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A STUDY OF STATE PROGRAMS FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS

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FINAL REPORT

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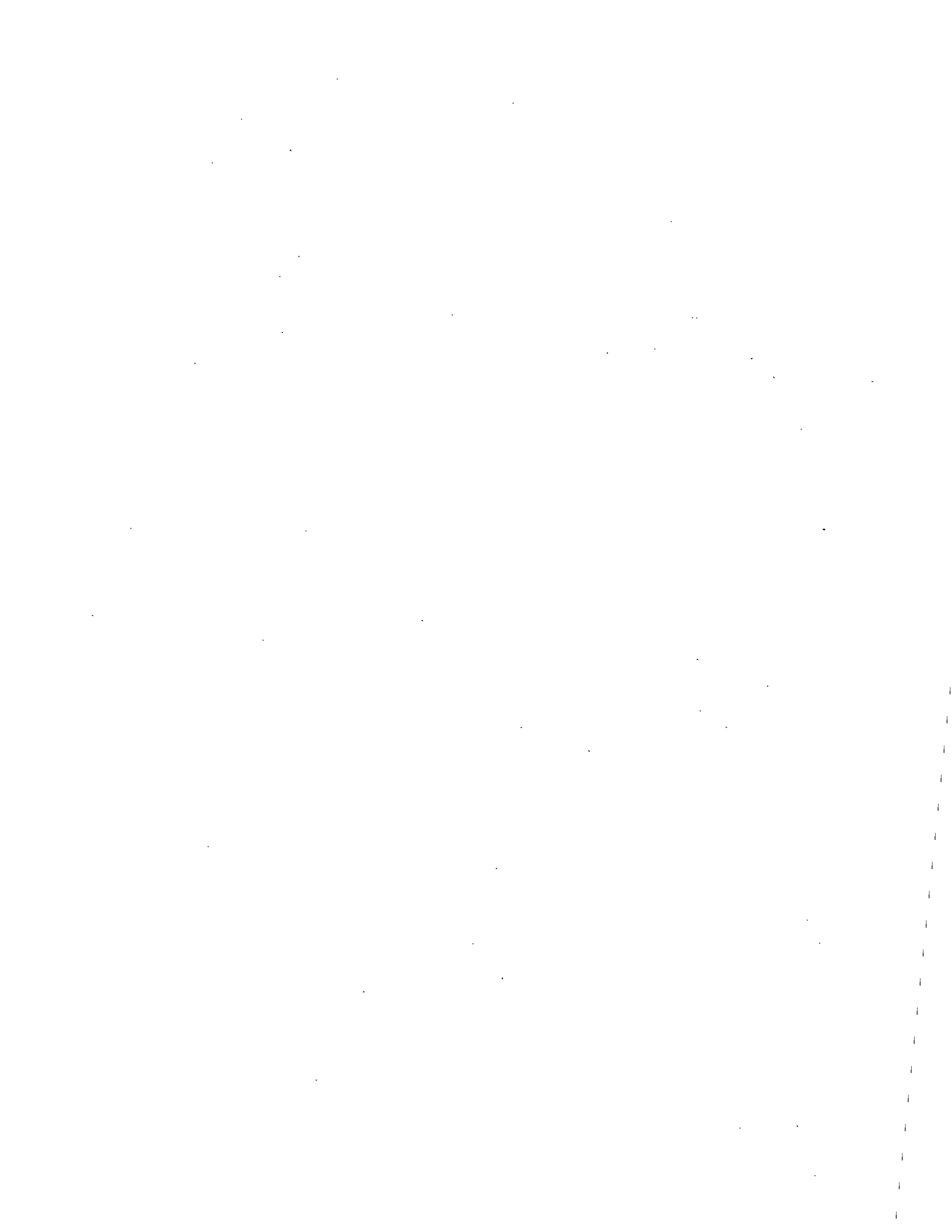
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| 16. Abstract In response to a DOT study of rail-highway grade crossing safety in the United States, the Congress passed the Highway Safety Act of 1973 which earmarked funds specifically for grade crossing improvements. Law requires the states to establish programs for identifying and implementing crossing improvement projects. This report examines the experiences of five states in establishing programs. The programs are discussed in terms of program initiation, project processing procedures, sources of funds, role of the regulatory agency, and maintenance of improved crossings. Descriptions of each state encompass grade crossing activity prior to 1973, the state's procedures, and types of improvements. The report also suggests some modifications to the current federal program which might enhance its effectiveness. | | | | | |
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PREFACE

This report describes one of several recent Transportation Systems Center studies of institutional factors related to rail-highway grade crossing safety improvements. The current study addressed state programs developed in response to federal funding made available through the Highway Acts of 1973 and 1976. Other reports to be published in 1978 will deal with the relationship between innovation and tort liability in grade crossing accidents, alternative mechanisms for liability management at the state level, and the funding allocation formula. The Office of Rail Systems Analysis and Information, Federal Railroad Administration, sponsored this work.

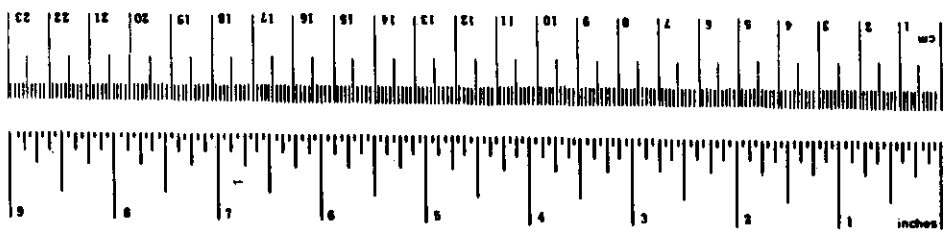
The author wishes to express her appreciation to the various state, railroad, and FHWA officials who offered their time to discuss their activities and to Nick Graf of FHWA, who provided funding data. Other individuals also contributed to the design and preparation of this report. Janet Coleman of FHWA and Bruce George of FRA provided numerous contacts and invaluable guidance in the design of this study. Nancy Cooney and Judith King, of Raytheon Service Company, participated in the field work associated with the case studies. They also contributed to the organization and writing of the case study results contained in the appendices.

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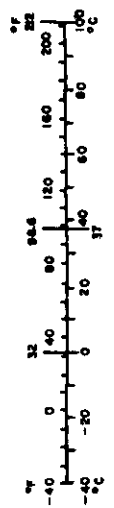
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METRIC CONVERSION FACTORS

| Symbol | When You Know | Multiply by | To Find | Symbol |
|----------------------------|------------------------|----------------------------|---------------------|-----------------|
| LENGTH | | | | |
| in | inches | 2.5 | centimeters | cm |
| ft | feet | 30 | centimeters | cm |
| yd | yards | 0.9 | meters | m |
| mi | miles | 1.6 | kilometers | km |
| AREA | | | | |
| in ² | square inches | 6.5 | square centimeters | cm ² |
| ft ² | square feet | 0.09 | square meters | m ² |
| yd ² | square yards | 0.8 | square meters | m ² |
| mi ² | square miles | 2.6 | square kilometers | km ² |
| | acres | 0.4 | hectares | ha |
| MASS (weight) | | | | |
| oz | ounces | 28 | grams | g |
| lb | pounds | 0.45 | kilograms | kg |
| | short tons (2000 lb) | 0.9 | tonnes | t |
| VOLUME | | | | |
| tblsp | tablespoons | 5 | milliliters | ml |
| Tbsp | tablespoons | 15 | milliliters | ml |
| fl oz | fluid ounces | 30 | milliliters | ml |
| c | cup | 0.24 | liters | l |
| pt | pints | 0.47 | liters | l |
| qt | quarts | 0.95 | liters | l |
| gal | gallons | 3.8 | liters | l |
| cu ft | cubic feet | 0.03 | cubic meters | m ³ |
| cu yd | cubic yards | 0.76 | cubic meters | m ³ |
| TEMPERATURE (exact) | | | | |
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |



| Symbol | When You Know | Multiply by | To Find | Symbol |
|----------------------------|-----------------------------------|-------------------|------------------------|-----------------|
| LENGTH | | | | |
| mm | millimeters | 0.04 | inches | in |
| cm | centimeters | 0.4 | inches | in |
| m | meters | 3.3 | feet | ft |
| km | kilometers | 0.6 | miles | mi |
| AREA | | | | |
| cm ² | square centimeters | 0.16 | square inches | in ² |
| m ² | square meters | 1.2 | square yards | yd ² |
| km ² | square kilometers | 0.4 | square miles | mi ² |
| ha | hectares (10,000 m ²) | 2.5 | acres | ac |
| MASS (weight) | | | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.2 | pounds | lb |
| t | tonnes (1000 kg) | 1.1 | short tons | sh |
| VOLUME | | | | |
| ml | milliliters | 0.03 | fluid ounces | fl oz |
| l | liters | 2.1 | pints | pt |
| l | liters | 1.06 | quarts | qt |
| l | liters | 0.26 | gallons | gal |
| m ³ | cubic meters | 35 | cubic feet | ft ³ |
| m ³ | cubic meters | 1.3 | cubic yards | yd ³ |
| TEMPERATURE (exact) | | | | |
| °C | Celsius temperature | 9/5 (then add 32) | Fahrenheit temperature | °F |



CONTENTS

| <u>Section</u> | <u>Page</u> |
|---|-------------|
| SUMMARY | S-1 |
| 1. INTRODUCTION | 1 |
| 1.1 Purpose | 1 |
| 1.2 Background | 2 |
| 1.3 Organization | 6 |
| 2. STATE SELECTION | 8 |
| 3. CASE STUDY HIGHLIGHTS | 13 |
| 3.1 Study Methodology | 13 |
| 3.2 Massachusetts | 15 |
| 3.3 New York | 19 |
| 3.4 Louisiana | 23 |
| 3.5 Texas | 27 |
| 3.6 Oregon | 31 |
| 4. CHARACTERISTICS OF STATE PROGRAMS | 36 |
| 4.1 Program Initiation | 36 |
| 4.1.1 Problems | 36 |
| 4.1.2 Facilitating Factors | 37 |
| 4.2 Project Processing Procedures | 38 |
| 4.3 Role of Regulatory Agency | 42 |
| 4.4 Use of Other Funds | 44 |
| 4.5 Maintenance of Improved Crossings | 45 |
| 4.6 Role of Federal Highway Administration | 46 |
| 4.6.1 Program Regulations | 46 |
| 4.6.2 Program Administration | 48 |
| 5. CONCLUSIONS | 51 |
| GENERAL REFERENCES | 56 |
| APPENDIX A - Massachusetts Case Study | A-1 |
| APPENDIX B - New York Case Study | B-1 |
| APPENDIX C - Louisiana Case Study | C-1 |
| APPENDIX D - Texas Case Study | D-1 |
| APPENDIX E - Oregon Case Study | E-1 |
| APPENDIX F - Representative Agreement Forms | F-1 |

ILLUSTRATIONS

| <u>Figure</u> | | <u>Page</u> |
|---------------|--|-------------|
| 3-1a | A Massachusetts Surface Scheduled for Improvement | 17 |
| 3-1b | Recently Installed Rubber Surface | 17 |
| 3-2 | Rubber Surface Starting to Break Apart Due to Louisiana's Poor Subsoil Conditions | 26 |
| 3-3 | Innovative Devices Tested in Texas Include Advance Warning Signs and Surfaces Made From Used Rubber Tires | 31 |
| 3-4 | Crossings Scheduled for Improvement in Oregon Involve Installation of Gates Coordinated With Traffic Signals | 34 |
| A-1 | Massachusetts Procedure for Rail-Highway Grade Crossing Improvements | A-7 |
| B-1 | New York Procedure for Rail-Highway Grade Crossing Improvements | B-8 |
| C-1 | Louisiana Procedure for Rail-Highway Grade Crossing Improvements | C-8 |
| D-1 | Texas Procedure for Rail-Highway Grade Crossing Improvements | D-9 |
| E-1 | Oregon Procedure for Rail-Highway Grade Crossing Improvements | E-11 |

TABLES

| <u>Table</u> | | <u>Page</u> |
|--------------|--|-------------|
| 1-1 | SOURCES OF FUNDS FOR RAIL-HIGHWAY GRADE CROSSING PROJECTS | 3 |
| 2-1 | CASE STUDY STATE SELECTION | 11 |
| 2-2 | CHARACTERISTICS OF SELECTED STATES | 12 |
| 3-1 | SUMMARY OF CHARACTERISTICS OF STATE RAIL- HIGHWAY GRADE CROSSING PROGRAMS | 14 |
| A-1 | MASSACHUSETTS ACCIDENT HISTORY, 1963-1975 | A-2 |
| A-2 | CHARACTERISTICS OF MASSACHUSETTS GRADE CROSSINGS | A-3 |
| B-1 | NEW YORK ACCIDENT HISTORY, 1963-1975 | B-2 |
| B-2 | CHARACTERISTICS OF NEW YORK GRADE CROSSINGS | B-5 |
| B-3 | NEW YORK STATE GRADE CROSSING IMPROVEMENT PROJECTS | B-15 |
| C-1 | LOUISIANA ACCIDENT HISTORY, 1963-1975 | C-4 |
| C-2a | CHARACTERISTICS OF LOUISIANA GRADE CROSSINGS | C-5 |
| C-2b | CHARACTERISTICS OF LOUISIANA GRADE CROSSINGS AS REPORTED BY LOUISIANA DEPARTMENT OF TRANS- PORTATION AND DEVELOPMENT | C-6 |
| D-1 | TEXAS STATE GRADE CROSSING PROGRAMS | D-3 |
| D-2 | TEXAS ACCIDENT HISTORY, 1963-1975 | D-6 |
| D-3 | CHARACTERISTICS OF TEXAS GRADE CROSSINGS | D-7 |
| E-1a | OREGON ACCIDENT HISTORY, 1963-1975 | E-6 |
| E-1b | OREGON PUC ACCIDENT STATISTICS, 1963-1975 | E-7 |
| E-2a | CHARACTERISTICS OF OREGON GRADE CROSSINGS | E-8 |

TABLES (Cont'd)

E-2b

CHARACTERISTICS OF OREGON PUBLIC GRADE
CROSSINGS AS REPORTED BY THE OREGON PUBLIC
UTILITY COMMISSIONER (December 31, 1976)

E-9

SYMBOLS AND ABBREVIATIONS

| | |
|-------|---|
| AAR | Association of American Railroads |
| ADT | Average daily traffic |
| B&M | Boston and Maine Railroad |
| CWT | Constant warning time |
| DPU | Department of Public Utilities (MA) |
| DPW | Department of Public Works (MA) |
| D&H | Delaware and Hudson Railroad |
| FHPM | Federal-Aid Highway Program Manual |
| FHWA | Federal Highway Administration |
| FRA | Federal Railroad Administration |
| LAHSC | Louisiana Highway Safety Commission |
| LHD | Louisiana Highway Department |
| MUTCD | Manual on Uniform Traffic Control Devices |
| NYDOT | New York Department of Transportation |
| OTS | Office of Traffic Safety (TX) |
| PSC | Public Service Commission (LA, NY) |
| PS&E | Plan, specification and estimate |
| PUC | Public Utilities Commission (OR) |
| SDHPT | State Department of Highways and Public Transportation (TX) |
| TSD | Traffic Safety Division (NY). |

SUMMARY

This report discusses five case studies of states' experiences in establishing rail-highway grade crossing programs using federal funds available through the Highway Safety Act of 1973 and the Federal-Aid Highway Act of 1976. The Transportation Systems Center undertook the study for the Federal Railroad Administration, Office of Rail Systems Analysis and Information, to identify the issues which the railroads and the states face in grade crossing improvement programs and to determine and understand the key institutional factors which contribute to effective implementation of state grade crossing improvement programs.

Criteria for the case study site selection were funding obligation level and accident rate. The following representative states were selected by the FRA for this study:

Massachusetts

New York

Louisiana

Texas

Oregon.

All but one of these states began development of a state rail-highway grade crossing program when the FHWA announced the availability of funds. New York, because of a legal obstacle, was unable to initiate a program for three years. The existence of state-funded programs in the other four states facilitated

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initiation of the federal program. Similarly, the availability of funds for the required local share and railroad initiatives also helped to get programs under way.

The project processing procedures for all of the states are characterized by four phases:

- (1) Project identification
- (2) Negotiation and authorization
- (3) Project initiation
- (4) Project completion.

A number of mechanisms developed by the FHWA and the states expedite project processing. This includes master agreements, lump sum billing, pre-assembly of materials, and use of field personnel for on-site construction monitoring.

Three of the five states examined in this study have regulatory agencies. One of the three has the regulatory powers vested in the state DOT and the other two have separate agencies. The presence of an active regulatory agency has a pronounced effect on grade crossing safety. Through inspections and accident investigation the agency performs a significant role in protecting the public against hazardous crossings. The regulatory body also serves as a focal point for public complaints and helps in the identification of crossings needing improvement.

The FHWA issues requirements and procedures for the use of federal grade crossing funds and administers the program through FHWA Division Offices in each state. Division Offices are

allowed considerable latitude in their degree of involvement with the states and the railroads. As a result, the FHWA Division Office role ranges from review and approval only to active involvement with every aspect of a state's procedures.

Based on the case studies, the following are the key institutional factors contributing to effective state programs:

Availability of state funds for the required local share of costs

Use of master agreements

Presence of an active regulatory agency

Cooperation among organizations involved in project processing.

The results of the case studies led to the following conclusions regarding possible modifications to the federal program which might enhance its effectiveness:

Meaningful near-term goals which relate to the safety aspect of the program are needed for each state. An annual comparison of the actual number of projects initiated with planned project activity would be a means of measuring program progress against an annual goal.

Revision of the apportionment formula to correct apparent imbalances will provide funds where they will have the greatest impact on safety.

There is a need for development and application of MUTCD-type guidelines for surface installations to prevent unnecessary use of more costly surface materials.

Use of federally employed railroad Signal Engineers to review signal projects and advise on the use of innovative devices will allow the federal government to exert more influence on selection and installation of signals.

FHWA Divisional Offices monitoring of the prioritization procedures of each state where necessary will assure that crossings off both the federal and state systems are not discounted.

1. INTRODUCTION

1.1 PURPOSE

The purpose of this study was twofold: (a) to acquaint the Federal Railroad Administration (FRA) staff and others who do not deal directly with the states with the types of issues which the railroads and states face in grade crossing improvement programs and (b) to determine and understand the key institutional factors which contribute to effective implementation of state grade crossing improvement programs.

This report is based on five case studies of states' experiences in establishing rail-highway grade crossing improvement programs supported by federal funds. The factors which contributed to the success or failure of the five state programs are identified and discussed. This information should be helpful to other states in improving their programs. In addition, the report suggests ways in which the federal government could modify its role in the program in order to facilitate implementation of state programs and to insure a reasonably consistent level of safety from state to state without infringing upon the states' right to select projects.

1.2 BACKGROUND

Passage of the Highway Safety Act of 1973 marked the first time that Congress earmarked federal funds specifically for rail-highway grade crossing improvements. Although federal dollars were spent on the improvement of crossings prior to 1973, the funds were always connected with a highway construction project or a special demonstration project on the Federal-Aid Highway System (See Table 1-1 for a listing of funds currently available for grade crossing work). A comprehensive DOT study of rail-highway grade crossing safety convinced Congress that grade crossing safety was in fact a problem that merited federal spending (See Refs. 5 and 6).

According to the DOT-AAR Grade Crossing Inventory, there are 219,162 public at-grade crossings in the United States (See Ref. 7). Only 23 percent of these crossings are on the Federal-Aid Highway System. From 1960 to 1970, over 15,000 people died as a result of rail-highway crossing accidents. While annual train-miles declined in the 1960's, highway vehicle-miles travelled continued to grow and the number of deaths due to crossing accidents rose from 1,173 in 1961 to a high of 1,657 in 1966.

The Railroad Safety Act of 1970 and the Highway Safety Act of 1970 required DOT to investigate the rail-highway grade crossing situation in the U.S. The Railroad Safety Act required DOT to undertake "...a comprehensive study of the problem of eliminating and protecting railroad grade crossings, including a

TABLE 1-1 SOURCES OF FUNDS FOR RAIL-HIGHWAY
GRADE CROSSING PROJECTS

| Source | Permissible Uses |
|-----------------------------|--|
| Highway Safety Act of 1973: | |
| Section 203 | Improvements of crossings on and off Federal-Aid System |
| Section 230 | Improvement of crossings off Federal-Aid System (repealed by 1976 Act and incorporated into 203) |
| Section 205 | Pavement markings on or off Federal-Aid System; preference given to rural areas and off-system roads |
| Section 219 | Construction, reconstruction and improvement of off-system roads; project selection at discretion of counties |
| 23 U.S.C. 120(d): | |
| "G" funds | General highway improvement funds; up to 10% may be used for elimination of hazards at railroad-highway crossings on Federal-Aid System. |
| 23 U.S.C. 402 | Advance warning signs both on and off Federal-Aid System |

study of measures to protect pedestrians in densely populated areas..., together with recommendations for appropriate action" (Sec. 204). Similarly, Section 205(a) of the Highway Act called for "...a full and complete investigation and study of the problem of providing increased highway safety at public and private ground-level rail-highway crossings... including the estimate of the cost of such a program." The Federal Railroad Administration (FRA) and the Federal Highway Administration (FHWA) prepared a two-part report to satisfy the requirements of the legislation. The DOT delivered the first report to Congress in November 1971. The scope of Part I was the rail-highway grade crossing problem. Part II, containing recommendations for resolution of the problem, was completed in August 1972. The DOT recommended a federal spending program to improve grade crossing safety.

One year later Congress passed the Highway Safety Act of 1973 (Public Law 93-87). Section 203 of the act appropriated \$175M from the Highway Trust Fund for the "...elimination of hazards of rail-highway grade crossings..." for crossings on the Federal-Aid System. At least 50 percent of this appropriation was earmarked for warning devices. In order to be eligible for funding, the act required each state to survey all crossings and establish a schedule of projects for improving the most hazardous crossings. At a minimum the schedule had to include warning signs for all crossings. Federal funding was available for up to 90 percent of the cost of any improvements made under Section

203. The act further specified that once a year each state must report to DOT on the progress being made under Section 203.

Section 230 of the act, dealing with the Safer Roads Demonstration Program, provided funding for improvements eliminating or lessening safety hazards on roads that are not part of the Federal-Aid System. One such improvement is the elimination of hazards at railroad-highway grade crossings. Congress appropriated \$250M for implementation of Section 230 projects.

The appropriation for Section 230 was \$75M larger than that for Section 203. However, it should be noted that rail-highway crossing improvements are only one category of safety improvements which can be paid for with 230 funding. The act specifically allocated money for 23 percent of the nation's crossings which are on the Federal-Aid System, but left the majority of crossings, those that are not on the Federal-Aid System, without earmarked funds. While the passage of the Highway Safety Act meant a major policy change in federal funding for grade crossing improvements, only a portion of the nation's crossings was explicitly guaranteed funds.

In 1976, three years after establishment of the Section 203 and Section 230 funding programs, Congress passed the Federal-Aid Highway Act (Public Law 94-280). This legislation appropriated an additional \$250M for crossings on the Federal-Aid System and authorized an additional \$150M for non-Federal-Aid roads. The 1976 legislation abolished the old 230 program and made the off-

system improvements part of Section 203 of the 1973 act. The new off-system money does not come from the Highway Trust Fund and must be appropriated before it is available to the states. Congress appropriated \$75M for off-system crossings in May 1977 as part of the Economic Stimulus Appropriations Act.

For crossings on the Federal-Aid System, the latest authorization means an average of \$8,500 per crossing nationwide (There are 49,951 crossings on the Federal-Aid System and a total of \$325M is available for improvements). Less than \$1,000 per crossing is available for non-Federal-Aid System crossings. Clearly non-FAS crossings are not adequately funded.

Implementation of grade crossing improvement programs must be done at the state level under FHWA guidelines. Law* requires that the State Highway Department administer the program. Since local laws and state government structure vary from state to state, a variety of problems has been encountered in attempting to design and implement state programs using federal funds. This report discusses the experiences of five states in establishing grade crossing improvement programs.

1.3 ORGANIZATION

This report provides descriptions of each case study, a discussion of the features of the state programs and suggestions

*Title 23 USC, 1970 edition, Supplement V, 1975.

for improving the program on a nationwide level. The rationale for the case study approach and state selection is described in Section 2. Section 3 provides a brief description of each of the state grade crossing programs while the appendices contain detailed descriptions. Various aspects of state programs are discussed in Section 4. Finally, Section 5 identifies key institutional factors contributing to effective programs and establishes conclusions regarding changes that the federal government might make in administering the rail-highway grade crossing program.

2. STATE SELECTION

The objective of this study was to identify factors contributing to the relative quality of state programs for improving grade crossing safety under the Federal-Aid Highway Acts of 1973 and 1976. A case study approach was adopted and a selection methodology was formulated to choose representative states. FRA wanted to insure that successful as well as problematic states would be included. Two measures were used to determine the success of a state program in the selection process. They were (1) the percent of appropriated funds obligated and (2) the accident rate.

The funding obligation level indicates how effective the state has been in selecting projects and securing concurrence from state, railroad and FHWA officials. Our selection methodology used the obligation levels for Section 203 funds only. Section 230 funds can be used for a number of safety improvements other than at-grade crossings and are therefore not a particularly representative measure of grade crossing improvements. Obligations as of January 30, 1977 were used in the selection process.

A decrease in accidents at rail-highway grade crossings is the goal of the federal program. An obvious measure of a state's success in using federal funds is the difference between the accident rates before and after inception of the federal program.

However, in 1975 the FRA changed its accident reporting criteria and the data from 1975 on is not comparable to earlier data. Since consistent time series accident data was not available, the selection process used the accident rate adjusted for number of vehicle registrations. Casualties per 10,000 vehicle registrations for 1975 as reported in FRA's Rail-Highway Grade-Crossing Accidents/Incidents Bulletin were the most recent accident data available.

The 48 Continental States were stratified into high, medium and low categories for each of the measures. The medium category for each measure was defined as within one standard deviation of the mean. The low category was below one standard deviation from the mean and the high category was greater than one standard deviation. The mean accident rate for the 48 States was 0.351 accidents per 10,000 vehicle registrations. The mean for percent of funds obligated was 40.7 percent.

The next step in the selection process was to identify states which fell into the following categories:

- (1) low accidents, high obligations;
- (2) low accidents, low obligations;
- (3) high accidents, high obligations;
- (4) high accidents, low obligations; and
- (5) medium accidents, medium obligations.

Twenty-seven states could be categorized by this stratification. The remaining 21 states fell into categories that were not of interest (i.e. - medium accidents, low obligations). Category

(4) had no entries (This was somewhat reassuring because it meant that states with the worst accident problems are participating in the improvement program). The results of the stratification are displayed in Table 2-1.

The FRA selected the following states for the case studies:

Massachusetts

New York

Louisiana

Texas

Oregon.

The selected states are underlined in Table 2-1. Since category (5) had a large number of candidates, two states were selected from this group.

The selected states are described in Table 2-2 in terms of their number of crossings, accident rate and funding levels. New York receives the largest funding apportionment while Texas has many more crossings than any of the other states. Massachusetts and New York have the lowest accident rate. As of June 30, 1977, Massachusetts was the only state to have obligated essentially all of its funds (Only \$23,000 remains available for obligation in Massachusetts).

TABLE 2-1 CASE STUDY STATE SELECTION

| CRITERIA | | CANDIDATE STATES* |
|-------------------------------------|-------------------|---|
| Casualties Per 10,000 Registrations | Percent Obligated | |
| Low | High | <u>Massachusetts</u> , Nevada |
| Low | Low | New Jersey, <u>New York</u> , Pennsylvania, Rhode Island |
| High | High | <u>Louisiana</u> |
| High | Low | None |
| Medium | Medium | California, Colorado, Florida, Illinois, Iowa, Kentucky, Maine, Minnesota, Montana, North Carolina, Oklahoma, <u>Oregon</u> , South Carolina, South Dakota, Tennessee, <u>Texas</u> , Vermont, Washington, Wisconsin, Wyoming |
| Mean | .351 | |
| Std. Deviation | .235 | |
| | .407 | |
| | .156 | |

*Selected states have been underscored.

TABLE 2-2 CHARACTERISTICS OF SELECTED STATES

| | Massachusetts | New York | Louisiana | Texas | Oregon |
|---|---------------|----------|-----------|--------|--------|
| Number of Crossings* | | | | | |
| On-system | 542 | 1,090 | 699 | 1,888 | 836 |
| Off-system | 688 | 3,360 | 4,229 | 12,728 | 2,133 |
| Total | 1,230 | 4,450 | 4,928 | 14,616 | 2,969 |
| Casualty rate per 10K registrations (1975)** | .06 | .06 | .76 | .54 | .34 |
| Apportionments (\$000) through FY77 | | | | | |
| 203-On-system | 5,732 | 19,447 | 4,625 | 16,411 | 3,602 |
| 203-Off-system | 1,475 | 5,033 | 1,200 | 4,263 | 928 |
| 230-Safer Roads Demonstration | 5,401 | 17,522 | 4,025 | 13,770 | 3,263 |
| Obligations through 6/30/77 - Sec. 203 | | | | | |
| On-system (\$000) | 5,707 | 9,685 | 3,560 | 6,807 | 2,192 |
| (%) | 99.6 | 49.8 | 76.9 | 41.5 | 60.8 |

* Source: DOT-AAR Grade Crossing Inventory as of August 1976.

** Source: Rail-Highway Grade Crossing Accidents/Incidents Bulletin, for the year ended December 31, 1975, Department of Transportation, Federal Railroad Administration, Office of Safety, Table 20-B.

3. CASE STUDY HIGHLIGHTS

3.1 STUDY METHODOLOGY

Fieldwork for this study consisted of 2 to 3 day visits to each of the states. In each state, meetings were held with staff of the State Highway Department (by law the agency responsible for administering the program), the FHWA Division Office, and at least one railroad, preferably the one with the largest number of crossings. In Oregon and Massachusetts, a regulatory agency is involved in the grade crossing improvement process so it was contacted as well. The site visits to Louisiana, Texas and Oregon included meetings with the Governor's Representative for Safety. In the first two states the Governor's Representative plays a role in the grade crossing improvement program.

Through interviews with state and railroad officials, the study team obtained information about crossing improvement activity and procedures for each state. The appendices to this report contain detailed descriptions of each state in terms of its grade crossing activities prior to establishment of the federal program, the procedure for selecting and implementing projects, and the types of improvements made to date. Flowcharts highlighting the role of each agency in the crossing improvement process are included in the appendices. Table 3-1 summarizes the major characteristics of the five state programs. The following sections highlight the salient findings of each case study.

TABLE 3-1 SUMMARY OF CHARACTERISTICS OF STATE RAIL-HIGHWAY GRADE CROSSING PROGRAMS

STATE:

| CHARACTERISTICS | MASSACHUSETTS | NEW YORK | LOUISIANA | TEXAS | ORIGIN |
|--|---|---|------------------------------------|--|---------------------------------------|
| Conflict w/ existing state law | no | yes | no | no | no |
| Prior state program | no | yes-state and rail-road funded; inventory | yes-state and rail-road funded | yes-signals, surfaces, maintenance | yes-accident prevention |
| Master agreement | yes | no | yes-since spring 1976 | yes-trial basis for lump sum jobs | yes-with Southern Pacific |
| Progress billing and advances | yes | yes-as of 5/77 | yes | yes-for materials on hand | yes up to 80% |
| % Crossings on FAS | 44% | 24% | 14% | 13% | 28% |
| Prioritizing Technique | Accident data and ADT | Hazard Index; on-site inspections | Hazard Index (N.H.) | Priority Index | Priority Index (Jacqua) |
| Source of local share | DPW budget-no additional legislative action | State legislative appropriation | Annual budget-general highway fund | Highway Trust Fund for on-system; local funds off-system | Highway Trust Fund |
| Section 230 project processing | Same as 203 | Funds appropriated to different section; process same | Same as 203 | Requires approval of Governor's representative | Same as 203 |
| Active Regulatory Agency | yes | yes-part of N.Y. DOT | no | no | yes |
| FHWA Division Office participation | Active | Review only | Active | Active | Review Only |
| State program management structure | Simple | Complex | Simple | Simple | Complex |
| Types of improvements | Surfaces, signs, some signals | Rubber Surfaces, signs, signals | Surfaces, signals | Signals, signs | Signals, signs |
| Use of "G" funds | Limited | Extensive | Some (6/year) | Some | Limited |
| Criteria for use of different surfaces | Greater than 5000 ADT | usually use rubber on major roads | Greater than 1000 ADT | no surface work under federal Program | no surface work under federal Program |

3.2 MASSACHUSETTS

Massachusetts did not have a formal state grade crossing program prior to 1973. The Department of Public Utilities (DPU), the state's regulatory agency, inspected crossings annually and ordered railroads to upgrade crossings which it deemed were dangerous. The cost of any improvements ordered by the DPU were shared by the railroad, the city or town, and the political subdivision controlling the road. The accident rate at Massachusetts' 1,230 crossings remained low consistently throughout the 1960's, presumably due to the activities of the DPU and the cooperation of the railroads.

Although there had been no history of state involvement in funding of grade crossing improvements, officials in Massachusetts were anxious to establish a state program using the funds made available by the 1973 Highway Act. Generally unfavorable economic conditions, evidenced by an unemployment rate in excess of 7 percent, combined with cancellation of the last major highway construction project in the state, made state officials receptive to the new federally funded program. The Boston and Maine Railroad (B&M) was anxious to get the program under way and sent AAR brochures describing the availability of federal funds to every town in which it had a crossing. There were no legal impediments so State Highway Department officials along with railroad and FHWA representatives were able to develop a procedure for identification and implementation of crossing

improvement projects in Massachusetts. The only time-consuming part of program initiation was negotiation of master agreements with each of the six railroads in the state.

Massachusetts' procedure for identifying and implementing crossing improvements is simple and efficient. The State Traffic Engineer in the Department of Public Works (DPW) is responsible for prioritizing potential crossing improvements. A quantitative measure such as a hazard index is not used. The prioritization is based on accident data provided by the DPU and grade crossing traffic volumes, but citizen complaints and railroad suggestions are also considered. Based on the DPW's priority listing, a diagnostic team, composed of representatives of the DPW, DPU, FHWA and the appropriate railroad, visits the crossings to determine the appropriate treatment. After the site visit, the railroad draws up plans for the agreed-upon work. If signal changes are involved, the DPU as well as the DPW must review the plans. Following DPU approval, DPW submits the project plans to FHWA and the DPW commissioners. After the DPW commissioners approve the project and commit state funds, the railroad may begin work under the supervision of the appropriate DPW District Engineer located in a field office.

When construction is completed, an inspection must be performed. If a surface was improved, the DPW inspects it. If signals were installed, the DPU Signal Inspector must test the signal system before it can be used. The FHWA Division Office performs inspections on a sampling basis.

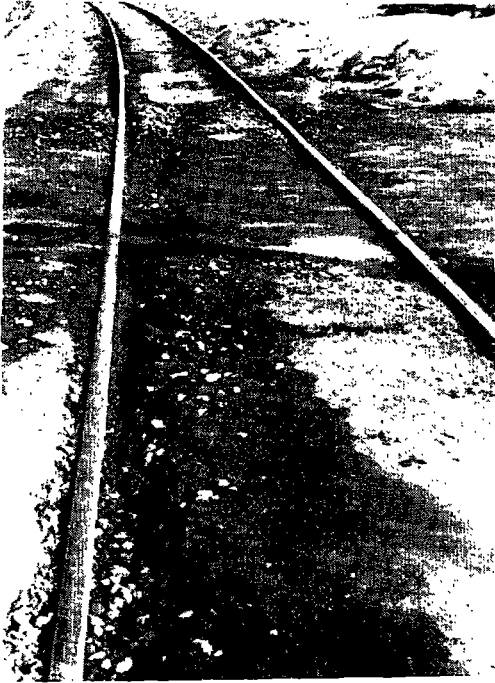


FIGURE 3-1a. A Massachusetts Surface Scheduled For Improvement

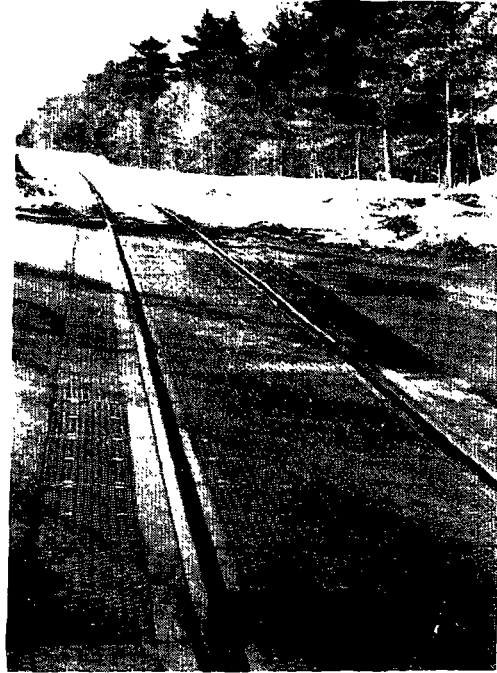


FIGURE 3-1b. Recently Installed Rubber Surface

Improvements funded by the federal program have involved surfaces, signals and signs (see Figure 3-1). A variety of surface materials including plastic, bituminous concrete, and a new product made of used rubber tires has been tried. However, on mainline track where average daily traffic (ADT) exceeds 5,000 and tonnage is over 15 million gross tons per year, rubber is used. Signal installations have involved primarily conventional circuitry. Conrail has installed one motion sensor, and the

Providence and Worcester Railroad plans to install several. A statewide signing program to bring all crossings into compliance with standards set forth in the Manual on Uniform Traffic Control Devices (MUTCD) is nearing completion.

The Massachusetts procedure has several features which expedite project processing. If project approval comes during the winter, the FHWA encourages pre-assembly indoors in preparation for spring construction. State law allows cash advances to the railroads, a feature which is reported to be of particular importance to the cash flow position of the B&M. The same procedures are used for processing both on-system and off-system projects. The existence of master agreements with each railroad avoids legal review on a project-by-project basis.

The B&M and Conrail each have over 500 public at-grade crossings. Since program inception, the B&M has been very active in identifying crossings for improvement while Conrail has only recently begun to participate. Since the railroad must prepare the specifications for the projects, improvements cannot be undertaken unless the railroads cooperate. Of course, if a crossing is extremely dangerous the DPU could order it to be improved, but to our knowledge this has not occurred.

State statute gives the DPU considerable power in overseeing safety at-grade crossings. Because of this power, the DPU can influence the types of signal systems installed under this program. The DPU reviews every signal project. This means that the DPU is in a position to influence whether or not any

innovative devices are used. The DPU carefully reviewed the experiences of other states with motion sensors and constant warning time devices before approving them for use in Massachusetts. The DPU will consider new devices, but it is still up to the railroads to propose using them.

The allocation formula appropriated adequate funds to Massachusetts. The available funds met the needs of Massachusetts grade crossings, which were in relatively good condition before the federal program began.

All of the agencies involved in grade crossing safety in Massachusetts worked closely to develop a streamlined and efficient procedure. Except for a somewhat subjective project prioritization process, the Massachusetts program is exemplary.

3.3 NEW YORK

Until March 1971 the New York State Public Service Commission (PSC) was responsible for overseeing safety at rail-highway grade crossings. The PSC performed annual inspections and investigated accidents. During the time of PSC jurisdiction the state had an active crossing improvement program. From 1956-1973 improvements were funded equally by the state and the railroads; in 1973 the share of costs changed to 90 percent state and 10 percent railroad. Installation of warning devices comprised the major portion of the program, but some crossing surfaces were improved if the work could be incorporated into a

highway project. Section "G" funds were used for crossing improvements which could be part of a highway project. A separate program, funded in total by state funds, eliminated 2,000 crossings through bridge construction. The grade separation program still exists but funding varies from year to year. When the Legislature created the New York State Department of Transportation (NYDOT) in March 1971, it transferred the PSC regulatory activities dealing with railroads to the NYDOT.

Although New York had a history of state involvement in grade crossing improvement, the state did not begin to participate in the federal program until 1976. The state's Division of Budget considered federal money appropriated to the state to be state money. Since state law limited the state share of crossing improvements to 90 percent, state funds could not be used for the 10 percent local share. The railroads were unable to offer the 10 percent, but in a number of instances localities paid it. The program could not really get under way until the state law was changed. Finally in 1976 the appropriate legislative change occurred and the NYDOT developed a procedure for using the federal funds.

The Traffic and Safety Division (TSD) of the NYDOT is responsible for prioritizing crossings. The TSD uses a hazard index, accident data and indications of local "trouble spots" in arriving at a list of candidate crossings. Data from site inspections performed by Regional Traffic Engineers is also used in selecting the crossings included in the annual program. The

railroads are not consulted in the prioritization process but they have the right to contest the TSD's recommendations by requesting a hearing. Once the annual program is set, the Bridge Planning and Railway Bureau takes responsibility for negotiating with the railroads and authorizing construction. However, if signals are involved in a project TSD must review the project plans.

The project negotiation phase can be time-consuming due to the number of approvals required. The state does not use master agreements and an individual legal agreement is signed for each project. The State Controller must certify the availability of funds before the Bridge Bureau authorizes the railroad to begin construction. For off-system projects, additional approvals are required from the Community Development Section, which oversees off-system funds, and the locality, if the crossing is off the state highway system. Once construction begins, a Regional Traffic Engineer oversees the activity.

The state reimburses the railroad for all costs in a "first and final" payment upon project completion. Since May 1977, it has been possible for the railroads to submit monthly progress billings. If a contractor performed the work, the state pays the contractor directly (The Delaware and Hudson, a relatively small railroad, has used contractors because of a lack of adequate in-house labor to do construction). Signal installations are always inspected by the TSD and the FHWA. For projects not involving

active warning devices, the FHWA inspects the completed jobs on a sampling basis.

Because New York had difficulties in initiating its program, total project activity to date lags behind other states. In addition, Conrail, which controls 70 percent of the state's crossings, has been slow in preparing project applications. The work undertaken thus far has involved signs, surfaces, and signals. Rubber has been used almost exclusively for new surfaces on major roads. Signal installations have included motion sensors and constant warning time devices. The TSD endorses the use of these signal systems and encourages the railroads to use them.

Unlike Massachusetts, the FHWA Division Office in New York does not play an active role in the grade crossing program. It does no field inspection until a project is completed and has no direct contact with the railroads. In general, its role is one of review and approval.

The NYDOT has significant regulatory authority but due to staffing shortages has not been able to fully exercise its power. Routine signal inspections are now done on a sampling rather than annual basis. The TSD, the group within the NYDOT which has regulatory powers, can influence the use of innovative signal devices through its review function. However, once again the railroads must initiate a proposal for a new signal system.

Because of New York's active state program in the 1960's, its crossings were in relatively good condition when the federal

program was established. A successful state program should have facilitated initiation of the federal program, but in New York's case a delay in modifying a state statute prevented it from using the federal funds for almost three years. This case study illustrates one type of start-up problem which other states have also encountered.

3.4 LOUISIANA

Railroads in Louisiana operate their grade crossings with relatively little control from the state. According to Louisiana state law the only obligations of the railroads with regard to grade crossings are to erect crossbuck signs at crossings not contained in the maintenance system of the State Highway Department (LHD)* and to construct and maintain a suitable and convenient crossing over any public road which its tracks cross.** The Public Service Commission subsumed the powers of the old Railroad Commission, which had the power to see that railroads kept roadbeds and tracks in safe condition. The absence of an active regulatory agency has given the railroads the freedom to determine the warning device level at their crossings.

Prior to passage of the 1973 Highway Act, Louisiana had a limited, state grade crossing program for crossings not on the

*La. Rev. Stat. Ann. ch. 45, sec. 562 (1972, Cum. Annual Pocket Part).

**La. Rev. Stat. Ann. ch. 45, sec. 841 (1950).

Federal-Aid System. Initially, the improvements were funded equally by the state and the railroads, but in 1973 the cost allocation was changed to 90 percent state and 10 percent railroad. This program improved 10 to 12 crossings per year and "G" funds covered another 8 crossings. When federal funding became available, the prioritized list developed for the state program was used temporarily while the LHD officials developed a new list based on the New Hampshire formula.* While Louisiana's state program had been modest, it provided state officials with enough experience to initiate a more comprehensive program using 203 and 230 funds.

Louisiana's procedures are simple and in many ways are similar to those of Massachusetts. Project prioritization is based on a hazard index but accident data provided by the state police is also considered by the LHD in identifying hazardous crossings. On-site inspections by a team composed of the Highway District Engineer, a railroad representative, an FHWA engineer, and at times a local city engineer, determine the appropriate improvements for the crossings on the prioritized list. Following the inspection, the railroad prepares a cost estimate which goes to the LHD and then to the FHWA.

Following preliminary FHWA approval, the railroad may order materials and prepares a detailed Plan, Specification and

*The New Hampshire formula is a method for computing a hazard index for a crossing. This hazard index is a function of train volume, vehicular traffic and the warning level for the crossing.

Estimate (PS&E). The LHD obligates funds and issues a work authorization when all plans are in order. The time from on-site inspection to issuance of a work order to begin construction can range from 3 to 12 months depending upon whether or not a master agreement is in effect (Currently the state has negotiated master agreements with 5 railroads).

A project engineer monitors construction. After construction is complete the LHD and the FHWA inspect the work. For projects involving only passive devices, the FHWA inspects on a sampling basis.

The improvements made to date in Louisiana involve signals and surfaces. State and FHWA officials are sceptical about the effectiveness of gates, but where the railroad can justify the need for them, they are installed. Some railroads operating in the state encourage the use of motion detecting devices but others have resisted their use. For surface projects, rubber is installed where ADT exceeds 1,000. Otherwise timber is used. The extensive use of rubber is due to Louisiana's poor subsoil conditions. The LHD feels that rubber on poor subsoil is less likely to break up than other materials although even rubber surfaces have not always been satisfactory (See Figure 3-2).

All crossings in the state highway system have advance warning signs and pavement markings. A comprehensive signing program between the LHD and the Louisiana Highway Safety Commission is in the planning stage. This signing program will

be funded with 203 funds. Prior work has been done using other federal highway money.



FIGURE 3-2. Rubber Surface Starting to Break Apart Due to Louisiana's Poor Subsoil Conditions

The modest state program before 1973 gave state officials a foundation for implementing the federal program. According to the DOT-AAR inventory as of August 1976, only 805 of Louisiana's 4,928 crossings had active warning devices. The state has 1,356 multiple-track crossings which means that at a minimum, 551 multiple-track crossings do not have active devices. Applying the MUTCD suggestion that multiple track crossings be considered for automatic gates, one finds that there is potential for more work in Louisiana.

3.5 TEXAS

The magnitude of the grade crossing problem in Texas far exceeds that in the other four states. Texas has over 14,000 crossings, as many as the other four states combined. Over 1,000 of these crossings have no signs or signals. In 1975, fatalities resulting from crossing accidents in Texas were 10 percent of fatalities from grade crossing accidents nationwide.

Recognizing the severity of the grade crossing safety problem in the state, Texas instituted a state grade crossing program in 1968 using funds from the state's Highway Trust Fund. A total of \$1.5M per year was appropriated for crossings on the state highway system and \$0.25M for off-system crossings. The on-system funds included a limited maintenance subsidy for improved crossings. In conjunction with this program, the state's Highway Department (now called the State Department of Highways and Public Transportation - SDHPT) inventoried all of the state's crossings and developed a prioritizing technique.

The SDHPT has jurisdiction over all public transportation in the state. This authority includes administration and funding of programs, conducting hearings and investigating problems.* While the state statute governing the SDHPT does not specifically discuss grade crossing safety, the authority to oversee grade crossings is implicit because the railroads are common carriers.

*TEX. CIV. STAT. art. 6663(b) (1969).

Texas has a Railroad Commission but this agency does not exercise any power over grade crossings. Prior to establishment of SDHPT, the Railroad Commission was empowered to oversee crossing safety. The Railroad Commission now forwards all complaints concerning grade crossings to SDHPT. Because of the broadly worded state statute, the SDHPT could potentially regulate crossing safety very strictly, through inspections and penalties, for failure to comply with regulations. However, the SDHPT has not adopted an aggressive regulatory posture.

The Governor's Representative for Highway Safety, the Office of Traffic Safety (OTS), is a part of the SDHPT and plays an active role in grade crossing programs. The Texas Governor's Representative is more involved in grade crossing safety than the Governor's Representatives of the other four states considered. This office has ten district offices which identify highway safety projects. The OTS ranks the projects recommended by the district offices and develops an annual highway safety plan. Grade crossing improvements are among the planned safety projects. The OTS also controls Section 402 and 230 funds.

The Railroad Section of the Bridge Division in the SDHPT developed expertise in managing the state grade crossing programs and became the focal point for the 203 program. Since the federal grade-crossing program requires interaction with the FHWA, the Railroad Section had to modify its procedures to incorporate the new program. The experience of the state program and the availability of funds through the Highway Trust Fund

enabled Texas to take advantage of federal funds when they became available.

Annually, the Bridge Division computes a priority index and ranks all of the state's crossings. Inputs from Highway District Engineers, Traffic Safety Coordinators reporting to the OTS, railroads and localities are used to select the final set of projects for the year. The Highway Commission approves the annual plan and commits state funds at this stage. The full Highway Commission is only involved in approving the annual plan. It does not have to approve each individual project as is done in Massachusetts by the DPW commissioners.

The FHWA becomes involved after an annual program is formulated and agreed upon. At this point a diagnostic team composed of representatives of the FHWA, the SDHPT, the railroad and the locality, if the crossing is off the Federal-Aid System, visits each project site to confirm project details. Most states use a diagnostic team as part of the project identification process but in Texas this group does its job at a later point in the project processing procedure. Texas has 25 district highway offices with sizable engineering staffs. Staff in these offices provide any field inspections which may be needed for project prioritizing. Thus the diagnostic team need not assemble until projects are identified. Given the size of the state, the use of field personnel is the more efficient route for preliminary site visits.

Texas does not use master agreements so a project agreement is signed for each project once the railroad has drawn up the required plans and cost estimate. When the railroad has the required materials on hand, the state will reimburse the railroad for up to 90 percent of its cost. The FHWA Division Office issues a letter authorizing construction after reviewing the complete plan. Construction monitoring is the responsibility of the appropriate District Engineer. When work is completed he notifies the SDHPT and a joint final inspection is done by the railroad, the FHWA and the SDHPT.

Section 203 and 230 funds have been used for signals and signs. All surface work is done under the state-funded program. Motion sensing devices are incorporated into many of the signal installations. Gates, cantilevers or flashing lights are used depending upon the particular crossing. Cantilevers are preferable for high speed or multi-lane roads because of the need for greater visibility. A signing inventory is under way to assess the signing requirements to bring all crossings in the state into compliance with MUTCD standards. The complete signing program will take 4 to 5 years to complete.

Texas has experimented with innovative signal devices, signs and surfaces, as shown in Figure 3-3. The Railroad Section keeps well informed on new products and has undertaken experimental signing and surface programs with state funds. A great many of Texas' crossings still need improvement. Given efficient program management structure and the enthusiasm of state highway

officials for experimenting with new products, the needed improvements are likely to be undertaken under either the federal or the state programs.

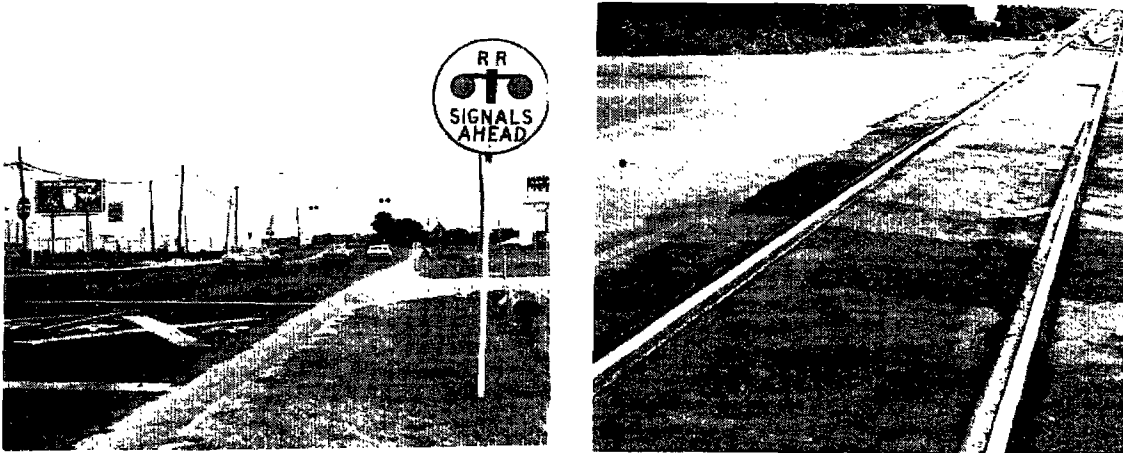


FIGURE 3-3. Innovative Devices Tested in Texas Include Advance Warning Signs and Surfaces Made From Used Rubber Tires

3.6 OREGON

Oregon's Public Utilities Commission (PUC) has been concerned with grade crossing safety since 1917. The PUC currently has jurisdiction over all construction at the state's 2,969 crossings including surfaces, signals, signs and lighting. In addition to PUC concern, several local traffic safety commissions established by the Governor's Representative for

Safety have addressed themselves to grade crossing hazards. Both the PUC and the local commissions lobbied for the establishment of the state's Grade Crossing Protection Account established in 1973. The fund, which derives its revenues from the state's Highway Trust Fund, was originally designed to support a state grade crossing improvement program, but it also became the source of the 10 percent required to obtain federal funding.

The PUC became active in grade crossing safety in the late 1960's. It instituted a crossing inspection program involving field inspections of every crossing at two to three-year intervals. Other activities of the PUC during the 1960's included development of a hazard index.

When federal funds became available for crossing improvements, Oregon was in an ideal situation to take advantage of them. The newly created Grade Crossing Protection Fund was available to meet the state's share of projects. The PUC had a project prioritizing system. State officials were concerned about crossing safety and were anxious to get a program under way. Since the state was in the midst of setting up its own program, the federal program was easily incorporated.

Oregon's procedures are more complex than those of any of the other states considered. The Highway Division in the State's DOT is responsible for developing an annual grade crossing program. However, the basis for the Highway Division's program is the PUC's hazard index calculations and accident reports. After the Highway Division, the PUC and the railroad agree on an

annual program, a lengthy project negotiation and authorization phase begins. Detailed project plans are developed by the railroad following FHWA Division Office concurrence on the annual program. If a master agreement is not in effect, a service agreement must be signed by the state, the FHWA Division Office and the railroad. A PUC application must be prepared by the Highway Division for each project after receipt of the application. The PUC's Rate and Service Division notifies interested parties, including local planning agencies, of the proposed project and solicits comments. Local government agreement must also be obtained at this time. If there are objections to a proposed project, the PUC holds a hearing to resolve the differences. Once all involved parties agree upon the project, the PUC issues a final order for the work and obligates state funds. Copies of the PUC order go to all parties and spell out in detail the obligations of each group.

Resident engineers from the Highway Division monitor construction. When the railroad finishes construction, the resident engineer notifies the Highway Division, which installs curbs, guardrails and passive warning devices. Each group notifies the PUC when its work is done and the PUC makes a final inspection. The railroad is reimbursed 90 percent of the construction costs when a bill is submitted. The remaining 10 percent is paid after a PUC audit of the railroad's accounting records. The Highway Division administers the state funds but PUC approval is required before disbursement.

The majority of the improvements made under the federal program are signal systems. Figure 3-4 shows a crossing scheduled for a new signal system. Almost all signal projects involve gates and motion sensors. Oregon chose to use federal funds for signals and signs. Surface improvements are paid for by the railroads. Statewide signing needs were assessed through



FIGURE 3-4 Crossings Scheduled for Improvement in Oregon
Involve Installation of Gates Coordinated with
Traffic Signals

an inventory paid for by state funds. State officials estimate that all signing will meet MUTCD standards by August 1978. The state is also experimenting with floodlights at crossings where

high-speed Amtrak trains travel at night. This project is paid for by the railroads and the state.

Oregon's procedures are designed to allow the maximum opportunity for public comment. Not only are the localities involved, but the PUC invites other planning agencies to comment. Oregon seems to have compromised on project processing time in order to allow for this review process.

The PUC in Oregon plays a more active role in the whole grade crossing improvement program than the regulatory agencies in any of the other four states considered. In addition to its regulatory activities, the PUC is involved in the analysis and planning of the annual program. While the Highway Division administers the program, the PUC controls obligation of funds. This case study illustrates the administration of the grade crossing improvement program in a state with an active and powerful regulatory agency which encourages public participation and review of all projects.

4. CHARACTERISTICS OF STATE PROGRAMS

4.1 PROGRAM INITIATION

4.1.1 Problems

Development of state programs for 203 and 230 funds began in all but one of the case study states when the FHWA announced the availability of funds. New York encountered a legal obstacle which effectively barred its participation in the program. However, the other four states had their share of problems which slowed down program initiation. Louisiana and Massachusetts spent up to a year negotiating master agreements, but both states concur that the delay at the outset was worth the time saved in project processing now that the agreements are signed. The Highway Departments in Louisiana and New York are prohibited by law from working on roads not in the state highway system. New York overcame this problem by obtaining approval from the locality for the state to install pavement markings and signs. Louisiana's Highway Department does not want to work outside of the state system.

New York's problems were further aggravated by the bankrupt state of its railroads. Seventy percent of New York's crossings were controlled by bankrupt railroads. Railroad managers were not motivated to start a crossing improvement program because of the more pressing problems of company survival. A lack of

support from the state's major railroads made NYDOT's task of instituting the new program and getting a legislative change even more difficult.

4.1.2 Facilitating Factors

The existence of prior state programs in Texas, Louisiana and Oregon meant that these states had staff who were accustomed to working with the railroads and a program management structure that was in place. All three states used their prior programs as a basis for organizing the federal program. New York's experience with a state program was moderately useful once its legal problems were solved. The value of the experience was diminished by state government reorganization which moved the old PSC functions to the NYDOT. Only one of the old PSC program staff is currently at the NYDOT.

The availability of state funds for the local share contributed to early program inception in several states. State Highway Trust Funds were available in Texas and Oregon to provide the local share so no legislative action was required for funding. In Louisiana and Massachusetts, the funds are drawn from the Highway Department's annual budget. New York's matching funds are appropriated annually by its legislature. The Trust Fund approach is more efficient because it does not involve the delays inherent in the legislative process. Until October 1977, Oregon required the localities where crossing improvements were scheduled to contribute 5 percent of the project cost. Many

towns had difficulty appropriating their share and consequently some projects were delayed. Finally, the state decided to assume the entire local share in order to insure that needed improvements were made. Texas still requires localities to provide the local share for off-system projects, but the state will help meet the local share if the locality has financial difficulties. In general, as long as the local share is contributed by the state government rather than localities, the source of funding is not a problem.

The railroad's initiatives in Massachusetts and Louisiana undoubtedly helped to get programs under way in these states. In addition, the economic conditions in Massachusetts made the state receptive to any federal spending program which meant added employment.

4.2 PROJECT PROCESSING PROCEDURES

The project processing procedures of each state are described in detail in the appendices to this report. The reader is referred to them for flowcharts for each state. All of the state procedures can be characterized by four phases: project identification, project negotiation and authorization, project initiation, and project completion. The amount of activity in each phase varies from state to state, as the flowcharts in the appendices show. Massachusetts and Louisiana have the simplest process involving a minimal number of agencies. New York and

Oregon require elaborate negotiation and authorization. The Texas procedure is not overly complicated considering the size of the state and the number of crossings in the state. Texas relies heavily on its District Offices while the other states do not.

The four phases of the project processing procedure are discussed below:

- (1) Project Identification - The first phase involves identification and prioritization of hazardous crossings. Prioritization may be based on a hazard or priority index, accident data, and citizen complaints. The State Highway Department is responsible for this activity but inputs are usually solicited from the railroads, the regulatory agency if one exists, District Highway Engineers and local Highway Safety Coordinators. A diagnostic team including representatives of the State Highway Department, the FHWA, the railroad, the regulatory agency and sometimes the locality may visit the crossings to determine the needed treatment.
- (2) Negotiation and Authorization - When the State Highway Department has identified a program of crossing improvements, negotiations begin with the relevant railroads to draw detailed plans and prepare cost estimates. If signals are involved, the state's regulatory agency reviews the plans. If a master agreement does not exist, the state and the railroad

negotiate a project agreement. The FHWA reviews the project plans and obligates the federal share. State funds are usually committed in this phase.

- (3) Project Initiation - Responsibility for overseeing construction moves to field offices of the State Highway Department. The construction period itself lasts only one to two weeks but the time that elapses between project identification and the start of construction may be as high as one year because of delays in the negotiation and authorization phase and lead times in obtaining materials. The more approvals required, the longer the process takes.
- (4) Project Completion - This phase involves inspection of the completed work by the State Highway Department and FHWA officials. If signals are involved, the regulatory agency inspects and tests the system before it goes into service. Railroad officials prepare final bills for submission to the state. The state pays the railroad and submits its bill to the FHWA. Delays of up to six months may occur between completion of construction and receipt of bills at the FHWA.

The following features expedite project processing:

- (1) Master agreements;
- (2) Identical procedures for both on and off-system projects;
- (3) Progress billing and cash advances to the railroads;

- (4) Use of contract labor when in-house staff is inadequate;
- (5) Pre-assembling of materials indoors during winter months;
- (6) FHWA authorization to order materials prior to preparation of final project plans; and
- (7) Use of field personnel to monitor on-site construction.

Under the old 230 program (Safer Roads Demonstration Program) the law allowed each state to determine which office would control the money. This resulted in different approval cycles for on and off-system crossings in two of the case study states, New York and Texas. The new funding for off-system crossings comes out of Section 203 as do the funds for on-system crossings so the differences in procedures between the two groups of crossings should no longer exist.

Laws in some states may prohibit adoption of some of the features mentioned above. Progress billing and cash advances are not permitted in Texas. In other states such as Louisiana, state law requires all materials to be assembled in-state. This can cause a problem for railroads that operate in several states but want to do all of their assembly in one location.

FHWA regulations provide several mechanisms to expedite projects. The FHWA Division Office may authorize ordering of materials prior to completion of all detailed plans and final authorization. The early ordering of materials compensates for the long lead time on signal equipment. Another recent addition

to FHWA's regulations provides for lump sum payments. Under this payment plan the railroad, the state and the FHWA agree on the project cost in the authorization phase. Once construction is completed the state, and in turn, the railroad is reimbursed by the FHWA at the agreed upon cost without any additional billing or auditing. The only potential delay when using this plan is that if the total project cost exceeds \$50,000, the FHWA requires a pre-award audit. Texas is currently experimenting with lump sum payments in its projects with Southern Pacific.

All of the states use staff in their regional highway district offices to monitor construction. Since the district offices have easy access to the construction sites, the railroads can coordinate with the engineer assigned to monitor the project. Such local contact is particularly useful when there are problems. The railroads are in favor of this arrangement.

4.3 ROLE OF REGULATORY AGENCY

Three of the five states examined in this study have regulatory agencies with jurisdiction over rail-highway grade crossings. Massachusetts and Oregon have separate agencies while in New York the regulatory power lies within the NYDOT. Texas has a Railway Commission but the Commission's statutory powers do not deal with rail-highway grade crossings. Louisiana's Public Service Commission has statutory jurisdiction over crossings, but it does not exercise its powers.

The presence of an active state regulatory agency has a pronounced effect on grade crossing safety. The regulatory agency performs a policing function in the interest of protecting the public against potential hazards at-grade crossings. Through routine inspections and accident investigations, the agency can determine the need for improvements and order them. The lack of a regulatory agency essentially leaves the railroads free to mark crossings and install warning devices at their own discretion. The primary motivation for a railroad to upgrade crossings under these circumstances is the consequences of an accident if it does not improve the crossing.

The regulatory agency also serves as a focal point for public complaints and comments. Citizens can notify the agency when signals malfunction or when they believe a crossing is hazardous. The regulatory agency usually has the power to ensure that malfunctioning equipment is repaired. In the absence of a regulatory agency, complaints go to the Highway Department or the FHWA Division Office.

Accident investigation is another function of the regulatory agency. The circumstances of the accident as well as the condition of the signals and of the crossing surface are pertinent to this investigation. If a regulatory agency does not exist, the state police perform the type of accident follow-up that they do for traffic accidents. A police investigation is probably not as complete as that of an agency primarily concerned with railroad problems.

Project prioritization is based on both citizen complaints and results of accident investigations. Such input is more detailed and complete if processed and provided by a state regulatory agency. Some 50 percent of Oregon's projects are initiated in the PUC as a result of railroad and citizen complaints. The role of Oregon's PUC in selecting crossings for the state's annual program also includes computing priority indices. The Massachusetts DPU provides input to the DPW, which does the prioritizing, but because of the subjective nature of the Massachusetts prioritization process it is difficult to determine to what extent the DPU information is used.

Oregon's PUC considers crossings as part of a "local system". For example, in assessing potential crossing improvements, the PUC considers whether or not other crossings ought to be closed. Traffic flow patterns as well as safety are considered in developing a "grade crossing" plan for a locality. A variety of funding sources may be tapped to carry out crossing closings and warning improvements.

4.4 USE OF OTHER FUNDS

The FHWA Region 6 Office has encouraged states under its jurisdiction to use other available highway funds in the 1973 and 1976 Acts for crossing improvements. Texas and Louisiana have taken advantage of this because the 203 and 230 funds are not adequate for their needs. Both states have used Section 402

funds for advance warning signs. Louisiana hopes to use 402 money to replace crossing inventory markers. In the past, Texas has used this money for sign replacement, but the current statewide advance warning sign program will be paid for from 203 funds. In addition, Texas has used Section 205 money for pavement markings.

Section 219 funds were unrestricted funds to be used at the discretion of localities on off-system roads. Louisiana made the money available to each parish (a Louisiana political subdivision comparable to a county) for safety improvements, but only a few used the money for grade crossing programs.

By taking advantage of other highway funding, Texas and Louisiana have been able to reserve 203 money for signal and surface work. The other three states have ample 203 funds to cover all signing, surface and signal work and do not need to use the other funds. The discretionary nature of many FHWA programs allows the states to tailor the available funding for their own particular needs.

4.5 MAINTENANCE OF IMPROVED CROSSINGS

Master agreements and project agreements between states and railroads clearly state that the railroad is responsible for maintenance of all signal and surface improvements made with 203 or 230 money. In Texas, the state provides a small maintenance subsidy to the railroads out of the state's Highway Trust Fund.

Many of the railroads interviewed expressed a desire for the federal government to contribute to rising maintenance costs. Signs are usually maintained by the State Highway Department if they are on the state highway system, or by the locality if they are off-system. Crossbuck maintenance is the responsibility of the railroads because crossbucks are usually on railroad property.

4.6 ROLE OF FEDERAL HIGHWAY ADMINISTRATION

4.6.1 Program Regulations

All FHWA programs must follow the procedures and requirements set forth by the FHWA in the Federal-Aid Highway Program Manual (FHPM). In July 1974 the FHWA issued Volume 6, Chapter 8, Section 2, Subsection 1 of the FHPM, which deals with the Highway Safety Improvement Program. The grade crossing program is a part of the Highway Safety Program. This section of the FHPM prescribes policies, procedures and guidelines. It requires the states to establish a priority schedule of crossing improvements based on the state's current hazard index, an on-site inspection and the site's accident history. The legislative requirement that at least one-half of Section 203 funds be used for warning devices is noted in this section along with the requirement for minimum signing at all crossings. This section constitutes general guidelines for identifying projects and does

not indicate any specific procedure. However, states are required to have a prioritizing procedure.

FHPM 6-6-2-1 describes the policies and procedures for railroad-highway projects. Crossing improvements which may be paid for with federal funds include:

- (1) Installation of standard signs and pavement markings;
- (2) Installation or replacement of active warning devices;
- (3) Upgrading of active warning devices;
- (4) Crossing illumination;
- (5) Crossing surface improvements; and
- (6) General site improvements.

All traffic control devices must conform to the requirements set forth in the MUTCD. The section also requires that there be a written agreement between the state and the railroad specifying the work to be done and the responsibilities of each party. Master agreements or individual project agreements satisfy this requirement. This section further states that states cannot require railroads to contribute to the required 10 percent state share of project cost.

The FHWA's procedures provide several mechanisms for expediting projects. A lump sum payment in lieu of later determination of actual costs is one such measure. This payment scheme requires that the railroad and the state agree upon the cost of the project based on planning estimates. When construction terminates, the railroad is reimbursed for the agreed-upon cost without any detailed bill or audit. However,

where the lump sum method is used, periodic reviews of the railroad's methods and cost data are made. Another expediting provision of the FHWA's regulations is that the FHWA Division Office may authorize ordering of materials prior to approval of final plans, specifications and estimates. The lump sum procedure has not been widely used by the five states considered in this study but all of the states do encourage early ordering of materials.

Another section of the FHPM (6-6-2-3) is intended as an aid in selecting suitable crossing surfaces. A list of factors to consider in selecting a surface material is presented as well as a general description of each surface type. This section of the FHPM is informational; it does not set forth any requirements or standards. While MUTCD standards govern signals, signs and pavement markings, no similar set of standards exists for surfaces. Since adherence to MUTCD standards is a prerequisite for FHWA funds, the FHWA can exert some control over signal and signing projects. However, the FHWA has no mandatory standards for surfaces.

4.6.2 Program Administration

The participation of FHWA Division Offices at the state level varies from a limited involvement in New York and Oregon to an active one in Louisiana, Texas and Massachusetts. In New York and Oregon the FHWA does no field inspection until work is

completed and then the inspection is merely to verify that the work was done. In the other three states the FHWA is a member of the diagnostic team and follows project processing from prioritization to final bill payment. Region 6 (Texas and Louisiana) and Oregon have Safety Coordinators in each Division Office to oversee all safety projects. The decision to appoint a Safety Coordinator rests with the Regional Administrator and the majority of the Division Offices throughout the country have Safety Coordinators. State and railroad officials feel that working with a safety specialist is an advantage.

In Louisiana, the FHWA has taken an active part in attempting to resolve problems between the state and the railroads in initiating construction. In New York and Oregon, the FHWA does not interact with the railroads. Railroad officials welcome active FHWA participation but find the differences among Division Offices inconvenient. FHWA participation in all states could, potentially, introduce uniformity among the various states, but, because the Division Office's functioning varies, there is a lack of consistent FHWA involvement and guidance.

Availability of data on project activity differs by state, as is evident from the appendices. Information on the amount of funds obligated is always readily available from Division Offices. Easy access to this data suggests that obligations are probably a major indicator of program progress. Data on the

number of projects initiated to date or the number of crossings improved was not easily accessible in Division Offices.

5. CONCLUSIONS

The five case studies revealed a number of institutional factors which contributed to effective implementation of state rail-highway grade crossing improvement programs. The availability of state funds for the 10 percent local share of costs appears to be a prerequisite to a successful program. Funding from a State Highway Trust Fund is ideal because it avoids legislative actions, but states which must seek legislative approval of the proposed grade crossing budget each year have been successful as well. Master agreements provide a means to reduce total project processing by several months. While the process of negotiating them is time consuming, there is unanimous agreement among the states interviewed that use them that the negotiation process is worth the time. Progress billing and cash advances, pre-assembly of materials and lump sum billing are additional measures to expedite project processing. The presence of an active regulatory agency which issues regulations and does periodic inspections assures that the most hazardous crossings will be improved. Finally, cooperation among the railroads, the state agencies, and the FHWA Division Office is essential for an effective state program.

This study focused on state government structure and procedures with which the railroads must work. It is worth remembering that the states must work with different railroad

management structures just as the railroads must face different state organizations. Some railroads, such as Conrail, centralize project approval and processing in one location. Such centralizing makes project processing extremely slow. In contrast, the Southern Pacific, as well as many of the other large railroads, are divided into divisions with authority to negotiate projects. This type of decentralized structure fosters and speeds project activity.

The primary purpose of this study was to identify and understand the key institutional factors contributing to effective state programs. However, several problems were identified through the case studies which, if solved, would enhance the effectiveness of the federal grade crossing program. The remainder of this section identifies these problems and suggests areas where the program might be modified.

The DOT's Report to Congress in August 1972 recommended a ten-year program involving annual expenditures of \$75M and 3,000 warning device installations. The program was designed to "eliminate nearly 400 motor vehicle-train collisions annually and save some 500 lives per year." The program as it was originally conceived had a specific goal in terms of installations per year and long-term safety improvements. Four years after inception of the program, the only immediate goal of the program appears to be obligation of all of the available funds. Safety impacts, the long-term goals of this program, will not be evident for a few years. Meanwhile, more meaningful near-term goals which relate

to the safety aspect of the program are needed. At the end of the year each state might compare the actual number of projects initiated with a target number set at the beginning of the year when the prioritization was prepared. A further check might be done to see if the most hazardous situations have been remedied.

The current funding apportionment formula is unrelated to the number of crossings or accidents. Consequently, states like New York receive a substantial apportionment while Texas, which has over three times as many crossings and nine times the accidents, receives \$3 million less than New York. The disproportionate funding formula aggravates any attempts to achieve relatively uniform safety standards or goals on a nationwide basis. Alternative methods for apportioning funds for this program need further investigation.

Comparison of the types of improvements made in each state reveals a need for guidelines on the use of different surface materials. The use of rubber, for example, varies from state to state. Massachusetts uses rubber if the ADT exceeds 5,000 while Louisiana uses 1,000 ADT as a cutoff. New York uses rubber almost exclusively on major roads. Rubber surfaces are expensive, some \$400 per foot installed. There is the possibility that rubber is being used in places where other, less expensive materials would be satisfactory. To prevent excessive spending for surface materials and to provide uniform safety standards, the federal government should prepare and disseminate MUTCD-type guidelines for surface improvements. Section 6-6-2-3

of the Federal-Aid Highway Program Manual sets forth detailed engineering specifications for surfaces. This section should be updated and expanded to stress the applicability of various surfaces and their current costs. In addition, the FHWA should institute a procedure to insure that the surface guidelines are followed.

Each state has a state highway system which may be a subset of the Federal-Aid System. The result of this dual classification scheme is that crossings which are on both the state highway and Federal-Aid Systems are most likely to be improved, especially if the state has its own program. Crossings "off" both the state and federal systems are the least likely to be upgraded if the State Highway Department cannot work outside of the state system and is not motivated to get localities involved. This latter situation exists in Louisiana. One leverage that the FHWA has to assure that these off-system crossings are not ignored is for the FHWA Divisional Offices to insure that they are equitably considered in the prioritization procedure.

The FHWA was selected to oversee the grade crossing improvement program because of its involvement with State Highway Departments on road construction and the fact that the Highway Trust Fund, which is administered by the FHWA, is the principal source of funding for the program. This arrangement appears to have worked well. The FHWA was organized to monitor construction and in many cases the FHWA has worked with the state and railroad

personnel who participate in the grade crossing program. However, the FHWA Division Offices are not staffed with railroad Signal Engineers to review signal projects and must rely on the state regulatory agencies or Highway Departments for this function. If the federal government wanted to exert more influence on signal installations, the FHWA Division Office would require additional staff with experience in signal engineering. FRA Signal Inspectors in the various FRA Regional Offices could possibly provide the expertise through a joint FHWA-FRA arrangement.

Funds from the 1976 Highway Act will be available for obligation through FY81. As of June 30, 1977, only 54 percent of the available 203 funds had been obligated. This performance suggest that improved methods for implementing grade crossing safety equipment at the state level are needed. Suggestions made in this report are intended to provide alternatives to current practice.

GENERAL REFERENCES

1. Federal-Aid Highway Act of 1976, Public Law 94-280.
2. Federal-Aid Highway Program Manual, Vol 6, Chap. 6, Section 2.
Subsection 1: Railroad-Highway Projects, April 1975.
Subsection 3: Railroad-Highway Grade Crossing Surfaces, December 1975.
3. Highway Safety Act of 1973, Public Law 93-87.
4. Rail-Highway Grade Crossing Accidents, for the year ended December 31, 1975, U.S. Department of Transportation, Federal Railroad Administration, Office of Safety.
5. Report to Congress, Railroad-Highway Safety, Part I: A Comprehensive Statement of the Problem, November 1971, U.S. Department of Transportation.
6. Report to Congress, Railroad-Highway Safety, Part II: Recommendations for Resolving the Problem, August 1972, U.S. Department of Transportation.
7. Summary Statistics of the National Railroad-Highway Crossing Inventory for Public At-Grade Crossings, June 1977, Report No. FRA-OPPD-77-8, U.S. Department of Transportation, Federal Railroad Administration.

APPENDIX A: MASSACHUSETTS CASE STUDY

A.1 BACKGROUND

Prior to the passage of the 1973 Highway Act, the accident rate at Massachusetts' 1,230 public rail-highway grade crossings was relatively low (See Table A-1 for accident data 1963-1972). Joint effort on the part of the Department of Public Utilities (DPU), the state regulatory agency, and the railroads maintained this low accident rate.

The DPU, in accordance with its statutory responsibility, conducts a yearly inspection of track and signals at the 1,230 public grade crossings. It examines equipment and approaches without giving advance notice to the railroad. The deliberate lack of notice insures that the equipment will be in its usual operating condition.

Through grade crossing accident investigations and hearings, the DPU has evolved standards for levels of protection. The DPU has the power to order a crossing "to be protected by gates, flagman, flashing light signals or such protective measures as the department determines the better security of human life or the convenience of public travel requires..."* (See Table A-2 for actual track types and gate installations). State law provides that the cost of gates and other safety installations be apportioned by the DPU among the railroad, the city or town, and the political subdivision controlling the road.

*Mass. Gen. Laws, Ch. 160, Sec. 147.

TABLE A-1 MASSACHUSETTS ACCIDENT HISTORY 1963-1975

| | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Total Accidents/ Incidents | 8 | 11 | 10 | 9 | 8 | 14 | 12 | 15 | 13 | 8 | 11 | 10 | 58* |
| Total Killed | 3 | 2 | 1 | 18 | 4 | 1 | 3 | 5 | 5 | 5 | 5 | 2 | 2 |
| Total Injured | 8 | 15 | 12 | 26 | 9 | 17 | 15 | 3 | 11 | 12 | 9 | 8 | 18 |
| Total Casualties | 11 | 17 | 13 | 44 | 13 | 18 | 19 | 8 | 16 | 17 | 14 | 10 | 20 |

Source: Department of Transportation, Federal Railroad Administration Office of Safety, Rail-Highway Grade-Crossing Accidents, 1963-1975, Table 17 1963-1973, Table 17-A 1974-1975.

*An accident/incident is defined by FRA as any impact between railroad on-track equipment and a motor vehicle, cyclist or pedestrian, regardless of whether it resulted in any casualties or damage. Prior to 1975 accidents/incidents were reported if there were any casualties or if damages to railroad equipment exceeded \$750.

TABLE A-2 CHARACTERISTICS OF MASSACHUSETTS GRADE CROSSINGS

| | |
|----------------------------|------|
| Number of Public Crossings | 1230 |
| On Federal-Aid System | 542 |
| Off Federal-Aid System | 688 |

| <u>Number of Tracks</u> | <u>Number of Crossings</u> |
|-------------------------|----------------------------|
| 1 | 952 |
| 2 | 210 |
| 3 | 41 |
| 4 | 15 |
| 5 | 7 |
| >5 | 4 |

| <u>Warning Level</u> | <u>Number of Crossings</u> |
|--------------------------|----------------------------|
| Active: | |
| Gates | 164 |
| Flashing Lights | 442 |
| Highway Signals or Bells | <u>43</u> |
| Total with Active | |
| Warning | 649 |
| Passive: | |
| Special Protection | 247 |
| Crossbucks | 283 |
| Stop Signs | 2 |
| Other Signs | 2 |
| No Signs or Signals | <u>47</u> |
| Total with Passive | |
| Warning | 581 |

| <u>Railroad</u> | <u>Number of Crossings</u> |
|----------------------------|----------------------------|
| Boston and Maine | 583 |
| Conrail | 536 |
| Central Vermont | 43 |
| Providence and Worcester | 34 |
| Grafton and Upton | 29 |
| Fore River and New Bedford | 5 |

Source: DOT-AAR Grade Crossing Inventory as of August 1976

Although the fines for railroad non-compliance have been minimal -- many were set in the nineteenth century -- the DPU has at its disposal methods for insuring compliance. One of the strongest is the "stop and protect" order. This order requires that the railroad stop the train and place a crew member at the crossing to flag the vehicles until the train has passed. The DPU considers this measure with its attendant nuisance value a more severe penalty for non-compliance than monetary fines.

It should be noted that safety programs generally enjoy great popularity. Recognizing the generally negative public (and official) attitude towards highways and the more positive attitude toward safety programs, the Department of Public Works (DPW), which is the State Highway Department, adopted an attitude favorable to the grade crossing program. Furthermore, this program was properly perceived to be an employment generator, a significant economic aspect because of the high unemployment rate in Massachusetts.

State assumption of the 10 percent local share required by the 1973 Act was not a great issue since the benefits to be gained by this investment were considered substantial. There were no legal impediments to the DPW's assumption of the 10 percent share. In fact, the groundwork for financial assistance to railroads had already been laid in 1962. Specifically, state law authorized the DPU to enter into contracts with railroads whenever public works construction "... would entail relocation, alteration, or other work on the tracks, bridges, or other

property of such corporation and would disrupt the free flow of public transportation."* Furthermore, in situations where the Commonwealth is funding part of the construction, "...the agreement may provide for the monthly advancement by the department to such corporation of funds covering the estimated cost of such construction or work then in progress."**

The Boston and Maine Railroad (B&M) welcomed the grade crossing safety program. In order to acquaint all local officials with this new program, the B&M distributed Association of American Railroads (AAR) brochures explaining the 203 and 230 programs to every town in which the B&M had a grade crossing. Blanket distribution of information was part of the B&M's overall program intended to catalyze states and localities into action. Given the employment-generating nature of the project, the unions found no grounds for resistance. State provision of the local share removed any potential obstacle to railroad participation in the program.

*Mass. Gen. Laws, Ch. 81, Sec. 71.

**Ibid.

A.2 DESCRIPTION OF STATE PROCEDURAL MECHANISMS

The process through which FHWA 203 and 230 funds are translated into grade crossing treatment in Massachusetts can be divided into four phases. In Phase I, representatives of the Federal Highway Administration, the railroad, the Department of Public Works (DPW) and the Department of Public Utilities (DPU) participate in the diagnostic process. Phase II begins with the railroad taking initiative for preliminary engineering. The remainder of this phase consists of DPW processing for project review and funding. Phase III is primarily a period of construction by the railroad while Phase IV comprises the state and federal inspection period. The accompanying flowchart (Fig. A-1) illustrates the interactive process. A more detailed explanation of the process is found below.

Phase I: Project Identification

After passage of the Highway Act of 1973, the DPW undertook an inventory of rail-highway grade crossings and developed a system of prioritization for potential projects. Massachusetts decided not to use a hazard index. Instead, the DPW establishes project priorities using vehicle traffic and accident history weighted in indeterminate proportions. The DPW Traffic Engineer has responsibility for project prioritization. The diagnostic team makes on-site investigations based on DOT-AAR Grade Crossing Inventory data, DPU recommendations, and accident history. The

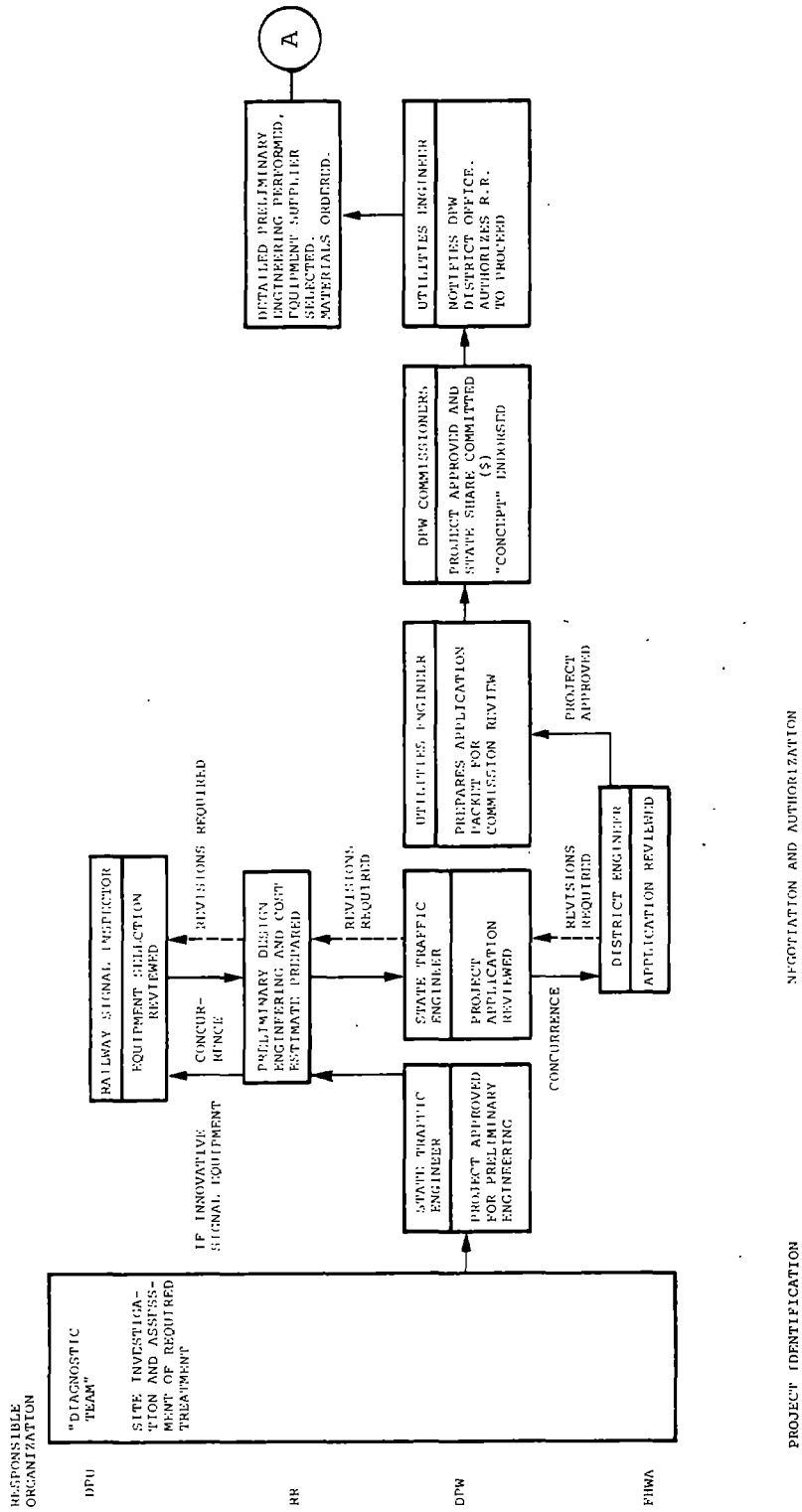


FIGURE A-1 MASSACHUSETTS PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (1 of 2)

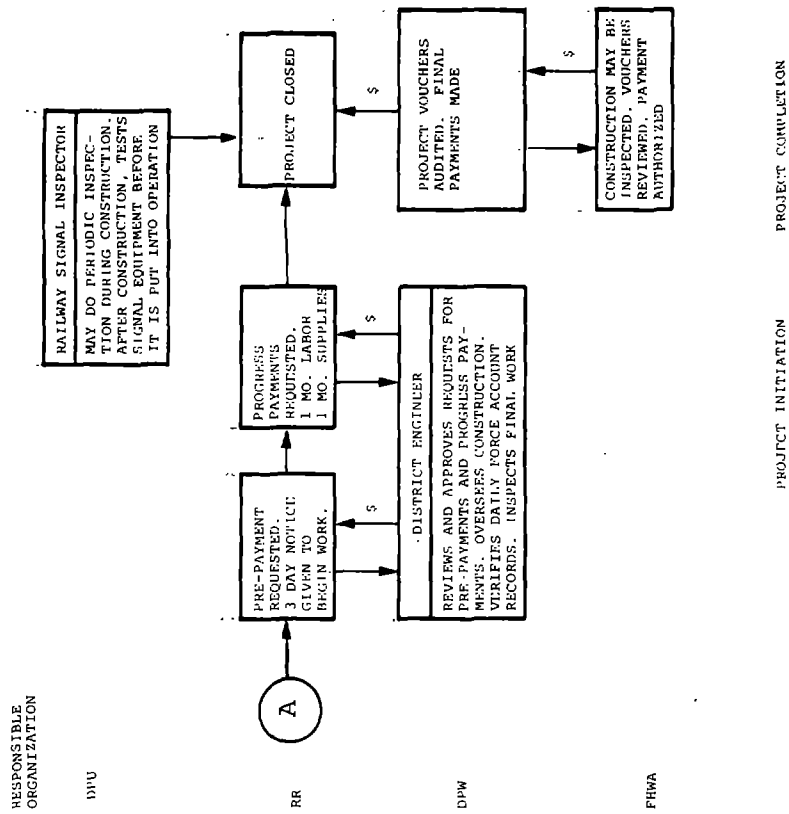


FIGURE A-1 MASSACHUSETTS PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (2 of 2)

team is made up of representatives of the Federal Highway Administration Division Office (FHWA), the Massachusetts Department of Public Utilities, the Massachusetts Department of Public Works and the railroad responsible for the particular crossing. During the on-site investigation, an agreement is reached as to the type of improvement needed and the DPW Traffic Engineer prepares a written authorization for the railroad to prepare a preliminary design and cost-estimate package based on the team analysis.

Phase II: Project Negotiation and Authorization

Much of the initiative for putting diagnostic team recommendations into effect rests with the railroads. Recognizing this, the DPW requires only an extremely simple preliminary application from the railroad. The application has three components: (1) project site identification on an area map, (2) a sketch of the work to be done, and (3) a cost estimate for materials and labor. The cost estimate is a "ball park" figure --the railroad will be reimbursed for whatever justifiable costs are incurred during construction provided a revised force account is submitted. Similarly, legal agreements are kept to a minimum through the use of a Master Force Account Agreement. This is the only legal agreement necessary for all projects undertaken. Once the railroad has entered into a master agreement with the state DPW, any crossing examined by the diagnostic team can be treated with no further legal negotiations. All six railroads with grade

crossings in Massachusetts have signed master agreements. To expedite project completion, both on-system (Section 203) and off-system (Section 230) funds are covered by the master agreement and are administered identically.

The completed preliminary design package is sent by the railroad to the DPW State Traffic Engineer, who reviews the application and either requires revisions or forwards the satisfactory application to the FHWA Division Office. The Division Office can process approvals in as little as two weeks. If any revisions are necessary, the FHWA Officer notifies the DPW Traffic Engineer, who notifies the railroads. Generally, the projects are approved as submitted.

The FHWA-approved preliminary design is routinely submitted to the DPW State Utilities Engineer, who prepares project documentation for funding consideration by the DPW Commissioners. If, however, the railroad wishes to use innovative equipment such as constant warning time devices, the railroad submits its choice of equipment to the DPU Railway Signal Inspector, who analyzes the type and brand of equipment chosen. After review, the DPU endorses selected equipment or explains its reservations regarding the equipment. After this stage, the preliminary engineering package containing innovative equipment is sent to the State Traffic Engineer.

Having reviewed the preliminary engineering package for conformance with diagnostic team recommendations, the FHWA District Officer forwards the approved application to the State

Utilities Engineer. It should be noted that when a project is approved, the railroad may be reimbursed for preliminary engineering work. The State Utilities Engineer prepares the approved proposal for presentation to the DPW Board of Commissioners at one of their regularly scheduled weekly meetings. Approval of the proposal by the Commissioners is on a conceptual basis. That is, the level of signaling or the type of surface is approved, but a particular piece of equipment is not specified. This "conceptual approval" process also includes the commitment of state monies for the local share of the project.

Phase III: Project Initiation

The greater portion of Phase III activity is railroad construction supervised by the appropriate DPW District Engineer, of which there are eight. The railroads select construction materials without competitive bidding. The chief determinants of signal equipment choice are compatibility with existing railway signal equipment installations and the need to carry a simple replacement/maintenance inventory. Generally, the railroads complete projects with their own union labor except in the case of small railroads which lack in-house expertise and therefore contract out the work.

The railroad must notify the District Engineer of intention to begin work at least three days in advance of construction initiation. Based on legislation allowing the DPW to advance funds to the railroad, a one-month advance for materials from the

state is secured by the DPW District Engineer if the railroad so requests. Similarly, the railroad can request cash for up to one month's labor in advance. Hence, the railroad never suffers a cash flow problem due to the project. The monitoring of on-site work, receiving of materials, sale of salvageables, and the auditing of daily force account records are the responsibility of the DPW District Engineer. If signals are included in the construction package, the DPU Railway Signal Engineer is likely to make on-site investigations during construction. As work progresses, the railroad may continue to request payments. The maximum amount likely to be advanced is 80 - 85 percent of the total project cost. The remaining 15 - 20 percent is given to the railroads after the project has been inspected and the records audited.

Phase IV: Project Completion

Upon project completion, the railroad prepares its vouchers for auditing and notifies the DPU of the crossing's condition. At signalized crossings, the DPU Railway Signal Engineer tests all signals before allowing the signals to control the crossing. Having inspected the crossing and certified that the work was properly completed, the DPW makes the final payment to the railroad. Cost vouchers for all projects are audited by the FHWA, but inspection of the work is done on a sampling basis. After the FHWA certifies project completion, the FHWA reimburses the DPW 90 percent of the project cost. This final reimbursement

process may require as much as one year beyond project construction completion.

A.3 TYPES OF IMPROVEMENTS

As of February 1977, Massachusetts had obligated all of its Section 203 and 230 funds available through FY77. The FHWA Division Office provided the following breakdown of the funding obligations by category of use:

| <u>Use</u> | <u>SOURCE</u> | |
|---------------------------------------|------------------|------------------|
| | <u>Sec. 203</u> | <u>Sec. 230</u> |
| Approach signing and pavement marking | \$ 605,296 | \$1,428,403 |
| Other warning devices | <u>5,125,379</u> | <u>3,972,735</u> |
| Total Obligations | \$5,730,675 | \$5,401,138 |

(The term, "Other warning devices," includes signals as well as surface treatment) As of 6/30/76, the FHWA reported that 94 percent of the Section 230 funds was used for railroad improvements.

Massachusetts has 542 crossings on the Federal-Aid System. This means that roughly \$10,000 per crossing is available for these crossings - \$1,500 more per crossing than the nationwide average. The types of improvements made under the 203 and 230 programs are described in the following sections.

A.3.1 Signs

The state has undertaken a program to make all signs and pavement markings consistent. As of February 1977, advance warning signs and crossbucks at 976 of the 1,230 public crossings were upgraded. A contract for work on the remaining 254 crossings was scheduled to begin in the spring. The statewide signing program will be completed by June 1978. Three reflectorized signs, pavement markings and breakaway crossbucks are the elements used in the marking program.

A.3.2 Surfaces

In Massachusetts, new crossing surface materials have been used extensively. A surface made from used rubber tires is being tested at several crossings but to date it has not been completely satisfactory. Two types of rubber, plastic, and bituminous concrete are being used successfully. The rubber and plastic surfaces are relatively new surface treatment techniques. Rubber is used for ADTs over 5,000 on mainline tracks. On non-mainline track, rubber is used for ADTs over 10,000.

A.3.3 Signals

The technology of grade crossing signals has changed very little in Massachusetts. Gate arms have been upgraded to incorporate some state-of-the-art advances. Wooden gate arms are being replaced with reflectorized fiberglass and aluminum ones. The DPU, in order to standardize all crossing markings throughout the state, requires that gate arms be marked in red and white as

specified by the MUTCD. The railroads are also using breakaway arms when replacements are made.

At the present time there is one motion sensor in use at a Conrail crossing, and the Providence and Worcester Railroad plans to install several more this year. The B&M does not have any innovative signal devices in use in Massachusetts, but does have one grade crossing predictor in operation in Mechanicsville, N.Y., at a heavily traveled crossing near a freight yard. This one application indicates the B&M's willingness to use innovative technology when required.

One signal system innovation used throughout the state is light pre-emption. In densely populated areas with traffic signals within 200 feet of a grade crossing, the DPU requires the use of light pre-emption systems. This mechanism coordinates the traffic signal with the crossing signal so that vehicular movement stops when a train approaches the crossing.

Of the 1,230 public crossings in Massachusetts, 920 are single-track, 210 are double-track, and 67 are triple-track or greater. Applying the criterion that a crossing of two or more tracks requires gates, we find that only 277 crossings in Massachusetts require gates. Currently, 164 crossings are equipped with gates. At a minimum, 113 multiple-track crossings need gates.

A.3.4 Maintenance

The railroads are responsible for maintenance of all signal equipment after installation. In addition, the railroads have

responsibility for maintaining all crossbucks whether installed by the state using federal funds or by the railroad with its funds. Although state law permits cities and towns to contribute to the maintenance expenses associated with signals and surfaces, few towns have exercised the option. Advance warning signs on state highways are maintained by the DPW. The localities are responsible for advance warning signs located elsewhere.

A.3.5 Factors Affecting Use of Innovative Technology

The DPU must approve all signal devices proposed by a railroad. The DPU Railway Signal Inspector can, therefore, exert considerable influence on whether or not any innovative devices are installed. However, the initiative for proposing an innovative signal system lies with the railroads and to a lesser extent with the diagnostic team. The railroads in the state, with the exception of the Providence and Worcester, have chosen to use conventional signal equipment.

There are two factors which have discouraged the railroads from upgrading their signals to incorporate motion sensor or constant warning time (CWT) devices. First, sophisticated equipment is costly to maintain; railroads, in general, want to avoid higher maintenance charges. The railroads are also concerned with potential liability in the event of an accident. The railroads claim that they do not know what their liability would be should an accident occur at a crossing where an innovative device was used.

APPENDIX B: NEW YORK CASE STUDY

B.1 BACKGROUND

Prior to March 1971, the New York State Public Service Commission (PSC) was responsible for overseeing railroad grade crossing safety. The PSC inspected crossings to insure proper functioning of warning devices, and investigated accidents. It had the power to order the railroads to improve crossings. Initially, the PSC held hearings to determine the necessity of improvements at a particular crossing, but this procedure was abandoned in the 1950's. Instead, the railroad was given the responsibility to show cause why the PSC-recommended improvements should not be undertaken. This shift in burden of proof probably encouraged warning device improvements.

It is difficult to determine the effect of PSC activities on accident incidence. Examination of the accident history (see Table B-1) for the period of PSC regulation reveals that the number of accidents, deaths, and injuries varied only slightly within a fixed range from 1963 through 1970. Assuming that the number of vehicle registrations increased each year and the level of rail traffic remained constant, we find a decline in accidents adjusted for vehicle registrations. Thus, if New York has 4,450 public at-grade crossings, there was not a serious state crossing problem.

TABLE B-1 NEW YORK ACCIDENT HISTORY 1963-1975

| | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Total Accidents/ Incidents | 71 | 90 | 71 | 80 | 72 | 64 | 75 | 64 | 62 | 34 | 37 | 55 | 154* |
| Total Killed | 34 | 33 | 31 | 40 | 32 | 20 | 34 | 13 | 21 | 14 | 13 | 24 | 11 |
| Total Injured | 74 | 87 | 78 | 80 | 84 | 58 | 74 | 67 | 62 | 93 | 36 | 55 | 38 |
| Total Casualties | 108 | 120 | 109 | 120 | 116 | 78 | 108 | 80 | 83 | 107 | 49 | 79 | 49 |

Source: Department of Transportation, Federal Railroad Administration Office of Safety, Rail-Highway Grade-Crossing Accidents, 1963-1975, Table 17 1963-1973, Table 17-A 1974-1975.

*An accident/incident is defined by FRA as any impact between railroad on-track equipment and a motor vehicle, cyclist or pedestrian, regardless of whether it resulted in any casualties or damage. Prior to 1975 accidents/incidents were reported if there were any casualties or if damages to railroad equipment exceeded \$750.

The PSC undertook a program for grade crossing improvement. Initially the improvements were funded equally by the railroads and the state, but in 1973 the sharing of costs was changed to 90 percent state and 10 percent railroad. From 1956 through 1960 the program progressed at a rate of 100 crossings improved per year. Program activity slowed between 1960 and 1970, primarily due to financial difficulties of the railroads. During this period, about 30 crossings per year were treated. Warning device improvement comprised the major portion of the program. However, some surface improvements were made at crossings on state roads scheduled for surface work as part of a highway project.

During the same period two additional state programs supported crossing improvements. The first involved the use of Section "G" money in conjunction with highway improvements. When crossings needing improvements were located on Federal-Aid System roads scheduled for upgrading, the crossing improvements were incorporated into the highway project and funded with Section "G" highway funds. Another program involved grade separation. This program was funded totally by the state. It involved building bridges over existing grade crossings to effect a grade separation. The program has eliminated over 2,000 crossings since its inception in the 1920's. This program still exists but funding varies from year to year.

In March 1971, the state legislature transferred responsibility for railroad regulation and grade crossing safety from the PSC to the New York Department of Transportation.

(NYDOT). The transfer of regulatory function was incorporated into legislation establishing the NYDOT. Former PSC staff were transferred to the NYDOT to support the regulatory activities. After the NYDOT assumed responsibility for overseeing the state's 4,450 public at-grade crossings (see Table B-2 for a description of the crossings), one of its major activities was coordinating the DOT-AAR inventory data with existing New York inventory data. In addition, it continued to perform the responsibilities previously held by the PSC.

Although New York had been very active in grade crossing improvements, the state did not begin to participate in the Section 203 and 230 programs until 1976. After passage of the 1973 Highway Act, the NYDOT was anxious to begin using the newly appropriated federal funds. The Division of Budget in the Executive Department of the state government (similar to OMB in the federal government) declared that there was a state law limiting state funding of grade crossing projects to 90 percent of the total cost. The Division of Budget considered federal funds given to the state to be state funds. Since the federal funds constituted 90 percent of project costs, the state could not pay the final 10 percent. The localities were not willing to provide the state share. The railroads were having financial difficulties and were not able to provide the 10 percent share. Consequently, the program could not begin. Finally, in 1976 the State Legislature amended the state code so that the Commissioner of Transportation could authorize expenditure of state funds to

TABLE B-2 CHARACTERISTICS OF NEW YORK GRADE CROSSINGS

| | |
|----------------------------|----------------------------|
| Number of Public Crossings | 4450 |
| On Federal-Aid System | 1090 |
| Off Federal-Aid System | 3360 |
| <u>Number of Tracks</u> | <u>Number of Crossings</u> |
| 1 | 3198 |
| 2 | 914 |
| 3 | 230 |
| 4 | 71 |
| 5 | 17 |
| >5 | 20 |
| <u>Warning Level</u> | <u>Number of Crossings</u> |
| Active: | |
| Gates | 674 |
| Flashing Lights | 1299 |
| Highway Signals or Bells | 104 |
| Total with Active | <u>2077</u> |
| Warning | |
| Passive: | |
| Special Protection | 536 |
| Crossbucks | 1547 |
| Stop Signs | 3 |
| Other Signs | 56 |
| No Signs or Signals | <u>231</u> |
| Total with Passive | <u>2373</u> |
| Warning | |
| <u>Railroad</u> | <u>Number of Crossings</u> |
| Conrail | 3093 |
| Delaware & Hudson | 412 |
| B & O (Chessie) | 155 |
| Long Island | 133 |
| Others (26) | 477 |

Source: DOT-AAR Grade Crossing Inventory as of August 1976

match federal funds available for railroad grade crossing work on any road system.* Funds for the state share of the crossing improvements are appropriated annually by the Legislature from general revenue. The NYDOT has indicated that to date sufficient funds have been appropriated.

A second legal obstacle was the inability of the NYDOT to work on crossings not on state highway system roads. In order for the NYDOT to perform work on a county, city or town road, the NYDOT must obtain a resolution from the locality authorizing the state to perform the work and making the locality responsible for maintenance of improvements on local roads. This restriction applies to pavement markings and advance warning signs. Unlike the first obstacle, this legal requirement still exists, but it has not been a problem for state officials.

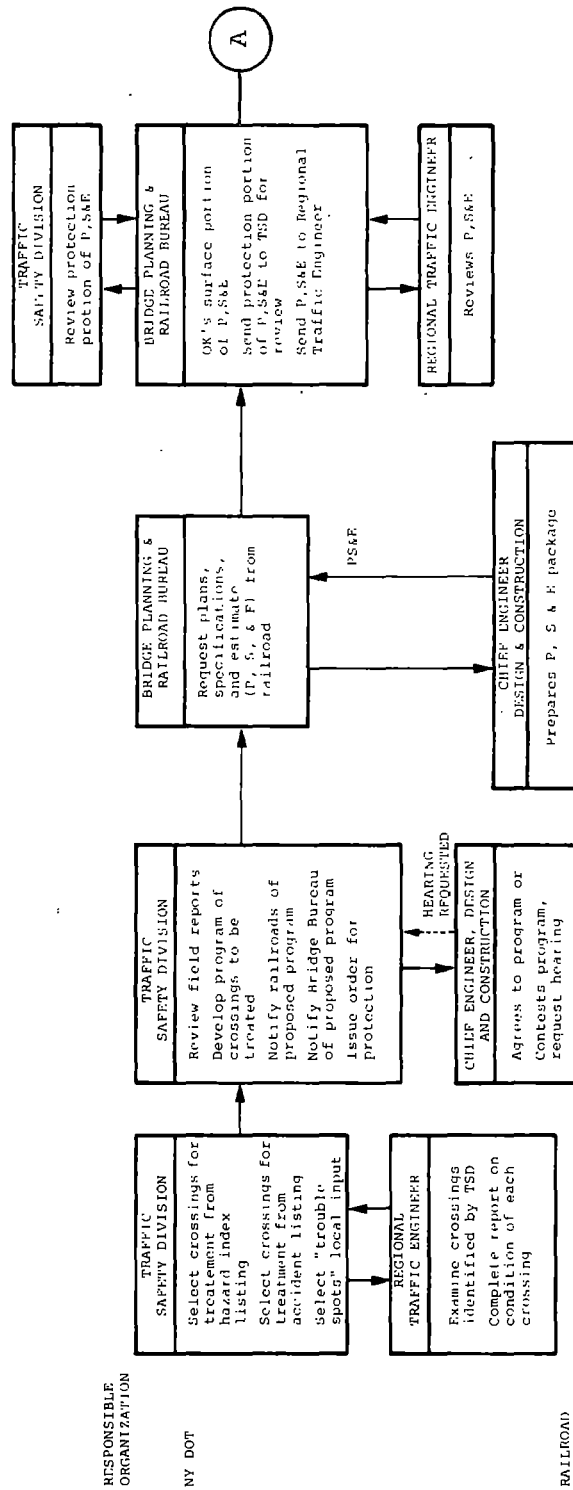
*Railroad Law Section 94, Subdivision 4 (a) as amended by the Laws of 1976, Chap. 946.

B.2 DESCRIPTION OF STATE PROCEDURAL MECHANISMS

New York State's procedure for selecting and implementing grade crossing improvements consists of four phases. In Phase I the Traffic and Safety Division identifies and investigates crossing conditions. Phase II is concerned with negotiations between the railroad and the NYDOT Traffic and Safety Division. Phase II also includes a complex state authorization process which involves not only the NYDOT budgetary bureaus (Capital Planning, and Audits and Accounts) but also the State Comptroller. During Phase III, construction, only the railroad and the NYDOT Regional Construction Section are involved. Phase IV, project completion, once again brings together the Regional Construction Section, the Traffic and Safety Division, Audits and Accounts, and finally, the FHWA. A more detailed discussion of the process follows. Figure B-1 illustrates the process in flowchart format.

PHASE I: Project Identification

The impetus for project identification originates in NYDOT's Traffic and Safety Division. The Railroad Safety Section, a subdivision of Traffic and Safety, annually prepares a list of approximately 500 crossings from the Hazard Index Listing, accident listings, and listings of miscellaneous local "trouble spots." The Railroad Safety Section then requests that the Regional Traffic Engineers in the Division's 10 regions



PROJECT IDENTIFICATION

NEGOTIATION AND AUTHORIZATION

FIGURE B-1 NEW YORK PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (1 of 2)

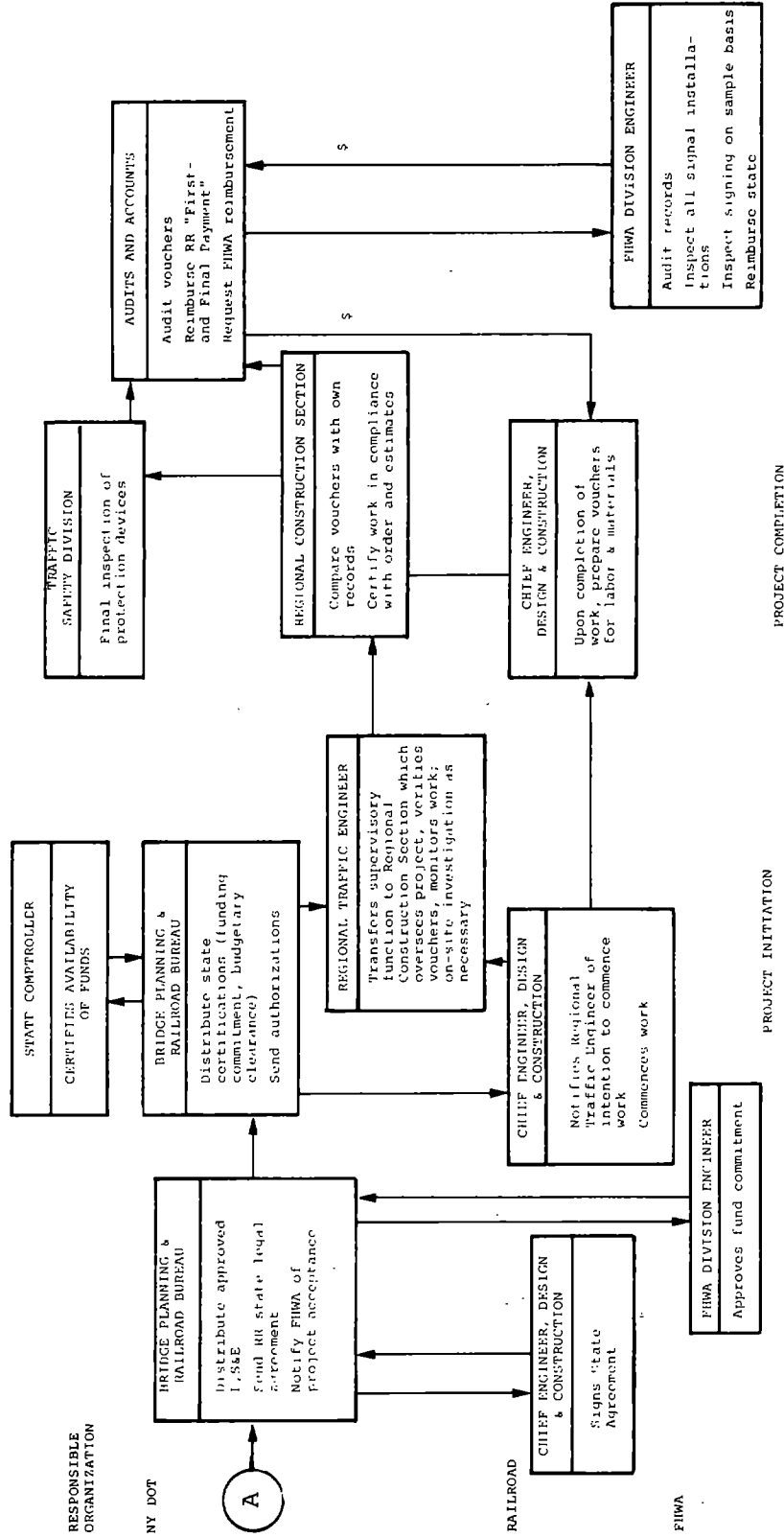


FIGURE B-1 NEW YORK PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (2 of 2)

physically inspect the selected crossings and report on the condition of each. Field staff, assigned by Regional Traffic Engineers, examine each crossing and complete a report on the condition of each crossing. Although the field staff is encouraged to make recommendations regarding crossing treatments, they generally do not avail themselves of this privilege.

The Railroad Safety Section develops its yearly program using the regional reports on crossing conditions, hazard index calculations, and complaint files. The Railroad Safety Section determines the appropriate treatment for each crossing selected for improvement and notifies the appropriate railroads of the program. The railroad may agree to the program or it can request a hearing in which it can attempt to show cause why the recommended treatment is unnecessary. In its role as regulatory agency, the NYDOT can grant a hearing or deny permission. The primary administrative responsibility for program administration transfers to the Bridge Planning and Railroad Bureau. The last action of the Traffic and Safety Division before construction begins is to issue an "order for protection," which is the authorization to proceed.

PHASE II: Project Negotiation and Authorization

Under Phase II, the Bridge Planning and Railroad Bureau essentially assumes all responsibility for administration while the Traffic and Safety Division's participation diminishes to that of review and comment. In this negotiation phase, the

Bridge Bureau requests a Plan, Specification, and Estimate (P,S&E) package from the railroad.* Having received the P,S&E, the Bridge Bureau reviews that part dealing with surfacing, sends the part dealing with signals to Traffic and Safety for review, and forwards a copy of the P,S&E to the Regional Traffic Engineer for review.

After receiving the fully-reviewed P,S&E the Bridge Bureau makes up and sends a copy of the State Railroad Agreement to the railroad for execution. The State Railroad Agreement specifies the obligations of the railroad in performing construction. Simultaneously the Bridge Bureau notifies the FHWA of the project acceptance. FHWA review and approval of the project generally requires one week or less. Once FHWA approval and railroad agreement are obtained, the Bridge Bureau notifies the NYDOT Audits and Accounts Bureau (both the Obligations and Expenditures Units) and the Capital Project Coordination Bureau of the project acceptance. Approval by these two bureaus signifies a state commitment of funds.** This commitment is finalized when the State Comptroller signs the State Railroad Agreement. This "fully executed agreement" is necessary for each individual

*If the railroad lacks the in-house talent to perform the work outlined in the requested P,S&E it may contract out the project. In such cases, the railroad notifies the Bridge Bureau of its intent to contract work. The state requires bidding for all contract work.

**It should be noted that 203 and 230 funds are handled somewhat differently. The Railroad Safety Section receives 203 funds while the Community Development Section initially receives 230 funds, which it transfers to the Railroad Safety Section for project use.

project or small group of projects since no provision for a master agreement exists.

After the above mentioned approvals are secured, the Bridge Bureau distributes project authorization notices to the railroad, the FHWA Division Engineer, the Traffic Safety Division, the Capital Projects Bureau and the Regional Traffic Safety Engineer. The railroad, the FHWA, and the Traffic and Safety Division's Regional Office also receive a copy of the "fully executed agreement" (signed by the State Comptroller). Beyond this stage the railroads and the Traffic and Safety Division's Regional Office dominate project activity.

PHASE III: Project Initiation

Upon receipt of the project authorization letter and the fully executed agreement, the Regional Traffic Engineer transfers the supervisory responsibility to the Regional Construction Section. An inspector is then selected who will make periodic on-site inspections, maintain project records for labor and materials, and later negotiate with railroads for closing costs.

The railroad's design and construction organization may begin work after receiving the project authorization letter. It must notify the Regional Construction Section 5 to 10 days in advance of the intended initiation date. Currently, the railroads receive no cash advance and make no progress billings. As of May 1977, it will be possible for the railroads to submit monthly progress billings. Under current procedures, the

railroad's design and construction organization and the regional inspector examine the completed project, prepare vouchers and arrive at a final project cost. Materials selection is left to the discretion of the railroad.

PHASE IV: Project Completion

After examining the completed work to certify that it is in compliance with original order provisions as well as cost estimates, the Regional Construction Section representative contacts the Traffic and Safety Division, which will inspect warning devices. When all work has been certified the NYDOT Audits and Accounts Division is sent all project vouchers. After examining these vouchers, Audits and Accounts reimburses the railroad with a "first and final payment" within six weeks and in turn requests reimbursement from the FHWA. If a contractor performed the work, the state pays the contractor directly. Audits and Accounts generally submits monthly bills to the FHWA for all NYDOT projects.

The FHWA Division Engineer examines all project vouchers, makes field inspections of all active warning device installations and makes inspections of signing and surface installations on a sampling basis.

B.3 TYPES OF IMPROVEMENTS

As of February 1977, New York State had obligated only 25 percent of its Section 203 funds and 40 percent of its Section 230 funds. The delay in start-up of the program accounts for the low obligation level to date. The FHWA reported that as of 6/30/76, 26 percent of New York's Section 230 obligations had been used for railroad-related improvements. The New York FHWA Division Office reported the following funding obligations through June 1977:

| | <u>SOURCE</u> | |
|---------------------------|------------------|------------------|
| <u>Use</u> | <u>Sec. 203</u> | <u>Sec. 230</u> |
| Warning devices | \$1,903,134 | \$----- |
| Other hazard eliminations | <u>7,782,243</u> | ----- |
| Total obligations | \$9,685,377 | 13,821,675 |
| Balance available | <u>9,761,137</u> | <u>3,700,594</u> |
| Total apportionment | \$19,446,514 | \$17,522,269 |

New York has 630 crossings on the Federal-Aid System. If Section 203 funds are used to provide minimum signing at all 4,450 crossings in the state at a cost of \$500 per crossing, there will be an average of \$16,000 per crossing available for crossings on the Federal-Aid System. The funding apportionment

procedure appropriated adequate funding for New York's on-system crossings.

Table B-3 summarizes the status of New York's improvements as of November 1977. A description of the types of improvements follows.

TABLE B-3 NEW YORK STATE GRADE CROSSING IMPROVEMENT PROJECTS

| <u>Type of Project</u> | <u>Status</u> | |
|--|---------------|-----------|
| | Completed* | Scheduled |
| Pavement Markings and approach warning signs | 434 | 2940 |
| Crossbucks | 2 | 1600 |
| Warning Device and surface | 34 | 119 |
| Warning Device only | 31 | 66 |
| Surface only | 14 | 31 |

*As of November 9, 1977, as reported by Railroad Safety Section, NYDOT.

B.3.1 Signs

New York State has installed new pavement markings and approved warning signs at 434 crossings on the state highway system. Section 203 funds have paid for almost all of the signing work. The state is attempting to work out an agreement with the railroads to allow the state to replace crossbucks. The

railroads are reluctant to allow the state to work on crossbucks because they are on railroad property. The scheduled completion date for signing and marking all state crossings is July 1979.

B.3.2 Surfaces

As of November 1977, new surfaces were installed at 48 crossings. In addition, 150 crossings have been scheduled to receive new surfaces. Rubber is used almost exclusively for crossing surfaces on major roads. Timber and asphalt are used on other roads.

B.3.3 Signals

A number of innovations in signal devices is included at New York's grade crossings. The NYDOT endorses the use of motion sensors and constant warning time signals (CWT). The Delaware and Hudson (D&H) has installed motion sensors at roughly 25 of its 412 crossings in the state. In selecting crossing signal equipment, the D&H has specified that the motion sensors must be designed so that they can be upgraded to CWT devices. Light pre-emption is routinely incorporated where appropriate as recommended by the MUTCD. When new gate arms are part of a signal installation, red and white fiberglass arms are used. The railroads usually choose breakaway arms although the NYDOT does

not require them. The state requires sidewalk gates as well as roadway gates if a sidewalk crosses the tracks.

B.3.4 Maintenance

The railroads maintain all signal equipment after installation. The state recognizes the increased maintenance burden due to motion sensors and CWT signals, but the state has not offered any financial assistance for maintenance.

Advance warning signs are maintained by the state for crossings on the state highway system. Local jurisdictions are responsible for off-system warning signs. Railroads maintain the crossbucks because they are on railroad property.

B.3.5 Factors Affecting Use of Innovative Equipment

The Traffic and Safety Division (TSD) is responsible for identifying crossings needing improvements. Once TSD identifies a set of projects the Bridge Planning and Railroad Bureau arranges for the work to be done. However, if a signal installation is part of a project, TSD must review the specific plans drafted by the railroad. The initiative for selecting a particular type of signal system lies with the railroad, but the TSD is in a position to influence the railroad's choice. The fact that the railroads in New York are using motion sensors and

CWT devices indicates that both TSD and the railroads feel the devices enhance the safety of rail-highway grade crossings.

APPENDIX C: LOUISIANA CASE STUDY

C.1 BACKGROUND

In Louisiana the Public Service Commission (PSC) has statutory authority to require railroads to maintain "suitable and convenient" crossings at all railroad-public road intersections. The Commission may order the construction of such crossings under penalty of fines. However, in practice the PSC is relatively inactive with regard to grade crossing improvements. Complaints received at the PSC are usually forwarded to the Highway Department for action. Localities have some regulatory power over railroads exemplified by ordinances regulating train speed and setting a maximum number of cars per train, but enforcement of these laws is a problem.

Prior to the 1973 Federal Highway legislation creating funds earmarked for grade crossing improvements, the state of Louisiana had been involved in a railroad grade crossing safety program for crossings off the Federal-Aid System. Prior to 1973, the state provided a 50 percent funding to match the 50 percent railroad funding for upgrading crossing safety on off-system roads. Railroads were reluctant to pay their share on the grounds that federal guidelines exempted railroads from paying more than 10 percent of costs on federally-funded projects. The funding share was changed to 90 percent state and 10 percent railroad shortly

before the 1973 federal legislation took effect. Crossing improvements were carried out under this program at a rate of approximately 10-12 per year. In 1970, 1971 and 1972 approximately \$750,000 in state funds was allocated for grade crossing improvements as part of this state program. These sums were set aside by the head of the Highway Department to be devoted exclusively to grade crossing improvements with sufficient funds being made available for up to 50 projects per year. In 1973, when federal 203 and 230 funds became available, they were first applied to an accumulated backlog of projects on the state program. In addition, prior to 1973 Federal-Aid "G" funds were used in Louisiana to upgrade crossing warning devices in conjunction with highway improvements to federal roads as well as for individual sites requiring warning devices. Approximately 8 crossings per year were improved using this funding. The Federal-Aid "G" funds are still being used in conjunction with highway improvements where the crossing site is not on the state's priority list.

In conjunction with the state's crossing improvement program all state crossings were inventoried in 1968 and ranked using the Peabody-Dimick Hazard Index. After the DOT-AAR inventory of 1973-74 and in conjunction with the new federal funding, all public crossings in the state were ranked using the New Hampshire hazard formula. This formula is considered preferable because it permits easier computerization of the data. The hazard index is used by the Highway Department as a guide rather than as an

absolute rule, with railroad input, local input and input from the Louisiana Department of Public Safety (Accident Reports) also considered in project selection. Although the Highway Department maintains a 5-year accident record based on information supplied by the state police, accident data is not used directly in the prioritization process.

Louisiana has a Highway Safety Commission (LAHSC), a distinct agency from the Highway Department. The LAHSC, headed by the Governor's Representative for Highway Safety, coordinates highway safety improvements throughout the state. The agency is mandated to inventory and study safety problems, using Section 402 "3 plus" funds, but it has only the power to recommend and must rely on the Highway Department for implementation. LAHSC works together with the Highway Department in improving passive warning devices at railroad grade crossings.

Louisiana's accident history from 1963-1975 is shown in Table C-1. Note that there have been no significant trends over the past decade. Table C-2a shows the types of crossings and warning levels and the major railroads found in Louisiana as reported in the DOT-AAR Grade Crossing Inventory. Table C-2b reports the number of crossings according to the Louisiana Department of Transportation and Development.

TABLE C-1 LOUISIANA ACCIDENT HISTORY 1963-1975

| | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Total Accidents/ Incidents | 62 | 82 | 76 | 91 | 88 | 88 | 77 | 84 | 75 | 80 | 66 | 80 | 325* |
| Total Killed | 20 | 28 | 34 | 26 | 30 | 46 | 29 | 32 | 32 | 30 | 17 | 22 | 16 |
| Total Injured | 62 | 85 | 74 | 132 | 101 | 87 | 84 | 89 | 78 | 73 | 81 | 89 | 153 |
| Total Casualties | 82 | 113 | 108 | 158 | 131 | 133 | 113 | 121 | 110 | 103 | 98 | 111 | 169 |

C
F

Source: Department of Transportation, Federal Railroad Administration Office of Safety, Rail-Highway Grade-Crossing Accidents, 1963-1975, Table 17 1963-1973, Table 17-A 1974-1975.

*An accident/incident is defined by FRA as any impact between railroad on-track equipment and a motor vehicle, cyclist or pedestrian, regardless of whether it resulted in any casualties or damage. Prior to 1975 accidents/incidents were reported if there were any casualties or if damages to railroad equipment exceeded \$750.

TABLE C-2a CHARACTERISTICS OF LOUISIANA GRADE CROSSINGS

| | |
|----------------------------|------|
| Number of Public Crossings | 4928 |
| On Federal-Aid System | 2619 |
| Off Federal-Aid System | 2309 |

| <u>Number of Tracks</u> | <u>Number of Crossings</u> |
|-------------------------|----------------------------|
| 1 | 3546 |
| 2 | 902 |
| 3 | 287 |
| 4 | 96 |
| 5 | 33 |
| >5 | 38 |

| <u>Warning Level</u> | <u>Number of Crossings</u> |
|--------------------------|----------------------------|
| Active: | |
| Gates | 101 |
| Flashing Lights | 686 |
| Highway Signals or Bells | 18 |
| Total with Active | |
| Warning Devices | 805 |
| Passive: | |
| Special Protection | 85 |
| Crossbucks | 2878 |
| Stop Signs | 311 |
| Other Signs | 26 |
| No Signs or Signals | 823 |
| Total with Passive | |
| Warning Devices | 4123 |

| <u>Railroad</u> | <u>Number of Crossings</u> |
|-----------------------|----------------------------|
| Missouri Pacific | 1422 |
| Southern Pacific | 989 |
| Illinois Central Gulf | 907 |
| All Others | 1610 |

Source: DOT-AAR Grade Crossing Inventory as of August 1976

TABLE C-2b CHARACTERISTICS OF LOUISIANA GRADE CROSSINGS AS
 REPORTED BY LOUISIANA DEPARTMENT OF TRANSPORTATION
 AND DEVELOPMENT

| | |
|----------------------------|------|
| Number of Public Crossings | 5023 |
| On Federal-Aid System | 718 |
| On State System | 348 |
| On Local Roads and Streets | 3957 |

| <u>Active Warning Devices</u> | <u>Number of Crossings</u> |
|-------------------------------|----------------------------|
| Gates | 106 |
| Flashing Lights | <u>705</u> |
| Total with Active Devices | 811 |

| <u>Railroad</u> | <u>Number of Crossings</u> |
|--|----------------------------|
| Missouri Pacific | 1596 |
| Southern Pacific | 990 |
| Illinois Central Gulf | 913 |
| Kansas City Southern and Louisiana and Arkansas | 605 |
| Others | 919 |

C.2 DESCRIPTION OF STATE PROCEDURAL MECHANISMS

Louisiana's procedure for railroad grade crossing improvements can be divided into four phases. Participants in this process are the Louisiana Highway Department (LHD), the FHWA and the particular railroad(s) involved in grade crossing improvements. Phase I, project identification, involves selection of crossings to be upgraded based on the State Highway Department's priority listing and a site inspection by a diagnostic team. Phase II, project negotiation and authorization, involves the development by the Highway Department of a "project notice" for those railroads with a "master agreement" or a complete agreement for each project for those who do not, each to be signed by all parties. The approved project notice or agreement allows the railroad to assemble materials and to prepare detailed project plans. In Phase III, project initiation, the Highway Department issues a work authorization upon review of the railroad's detailed plans and assigns a project engineer to monitor construction, at which point construction commences. Phase IV, project completion, encompasses final site inspection by the State Highway Department and the FHWA and reimbursements for work done. These phases are spelled out in more detail in the following sections. Figure C-1 illustrates the process.

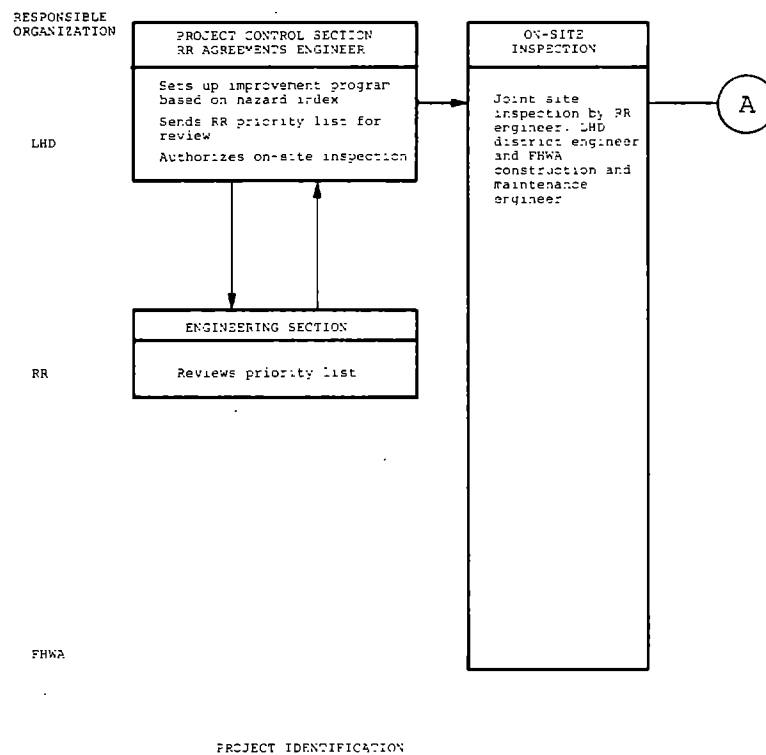


FIGURE C-1 LOUISIANA PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (1 OF 4)

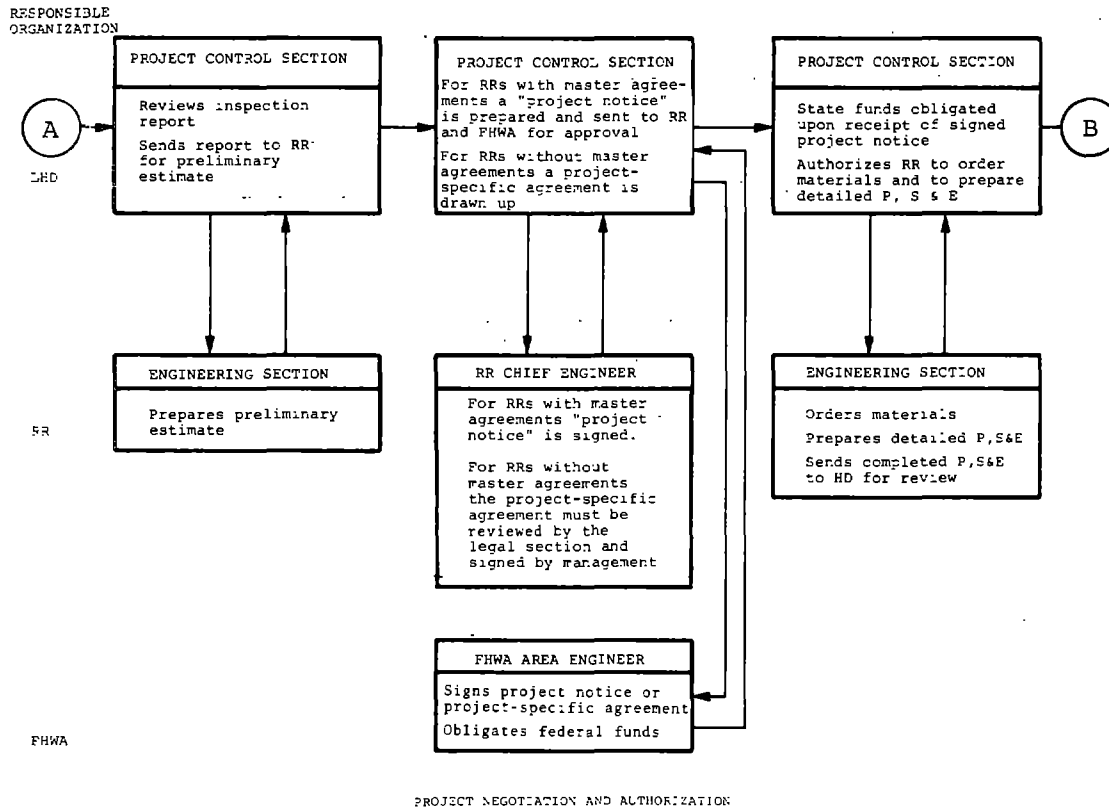


FIGURE C-1 LOUISIANA PROCEDURE FOR RAIL-HIGHWAY
GRADE CROSSING IMPROVEMENTS (2 OF 4)

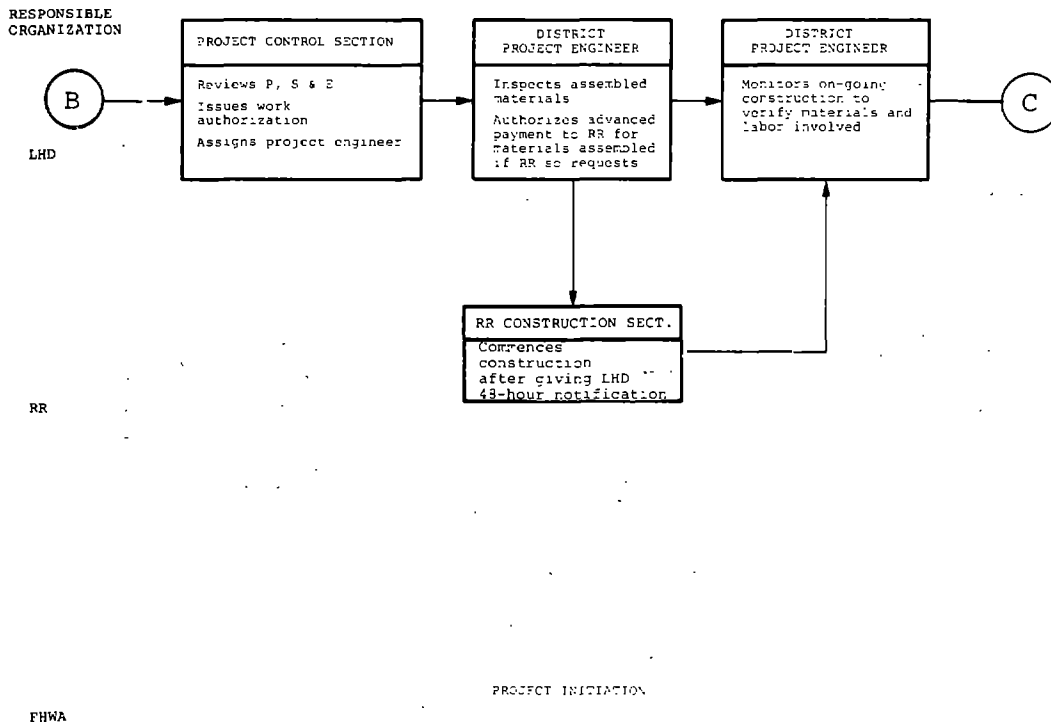


FIGURE C-1 LOUISIANA PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (3 OF 4)

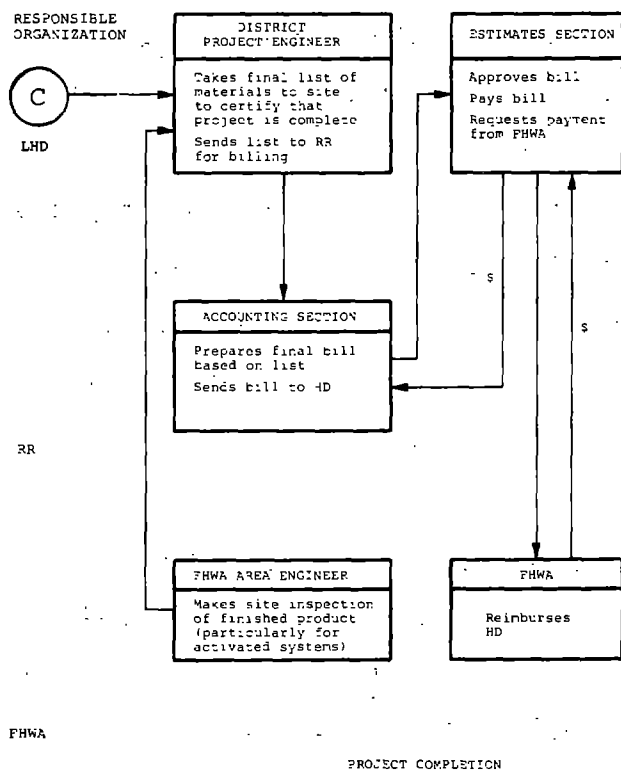


FIGURE C-1 LOUISIANA PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (4 OF 4)

Phase I: Project Identification

The process of railroad grade crossing improvement begins in the Louisiana Highway Department's Project Control Section. The Railroad Agreements Engineer selects a group of projects based on the department's hazard index. This listing of projects is sent to the engineering section of the pertinent railroad(s) for review and comment. Following railroad review, the Highway Department sets up a joint on-site inspection, which includes the Highway District Engineer, a railroad engineer, an FHWA construction and maintenance engineer and, at times, a local city engineer. This diagnostic team determines what improvements are necessary at each crossing and makes out an inspection report. Formerly these inspections were done piecemeal, but beginning in 1976 they were done in one sweep covering 80 locations, a change in procedure which the railroads applaud.

Phase II: Project Negotiation and Authorization

Following the on-site inspection the Highway Department's Project Control Section reviews the inspection report and sends it to the railroad's engineering section for a preliminary estimate. Upon receipt of this estimate the Highway Department determines the lump sum amount or estimated force account which will be paid to the railroad for the particular project. For all projects over \$50,000 the Highway Department must do a pre-award audit for approval by FHWA before committing federal funds, thus introducing a slight delay into the overall process. In addition

to arriving at a lump sum amount or estimated force account, the Project Control Section of the Highway Department prepares a "project notice" for those railroads with a "master agreement" or project-specific agreement to be signed by all parties. The "project notice" is signed by the LHD's Chief Engineer, the railroad's Chief Engineer and by the FHWA Division Administrator. In addition, the project-specific agreement for those railroads without "master agreements" must be reviewed by their legal unit and signed by the designated company officials. The FHWA's approval obligates federal funds, and the LHD's approval obligates state funds. Upon approval by all parties, the Highway Department authorizes the railroad to order materials and to prepare a detailed P,S&E (Plan, Specification and Estimate). In Louisiana, railroads are allowed to preassemble equipment before shipment to site, but the assembly point must be within the state.

Phase III: Project Initiation

Upon review of the railroad's P,S&E, the Highway Department issues a work authorization to the railroad and assigns a project engineer to monitor project construction. At this point, the responsibility for project administration shifts from LHD's central office to the district office. The project engineer monitors on-going construction, verifying amounts of materials and labor for the purpose of future billing. With the issuance of a work authorization, the railroad is free to begin

construction although it is obligated to give the Highway Department 48 hours notice before beginning work. If the railroad so desires, the project engineer will, at any time prior to beginning work, inspect materials assembled and authorize advanced payment to the railroad.

Phase IV: Project Completion

Upon notification by the railroad of project completion, the project engineer takes a final list of materials when received from the railroad to the project site and verifies that all items are in place and are functioning. The FHWA generally participates in this final inspection. This list is then sent to the railroad's accounting section for billing purposes. Here a final bill is prepared and sent to LHD's Estimate Section for approval and reimbursement. At the time of project completion the LHD notifies the FHWA, whose area engineer makes a site visit to verify the proper functioning of the new installation. FHWA site inspections are always made in the case of activated signals, but are done only on a sampling basis for passive devices. When the LHD reimburses the railroad for project expenses, it also requests reimbursement of the federal share of project costs from the FHWA. If the site inspection has proven satisfactory, FHWA reimburses the state.

During 1976 and 1977, Louisiana negotiated master agreements with the five major railroads in the state, the Southern Pacific, the Missouri Pacific, the Illinois Central Gulf, the Kansas City

Southern and Louisiana and Arkansas. Master agreements have helped speed up the time from project identification to project completion because legal negotiations are no longer necessary for every project. However, projects can still take a considerable amount of time to complete. The period from on-site inspection to an approved "project notice" usually takes 3-6 months as opposed to the approximate 8-12 months required from on-site inspection to approval plans and estimates prior to the use of master agreements. The period from project notice through final payment still runs from 1 1/2 to 2 years. Railroad delay in preparing detailed estimates and plans as well as in submitting final bills is seen by LHD as a contributing factor. Railroads, on the other hand, complain that LHD is slow in making final inspections and in reimbursing the railroads for work done.

C.3 TYPES OF IMPROVEMENTS

Louisiana has about 56,000 miles of roadway of which about 40,000 miles (or 72 percent) are off both the state and federal system. Consequently most of the railroad crossings are on roads not in either system. Money to fund improvements to crossings on these roads is quickly used up. Federal funds for off-federal-system roads tend to concentrate on the approximately 4,000 miles of state system roads to the neglect of the 40,000 miles of "off-off" system roadway. The State Highway Department has shown a reluctance to spend funds off the state system, but under

pressure from the FHWA it is planning to put more funds towards this purpose.

In Louisiana, the state pays the 10 percent local share for both on-system and off-system federal programs. Federal on-system funding for FY77 was \$4.6 million. All but \$1 million had been obligated as of July 1977. Federal 230 off-system funding for FY76 was \$4.0 million and was also quickly expended. Federal on-system funding provided on average \$6,600 per crossing while federal off-system funding provided on average \$950 per crossing (A typical crossing improvement project costs approximately \$80,000). Louisiana has used other sources of funding to do off-federal system work in response to a general shortage of off-federal system funds. Section 219 funds for off-federal system safety improvements have been used, but the legislative requirement of dealing with localities in the dispersal of these funds has hindered their use up to the present time. Section 205 funds for pavement marking have been used to do railroad grade crossing pavement markings.

C.3.1 Signs

Currently, all state roads have advanced warning signs, pavement markings and crossbucks. Parish and town roads, on the other hand, have only about one quarter of this protection. The Louisiana Highway Department and the Louisiana Highway Safety Commission are currently undertaking a program to put advanced

warning signs and pavement markings at all public crossings. The process should be completed by 1/79. The installation of crossbucks is included as part of this program. A second program planned by the LHD and the LAHSC would replace the cardboard inventory numbering at crossings throughout the state with aluminum inventory signs. The state is considering having the same contractor install crossbucks at all crossings where they are missing at the same time that the cardboard inventory numbering is replaced. The crossbuck installations must be cleared with each railroad first, however, since the railroads are legally in charge of their own installation and maintenance. The combination of the advanced warning signs and pavement markings program and the crossbuck installation would bring all public crossings up to MUTCD standards. Advanced warning signs and crossbucks will be installed using 203 funds, pavement markings will probably be paid for out fo 205 funds, and inventory numbering will probably be done with 402 funds.

C.3.2 Surfaces

Surface conditions at crossings are not incorporated into the Louisiana Highway Department's Hazard Index. As a result, many crossings with bad surface conditions have received insufficient attention. Recently a separate inventory was done of the physical condition of crossings surfaces in an effort to overcome this problem.

The two most common surfaces currently being installed in Louisiana are rubber and timber. Rubber surfaces are used on crossings where the traffic is greater than 1,000 ADT, while timber is used for crossings with less traffic. Louisiana has also been experimenting with steel and with polyethelene surfaces. Polyethelene has proven unsatisfactory because the plastic tends to break up, a process which is hastened by the poor subsoil conditions prevalent in much of Louisiana.

C.3.3 Signals

Compared to the majority of states, Louisiana's use of gates and flashing lights is relatively limited. Although state officials denied being "anti-gate," there was some expression of scepticism regarding the usefulness of gates in preventing accidents. Officials cite numerous complaints by motorists who encounter gates in the down position with no trains apparently operating on the tracks. Poor signal maintenance or improper circuitry results in abuses by the motoring public in driving through and around gates. The state currently has a policy of putting in gates at multi-track and high-speed track locations. The Southern Pacific, the railroad with the second largest number of crossings in the state, claims to be actively pursuing the use of gates throughout its system, using federal regulations to push states in this direction.

The state's two largest railroads, the Southern Pacific and the Missouri Pacific, both use grade crossing predictors and motion sensors, particularly where switching movements occur in urban areas. The Southern Pacific indicates that it routinely installs these devices in conjunction with signal installations. The Missouri Pacific, a railroad on somewhat less firm financial footing, mentioned the high maintenance costs associated with motion sensors (roughly double that of conventional circuits). These devices are very susceptible to lightning, and the cost of replacement doubles the maintenance cost over that of a similar installation without motion sensors.

C.3.4 Maintenance

The railroads are responsible for maintaining all active devices which they install, as well as all crossbucks. The State Highway Department maintains all grade crossing signs and markings on the state system. On local roads, the city or town is responsible for maintenance although the state may carry out signing or marking under contract from the locality.

C.3.5 Factors Affecting Use of Innovative Technology

There has been some scepticism in Louisiana in the past regarding the usefulness of gates. The railroads seem to favor expanding the use of gates, although increases in maintenance

costs may be a problem for the less financially-sound Missouri Pacific and perhaps for some of the smaller railroads.

Some railroads are also favorably disposed towards grade crossing predictors and motion sensors on the grounds that they increase the "integrity" of flashing lights and/or gate installations, although other railroads mentioned high maintenance costs and lack of trained signal maintainers as a problem. The Southern Pacific gave some credence to the argument that the use of new technologies might leave the railroad open to new legal challenges although the Missouri Pacific did not see this as a factor. The role of railroad unions does not seem to have been an important factor in the introduction of new technologies although unions do oppose the use of contractors for equipment installation. The railroads also mentioned the friction that many times exists between the signal division and track maintenance division of a railroad. It has been known to result in damaged signal installations, probably because of the lack of cooperative attitudes.

APPENDIX D: TEXAS CASE STUDY

D.1 BACKGROUND

For almost a decade the State of Texas has funded improvements to railroad grade crossings on the state road system. Beginning in 1968, the state has appropriated \$1.5 million per year from the State Highway Trust Fund for the installation of activated signals for crossings on the state system. Projects are funded 90 percent state and 10 percent railroad. To date, \$14.3 million has been spent under this program. In addition, the state pays the railroads a maintenance subsidy for crossings on the state system of \$100 per year for maintenance of single-track crossings and \$150 per year for multi-track crossings. This subsidy applies to maintenance of signals only.

Since 1972, the state has also funded signal installations at crossings off the state system. Each year, \$250,000 is appropriated from state general revenues for this program. Funding is 80 percent state, 10 percent railroad and 10 percent local. In addition to these signal programs, the state has a program devoted exclusively to surface improvements, funded out of the State Highway Trust Fund, for use on the State Highway System.

With regard to federal funding, the state has in the past used and currently uses "G" funds to make improvements to grade crossings on the federal system. Section 203 funds are used for on-federal crossings with the state paying the 10 percent local match. In Texas 203 funds are generally not used for surface improvements because of the state funding already available for surface work. Section 230 funds were used for off-system crossings with the local share formerly divided 5 percent state funds and 5 percent railroad funds. With the new 203 off-system funding, the 10 percent local share will be paid 5 percent by the state and 5 percent by the municipality involved. Table D-1 summarizes the Texas grade crossing programs and shows the allocation of costs.

Texas has a fair number of crossings which are off the federal system, but on the state system. Although it is possible to use federal off-system funds for these crossings, Texas chooses to reserve this money for crossings off both the state and federal system where funding is in short supply.

In Texas the Highway Department is now part of a state DOT - the State Department of Highways and Public Transportation (SDHPT). Unlike many other Highway Departments, it has a highly decentralized structure with 25 district offices which are full-blown Highway Departments in their own right. The Highway Department's central office is involved principally in guideline development and policy formulation. The incredible geographic diversity and the sheer size of the state of Texas are major factors causing this decentralized structure.

TABLE D-1 TEXAS STATE GRADE CROSSING PROGRAMS

| <u>Crossings</u> | <u>Type of Improvements</u> | <u>Cost Allocation</u> | | | <u>Annual Budget</u> | <u>Source of Funds</u> |
|------------------|-----------------------------|--|-------------|----------------|----------------------|------------------------|
| | | <u>State</u> | <u>- RR</u> | <u>- Local</u> | | |
| On-State System | Signals | 90% | - 10% | - 0 | \$1.5M | Highway Trust Fund |
| | Maintenance | \$100 per single-track xing \$150 per multiple-track xing | | | | Highway Trust Fund |
| | Surfaces | 100% | - 0 | - 0 | \$750K | Highway Trust Fund |
| Off-State System | Signals | 80% | - 10% | - 10% | \$250K | General revenues |

The state legislation creating the SDHPT gave this agency complete authority over public transportation in the state, including investigatory powers and the power to hold hearings. These powers could be exercised in relation to railroad grade crossings, but the SDHPT has not adopted a strong regulatory stance in this area. Texas has a Railroad Commission which has some broad functional control over railroads, but forwards complaints on crossing safety to SDHPT for remedial action.

The position of Governor's Representative for Highway Safety, a political figurehead in many states, involves real functions in Texas. This position, formerly an independent state office, is now a part of the SDHPT and is entitled the Office of Traffic Safety (OTS). Since incorporation into SDHPT, the Governor's Representative does not control 230 off-system funding. OTS does control 402 funding. In Texas, these funds

support a state-wide highway safety program known as the Community Impact Program. Under this program, Traffic Safety Coordinators were hired for all cities of 25,000 population or less throughout the state, as well as 10 district managers who gather information from the Traffic Safety Coordinators in their jurisdictions (roughly 10-15 counties wide). This information is in turn fed into SDHPT's Highway Safety Section. By means of a cost-benefit-oriented Safety Improvement Index, safety improvements including those for railroad grade crossings, are ranked. Information on needed grade crossing improvements, gathered through OTS, is used as input to SDHPT's selection process for grade crossing improvements, which are undertaken by the Bridge Division of the SDHPT. The Community Impact Program and SDHPT's district offices exist as parallel structures throughout the state. In general, they reinforce each other.

Prior to the DOT-AAR Inventory, Texas had already surveyed all state crossings in conjunction with the state funding programs. Crossings were ranked on the basis of a hazard index formula similar to the New Hampshire formula. After 1973, the rating index was changed from a pure hazard index to a priority index which includes accident data. Presently, accidents are used as a multiplier in index calculations.

The DOT-AAR Inventory was felt to be inadequate with respect to the status of passive devices. As a consequence, in 1976 the state reinventoried passive devices at all crossings, using Section 402 funds. Data from this survey was combined with the

DOT-AAR inventory data on active devices to produce a comprehensive inventory of all crossings.

Accident data for the state is collected by the Department of Public Safety, where it is computerized and sent on to the Highway Department's Planning Section (Division D-10). The Planning Section collects accident data from a number of sources including the Department of Public Safety, the Highway Department's district offices and from newspaper clippings. This data is then used in hazard index calculations.

Texas currently does not use master agreements for improvements employing active devices. The various jurisdiction mixes involved in providing matching funds and the various locations of responsibilities for maintenance make each project unique and master agreements unfeasible. The state does have, however, letter agreements with the railroads regarding passive devices (including crossbucks, advanced signing and pavement markings), and master agreements are being used on a trial basis for lump sum jobs.

Texas' accident history for the past decade is shown in Table D-2. Note that there have been no strong trends upward or downward. The types of crossings found in Texas and the current warning level are shown in Table D-3, along with a list of the state's major railroads.

TABLE D-2 TEXAS ACCIDENT HISTORY 1963-1975

| | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| Total Accidents/ Incidents | 273 | 314 | 312 | 362 | 336 | 305 | 320 | 322 | 273 | 302 | 292 | 255 | 1077* |
| Total Killed | 86 | 101 | 92 | 139 | 121 | 112 | 105 | 116 | 90 | 101 | 93 | 118 | 80 |
| Total Injured | 319 | 354 | 366 | 390 | 363 | 328 | 335 | 320 | 266 | 311 | 302 | 254 | 367 |
| Total Casualties | 405 | 455 | 458 | 529 | 484 | 440 | 440 | 436 | 356 | 412 | 395 | 372 | 1167 |

Source: Department of Transportation, Federal Railroad Administration Office of Safety, Rail-Highway Grade-Crossing Accidents, 1963-1975, Table 17 1963-1973, Table 17-A 1974-1975.

*An accident/incident is defined by FRA as any impact between railroad on-track equipment and a motor vehicle, cyclist or pedestrian, regardless of whether it resulted in any casualties or damage. Prior to 1975 accidents/incidents were reported if there were any casualties or if damages to railroad equipment exceeded \$750.

TABLE D-3 CHARACTERISTICS OF TEXAS GRADE CROSSINGS

| | |
|----------------------------|-------|
| Number of Public Crossings | 14616 |
| On Federal-Aid System | 1888 |
| Off Federal-Aid System | 12728 |

| <u>Number of Tracks</u> | <u>Number of Crossings</u> |
|-------------------------|----------------------------|
| 1 | 10429 |
| 2 | 2660 |
| 3 | 941 |
| 4 | 343 |
| 5 | 121 |
| >5 | 118 |

| <u>Warning Level</u> | <u>Number of Crossings</u> |
|--------------------------|----------------------------|
| Active: | |
| Gates | 519 |
| Flashing Lights | 2755 |
| Highway Signals or Bells | <u>150</u> |
| Total with Active | |
| Warning Devices | 3424 |
| Passive: | |
| Special Protection | 481 |
| Crossbucks | 9545 |
| Stop Signs | 32 |
| Other Signs | 16 |
| No Signs or Signals | <u>1118</u> |
| Total with Passive | |
| Warning Devices | 11,192 |

| <u>Railroad</u> | <u>Number of Crossings</u> |
|-------------------------------|----------------------------|
| Southern Pacific | 3544 |
| Atchison, Topeka and Sante Fe | 3165 |
| Missouri Pacific | 2069 |
| Texas and Pacific | 1082 |
| Missouri-Kansas-Texas | 1077 |
| Fort Worth and Denver | 938 |
| All Others | 2741 |

Source: DOT-AAR Grade Crossing Inventory as of August 1976

D.2 TEXAS PROCEDURE FOR RAIL GRADE CROSSING IMPROVEMENTS

Railroad grade crossing improvements in the state of Texas involve actions on the part of the State Department of Highways and Public Transportation (SDHPT), the Federal Highway Administration's Division office, the railroads operating in Texas and the municipalities where the crossings are located. Four stages can be identified in the overall process: project identification, project negotiation and authorization, project initiation and project completion. Figure D-1 shows the procedure graphically.

The project identification stage involves development by SDHPT of a list of projects to be upgraded based on priority ranking, and the review of this list by the various parties involved. During project negotiation and authorization the list is finalized and approved by the various parties. A joint on-site inspection generates agreement on the exact kinds of improvements needed at each selected site. Following this inspection, the railroad begins ordering materials and preparation of detailed plans. Project initiation involves an issuance of authority for construction by SDHPT upon review of the railroad's detailed plans and the assignment of a District Engineer to monitor on-going construction activities. Project completion encompasses a joint on-site inspection to verify that the installation was done to specifications and that it functions properly. Bills are submitted by the railroad and SDHPT.

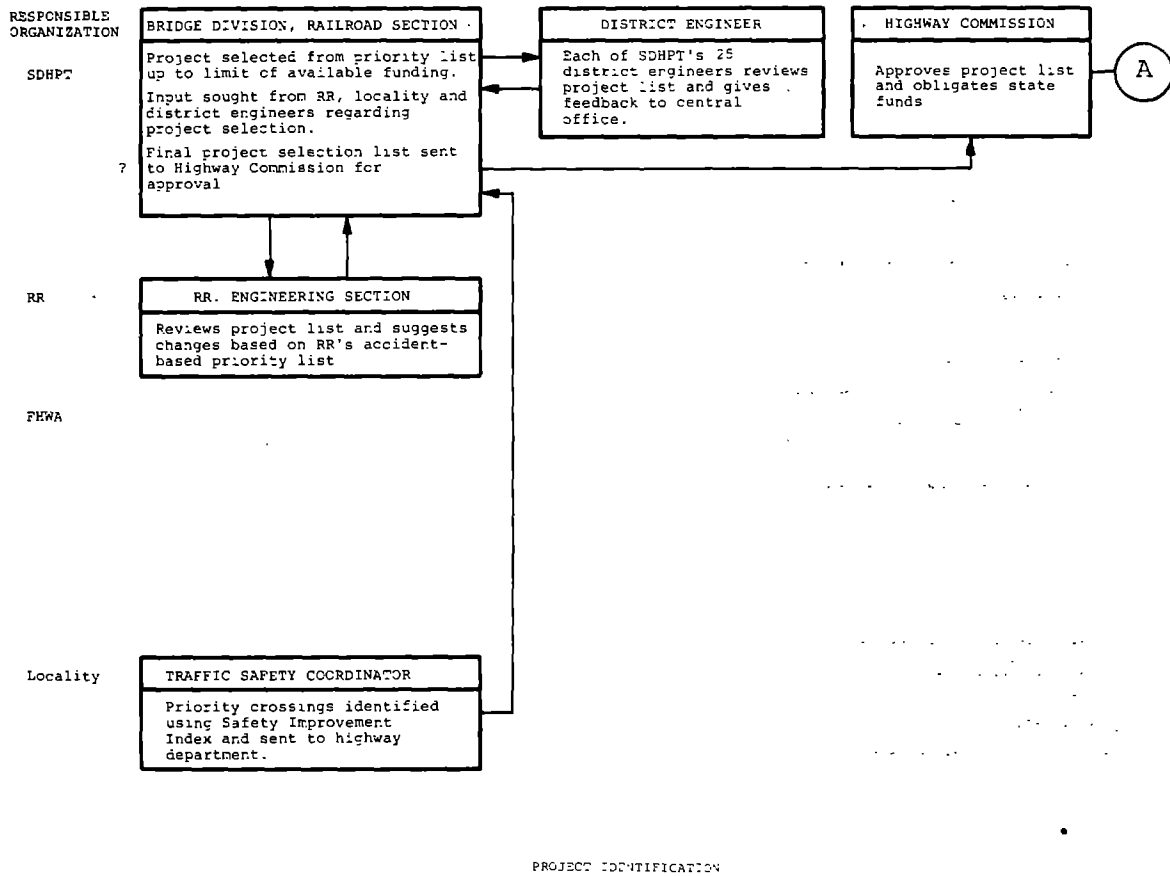
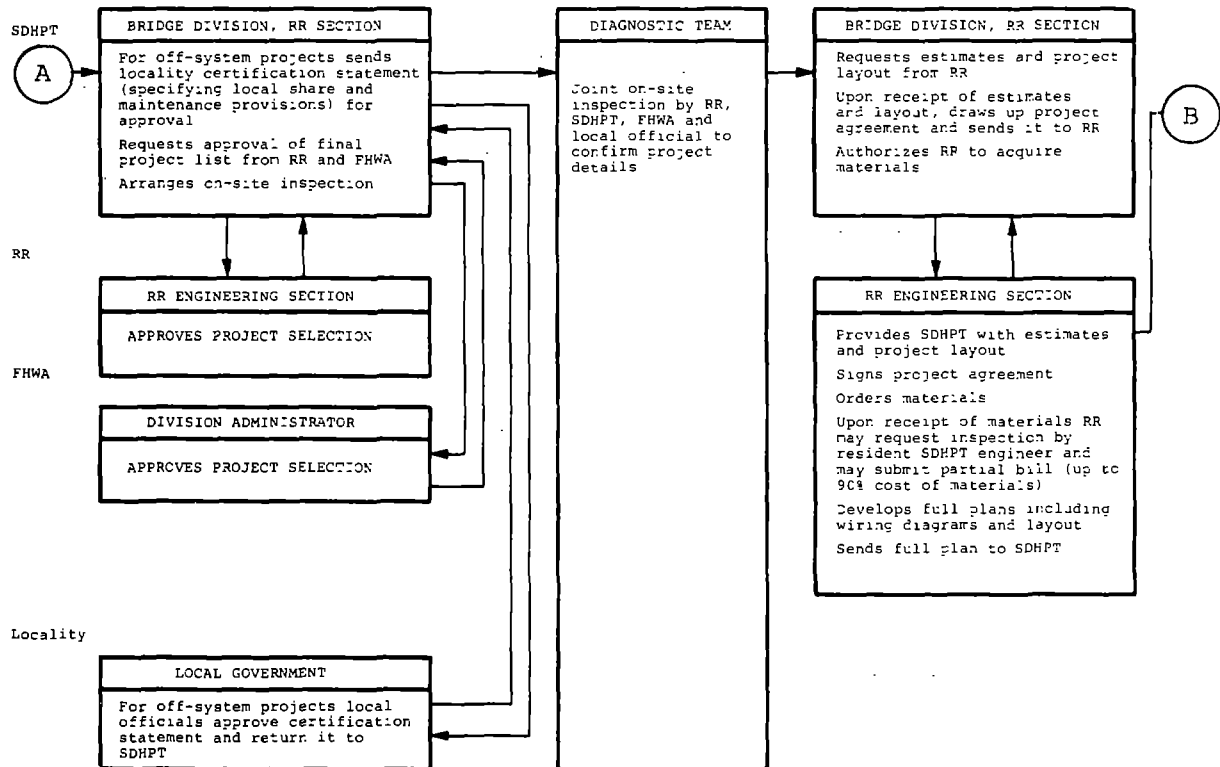


FIGURE D-1 TEXAS PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (1 OF 3)

RESPONSIBLE ORGANIZATION



PROJECT NEGOTIATION AND AUTHORIZATION

FIGURE D-1 TEXAS PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (2 OF 3)

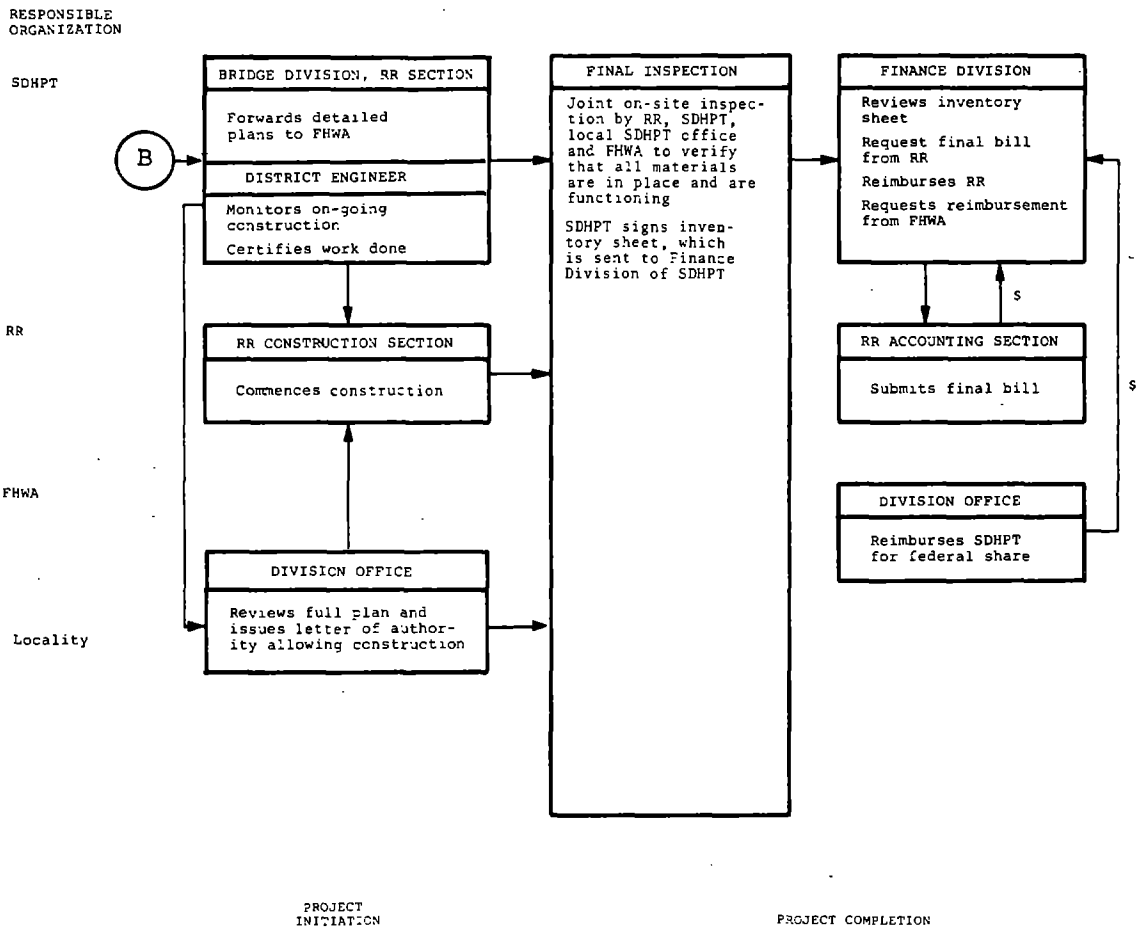


FIGURE D-1 TEXAS PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (3 OF 3)

The following is a more detailed discussion of the four stages in the Texas railroad grade crossing improvement procedure.

Phase I: Project Identification

Initial identification of crossings to be upgraded is undertaken by the Railroad Section of the Bridge Division. Based on a priority ranking in which accidents are used as a multiplier, a tentative list is generated up to the limit of available funding. This tentative list is available to the railroads and to the local Traffic Safety Coordinators for review. The railroads may suggest additions to the list based on their own accident-based priority ranking. The Traffic Safety Coordinators also may suggest additions based on their cost-benefit-oriented Safety Improvement Index. Input on particular crossings is obtained from each District Engineer regarding the improvements proposed for that particular district. Finally, the list of projects is sent to the State Highway Commission, a 3-member board, for approval and obligation of state funds.

Phase II: Project Negotiation and Authorization

SDHPT's Bridge Division obtains approval of the finalized list from the railroads and from FHWA's Division Administrator. At the same time, for all off-system work, SDHPT sends the locality a certification statement which, if approved, obligates the local share. Following this approval process, the Bridge

Division arranges a joint on-site inspection. The inspection team includes representatives of SDHPT, the railroads, the FHWA and the locality where the project is situated. The inspection is designed to generate consensus regarding the exact kind of improvements needed at each crossing. Subsequent to the inspection, the Bridge Division requests initial estimates and a project layout from the railroads, at the same time authorizing the railroads to order materials. When the railroads send SDHPT an approved project layout, a project agreement is drawn up with the layout attached as "Exhibit A." The agreement is signed by the railroad and the Bridge Division of SDHPT. At this point, the railroads order necessary materials and begin work on the detailed plans, including wiring diagrams. Once completed, these detailed plans are sent by the railroads to the state for further transmittal to the FHWA, where a letter of authorization is issued authorizing construction to begin.

Materials are shipped to a storage site as near as possible to the point of installation. If the railroads so request, they may submit a partial bill of up to 90 percent of the cost of materials, prior to final inspection. In order for advanced billing to take place, a SDHPT resident engineer must check assembled materials and authorize billing. In Texas, as in Louisiana, material assemblage must occur within the state.

Phase III: Project Initiation

At the time that construction is authorized, SDHPT's central office notifies the district office, and a District Engineer is assigned to monitor on-going construction and to verify materials, labor, and equipment used for billing purposes. Meanwhile, the railroad assembles previously-ordered materials and begins construction. At this point, the railroads may submit partial bills for materials and estimated labor of which SDHPT will pay up to 90 percent prior to final inspection.

Phase IV: Project Completion

Upon notification of construction completion, SDHPT arranges a joint on-site inspection by representatives of the SDHPT's Bridge Division, the local SDHPT office, the railroads and the FHWA, for the purpose of verifying that all materials are in place and that the installation is functioning properly. At this point, the SDHPT requests a final bill from the railroad, through its Finance Division.

The railroad submits a final bill to SDHPT and is reimbursed for the full amount. The SDHPT, in turn, requests and receives reimbursement from the FHWA for the federal share of project costs.

D.3 TYPES OF IMPROVEMENTS

As of August 1977, Texas had obligated \$6.85 million of its 203 funds and \$3.69 million of its 230 funds for railroad grade crossing improvements. There are roughly 1,888 crossings on the federal system, so that about \$3,630 was available for each on-system crossing and about \$290 available for each of the 12,718 off-system crossings. All of these funds were expended for activated signals with the exception of the signing inventory. The types of improvements made with 203 and 230 funds are described in the following sections.

D.3.1 Signs

In 1976 the Highway Safety Section of SDHPT undertook a state-wide inventory to determine the signing needs at all crossings in the state. This inventory grew out of a perceived deficiency in the DOT-AAR inventory data regarding the status of passive devices. On-system crossings are being inventoried using 203 funds and off-system crossings using 230 funds. The inventory is still in progress with an expected completion date of December 1977. As mentioned previously, the state has letter agreements with the various railroads allowing installation of passive devices on their property. The state hopes to utilize contractors to do all the work needed to bring all public crossings up to the MUTCD standard, including installation of crossbucks, DOT-AAR inventory numbers, number of tracks, pavement

markings and advanced warning signs. It is necessary to replace the current DOT-AAR numbering as some of the cardboard signs are in poor condition. New inventory number tags will be put on the crossbuck posts. The complete total signing program will take 4-5 years to complete.

In addition to the signing program, SDHPT has been involved in the development and testing of innovative signs at railroad grade crossings, using colors and layouts that are more highly visible than those of the standard grade crossing signs. Such innovative signs have been placed at key crossings, and accident rates are being used to measure their effectiveness.

In the past, signing improvements have been undertaken using 402 funds to purchase signs, with localities paying for mounting materials and installation costs. This arrangement usually results in about a 50-50 funding split.

D.3.2 Surfaces

A separate state program using State Highway Trust Fund money is devoted to upgrading railroad grade crossing surfaces. Generally, the local SDHPT district initiates the surface improvements. Alternatively, the railroads, as part of their routine maintenance program, may discover rough crossings and request improvements via the local SDHPT district office.

Most crossing surfaces in the state are of timber. State guidelines now require that crossings with greater than 8,000 ADT must have a higher grade surface than timber, such as rubber,

steel, concrete, epoxy rubber or structural foam. All of these types of crossing surfaces have been installed on an experimental basis in Texas. The only experimental surfaces that Texas feels have been in service long enough to warrant conclusions on effectiveness are rubber surfaces, which have proven very successful.

D.3.3 Signals

Texas has had a state program for the installation of activated signals for a number of years and since 1973 federal funds have been used for signal installation. Over \$27 million in state and federal funds has been spent on signal installations since 1968. State and federal guidelines are followed in determining which crossings warrant installation of gates, cantilevers and/or flashing lights. For example, gates are usually installed at multi-track locations or on high-speed single tracks. Deviations from these guidelines are generally the result of diagnostic inspection decisions. Cantilevers are generally installed on high-speed or multi-lane roads and streets because of the need for greater visibility.

The two major railroads in the state, Missouri Pacific and Southern Pacific, generally favor gate installations, as well as installation of motion sensing devices or grade crossing predictors in areas where train traffic warrants them.

D.3.4 Maintenance

Railroads are responsible for the maintenance of signal equipment and crossbucks. Local governments are responsible for maintenance of advanced warning signs and pavement markings if they are off the state system; otherwise these devices are maintained by the state.

D.3.5 Factors Affecting Use Of Innovative Technology

The Southern Pacific and the Missouri Pacific railroads, both claim they are actively pushing the use of gates and motion sensing devices or predictors. The maintenance cost of motion sensing devices and predictors was mentioned by the Missouri Pacific as a drawback to their widespread use. The use of gates in Texas is somewhat influenced by roads which are typically wider than those of other states although this does not appear to be a major obstacle.

Texas is experimenting with a wide variety of crossing surfaces and should, in the near future, be able to draw conclusions about which surfaces stand up best and under what conditions.

APPENDIX E: OREGON CASE STUDY

E.1 BACKGROUND

Oregon's involvement in grade crossing safety dates back to around 1917, at a time when auto-train collisions were first becoming a serious safety problem. The jurisdiction of the Oregon Public Utility Commissioner over grade crossing safety dates back to this era. Over the years the state legislature has added responsibilities to the Public Utilities Commission (PUC) in this area. In 1973 the legislature vested exclusive authority in the PUC for the regulation of construction, alteration and protection of railroad-highway crossings. In addition, the PUC inspects all public grade crossings on a bi-annual basis, inspects warning signals at all signalized crossings for effective and proper operation, investigates fatal accidents to determine the need for crossing improvements, administers Oregon's Grade Crossing Protection Account, maintains a comprehensive data base of grade crossing-related statistics (including accident statistics), prioritizes all grade crossings for signalization, oversees the elimination of unneeded crossings and provides general assistance and education to the public with regard to the above areas of concern.

The Oregon Department of Transportation's Highway Division of the state Department of Transportation (DOT) is the state agency in charge of railroad grade crossing improvements. More

specifically, the Railroad and Utility Unit of the Highway Division deals directly with grade crossing improvements. In Oregon, highway safety funds are not administered by the Highway Division, but through a separate agency, the Oregon Traffic Safety Commission headed by the Governor's Representative for Highway Safety. The purpose of this agency is to administer federal highway safety funds and to keep highway safety statistics. In conjunction with this program, a number of local traffic safety commissions have been established in communities around the state. These informal groups identify local safety needs for which federal funds might be appropriate. Railroad grade crossing safety has been the focus for several of these commissions. The Oregon Traffic Safety Commission also took part in the lobbying effort which helped to establish a state grade crossing protection fund. In general, however, grade crossing safety plays a minor part in the overall program. The Governor's Representative for Highway Safety does not control federal off-system Title 2 funds as he might in some states.

Oregon, through the PUC, has maintained a grade crossing inventory for many years. Each crossing has a state-assigned number as well as the more recent DOT-AAR inventory number. The state number indicates the nearest railroad milepost and is useful in helping the PUC locate crossings which are complained about. During the 1960's, the PUC developed the "Jacqua" formula, an index of 19 grade crossing characteristics used to obtain a projected 5-year accident rate. This index, along with

actual accident data and a measure of school bus traffic over the crossing, is used by the PUC to rank all public crossings on an improvement priority list. All of this information has been computerized. The PUC continually updates the priority list based on new information. Railroads are required by statute to report all grade crossing accidents to the Commissioner. To amplify this information, police reports are solicited from local police and state police sources. In addition to the computerized data, the PUC maintains individual characteristic sheets, including diagrams and photographs in the Catalog of Public Grade Crossing as well as a file on each crossing. Correspondence and data from the field inspections, made every 2-3 years, are located in the crossing files (This year the PUC has inspected all crossings in a one-year period as part of its signing inventory effort).

Prior to 1973, the Oregon Department of Transportation had made some crossing improvements using "G" funds in conjunction with highway improvements on the federal system. This amounted to about 12 crossing improvements per year. In 1973, Oregon established a state Grade Crossing Protection Account (GCPA) using the state's gasoline tax. Each year \$600,000 is appropriated, of which \$500,000 is available for grade crossing protection and \$100,000 is available for grade separation. This fund is used to match federal 203 and 230 funds, as well as to fund the state's program for crossing improvements. The fund is controlled by the PUC, but is distributed by the Highway Division

of the state DOT. The actual funds are kept in the Accounting Section of the Highway Division. However, a voucher from the PUC is necessary for release of funds. Currently the 10 percent local share of federal funding is made up of 7-1/2 percent state funds and 2-1/2 percent local funds. A recent piece of legislation, S.290, has changed this and after October 1977, the state will pick up the entire 10 percent local share. It is hoped that this change will expedite grade crossing improvements. Localities have had a hard time coming up with their share of the funding due to the vagaries of the local political process. In contrast to federal funding shares, funding on the state's program for crossing improvements is 75 percent state, 20 percent railroad and 5 percent locality.

The PUC serves a coordinating role in grade crossing improvements, working closely with localities in an attempt to treat all local crossings at once. State law requires that if a locality agrees to close one crossing, the railroad must pay the local share of upgrading another crossing. The PUC plays an active role in promoting such crossing closings. In addition, it promotes the joint use of federal and state funds for grade crossing improvements. If a locality has a number of crossings to upgrade, but not all of them are high on the priority list, the PUC encourages the use of state grade crossing funds for the lower priority crossings so that the work can be done together.

The Oregon DOT has a master agreement with the Union Pacific. The volume of work generated as a result of the 1973

federal grade crossing legislation provided the impetus for this master agreement. It is estimated that this agreement, in effect since 1976, saves approximately 3 months over the overall process. Oregon DOT has standardized service agreements with the two other major railroads, the Southern Pacific and the Burlington Northern. A service agreement is a standardized document, similar to a master agreement, stating the obligations of all parties, but covers only one project.

Oregon's accident history as determined by FRA accident data is shown in Table E-1a. Oregon's PUC arrived at another set of accident statistics for the same period as shown in Table E-1b. The discrepancies between the two sources are due in part to the difference in definition of accident/incident prior to 1975. Some of the discrepancy may also be accounted for by the Oregon PUC's diligent pursuit of accident data on the local level.

Table E-2a shows the types of crossings, the warning levels and the major railroads that operate in Oregon as reported in the DOT-AAR inventory in August 1976. Table E-2b shows crossing characteristics as reported by the Oregon Public Utility Commissioner as of December 1976.

TABLE E-1a OREGON ACCIDENT HISTORY 1963-1975

| | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Total Accidents/ Incidents | 32 | 34 | 47 | 51 | 57 | 70 | 61 | 53 | 52 | 52 | 44 | 49 | 173* |
| Total Killed | 10 | 13 | 21 | 13 | 15 | 26 | 20 | 15 | 17 | 7 | 9 | 9 | 3 |
| Total Injured | 31 | 119 | 100 | 52 | 55 | 69 | 89 | 47 | 51 | 52 | 45 | 62 | 52 |
| Total Casualties | 41 | 132 | 121 | 65 | 70 | 95 | 79 | 62 | 68 | 60 | 54 | 71 | 55 |

Source: Department of Transportation, Federal Railroad Administration Office of Safety, Rail-Highway Grade-Crossing Accidents, 1963-1975, Table 17 1963-1973, Table 17-A 1974-1975.

*An accident/incident is defined by FRA as any impact between railroad on-track equipment and a motor vehicle, cyclist or pedestrian, regardless of whether it resulted in any casualties or damage. Prior to 1975 accidents/incidents were reported if there were any casualties or if damages to railroad equipment exceeded \$750.

TABLE E-1b OREGON PUC ACCIDENT STATISTICS 1963-1975

| | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Total Accidents/ Incidents | 240 | 269 | 285 | 276 | 291 | 313 | 259 | 261 | 232 | 233 | 216 | 169 | 173 |
| Total Killed | 10 | 18 | 20 | 12 | 14 | 26 | 22 | 14 | 17 | 7 | 11 | 11 | 4 |
| Total Injured | 33 | 27 | 48 | 49 | 49 | 67 | 52 | 49 | 44 | 51 | 47 | 71 | 54 |
| Total Casualties | 43 | 45 | 68 | 61 | 63 | 93 | 74 | 63 | 61 | 58 | 68 | 82 | 58 |

Source: Yearly reports of "(year) Report--Railroad Accidents in Oregon," Public Utility Commissioner of Oregon.

TABLE E-2a CHARACTERISTICS OF OREGON GRADE CROSSINGS

| | |
|----------------------------|----------------------------|
| Number of Public Crossings | 2969 |
| Urban | 1591 |
| Rural | 1378 |
| <u>Number of Tracks</u> | <u>Number of Crossings</u> |
| 1 | 2167 |
| 2 | 509 |
| 3 | 202 |
| 4 | 60 |
| 5 | 15 |
| >5 | 13 |
| <u>Warning Level</u> | <u>Number of Crossings</u> |
| Active: | |
| Gates | 208 |
| Flashing Lights | 194 |
| Highway Signals or Bells | 86 |
| Total with Active | 488 |
| Warning Devices | |
| Passive: | |
| Special Protection | 112 |
| Crossbucks | 1898 |
| Stop Signs | 100 |
| Other Signs | 12 |
| No Signs or Signals | 359 |
| Total with Passive | 2481 |
| Warning Devices | |
| <u>Railroad</u> | <u>Number of Crossings</u> |
| Southern Pacific | 1309 |
| Burlington Northern | 716 |
| Union Pacific | 556 |
| All Others | 388 |

Source: DOT-AAR Grade Crossing Inventory as of August 1976

TABLE E-2b CHARACTERISTICS OF OREGON PUBLIC GRADE CROSSINGS
AS REPORTED BY THE OREGON PUBLIC UTILITY
COMMISSIONER (DECEMBER 31, 1976)

| | |
|----------------------------|--------------------|
| Number of Public Crossings | 2781 |
| Urban | (Unable to provide |
| Rural | a breakdown) |

| <u>Number of Tracks</u> | <u>Number of Crossings</u> |
|-------------------------|----------------------------|
| 1 | 1917 |
| 2 | 519 |
| 3 | 218 |
| 4 | 59 |
| 5 | 26 |
| >5 | 42 |

| <u>Warning Level</u> | <u>Number of Crossings</u> |
|----------------------|----------------------------|
| Active: | |
| Gates | 259 |
| Flashing Lights | 172 |
| Wig Wag | 71 |
| Total with Active | 502 |
| Warning Devices | |
| Passive: | |
| Crossbucks | 1282 |
| Vehicle Stop Signs | 656 |
| None of the above | 341 |
| | <u>2279</u> |

| <u>Railroad</u> | <u>Number of Crossings</u> |
|---------------------|----------------------------|
| Southern Pacific | 1240 |
| Burlington Northern | 652 |
| Union Pacific | 502 |
| All Others | 387 |
| | <u>2781</u> |

Source: Public Utility Commissioner of Oregon

E.2 DESCRIPTION OF STATE PROCEDURAL MECHANISMS

The process of federally-funded railroad grade crossing improvement in Oregon encompasses project identification, project negotiation and authorization, project initiation and project completion, as shown in Figure E-1. In project identification, the Highway Division of the state DOT develops a group of improvement projects based on the Public Utility Commission's (PUC) priority ranking formula and on input from interested parties. During project negotiation and authorization the Highway Division plays a central role in negotiating agreement on project details between the railroads and the FHWA. Once agreement has been reached, an application is submitted to the PUC. At this point, the Highway Division takes its place as one of a number of interested parties, including the railroad, the FHWA, the local road jurisdiction (city or county), State Department of Land Conservation and Development and other appropriate agencies. The PUC ensures that all potentially interested groups have a chance to review and state their positions on the project. After all parties have reached agreement, the PUC issues a final order specifying who will do the work and who will bear the cost. The project initiation stage begins with this PUC order. During the final stage, project completion, parties involved in construction notify the PUC when their portion of the work is complete. Final

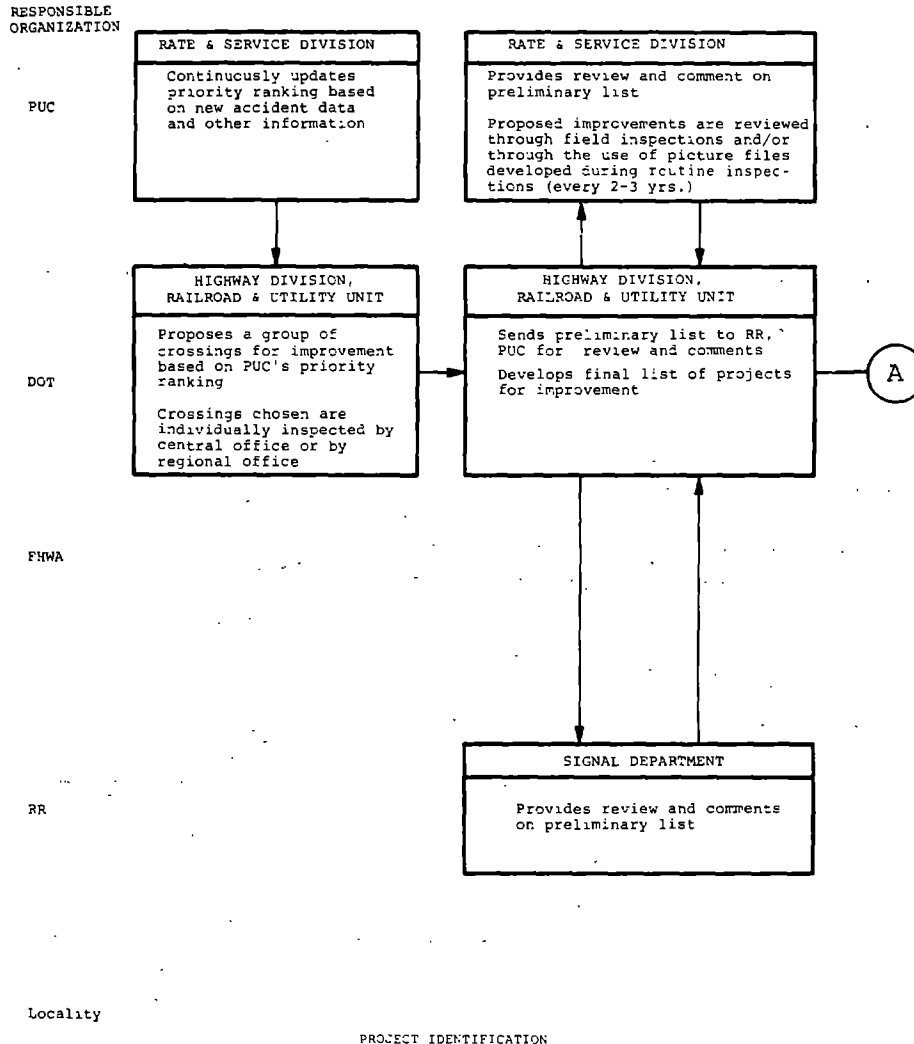
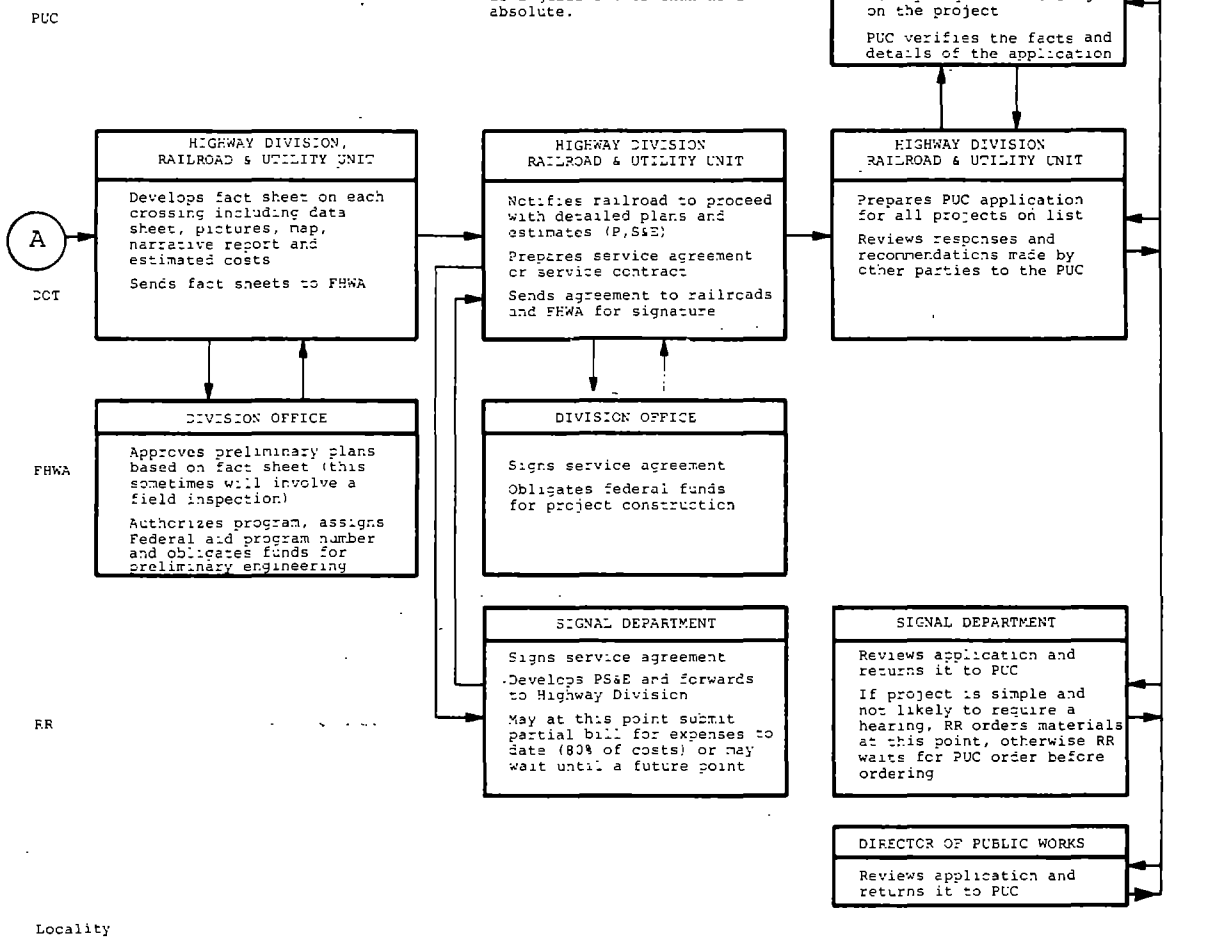


FIGURE E-1 OREGON PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (1 OF 3)

RESPONSIBLE ORGANIZATION

Note: Application for crossing improvements may also come to PUC directly from a locality. In this case the PUC consults the priority list, but uses it as a guide rather than as an absolute.



PROJECT NEGOTIATION AND AUTHORIZATION

FIGURE E-1 OREGON PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (2 OF 3)

RESPONSIBLE ORGANIZATION

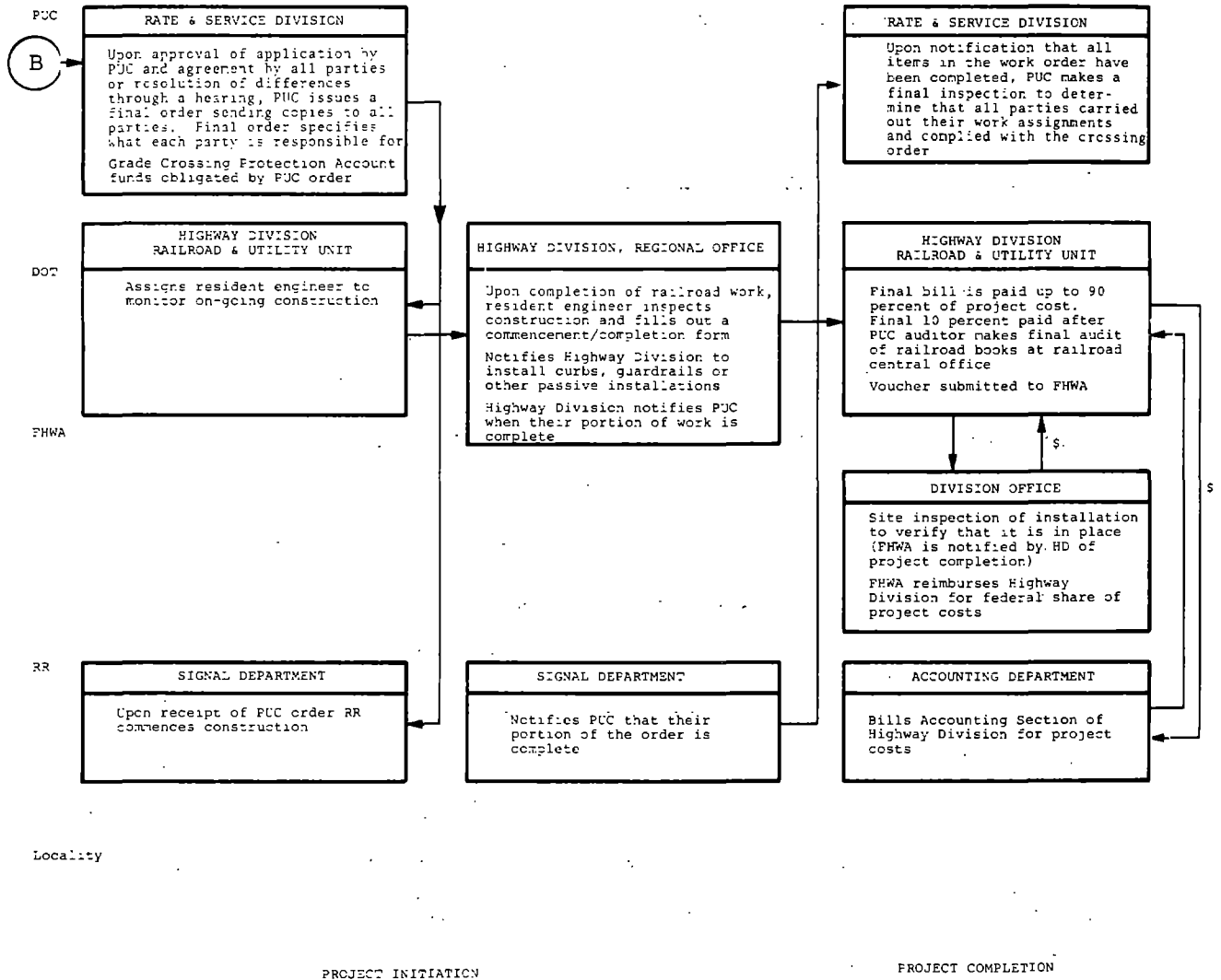


FIGURE E-1 OREGON PROCEDURE FOR RAIL-HIGHWAY GRADE CROSSING IMPROVEMENTS (3 OF 3)

inspections are made separately by the Highway Division, the FHWA and the PUC. Railroads are reimbursed at project completion up to 90 percent of project costs, the final 10 percent awaiting a PUC audit of railroad books.

Phase I: Project Identification

The project identification stage involves the annual development of a list of crossings to be upgraded by the Railroad and Utility Unit in the Highway Division of the Oregon DOT utilizing federal crossing funds. Projects are chosen using the PUC's priority ranking, which combines a predicted accident rate, a 5-year accident history, and bus utilization of the grade crossing. Site inspections are made of each proposed crossing by the railroad and utility engineer of the Highway Division's central office or by a utility engineer of one of the Highway Division's regional offices. In addition, the proposed project list is sent to the PUC for approval. The railroads and the FHWA also review and provide feedback. A weeding out process occurs based on the site inspections and the feedback from other agencies. Inappropriate projects are dropped and a final list is formulated.

Phase II: Project Negotiation and Authorization

The project authorization and negotiation stage begins with the development at the Highway Division of a fact sheet on each crossing, documenting the need for protection. Included in these fact sheets are a data sheet, pictures, a map, and a narrative report including estimated costs. These fact sheets are sent to the FHWA, where a preliminary approval is granted along with assignment of a Federal-Aid Program number and obligation of funds for preliminary engineering. Following FHWA approval, the Highway Division notifies each railroad that it may proceed with detailed plans and estimates. As soon as a railroad begins detailed plans, it may bill for 80 percent of costs incurred to date or it may defer billing to some future point in the project. Next the Highway Division prepares a service agreement and sends copies to the railroad and to the FHWA for approval. The FHWA's approval obligates federal funds for the project. The Highway Division at this point also submits an application to the PUC. As of this year, there is enforcement of a requirement that the application must come "officially" from a locality. In point of fact, the Highway Division fills out the application and sends it to the locality for signature. This new detour has introduced a delay of from 2 to 8 weeks into the negotiation process. Upon receipt of the application, the PUC serves the application to all parties involved in the proposed grade crossing improvement (railroad, Highway Division, locality and the State Department of

Land Conservation and Development). Copies were formerly sent to the FHWA, but it now allows the service agreements to stand as its consent. In addition to parties directly involved, the PUC also distributes copies of the order to other potentially interested parties, such as the Regional Association of Governments. Any of the above parties may amend the application or may request a hearing on the proposed improvement. All parties involved are sent copies of the responses and recommendations of the other parties. After all parties have indicated satisfaction with the application or after a hearing has been held to settle differences, the PUC issues a final order with duplicate copies to all parties involved. This order specifies what each party is to do in relation to project construction. Each party is instructed to inform the PUC in written form when it has fulfilled its obligations. The PUC order obligates the state's funding share, which comes out of the Grade Crossing Protection Account.

It should be noted that not all applications to the PUC for railroad grade crossing improvements are initiated by the Highway Division although approximately 50 percent do originate in this way. Other parties, principally local road jurisdictions and railroads, also petition the PUC for grade crossing improvements. In determining whether such projects should be undertaken, the PUC uses its priority list as a guide, but not as an absolute rule.

Upon receipt of the PUC application for crossing improvements, the railroad may order materials if it feels the project is noncontroversial. Otherwise it may wait for a PUC order before it commits itself in this way. In Oregon, railroads are allowed to preassemble materials outside of the state, which allows for more efficient methods of assembly.

Phase III: Project Initiation

The project initiation stage begins with the PUC order. Railroad receipt of this order allows construction to begin. The Highway Division assigns a resident engineer at this point to monitor railroad work on the project.

Phase IV: Project Completion

The project completion stage begins with the railroad's notifying the PUC that it has completed its portion of the project work. The Highway Division resident engineer makes a final site inspection and fills out a commencement/completion form. He notifies the state forces to put in curbs, guardrails and other passive elements required as part of the project. When the state has completed this second phase of installation, it notifies the PUC. The Highway Division notifies the FHWA of

project completion, and the FHWA makes its own site inspection. The PUC will inspect the installation, for both active and passive warning devices, correct placement and alignment, etc. However, this inspection does not always occur immediately and is not necessary before the billing and reimbursement process can take place. After Highway Division and FHWA approval, bills are submitted and appropriate reimbursements made. The railroads are reimbursed up to 90 percent of project costs. The remaining 10 percent is paid only after the Public Utility Commissioner has authorized the expenditures and a final audit of railroad books has been completed. The auditor visits each railroad's central office approximately three times a year.

E.3 TYPES OF IMPROVEMENTS

As of June 1977, Oregon had obligated \$2.2 million or 61 percent of available on-system funds, and \$3.1 million or 94 percent of available off-system funds. The total number of public crossings in Oregon is 2,969 (according to the DOT-AAR inventory), a relatively small number of crossings compared to some states and considering the amount of funding available for grade crossing improvements. The total available funding represents approximately \$4,300 for each on-system crossing and \$1,500 for each off-system crossing. All of the 203 funding spent to date has been for railroad grade crossing warning devices rather than grade separation. Of the 230 funding spent

to date, 72 percent has been for railroad grade crossing warning devices. The types of improvements made with 203 and 230 funds are described in the following sections.

E.3.1 Signs

Oregon is currently involved in a program to bring all passive warning devices up to Public Utility Commissioner Standards and up to the MUTCD standards. As a minimum, 2 reflectorized crossbucks, 2 advanced warning signs and pavement markings will be installed at each crossing. An inventory is currently being conducted by PUC staff to determine signing needs at all public crossings. The deadline for the completion of the inventory is the end of 1977. All crossings are expected to be up to standard by August 1978. A program to put stop signs at all private crossings, a PUC requirement, was completed 2 years ago.

E.3.2 Surfaces

In Oregon, crossing surfaces are the responsibility of the railroads. Typical surfaces are asphalt with planks, asphalt with steel, and prefab hardwood timber. The fact that the state is not systematically involved and hence federal funds are not involved in surface improvements has resulted in a lack of experimentation on the part of the railroads in crossing surfaces. However, in cases where localities are willing to pay

for surface improvements, innovation is possible. Currently the state is installing a rubber and a plastic surface at adjacent crossings for comparison purposes using federal "G" funds.

E.3.3 Signals

Installation of automatic gates and flashing lights is considered standard in Oregon although an exception can be made. In about 95 percent of crossing improvements, gates are used. Some kind of motion-detecting device in conjunction with gates is also considered standard. When the FY76 funds have been spent, approximately 20 percent of Oregon's grade crossings will have active protection.

The Union Pacific has several experimental strobe light installations in Oregon, as it does in other states. This experiment, funded entirely by the railroad, is designed to see if strobe lights provide higher visibility, especially in conditions of bright sunlight.

In addition, railroads in Oregon are experimenting with flood lighting at crossings where high speed AMTRAK trains travel through at night. This project, currently underway, is to be jointly funded by specific railroads and by the State of Oregon.

E.3.4 Maintenance

Railroads in Oregon are responsible for maintenance of signal devices, crossing surfaces and crossbucks. Advanced

warning signs and pavement markings are maintained by whichever governmental unit has jurisdiction over the roadway.

E.3.5 Factors Affecting Use of Innovative Technology

The major railroads in Oregon are generally in favor of gates and motion sensors. They do, however, cite high maintenance costs (approximately \$1,500/yr. for gate installations) as a problem and suggest federal maintenance assistance as an answer.

As stated above, the lack of state involvement with surface installation has led to a lack of innovative surfacing on the part of the railroads. They do experiment, but have chosen to do so outside of Oregon. Oregon's experiments with flood lighting and strobe lights are due in large part to railroad cooperation, which indicates a willingness on the part of Oregon's major railroads to spend money on innovations. The financially sound condition of these railroads may account in part for this attitude.

APPENDIX F
REPRESENTATIVE AGREEMENT FORMS

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AGREEMENT made this _____ day of _____
by and between the COMMONWEALTH OF MASSACHUSETTS, hereinafter called the
Commonwealth, through its DEPARTMENT OF PUBLIC WORKS, hereinafter called the
Department and the _____, hereinafter called
the Railroad.

WHEREAS, the Department proposes to conduct various Projects under
its RAILROAD GRADE-CROSSING IMPROVEMENT PROGRAM with funds to be provided
by the Federal Government pursuant to Section 203 and Section 230 of the
Federal Highway Safety Act of 1973, and

WHEREAS, several at-grade railroad crossings throughout the
Commonwealth consist of tracks owned by the Railroad, and

WHEREAS, the Railroad desire to participate in said RAILROAD
GRADE-CROSSING IMPROVEMENT PROGRAM by undertaking projects awarded to them
through said Program, and

WHEREAS, the Railroad possess the necessary labor, equipment and
expertise to improve said grade crossings, and

WHEREAS, the parties hereto have reached an agreement as to the
general provisions, work to be done, expense of carrying out said work, and
the future maintenance for projects to be conducted under this Agreement,
and

WHEREAS, the parties hereto further agree that the clauses here-
inafter set forth shall be incorporated by reference in each project awarded
to the Railroad under this Agreement.

NOW THEREFORE, in consideration thereof, the Department and the
Railroad agree, each with the other, as follows:

GENERAL PROVISIONS

The Railroad shall undertake projects only with the written
approval of the Department. Said approval shall constitute
authority to commence preliminary engineering which shall be
reimbursable by the Department.

The Railroad shall then submit for approval by the Department
a proposal of work to be done; an estimate of the labor, materials,
equipment, and other services required to carry out said proposal;
and sufficient drawings to supplement said proposal and estimate.
Said proposal shall be signed by an authorized agent of the Rail-
road.

The Department shall notify the Railroad, in writing, of
the Department's approval of their proposal. Said approval shall
constitute authority for the Railroad to commence work on the
project.

WORK TO BE DONE

The Railroad shall provide the required labor, materials, equipment and other services to carry out all the work as set forth in the approved proposal.

All work by the Railroad shall be done in accordance with the applicable provisions of Policy and Procedure Memorandum 30-3 of the United States Department of Transportation.

The Railroad agrees to notify the District Highway Engineer in writing, prior to the start of any work on the project by the Railroad.

The Railroad hereby agrees to coordinate their force account work on a daily basis with the Resident Engineer assigned to the project by the Department, by requiring its Engineer Inspector to notify the Resident Engineer each day the Railroad works on the project.

The Railroad hereby agrees that its Engineer Inspector or other authorized representative shall furnish to the Resident Engineer a substantially accurate written daily report of labor, materials incorporated in the work, equipment and salvage (regardless of condition) exclusive of prices within five (5) working days from the close of the work day reported, except in the case of an emergency. The subject daily report shall be submitted in triplicate to the Resident Engineer on Form CSD-123 entitled: DAILY FORCE ACCOUNT REPORT.

The Railroad hereby agrees that any work to be done on a Saturday, Sunday or Legal Holiday will be done only after the work has been so scheduled and the Resident Engineer agrees three (3) days in advance, except in a case which is an actual threat to the public safety and/or safe operation of the Railroad. In the latter case, the Resident Engineer shall be notified as soon as possible. Verbal advice is acceptable in all cases.

DIVISION OF EXPENSE

The entire cost of said changes will be borne by the Commonwealth and the Commonwealth will reimburse the Railroad for the actual cost of the labor, materials, equipment and other services furnished by and for the Railroad including the preliminary engineering performed by the Railroad from the date of original authorization, less the value of materials removed, determined in accordance with the Policy and Procedure Memorandum 30-3 of the United States Department of Transportation.*

It is hereby agreed that any supplementary estimate which may subsequently be approved by the Chief Engineer of the Department and the Chief Engineering Officer of the Railroad shall also be made a part of the project.

All reimbursable charges in connection with the project will be subject to audit.

PROVISIONS FOR METHOD OF PAYMENT TO THE RAILROAD

1. An estimate of the cost to be expended in one month by the Railroad will be prepared by the Railroad's Inspector on site, consulting with the Department's Resident Engineer.

2. From this estimate, a bill will be prepared by the Railroad to be submitted to the Department's Resident Engineer for approval and subsequent submittal.

*Currently incorporated into the Federal-Aid Highway Program Manual.

3. This bill and other progressive estimated bills will be submitted by the Railroad to the Department on the first of the month and the Department will reimburse the Railroad in the full amount of these bills as expeditiously as possible.

4. As the Project progresses, the Railroad will, from Auditor's machine runs, adjust percentages so that the estimated amount billed will closely follow actual expense.

5. Final and summary billing for force account work is to be submitted as soon as practicable, after written notification to the District Highway Engineer that Railroad's force account work has been completed in conformance with the procedures of the Commonwealth in effect, insofar as same have been called to the Railroad's attention.

FUTURE MAINTENANCE

Upon completion of the project, the Railroad shall be responsible, including the cost thereof, for the maintenance of the trackage and other appurtenances of the Railroad constructed under this project.

TERMINATION OR AMENDMENT

This Agreement shall continue in full force and effect until rescinded in writing. Said Agreement may be terminated in its entirety by either party upon thirty (30) days written notice to the other party.

Amendment may be made only by mutual agreement of the parties.

No deletion, modification, addition to, or termination of this Agreement shall affect any projects previously entered into between the parties in which this Agreement has been incorporated by reference.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day and year first above written.

Approved

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

U _____

AGREEMENT FOR IMPROVEMENT OF GRADE CROSSINGS

This agreement made this _____ day of _____ 19____, by and between THE PEOPLE OF THE STATE OF NEW YORK (hereinafter called "STATE"), acting by and through Raymond T. Schuler as Commissioner of Transportation (hereinafter called "Commissioner"), whose office is in the Department of Transportation Administration and Engineering Building, State Campus in the City and County of Albany and State of New York, and

(hereinafter called "Company"), a corporation organized under and existing by virtue of the laws of the State of _____ and of other States, and having its general office at _____

WITNESSETH:

WHEREAS, the Company is the owner of certain lands and premises constituting its right-of-way, in the _____ State of New York, and over which it operates its railroad, and

WHEREAS, the Commissioner of Transportation of the State of New York (hereinafter called "Commissioner"), directed the Company

_____ County, State of New York (hereinafter called "Project"), and

WHEREAS, the Company has informed the State of its intention to use federal funds for the project insofar as they may be applicable.

NOW, THEREFORE, in consideration of the benefits moving to each of the parties hereto, they do mutually agree as follows:

ARTICLE 1. DESCRIPTION OF WORK. The Company agrees to make necessary changes in its railroad and railroad facilities to the extent required as directed by the Commissioner of Transportation, and to construct and provide such facilities in addition as may be needed in connection with the maintenance and protection of railroad traffic during such changes in its railroad.

ARTICLE 2. REIMBURSEMENT. The State agrees to reimburse the Company for the cost of any work performed, material furnished, and liability insurance policies provided by the Company under this agreement in connection with the project pursuant to Federal Highway Administration's Volume 1, Chapter 4, Section 3 (Reimbursement for Railroad Work) of the Federal-Aid Highway Program Manual and amendments thereto, it being intended by the parties hereto that by this reference to the said Federal-Aid Highway Program Manual and amendments, it is agreed that the provisions thereof are deemed to be included herein and are accepted as binding upon the said parties to the same extent and with the same force and effect as if such Federal-Aid Highway Program Manual and amendments thereto had been set forth in and made part of this agreement, but such reimbursement shall not exceed the sum of

Dollars

unless such sum shall be increased pursuant to a supplemental agreement therefore.

The Company shall submit to the Commissioner fair and reasonable costs for the aforesaid work performed or facilities provided by the Company, less the value of the materials recovered, as evidenced by detailed invoices acceptable to the Commissioner. All costs so submitted by the Company on a first and final accounting shall be subject to the approval of the State and to audit by the Comptroller of the State of New York.

The Company does, in recognition of the use of Federal Aid funds by the State in related projects and also to the usual claim by the State for reimbursement from the Federal Government of the expenditures for such projects, hereby agree to retain its cost records and accounts so that they will be available for audit by authorized representatives of the Federal Highway Administration of the U.S. Department of Transportation. The Company does further agree that on or before the date of its final billing pursuant to this agreement, it will notify the Commissioner, in writing, of the location where such cost records and accounts will be so available for the purpose of said audit.

ARTICLE 3. FUNDS AVAILABLE. This agreement shall be deemed executory only to the extent of the funds available therefor, in the amount set forth in Article 2 above.

ARTICLE 4. DIVISION OF MAINTENANCE. Upon the completion of the project, the improvements shall be maintained by the Company.

ARTICLE 5. RESPONSIBILITY. The Company shall be responsible for all injuries or damages to persons or property caused by or occurring as the result of its sole negligence or the sole negligence of its agents or contractors in connection with the construction work to be performed by the Company, its agents or contractors. This responsibility shall be deemed limited or discharged only to the extent of the enumeration or procurement of any insurance for liability for damages imposed by law upon the Company or its contractor with respect to all work performed by the Company or its contractor under this agreement.

ARTICLE 6. LIABILITY AND WORKMEN'S COMPENSATION INSURANCE. The Company shall procure and maintain until the work covered by this agreement has been completed to the satisfaction of the State and the Company, insurance for liability for damages imposed by law of the kinds and in the amounts hereinafter provided, in insurance companies authorized to do such business in the State of New York, covering all work under this agreement. Before commencing the work, the Company shall furnish to the Commissioner a certificate or certificates of insurance in a form satisfactory to the Commissioner, showing that the Company has complied with this Article, which certificate or certificates shall provide that the policies shall not be changed or cancelled until thirty (30) days' written notice has been given to the Commissioner. The kinds and amounts of insurance are as follows:

1. A policy covering the obligations of the Company in accordance with the provisions of Chapter 41 of the Laws of 1914, as amended, known as the Workmen's Compensation Law and also by the provisions of Article 9 of the Workmen's Compensation Law, known as the Disability Benefits Law, and covering all work of the Company under this agreement, whether performed by the employees of the Company or its contractors. This agreement shall be void and of no effect unless the Company or its contractors comply with and meet the requirements of the Workmen's Compensation Law of the State of New York during the period of performance of any work by it, or its contractors in connection with said construction work for the benefit of said employees of the Company, or its contractors (State Finance Law, Section 142).

2. Liability and property damage insurance policies, each with limits of not less than

| <u>Bodily Injury Liability</u> | | <u>Property Damage Liability</u> | |
|--------------------------------|----------------------|----------------------------------|------------------|
| <u>Each Person</u> | <u>Each Accident</u> | <u>Each Accident</u> | <u>Aggregate</u> |
| \$500,000. | \$1,000,000. | \$500,000. | \$1,000,000 |

for all damages arising during the policy period, in the types specified, viz

- (a) Contractor's liability insurance issued to and covering liability for damages imposed by law upon the Company with respect to all work performed by it under this agreement;
- (b) Contractor's liability insurance issued to and covering liability for damages imposed by law upon each contractor of the Company with respect to all work performed by said contractor under this agreement;
- (c) Protective liability insurance issued to and covering liability for damages imposed by law upon the Company with respect to all work performed by its contractor under this agreement for the Company;
- (d) Protective liability insurance issued to and covering liability for damages imposed by law upon The People of the State of New York, the Commissioner of Transportation and employees of the Commissioner of Transportation, both officially and personally, with respect to all work under this agreement by the Company, or by its contractors, including omissions and supervisory acts of the State.

ARTICLE 7. ASSIGNMENT OF AGREEMENT. The Company agrees not to assign, transfer, convey, sublet or otherwise dispose of this agreement or any part thereof, or of its right, title, or interest therein or its power to execute such agreement, to any person, company or corporation without the previous consent in writing of the Commissioner unless a transfer of its entire property and assets is made. In case the Company shall, with the consent of the State, make contracts for any part of the work or facilities covered by this agreement, the terms of said contracts shall be subject to the approval of the State. The Company shall pay its contractors in accordance with the terms of such contracts and the State agrees to reimburse the Company for the cost thereof. Any contract for the performance of any work by means other than by the Company's own forces shall contain the "contract clauses required in public work" as shown in Section 102-08, pages 13 to 17 inclusive, of "Department of Transportation Specifications of January 2, 1973".

ARTICLE 8. STARTING OF WORK. The Company agrees to start the work covered by this agreement only after the Commissioner or his authorized representative has notified the Chief Engineer of the Company in writing that it may proceed.

ARTICLE 9. REQUIRED FEDERAL AND STATE CONTRACT CLAUSES. The Company agrees to comply with all applicable Federal Required Contract Provisions [CONR 295-1 (10/72)] a copy of which is attached hereto and hereby made a part of this agreement and marked "Scheduled A". The Company agrees further that any contract entered into for the performance of any work comprising part of the PROJECT shall contain the New York State Required Standard Clauses [CONR 296-1 (10/72)] a copy of which is attached hereto and hereby made a part of this agreement and marked "Scheduled B".

IN WITNESS WHEREOF, the State has caused this agreement to be signed by the Commissioner of Transportation, and the Company has caused these presents to be signed by its duly authorized officer on the day and year first above written:

If any clause, sentence, subdivision, paragraph, section or part of this contract be adjudged by any court of competent jurisdiction to be invalid, such judgment shall not affect, impair or invalidate the remainder thereof, but shall be confined in its operation to the clause, sentence, subdivision, paragraph, section or part thereof directly involved in the controversy in which such judgment shall have been rendered.



COMMISSION
REAGAN HOUSTON CHAIRMAN
DEWITT C GREER
CHARLES E SIMONS

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION
AUSTIN, TEXAS 78701

ENGINEER-DIRECTOR
B L DEBERRY

December 21, 1976

SUBJECT: Placement of Passive Warning Devices on Railway
Company Property at Public Crossings in Texas

IN REPLY REFER TO
FILE NO D-5RR

Mr. J. H. Hughes, Chief Engineer
Missouri-Kansas-Texas Railroad Company
101 E. Main, Room 203
Denison, Texas 75020

Dear Sir:

We are developing a project in cooperation with the Federal Highway Administration utilizing Safety Funds under Section 203 of the Federal-Aid Highway Act of 1976 to install passive warning devices at all public road crossings of all railway lines in the State of Texas. This project is designed to bring each crossing up to the minimum standard as specified in the Manual of Uniform Traffic Control Devices.

Generally, the work performed on your right of way will be the installation or upgrading of reflectorized crossbuck and number-of-track signs and placement of pavement markings and stop lines on the pavement surface, part of which may be on your right of way. We anticipate that this work will be done either with State forces or by contract in the calendar years 1977 and 1978. We propose to utilize all of the existing crossbuck signs and mountings as appropriate. Where new material is installed the State will salvage and dispose of the existing signs, without credit to your company.

While these installations will be made without cost to your company, this letter agreement does require the railroads to maintain the crossbuck signs (including number-of-track signs) installed under this work program.

Mr. J. H. Hughes

-2-

December 21, 1976

Workmen making these installations will be cautioned that your tracks shall not be blocked at any time and advised to use all reasonable care so as not to interfere with your train operations. Our records indicate that you have approximately 1,100 road crossings on your rail system in the State of Texas. By signing and returning one copy of this letter, you grant your company's permission for the State or its Agent to perform the work herein described as may be necessary to provide a minimum passive warning system at public highway or road crossings on your rail system in Texas. Your early consideration and approval will be appreciated.

Sincerely yours,

B. L. DeBerry
Engineer-Director

By: *Wayne Henneberger*
Wayne Henneberger
Bridge Engineer

Accepted by *J. H. Hughes*
Title *Chief Engineer*
Railroad Company *SPRINT RRCO*