transit and San Francisco MUNI. Newer systems are experiencing grade crossing accidents and increasing public concern as a result of these incidents. Most of these accidents are not the result of unsafe operation of the rail vehicle, but rather a lack of education about the dangers of attempting to cross the tracks while a rail vehicle is approaching. The cultural diversity of the surrounding community, language barriers and the unfamiliarity with living in an environment with light rail vehicles at grade crossings also have an impact on the number of grade crossing accidents.

1. Metro Blue Line Grade Crossing Safety Program

In the three years since the opening of the Los Angeles Metro Blue Line (MBL), a 22 mile light rail system, there have been 182 train-vehicle and 24 train-pedestrian collisions resulting in 16 fatalities and numerous injuries (as reported through June 1993). There are 100 grade crossings on the MBL. Officials from the Los Angeles County Metropolitan Transportation Authority (MTA) are taking an aggressive and innovative approach to finding solutions.

The MBL Grade Crossing Safety Program was initiated in March 1993 to evaluate various means to discourage or prevent illegal movements being made by motor vehicles at grade crossings that are causing train-vehicle accidents. While the program is focused primarily on evaluating measures to decrease train-vehicle accidents, the safety program is also concerned with improvements that will reduce train-pedestrian accidents.

The MTA is seeking to apply innovative equipment and safety methods developed for street and highway traffic applications. These engineering improvements will address the unique characteristics of grade crossings and improve public safety. The program includes four elements:

Enforcement using sheriff's deputies and photo enforcement systems.

Engineering improvements including use of Intelligent Vehicle Highway Systems (IVHS) technology, warning devices, street and traffic signal improvements.

Legislation to establish higher fines and statewide rail safety educational programs.

Bilingual public information and safety education.

The photo enforcement program has been extremely successful in terms of reducing the numbers of motorists who are violating grade crossings. Over a four month period, a photo enforcement demonstration project resulted in an 84 percent reduction in the number of violations occurring at two targeted crossings.

Their efforts are worthy of emulation, as they have had success in reducing accidents.

The FTA, in collaboration with the FHWA and FRA, provided funding to the MTA to test and evaluate technologies that will support the enforcement of traffic laws and decrease the frequency of grade crossing violations and accidents.

2. Integration of Light Rail into City Streets

Through the Transit Cooperative Research Program (TCRP), the FTA funded a research project to improve the safety of light rail operations in shared rights-of-way and to provide guidelines that may be used in updating the Manual on Uniform Traffic Control Devices (MUTCD).

Korve Engineering, Inc. of Oakland, California is the recipient of a $250,000 TCRP contract to (1) identify problems and potential solutions, and (2) conduct in-depth behavioral analysis of the most significant issues that impact integration of light rail transit into city streets. The anticipated products from this project are (1) identification of methods now in use to mitigate hazards of light rail transit operations, (2) calculation of measures of effectiveness, (3) recommendations for additions to the MUTCD,

(4) demonstration of at least one proposed technique to improve safety, and (5) recommendations for future research.

Using a hazard analysis approach, the project will identify the most effective control devices, public education techniques and enforcement techniques to improve safety for rail passengers, motorists and pedestrians. The project will identify the most promising techniques to address problems such as:

Lack of pedestrian awareness of approaching light rail vehicles.

Unsafe pedestrian activity in close proximity to tracks, stations and intersections.

Motor vehicles operating parallel to light rail tracks turning into the path of light rail vehicles.

Failure of motor vehicles to yield right-of-way to light rail vehicles at street crossings.

Motor vehicles obstructing tracks.

Motor vehicles driving around closed railroad gates.

Nonstandard crossing configurations (e.g., light rail vehicles that turn in intersections, skewed intersections).

Techniques to be analyzed will include passive and active signs; traffic signalization (including light rail indications); pavement marking, texturing and striping; geometric improvements; channelization; audible warning devices (bells, whistles, horns, etc.); intersection illumination; illumination and marking of light rail vehicles for better nighttime visibility; moveable traffic barriers; application of advanced technology; enforcement; and education.

An additional objective is to provide material for possible use in the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD addresses traffic control for highway-rail crossings, but light rail vehicles interact with motor vehicles and pedestrian traffic in more complex ways than do traditional railroads.

3. State Safety Oversight

Section 28 of the Federal Transit Act, as amended (FT Act) directs the FTA to issue a rule requiring states to oversee the safety of rail fixed guideway systems not regulated by the FRA. A Notice of Proposed Rule Making (NPRM) was published in the Federal Register on December 9, 1993. The NPRM proposes the FTA's State Safety Oversight Program, which should improve the safety of light rail fixed guideway systems.

Section 28 requires each state to designate a state oversight agency to be responsible for overseeing the rail fixed guideway system's safety practices. FTA may withhold Federal funds if a state fails to implement the oversight program.

More specifically, the statute describes the responsibilities of the state, the agency the state designates to provide oversight, and the type of activities the agency is expected to carry out. In most instances, this entity will be an agency of the state because most rail fixed guideway systems operate only in one state. Where a rail fixed guideway system operates in more than one state, however, the statute permits the affected states to designate any entity, other than the transit agency itself, to oversee that rail fixed guideway system.

D. Crossing Consolidation and Closure

A March 4, 1993 memorandum from FHWA's Associate Administrator for Safety and System Applications to the FHWA Regional Administrators provided direction: "When considering [highway-rail crossing] improvement options, the ultimate solution to train-vehicle collisions is to eliminate the crossing by constructing a grade separation or closing the crossing. ... In addition to considering the closure of unnecessary grade crossings, states and local communities should make every effort to minimize the number of new crossings." Implementation is left to the FHWA Region and Division offices working with FRA Region offices.

FRA has an ongoing project designed to encourage railroads and state transportation agencies to consolidate and close unnecessary crossings. Case studies of two dozen crossing consolidation and closure projects were prepared. The case studies highlight effective strategies that have been used to consolidate crossings, and the lessons that can be learned from unsuccessful closure projects. Case studies were selected to reflect the diversity of state law on the subject of crossing closure and the range of crossing consolidation experience on freight and commuter railroads in rural and urban areas.

In February 1993, Operation Lifesaver, Inc. (OLI) subscribed to the general notion of closing crossings for safety: "To enhance highway-rail grade crossing safety, Operation Lifesaver, Inc. endorses the concept of reducing the number of crossings through consolidation, elimination, grade separation and restricting the number of new crossings." Several state level OL programs are promoting crossing closure.

The Association of American Railroads (AAR) and the American Association of State Highway and Transportation Officials (AASHTO), working through the National Conference of State Rail Officials (NCSRO), have established an ad hoc committee to address the promotion of crossing closure programs. Both the FHWA and FRA are supporting this effort co-chaired by individuals from the Iowa Department of Transportation and the Union Pacific Railroad. The goal is to publish a report outlining the rationale for crossing closure, a compendium of state laws regarding crossing closures and openings, a series of "provisions" that might be incorporated in new state legislation to promote closures and limit openings (selection of provisions would depend on the structure of state government) and to provide some tools to promote progress (e.g., procedures, pamphlets, possibly a video). The committee is promoting a study by the National Cooperative Highway Research Program (NCHRP) to develop an analytical procedure for assessing a group of crossings (a corridor) and developing criteria for weighing the pros and cons of closing specific crossings within the group.

In August 1993, at the annual NCSRO meeting, the Safety Committee proposed a resolution which was positively received, to wit, that cash incentives to local governments for crossing closure should be permitted (at state discretion) from the Federally funded (Highway Trust Fund) crossing safety improvement program. Such a provision would have to be sanctioned by Congress. As proposed by NCSRO, the local jurisdiction receiving these funds would have complete latitude in their use. However, they could be used for some items or indirect costs which cannot be paid with Federal funds. Examples from FRA's case studies include landscaping and the extension of a water line to a new fire hydrant necessitated by the closure.

This resolution has been approved by both NCSRO and AASHTO state officers and was formally forwarded to the Department by AASHTO on May 12, 1994.

The FHWA will currently allow Federal funds to be used for purchasing a property "right" from a private entity for public purposes, but has not extended that allowance to a public entity.

Such a program will be needed, if not for all railroads' right-of-way, at least for high speed corridors.

Several railroads have established their own programs to promote crossing closure. Burlington Northern Railroad (BN), Conrail (CR), CSX Transportation (CSX), Norfolk Southern Corporation (NS) and Union Pacific Railroad (UP) are examples. They use different approaches, each with varying success, but learning as they go. For example, in Florida, CSX, "which represents 60 percent of the rail mileage in Florida, has agreed to be the applicant on crossing closures on their system, pay 100 per cent of the cost of closure and share the costs associated with roadway improvements required as a result of the crossing closure."[1] UP is working through their OL presenters and is willing to match the Nebraska cash incentive for local communities. (UP and BN have both agreed to match state incentive payments in Missouri as well, if the state approves a program.)

The legislatures of Kentucky, Missouri and Illinois have each recently enacted crossing closure initiatives. Missouri and Illinois have tasked rail offices in their respective states with studying the closure alternative. In the case of Missouri, the Missouri Division of Transportation has reported back and recommended a crossing closure plan describing both procedures and funding.[2] In Illinois, they are to publish specific criteria which will be considered when weighing the retention of an existing crossing or the opening of a new crossing. Authority to close crossings is (and was) vested in the Illinois Commerce Commission. In Kentucky, the Transportation Cabinet has been given the authority to close crossings used by less than 4,000 vehicles per day. The existence of this authority has led to many cooperative (between local communities, the Commonwealth and the railroads) ventures resulting in the closing of several crossings. The Cabinet has not yet had to exercise the "authority" in order to consummate a project. Florida DOT "discourages the opening of new public grade crossings." In fact, Florida's Secretary of Transportation has placed a moratorium on new at-grade crossings on Florida's Section 1010 corridor.[3]

Currently, there are no Federal restrictions or standards on how many or what types of crossings should be consolidated within a given area. However, some jurisdictions have found the following criteria useful for selecting crossings for consolidation:

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[1] Report to the Governor and the 1994 Florida Legislature on the Safety and Security of Railroad-Highway Grade Crossings, January 21, 1994, page 12.

[2] Executive Summary of the Missouri Grade Crossing Closure Study, Missouri Division of Transportation Staff, January, 1994.

[3] Florida Report, page 11.

1. Consolidate crossings where there are more than four per mile in urban areas, and one per mile in rural areas and an alternate route is available;

2. Consolidate crossings which have fewer than 2,000 vehicles per day and more than two trains per day and an alternate route is available;

3. Eliminate crossings where the road crosses the tracks at a skewed angle or where the track is curved;

4. Link construction work with eliminations. This linkage will be especially important when upgrading rail corridors for high speed trains;

5. When improving one crossing (by grade-separation or installation of automated warning devices), consider eliminating adjacent crossings and rerouting traffic from these crossings to the improved crossing;

6. For every new crossing built, consolidate traffic from two or three other crossings; and

7. Eliminate complex crossings where it is difficult to provide adequate warning devices or which have severe operating problems (e.g., multiple tracks, extensive switching operations, long periods blocked, etc.).

Before consolidation, identify alternate routes for ambulances, fire, and other emergency vehicles. Past experience shows that even when communities support crossing consolidation, they may oppose proposed changes in traffic patterns. In these cases, "trade-offs," such as upgrading other crossings in the area of the targeted closure, have been successful.

When set against the backdrop of current high speed rail proposals, all this is particularly timely. Crossings are the major impediment to the realization of true wide spread high speed rail operations, both passenger and intermodal, in this country. The crossing problem must be solved, or we will not realize full potential. Consolidating crossings is the safest and only long term solution. The momentum which now exists must be nurtured.

E. Corridor Reviews

For the last 20 years, states have been able to identify and improve many hazardous highway-rail crossings, most often by installing train-activated warning devices with Federal-aid highway safety funds. Today, many of the most

hazardous crossings have been improved. There is some concern, however, that too little attention has been paid to the less expensive safety improvements that are needed at a far greater number of crossings, including private crossings.

Under the current program, low-volume crossings are seldom reviewed by diagnostic teams and any work done at these crossings is usually limited to the installation of passive warning devices. Statistics show that more than half of the fatalities resulting from highway-rail crossing accidents occur at low-volume crossings where active warning devices may never be installed.

Actions have been taken over the years to encourage states to expand their programs to encompass significantly more crossings each year and emphasize low-cost improvements at crossings not often addressed by diagnostic teams. In a June 1983 memo, the FHWA's Office of Highway Safety urged its field offices to encourage states to consider a number of low-cost projects that had the potential to improve safety at crossings without active warning devices. Such projects included: (1) Vegetation clearing and other means of improving sight distance; (2) installing standard signs and pavement markings; (3) improving roadway approach grades and alignment; (4) improving crossing surfaces, and (5) closing unnecessary crossings.

It was pointed out that these low-cost improvements could frequently best be carried out if all the crossings along a railroad corridor or in a given area, such as an urban area or a highway district, were analyzed at the same time for possible improvement. This method of analyzing crossings is especially important in determining which crossings can be closed. The memo further pointed out that Federal-aid highway funds are eligible for making improvements in these corridors even if every crossing in the corridor does not appear on the state's high priority list of crossings.

In 1986, the FHWA published a report titled Demonstration Project No. 70, Railroad Crossing Corridor Improvements, which presented a model program combining the benefits of individual high-risk crossing programs with those of a corridor approach. The report also spelled out specific aspects of a corridor approach that should be emphasized to maximize a state's crossing safety effort.

In March 1993, FHWA's Associate Administrator for Safety and System Applications issued a memo reminding FHWA field offices that the ultimate solution to train-vehicle collisions is to eliminate crossings by constructing grade separations or closing the crossings. Again, these are the types of actions that can best be analyzed by looking at numerous adjacent crossings in a corridor or systems approach to crossing improvements.

F. Operation Lifesaver™ (OL) and OL, Inc. (OLI)

Operation Lifesaver™ is an active, continuing public education program designed to reduce the number of crashes, deaths and injuries at highway-rail intersections. It is sponsored cooperatively by Federal, state and local government agencies, highway safety organizations and the nation's railroads.

1. Education

Operation Lifesaver's success lies in educating people of all ages as to just how potentially hazardous grade crossings can be. Methods used to reach the public include civic presentations, early elementary and driver education curriculum activities, school bus driver programs, industrial safety, law enforcement programs and media coverage. Both OLI and FRA have produced Public Service Announcements (PSAs) for television and radio. Some state programs have also produced PSAs, including some in Spanish.

2. Enforcement

Nearly 50 percent of all highway-rail crossing accidents occur at crossings equipped with automated warning devices, indicating that some members of the public ignore the devices. This statistic underscores the need for increased enforcement.

The DOT does not enforce traffic laws at crossings, which is why the support of state, local, and railroad enforcement officers is so critical. The DOT and OLI work with state and local police, highway, and judicial authorities to promote broader enforcement programs and imposition of stiff fines for disregarding warning devices and STOP signs at highway-rail crossings. State and local law enforcement agencies are urged to "crack down" on motorists and pedestrians who disregard these laws and jeopardize their own as well as the lives of others. FRA/OLI are making available the Law Enforcement Television Network series, "On-Track," for training of police officers regarding enforcement of crossing safety laws. FRA, sometimes jointly with OLI, has displayed at national meetings of the International Association of Chiefs of Police, the National Fraternal Order of Police and the National Sheriffs' Association.

Vandalism of active warning devices at highway-rail crossings is also a problem which can be aided by police involvement. Approximately one in twenty warning device failures is reportedly attributable to vandalism, and vandalism is suspect in many more.

3. Engineering

The public is made aware of Federal, state and railroad programs that plan, install and maintain grade crossings. FRA/FHWA/OLI offer technical training to employees of railroads and state and local governments in crossing improvement and safety programs.

4. Funding

Operation Lifesaver, Inc. receives nearly 60 percent of its funding on a national level from FHWA ($300,000) and FRA ($100,000) grants. Private corporate sources providing funding include the Association of American Railroads (AAR), the National Railroad Passenger Corporation (Amtrak) and the Railway Progress Institute (RPI), with individuals providing small levels of support through individual and small corporate donations. As a 501(c)3 organization, OLI is federally tax-exempt, and all donations to it are tax-deductible, based on current IRS regulations for charitable deductions.

State and local programs are funded from myriad sources including state and corporate contributions. Some assistance, mostly non-financial, is provided by OLI. Many state programs are incorporated in a fashion similar to OLI.

5. Staffing

Located in Alexandria, Virginia, just outside of Washington, D.C., the National Support Center (NSC) serves first and foremost as a central coordinating point for all OL activities nationwide (national headquarters office). The headquarters employs three full-time staff members: Executive Director, Communications Director and Executive Assistant. The NSC functions on a full-time basis five days per week. OLI also employs a full-time individual designated as the National Field Coordinator (NFC), whose primary role is to offer direct technical assistance to the state OL programs. Working from a field office in Phoenix, Arizona, the NFC assists state programs, reorganizes dormant programs, helps maintain current programs and establishes new programs. The NFC provides the training necessary to have individuals certified as Operation Lifesaver Presenters.

There is an OL State Coordinator for each state (except Hawaii). This individual promotes and coordinates crossing safety and enforcement programs within the state, often orchestrating the efforts of speakers/presenters, displays at state and county fairs, special events, responding to and initiating media coverage, attending public

hearings/meetings re crossing safety, developing and/or distributing promotional materials, etc.

G. Research

1. Locomotive Conspicuity

Many railroads have equipped locomotives with alerting lights (such as ditch lights, strobe lights, oscillating lights, low-level-additional-headlights, and flood lights) to make them more visible at night. In 1983, the FRA conducted a benefit-cost analysis of alerting lights and concluded that a Federal requirement that all railroads use such lights on every leading railroad car could not be justified. After comparing the safety records of railroads that equipped locomotives with alerting lights to those of railroads that did not equip their locomotives with such lights, the FRA found no evidence that alerting lights reduced highway-rail crossing accidents. The FRA determined, in light of this information and the maintenance and reliability problems found, that the costs of requiring alerting lights would far exceed the benefits. The 1983 report stated if the FRA issued such a regulation under these circumstances, railroads would be compelled to reallocate resources from programs already proven successful in reducing rates for crossing accidents to a less effective approach.

However, two years ago, in light of improved device reliability and in frustration with the continuing toll of crossing accidents, the FRA asked VNTSC to again research this option. In recent legislation, specifically the Amtrak Authorization and Development Act passed in 1992, the Congress directed the Secretary of Transportation to complete research by the end of 1993 and to issue final rules before July 1995 requiring "enhanced locomotive conspicuity measures." The legislation defines this as any "enhancement of day and night visibility of the front-end unit of a train, by means of lighting, reflective materials, or other perspective of drivers of motor vehicles at grade crossings."

2. Reflectorization of Rail Cars

In 1982, the FRA studied the safety potential of requiring some reflective patches on the sides of rail cars. Principally because of the rapid degradation of available materials at that time, the FRA concluded that such a requirement was not cost-effective.

However, in recognition of recent improvements in retro-reflective materials (more reflective ability and surface coatings that resist dirt

accumulation and afford some ultra violet protection), the FRA is reconsidering this option.

Tests have been conducted at the Transportation Test Center in Pueblo, Colorado, to measure performance and to establish the optimal size and position of the materials on freight cars. Full scale testing (in revenue service), with the cooperation of three major railroads, is now underway in Alabama, Alaska, Georgia, Illinois, Indiana, Kentucky, Minnesota, Ohio, Tennessee, and Virginia. As part of the overall effort, accident experience and data will be reviewed. Human factors, specifically motor vehicle operator recognition, comprehension and response, will be assessed. Upon completion of these tests in FY 1994, the FRA will re-examine its policy on this matter.

3. Illumination

VNTSC is developing illumination standards for street lights at highway-rail crossings. The purpose of such lighting is two fold; to provide advance notice to the approaching motorist of the existence of a crossing, and to illuminate a train when one is in the crossing. FRA is sponsoring this effort. VNTSC will consider in its evaluation a cost comparison of solar-powered and commercially-powered illumination systems and applicability of standard highway illumination. A draft report and illumination guidelines have been circulated for peer review and is projected to be available to FRA by Summer 1994.

While illumination has failed to gain widespread recognition as a safety improvement option, it has several benefits. Illumination is a low-cost improvement, especially if commercial power is already available. In addition, placement, operation, and maintenance can be effected with only minimal railroad involvement. States may use Federal funding for such projects through ISTEA.

4. Train Horns

The FRA is working with the Association of American Railroads (AAR) to study the safety impact of whistle bans nationwide, to determine if nationwide Federal action is required.

Federal noise standards for railroads are established by the Environmental Protection Agency (EPA) and enforced by the FRA. However, because of their primary use as safety devices, locomotive horns and whistles are exempt from the EPA noise emission standards. The FRA is sponsoring research by the VNTSC to develop an optimal warning signal for locomotive whistles, which minimizes noise for communities while not compromising safety. VNTSC also is investigating

potential alternative systems, such as audible warning devices installed directly at crossings. (A cooperative effort involving the State of Nebraska, the City of Gering, the Union Pacific Railroad and a private firm has produced some field testing of an Automated Horn System (AHS) mounted at the crossing. The Los Angeles County Transportation Commission is also considering a similar device offered by another firm.) Some Los Angeles County commuter trains have been equipped with an innovative train whistle device, somewhat toned down and mounted lower on the locomotive in order to minimize impacts on neighboring communities, but still meeting minimum FRA standards. (VNTSC and FRA are monitoring these efforts.) A final report with research project results is anticipated to be available in 1994.

5. Signing Innovation

The FHWA, the Ohio Department of Transportation (ODOT) and Texas A&M University (on behalf of the State of Texas) have been pursuing research regarding innovative signing for use at highway-rail crossings.

a. The FHWA has recently concluded an effort to contrast the recognition and interpretation of various proposed passive signing configurations. Signs considered included the Canadian and Buckeye Crossbucks as well as traditional and modified YIELD signs. A report of this study was published in December 1993.

b. ODOT has in progress a massive field experiment and comparison of a new crossbuck and YIELD sign configuration, called the Buckeye Crossbuck. Half of the crossings in Ohio which are not equipped with automated devices are now being equipped with the new sign, while the other half are being provided new, but conventional, crossbuck signs. Subsequent statistical assessments, two to five years after installation is complete, will provide conclusions regarding the efficacy of the proposed sign. Crash testing is also being planned, i.e., staged and monitored vehicle collisions with the new Buckeye Crossbuck.

c. The Texas Transportation Institute (TTI), part of Texas A&M University, has developed and has recently been experimenting with an innovative advanced warning sign for use at highway-rail crossings. Field and driver recognition and response experimentation has recently been completed. A report is being prepared.

6. Loss of Shunt:

The FRA is conducting a joint research project with the Association of American Railroads to study the reliability of train detection track circuits and to document potential or probable conditions contributing to "loss of shunt".

The safety and reliability of highway-rail crossing warning devices are a major concern of both the railroad industry and the FRA. The primary activation of a crossing warning device is through vehicle wheel sets which apply a shunt between the two rails along a designated section of track. This shunting action causes track circuit voltage to short-circuit and prevent electrical energy from reaching the control relays. This activates the relays which control the proper functioning of signals and highway-rail crossing gates and flashers.

It has been suggested that a loss of shunt may be occurring at certain locations, causing premature release of crossing warning systems. The inability to properly shunt the track circuit could be due to a number of individual parameters, or a combination of factors. Some suggested conditions leading to improper shunting include films or contamination at the wheel/rail interface; light axle loads; changes in the wheel/rail contact patch due to rail grinding practices or different wheel profiles; and truck hunting or irregular wheel rail surface. The exact combination of the above conditions that could lead to loss of shunt is not fully known, nor is it certain that these are the only items that adversely influence shunting.

This research program is intended to collect sufficient field data to document the occurrence of inadequate shunting and to document as fully as possible the conditions of both track and equipment that existed at the time the loss of shunt was experienced.

7. Photo-Enforcement:

FHWA, FTA and FRA are jointly funding an evaluation of a photo-enforcement demonstration being conducted by the Los Angeles County Transportation Commission. Early results at two crossings equipped with active photo-enforcement equipment indicate an 84 percent reduction in motorists driving around down gates. Crossing accidents along that portion of the light rail line where the devices have been installed are down 60 percent.

8. High Speed Rail Surveys

FRA has initiated investigation of hazard elimination alternatives at highway-rail crossings. FRA has also contracted for an investigation of current and new technologies for use at high speed rail crossings. Two contractors are involved:

Applied Systems Technologies, Inc. (ASTI) is investigating hazard elimination needs and options on the ISTEA Section 1010 corridors as well as the Northeast Corridor north end and the Empire Corridor. The research includes review of existing conditions on proposed high speed rail corridors and defines the problems with respect to the magnitude of the crossings affected, risk analysis of crossing warning devices proposed, overall view of current and innovative warning devices, prominent jurisdictional issues and any recommendations to resolve the identified problems. The contract was recently modified to identify and determine the degree to which liability issues may or have impeded progress in the crossing hazard elimination area.

Battelle Laboratories of Ohio is investigating the world-wide status of current and innovative technologies for use at high speed rail crossings. The research includes determining the feasibility and cost of each technology. Areas of concern include signal and train control, obstruction detection devices and active and passive warning devices. Another area of this research involves development of a methodology to assess alternative grade crossing technology for use on the proposed U.S. high speed rail grade crossings. Three testing options are included in this contract for either laboratory, computer modelling or field testing of the most promising technologies.