THE SECRETARY OF TRANSP
WASHINGTON, D.C. 205

GRADE CROSSING SAFETY
Alerting Lights

APR 1 1983

The Honorable George Bush
President of the Senate
Washington, D. C. 20510

Dear Mr. ~~Bush~~ George:

I am transmitting to the Congress this report entitled The Effects of Mounted Oscillating Lights on Leading Railroad Cars, as directed by Section 702 (c) (j) of the Federal Railroad Safety Authorization Act of 1982.

Reducing the rate of railroad accidents and achieving higher safety standards remain major goals for the Nation's railroads. As this report shows, however, goals in the area can be better achieved through means other than Federal regulation. Our analysis demonstrates that the costs of a Federal requirement to equip locomotives with oscillating lights exceed the benefits of doing so by 130 percent.

Sincerely,

Elizabeth

Elizabeth Hanford Dole

THE EFFECTS OF MOUNTED, OSCILLATING LIGHTS ON LEADING RAILROAD CARS

MARCH 1983

MANDATE

This document was prepared in response to the mandate contained in Section 702(c) (j) of the Federal Railroad Safety Authorization Act of 1982, which directed the Secretary of Transportation, within 60 days of enactment of the Act, to report to the Congress on whether or not to issue rules, regulations, orders, and standards to require that the leading car of any railroad train in operation after July 1, 1983, be equipped with an acceptable form of mounted oscillating light.

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EXECUTIVE SUMMARY

This report, a brief discussion of the costs and benefits of equipping locomotives with oscillating lights, reaches two major determinations. First, the data do not support the concept that oscillating lights are effective in reducing the frequency of rail-highway grade-crossing accidents. Second, even if oscillating lights were found to be effective for those cases where an added light might alert a motorist, the costs of requiring an oscillating light on every leading railroad car would far exceed the benefits.

The Federal Railroad Administration (FRA) analysis concluded that the use of oscillating headlights would result in benefits of $110 million, assuming a 100-percent effectiveness rate. But even using such an unrealistic rate, these benefits would fail to cover costs by 130 percent. The FRA has decided that any Federal action of this type may, indeed, compel railroads to reallocate resources from programs already proven successful in reducing the rate of accidents at grade crossings; and the consequence of such a Federal rule may be an increase in rail-highway crossing accidents. On the basis of our findings, presented in greater detail in the following report, a Federal requirement that railroads require such lights cannot be justified.

SAFETY AND ALERTING LIGHTS

An oscillating light is a type of lighted alerting device [1] used on 17 percent of the locomotives in the United States to increase the visibility, or perceptibility, of the locomotive. Originally installed on the assumption that they would alert motorists to approaching trains, oscillating lights were expected to reduce the likelihood of accidents at rail-highway grade crossings.

Rulemaking

Whether or not to require an alerting light on railroad locomotives has already been explored in depth by the FRA during the course of an extended rulemaking proceeding. On March 7, 1978, the FRA published an Advance Notice of Proposed Rulemaking (ANPRM) in Docket RSGC-2.[2] The ANPRM was proposed to determine whether a Federal regulation should be issued to require a locomotive to have an alerting light to warn motorists of an approaching train.

Although the majority of comments at the hearing were negative, FRA determined that the concept of an alerting light warranted further exploration. Hence, it issued a Notice of Proposed Rulemaking (NPRM) on June 18, 1979 (44 FR 34982). This NPRM proposed the use of strobe lights on locomotives at public rail-highway grade crossings.

Response of the industry to the NPRM on strobe lights was overwhelmingly negative.[3] Questions were raised about the

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[1] Oscillating light (MARS LIGHT) -- also called a "swept" headlight. It uses one or more standard locomotive headlight lamps on a mounting plate that is moved by a small motor in either a figure eight, a circular, or an oval pattern. Other types of alerting lights include:

Strobe light -- A type of roof light powered by a flash tube and capable of producing very high intensity with a very fast flash rate.

Rotating beacon light -- An incandescent type roof light that functions by rotation-turning lenses around a lamp bulb, a wedge-shaped reflector, or an assembly of sealed beam lamps.

Sequentially flashing light -- An incandescent type of roof light that operates by regularly flashing bulbs.

[2] Minutes of the Official Transcript of Hearing - ANPRM, Office of Safety, Federal Railroad Administration.

[3] Minutes of the Official Transcript of Hearing - ANPRM, Office of Safety, Federal Railroad Administration.

effectiveness of strobe lights, the costs involved, and the reliability of the strobes. FRA withdrew the strobe light NPRM on April 15, 1982 (47 FR 16189).

On October 12, 1982, FRA issued a second NPRM (47 FR 44791). The notice was not restricted to strobe lights, but included a proposal to allow a variety of types of alerting lights on locomotives. By removing the concerns of commenters in the earlier NPRM relating solely to the strobe lights, FRA was able to focus on the more basic issue of whether alerting lights were indeed effective. After serious consideration of all the data, FRA determined that there was no justification for a Federal regulation requiring that railroads equip their locomotives with an alerting light and will terminate the rulemaking.

Effectiveness

The notion of a flashing light on a leading railcar, in addition to the standard headlights, to make the train more conspicuous is not new. Some railroads have used oscillating headlights on locomotives for decades. More recently, other alerting light devices (strobe lights, beacon lights, and sequentially flashing lights) have been used by railroads.

The FRA began its analysis in the rulemaking proceeding with the assumption that an alerting light would make a locomotive more visible, and thereby reduce the number of rail-highway accidents at grade.

This assumption has been neither validated nor justified.

In a study by FRA, included in Docket RSGC-2, FRA compared the safety records of railroads that equip all locomotives with alerting lights to railroads that do not have locomotives equipped with alerting lights. The FRA found no evidence that alerting lights reduce grade-crossing accidents. On the contrary, the group of railroads using the alerting lights had a slightly higher accident rate at rail-highway crossings than the group without the lights. The only affirmative conclusion that can be drawn from the study is that alerting lights have had little or no discernible effect on the frequency of grade-crossing accidents.

Grade-Crossing Safety Efforts

As evidenced by railroad accident statistics, a variety of factors contribute to rail-highway grade-crossing accidents. Rail labor and management, safety officials at all levels of Government, as well as the academic community, have developed and implemented active countermeasures to reduce grade-crossing accidents, including;

- Educating the public through programs like "Operation Lifesaver"
- Upgrading crossings by installing gate and flashing light systems
- Removing brush from crossings
- Enforcing State safety laws
- Designing engineering programs for specific grade-crossing sites

These and other countermeasures have led to a nationwide decline in accidents and fatalities. Grade-crossing accidents declined from 12,925 in 1976 to 9,295 in 1981; fatalities declined from 1,115 to 728. This amounts to a 28.1-percent decline in accidents and a 34.7-percent reduction in deaths. Over the same period, the overall traffic flow at rail-highway crossings increased 4 percent.

The dramatic decline in the accident rate, when combined with the lack of evidence for demonstrating any positive safety benefits of alerting lights, leads the Department to conclude that a Federal regulation cannot be justified. An analysis of the costs and benefits of a rule requiring oscillating lights follows.

THE BENEFITS AND COSTS OF EQUIPPING RAILROAD LOCOMOTIVES WITH AN OSCILLATING LIGHT

There is no confirmation to warrant a finding that oscillating lights are effective in reducing grade-crossing accidents. Even if oscillating lights were assumed to be 100-percent effective, a Federal rule requiring that all locomotives be equipped with such lights would require expenditures of $254 million by the railroad industry while yielding $110 million in benefits -- a profitability index of 0.43.

Benefits

To present the best possible case for the oscillating headlight requirement, the benefit analysis assumed that oscillating headlights have a 100-percent effectiveness rate for those accidents that could be avoided if an alerting light were used.

Benefits are defined as "avoidable accidents and the attendant avoidable costs." To determine the share of avoidable accidents, FRA removed from the data base those accidents in which oscillating lights would be ineffective. These include accidents that involve:

- Vehicles stopped or stalled on tracks
- Locomotives pushing a train
- Freight cars stopped and blocking crossing
- Vehicles or trains struck past the 20th railcar
- An obstructed view by the motorist
- A motorist driving either behind or in front of a train -- who either struck or was struck by a second train
- A motorist driving around or through the gates
- A motorist stopping and then proceeding
- A pedestrian

Accidents caused or influenced by several other factors were also eliminated from the data base. These include:

- Extent of grade-crossing safeguards
- Adverse weather
- Speed of trains and other vehicles
- Degree of street illumination

Those types of accidents remaining in the data base were considered preventable by oscillating lights, even though it is unlikely that every motorist will react positively and avert an accident in every instance.

Table I summarizes the $110 million in the forecast savings from avoidable accidents.

Table I: Benefits in Dollars
(Dollars in Thousands)

Category	20-year Forecast
Fatalities	$ 66,886
Injuries	34,565
Material Losses	8,883
	$110,334

Table II details the computations in support of these projected dollar benefits.

TABLE II: Oscillating Lights -- Projected Avoidable Accidents, Fatalities and Injuries

Year Base	Accident Actual [a]	Forecast Year	Accident Trend [b]	Avoidable Accidents [c]	Avoidable Fatalities	Dollar Benefits (in thousands) from Avoidable Fatalities [d]	Avoidable Injuries	Dollar Benefits (in thousands) from Avoidable Injuries	Dollar Benefits (in thousands) from Avoidable Materials Losses [e]
1976	12,925	1	8,014	275	22	11,498	98	5,790	1,500
1977	13,101	2	7,361	253	20	9,499	90	5,055	1,254
1978	13,316	3	6,776	232	18	7,773	83	4,052	1,045
1979	12,509	4	6,230	214	17	6,676	76	3,374	877
1980	10,611	5	5,728	196	15	5,356	70	2,826	730
1981	9,295	6	5,267	181	14	4,540	65	2,383	613
		7	4,843	166	13	3,835	59	1,967	511
		8	4,453	153	12	3,222	55	1,670	429
		9	4,095	140	11	2,682	50	1,378	356
		10	3,765	129	10	2,220	46	1,154	299
		11	3,462	119	9	1,811	42	956	250
		12	3,183	109	9	1,651	39	809	209
		13	2,927	100	8	1,334	36	679	174
		14	2,691	92	7	1,059	33	564	145
		15	2,474	85	7	962	30	466	122
		16	2,275	78	6	752	28	397	102
		17	2,092	72	6	683	26	335	86
		18	1,924	66	5	518	24	281	71
		19	1,769	61	5	472	22	235	60
		20	1,626	56	4	343	20	194	50
		Total Dollar Benefits				$66,886		$34,565	$8,883

[a] FRA data base count includes grade-crossing accidents at both private and public crossings.

[b] The projected number of annual rail-highway grade-crossing accidents based on an exponential curve forecast from actual 1976-1981 accidents.

[c] The projected number of grade-crossing accidents which potentially could be avoided by requiring an oscillating light on each locomotive reflects the facts that 51 percent of the locomotives are already equipped with alerting lights and that alerting lights are not beneficial in a large number of grade-crossing accidents such as those involving a vehicle struck or stalled on the tracks, a motorist driving around or thorough a gate, weather conditions, etc. In this analysis, oscillating lights are assumed to have an effectiveness rate of 100 percent for the accidents remaining in the data base.

[d] Based on medical and settlement costs, a unit benefit of $575,000 per fatality avoided and $65,000 per injury avoided are used. A 10-percent discount factor has been applied to account for the time value of money.

[e] Based on $6,000 of actual railroad costs per avoidable accident. These costs include railroad property damage, wreck clearing loss and damage claims, non-railroad property damage, administrative and legal costs, lost equipment utilization, social services and inconvenience costs. A 10-percent discount factor has been applied to account for the time value of money.

Costs

Costs resulting from a Federal rule that railroads equip all locomotives with oscillating headlights include the retrofit of existing locomotives, new purchases, and servicing of equipment. The expected cost to the railroads would be $254 million over 20 years.

In addition, a Federal rule that specifically requires all locomotives to operate with oscillating headlights would automatically exclude all other types of alerting lights already in use by some railroads.

Under a Federal rule, 83 percent of existing locomotives would require the installation of an oscillating headlight. Railroad companies have already equipped 51 percent of their locomotives with one of the four types of alerting lights, as shown in Table III. The requirement for oscillating headlights would mean that 67 percent of the locomotives already equipped with an alerting light would have to replace the existing system with a new oscillating headlight.

TABLE III: Historical Distribution of Alerting Light Types

Alerting Light Types	Locomotives Equipped[a/]	All Locomotives	Percentage Share	Other than Oscillating Headlights
Oscillating Headlights	5,290		0.1675	-
Rotating Beacon Lights	7,793		.2467	0.2467
Strobe Lights	2,613		.0827	.0827
Sequentially Flashing Lights	540		.0171	.0171
Subtotals		16,236	.5140	
Locomotives not Equipped		15,350	.4860	
Totals		31,586[b/]	1.0000	.3465

a/ AAR's submission in Docket RSGC-2, covering the use of alerting lights on locomotives at public grade crossings.

b/ Amount taken from an AAR survey that includes Class I, II, and III railroads.

The Association of American Railroads (AAR) has stated that the mix of locomotives equipped with alerting lights and those not equipped will not change. FRA accepted this conclusion and assumed that a constant 51 percent of the locomotive fleet will have an alerting light--without the enactment of any Federal requirement.

This assumption affected FRA's cost estimates in that the purchasing of new equipment that would have otherwise occurred and related servicing expenses were subtracted from the cost of installing oscillating headlights. The FRA added to this estimate those servicing costs for the existing fleet minus the servicing costs that would have occurred without the rule and retrofit costs for locomotives not already equipped. The remainder is the new cost to the railroad industry. (See Table IV).

TABLE IV: Twenty-Year Expenditures Forecast for Oscillating Lights
(Dollars in Thousands)

Category	Cost
Capital Costs [a]	
New Installations	$ 9,811
Retrofitting	36,632
Annual Cost [b]	196,981
Subtotal	$ 243,424
Class II and III Railroads	10,379
Total	$ 253,803

[a] The costs of purchasing and installing oscillating headlights on locomotives. A 10-percent discount factor has been applied to account for the time value of money.

[b] The costs that recur year after year -- overhaul costs, routine maintenance costs, bulb changeout cost, and locomotive downtime cost. A 10-percent discount factor has been applied to account for the time value of money.

Tables V, VI, and VII detail the computations in support of the projected dollar costs.

TABLE V: New Capital Cost Purchases [a/]
(Dollars in Thousands)

Year	Oscillating Headlights: Locomotives Included	Oscillating Headlights: Totals [b/]	Remaining Light Systems [c/]	Subtotals	Totals [d/]
1	529	$ 927	$ 230	$ 1,157	$ 1,052
2	530	929	214	1,143	944
3	531	931	213	1,144	859
4	532	933	213	1,146	783
5	533	934	214	1,148	713
6	533	934	214	1,148	647
7	534	936	215	1,151	590
8	535	938	215	1,153	538
9	535	938	216	1,154	489
10	536	940	216	1,156	446
11	537	941	216	1,157	405
12	537	941	216	1,157	369
13	538	943	216	1,159	336
14	538	943	216	1,159	305
15	539	945	216	1,161	277
16	539	945	217	1,162	253
17	540	947	217	1,164	230
18	541	948	217	1,165	210
19	541	948	217	1,165	191
20	541	948	217	1,165	174
					$ 9,811

[a/] Represents 49 percent of all locomotive purchases -- number of locomotives which would not be equipped with any type of alerting light without a Federal requirement.

[b/] Based on a unit cost of $1,753 for an oscillating light per locomotive. Costs for each type of alerting light were developed by FRA from an AAR survey of equipment suppliers and AAR member railroads.

[c/] Additional cost incurred by replacing a less costly light system with the oscillating headlights for those locomotives that will otherwise be equipped with an alerting light without a Federal rule.

[d/] Reflects application of 10-percent discount rate to account for time value of money.

TABLE VI: Retrofit Capital Costs
(Dollars in Thousands)

Locomotives for Retrofit[a/]	Retired[b/]	Subtotal	Already Equipped[c/]	Scheduled for Retrofit	Total[d/]
28,137	523	27,614	4,625	22,989	$ 36,632

a/ Number of locomotives in service at the start of the first forecast year.

b/ Since all existing locomotives must be retrofitted by mid-year, only half the locomotives forecast to be retrofitted is counted.

c/ Locomotives already equipped with oscillating headlights.

d/ Costs are computed at the start of the forecast. A unit cost per oscillating light of $1,753 is used, and a discount of 10 percent is applied to account for the time value of money.

TABLE VII: Annual Costs
(Dollars in Thousands)

Year	Oscillating Headlights		Remaining Light Systems [c/]	Subtotals	Totals [d/]
	Locomotives Included [a/]	Totals [b/]			
1	13,696	$ 14,600	$ 8,335	$ 22,935	$ 20,848
2	13,718	14,623	8,349	22,972	18,975
3	13,737	14,644	8,360	23,004	17,276
4	13,756	14,664	8,373	23,037	15,734
5	13,776	14,685	8,384	23,069	14,326
6	13,795	14,705	8,396	23,101	13,029
7	13,812	14,724	8,408	23,132	11,867
8	13,830	14,743	8,418	23,161	10,816
9	13,847	14,761	8,429	23,190	9,833
10	13,864	14,779	8,438	23,217	8,962
11	13,880	14,796	8,449	23,245	8,136
12	13,896	14,813	8,458	23,271	7,423
13	13,912	14,830	8,469	23,299	6,757
14	13,928	14,847	8,480	23,327	6,135
15	13,943	14,863	8,486	23,349	5,580
16	13,957	14,878	8,495	23,373	5,095
17	13,972	14,894	8,503	23,397	4,633
18	13,985	14,908	8,512	23,420	4,216
19	13,998	14,922	8,520	23,442	3,844
20	14,012	14,937	8,528	23,465	3,496
Total					$196,981

[a/] Represents 49 percent of the locomotives in service -- number of locomotives which would not be equipped with any type of alerting light without a Federal requirement.

[b/] Based on a unit cost of $1,066 per locomotive.

[c/] Additional cost incurred by replacing a less costly light system with the oscillating headlights for those locomotives that will otherwise be equipped with an alerting light without a Federal rule.

[d/] Reflects application of a 10-percent discount rate to account for time value of money.