

EVALUATION OF THE FIRST FLASH INSTALLATION

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FLASH (Flash Lights And Send Help) is an electronic system that was installed on a 50-mile section of Interstate 4 in Florida to test the operational feasibility of cooperative motorists using their headlights to summon aid for distressed motorists. Signals from 20 roadside detectors are sent to the Florida Highway Patrol Troop Headquarters, which then renders the help needed. The evaluation program proved FLASH to be an effective motorist-aid system. Effectiveness measures included empirical data from a series of controlled experiments that showed that an operationally acceptable fraction (better than 12 percent) of passing motorists used the system properly. About 0.1 percent responded incorrectly, which is more than ample discrimination. Furthermore, detector spacings of up to 8 miles were found acceptable. Motorist acceptance and understanding of FLASH were determined from mail-back questionnaires distributed at exit ramps and rest areas. Motorists who had been disabled and were serviced as a result of FLASH indicated through similar mail-back questionnaires their satisfaction with the short (18-min average) waiting time for the highway patrol to arrive. During the evaluation period, design improvements were made to accommodate varying ambient light conditions and to allow for the fact that the test section had the heaviest concentration of thunderstorms in the country. To be implemented during the second half of 1971 are an improved communications system (frequency shift keyed) and more stable photodetectors. FLASH has proved to be the most economical and effective system for the detection and location of stranded motorists.

•AS THE Interstate Highway System has progressed toward completion, the federal government, who wrote the specifications, and the state governments, who designed, built, and currently operate the highway system, have become more concerned about ensuring the successful and comfortable completion of motorists' trips. Identifying and getting help to motorists whose vehicles have become disabled are an important aspect of this concern. Some years ago, the Federal Highway Administration asked AIL to investigate methods that would be cost-effective for locating disabled vehicles on limited-access highways in even the most rural areas as well as one that would be safe, simple, and convenient for motorists to use.

FLASH, an acronym for Flash Lights And Send Help, is a motorist-aid system that uses the passing motorist to convey information about vehicles needing help. Equipment was installed on a 50-mile segment of Interstate 4 between Lakeland and Orlando, Florida, to determine the operational feasibility of a system that relied on passing motorists to report motorists needing help by flashing their headlights and thereby alerting the Florida Highway Patrol to investigate the need. Figure 1 shows an artist's concept of the FLASH system.

This paper discusses system requirements and results of an evaluation program sponsored by the U. S. Department of Transportation, Federal Highway Administration, and operated by the Florida Department of Transportation and the Florida Highway Patrol. The evaluation program has included system performance, motorist attitudes, operational integration, and equipment maintenance. Because the I-4 installation is

first-generation equipment, an important aspect was to identify necessary system improvements as a result of on-the-road operating experience.

DESCRIPTION OF FLASH

The primary components of FLASH are roadside equipment and a central monitoring station at the Florida Highway Patrol Troop Headquarters. A detailed description of the system design and its operational specifications has been reported previously (2) and will not be repeated here. The nucleus of the roadside equipment is a detector that determines when a motorist flashes his lights. Twenty stations, 10 in each direction, are located along the 50-mile section of I-4 with detectors situated in advance of exit ramps (Fig. 2).

Along a typical section, a motorist, noting a disabled vehicle parked on the shoulder, continues until he reaches the next reporting location, at which time he flashes his bright lights three times. When a number of vehicles have proceeded accordingly, an indication appears at the monitoring station, and the radio operator dispatches a state trooper to that site to investigate.

INFORMING THE MOTORIST

Users of I-4 were initiated into the use of the FLASH system by two means: highway signs and mass media. It is intended that, when the FLASH system achieves widespread application, the only highway sign needed would be one designating the site of the reporting location. The FLASH sign was adopted for this purpose because it had a good potential for establishing an identity for the system and reminding the motorist what action needs to be taken and why. Because this was only a short segment of highway, two supplementary signs were designed for conveying more detailed information to the motorists (Fig. 1). The installation of the two signs was carefully selected to allow for experimental conclusions. It was found that there was no significant difference in motorists' responses when the road section contained all three signs or when the first sign (REPORT VEHICLES) was not present. However, the response was better on sections containing two or three signs than on sections containing just the FLASH sign. It was concluded that, at least for this installation, some form of supplemental signing is beneficial. Experiments with various sign messages are therefore continuing.

For this initial installation, a public information program was initiated and carried out throughout the entire evaluation period. We imparted knowledge of the FLASH system and proper operating techniques to drivers by radio, television, newspapers, and so on to provide a greater quantity of information to the motorist, which resulted in a larger driver population that would use FLASH correctly when the need arose.

The Governor of Florida declared November 13, 1969, as Electronic FLASH System Day, and opening day ceremonies were held at a rest area near Orlando.

Cooperation of the local press was secured, and articles highlighting the FLASH system appeared at regular intervals throughout the evaluation period, reinforcing public knowledge of the system and use of proper reporting techniques. Articles appeared in the major dailies of Tampa, Lakeland, and Orlando.

Several television features on FLASH appeared on news and public service broadcasts, running from a few minutes to a full half hour in length. Presentations to service clubs and organizations in the installation area were made at various meetings. Contact with groups such as these led to large word-of-mouth transmittal of information to other members of the local area population.

PUBLIC PARTICIPATION AND REACTION

Because drivers are an integral part of the system operation and acceptance, their participation and reaction helped determine FLASH system effectiveness. Two means of obtaining such information were controlled experiments and questionnaires.

Controlled Experiments

Basically, it was desired to measure the responses of the passing motorist to a stimulus such as a vehicle parked on the shoulder whose driver needed help. This was

Figure 1. FLASH system concept.

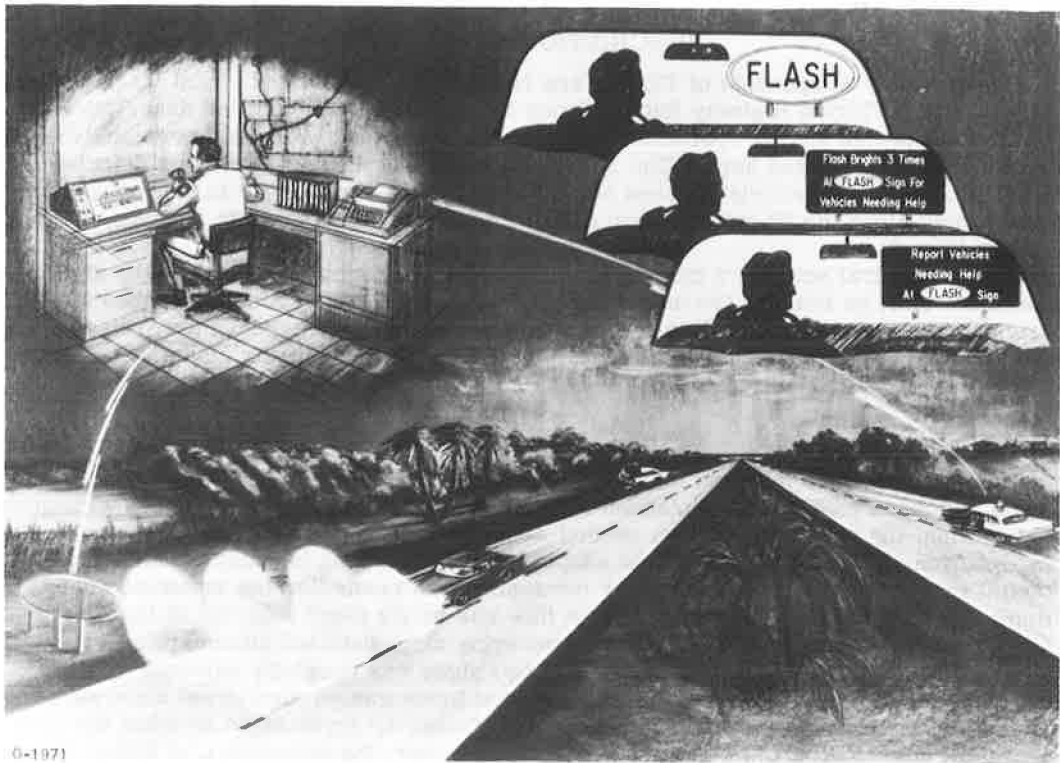
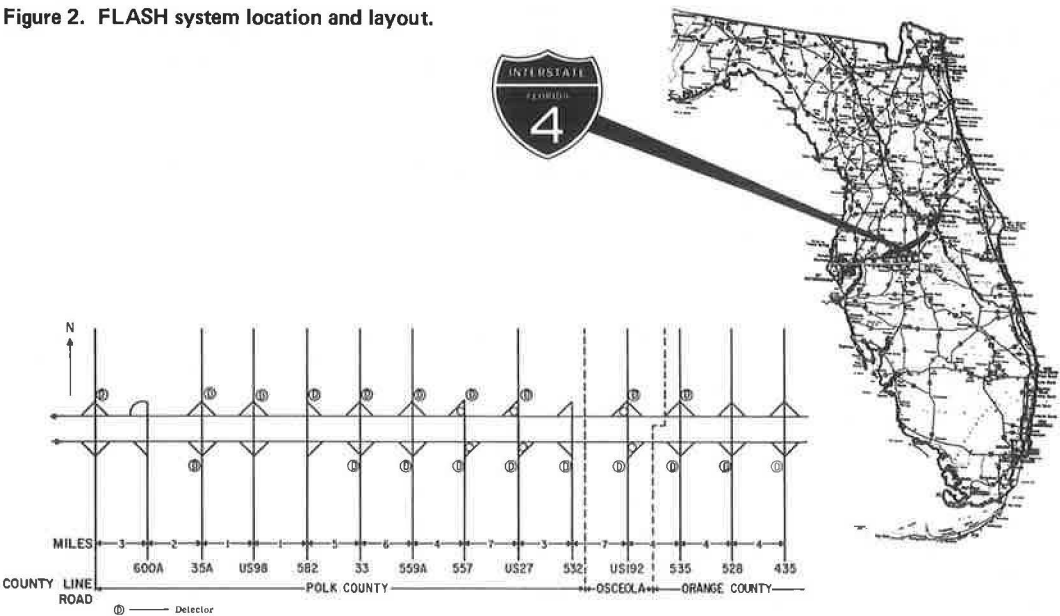


Figure 2. FLASH system location and layout.



to be compared with the passing motorist's response to a vehicle parked on the shoulder whose driver did not need help or to no vehicle. Such responses form the basis of determining the alarm settings at the monitor station.

Two vehicles were used in the experiments. The patrol vehicle, containing one driver and one observer, constantly patrolled the test section. This served the dual purpose of experimental control and data collection for actual (uncontrolled) disablements within the test section. A second vehicle was used for the staged disablement. Motorist responses were monitored at an observation point near the detector. The vehicles were equipped with citizens band (CB) radio transceivers for communications. A graphic recorder connected to the detector continuously monitored and recorded driver responses to the experiment in progress, and a traffic counter was installed near the reporting station to measure vehicular traffic flow. One observer watched the traffic and noted the drivers' flashes on the recorder paper.

Experiments showed that even on this short 50-mile section, more than 12 percent of the motorists participated correctly. This was more than adequate, inasmuch as the false-alarm rate (motorists who responded when no help was needed) was two orders of magnitude lower (0.1 percent). The difference in the two rates allows for proper operation of the system.

One of the criteria for selecting this particular section of I-4 was that its 5-mile average interchange spacing is typical of rural Interstate highways. Because specific spacings vary from 1 to 10 miles (Fig. 2), the experiments conducted helped determine how far apart detectors can be spaced without sacrificing response rate or time. It was found that detector spacings up to 8 miles gave satisfactory results.

FLASH Questionnaires

To measure the motorists' understanding and reaction to the FLASH system, we developed two questionnaires. A questionnaire was distributed to passing motorists at exit ramps and rest areas, and a second questionnaire was given to disabled motorists when they were serviced by the highway patrol as a result of FLASH.

Passing Motorist Questionnaire—Nearly 3,000 questionnaires, distributed at rest areas and exit ramps, were returned and analyzed. Rest areas were selected because it was expected that responses received would be those of motorists from outside of the local area where the publicity was concentrated. The exit ramps selected were those that were more likely to be used by local motorists and that would represent all traffic patterns. Figure 3 shows the questionnaire used at both exit ramps and rest areas. Table 1 gives the responses to the questionnaire. The effectiveness of the signs in explaining the procedure adequately may be measured by the response to question 4. As expected, local drivers make up a majority of the driver population, but less than 50 percent use the road more than 1 day a week.

The questionnaires were distributed during three periods to determine motorists' learning curves in how they used this system and how they reacted to it. The results given in Table 1 are for the last distribution period.

Data given in Table 2 indicate that public acceptance of FLASH increases with time. The results are the composite totals for the rest areas and exit ramps for each sample period.

Disabled Motorist Questionnaire—Disabled motorists assisted as a result of FLASH were given a questionnaire by the Florida Highway Patrol Trooper; it was used to determine the acceptability of the services received. The driver was asked to fill out the form at his leisure and to return it by mail and not to the trooper who had serviced him. In this way, an objective appraisal of the opinion of those serviced by FLASH could be obtained.

Figure 4 shows the questionnaire, and Table 3 gives the results. The numerous comments received overwhelmingly lauded the service rendered by the highway patrol and the speed of the response. The majority (60 percent) of the drivers made some attempt to fix their vehicle themselves but were either unsuccessful or still in the process of repair when the highway patrol arrived.

Public confidence in the ability of the FLASH system to promptly bring aid is measured by the fact that more than 83 percent of the people remained with their vehicle

Figure 3. Passing motorist questionnaire.


<p style="text-align: center;">PLEASE HELP US HELP YOU</p> <p>A new system called FLASH has been installed on this road. When passing motorists flash their bright lights at a FLASH location, the FLASH System quickly alerts the authorities so that they can dispatch service to the motorist needing help.</p> <p>You can help us improve the FLASH System by filling out this questionnaire. Please answer the following questions and mail this card at your earliest convenience. No stamp is necessary.</p> <p style="text-align: center;">Do not sign your name.</p> <p style="text-align: center;">Thank you.</p> 	<p style="text-align: right; font-size: small;">Budget Bureau No. 04 S59035 Approval Expires January 31, 1971</p> <ol style="list-style-type: none"> 1. Did you know before today that this section of highway was equipped with a disabled vehicle siding system (FLASH)? <input type="checkbox"/> Yes <input type="checkbox"/> No 2. Did you see the signs explaining the FLASH System? <input type="checkbox"/> Yes <input type="checkbox"/> No 3. Did you see a motorist needing help on this road? <input type="checkbox"/> Yes <input type="checkbox"/> No 4. How do you assist a motorist needing help on this road? <input type="checkbox"/> I do nothing to help him. <input type="checkbox"/> I stop to help him. <input type="checkbox"/> I flash my lights at the first FLASH Sign. <input type="checkbox"/> I flash my lights at more than one FLASH Sign. <input type="checkbox"/> I notify the authorities. (Explain) _____ 5. Do you drive this section of I-4 more than one day a week? <input type="checkbox"/> Yes <input type="checkbox"/> No 6. I am a resident of _____ <div style="text-align: center; font-size: x-small;">CITY STATE</div> 7. I am a <input type="checkbox"/> male. <input type="checkbox"/> female.
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Table 1. Responses to passing motorist questionnaire (Fig. 3).

Question	Alternatives	Response (percent)	
		Exit Ramps	Rest Areas
1	Yes	93	82
	No	7	18
2	Yes	98	97
	No	2	3
3	Yes	42	34
	No	58	66
4	Do nothing	4	4
	Stop and help	12	18
	Flash lights at first sign	82	75
	Flash lights at more than one sign	6	13
	Notify authorities	5	7
5	Yes	50	33
	No	50	67
6	Local	75	45
	Nonlocal	25	55
7	Male	79	81
	Female	21	19

Table 2. Composite results of motorists attitudes toward FLASH.

Motorist Attitude	Fall 1969 (percent)	Spring 1970 (percent)	Fall 1970 (percent)
Knew before that day about FLASH	58	72	88
Saw signs explaining system	62	96	98
Willing to help other motorists	65	96	96
Uses FLASH	27	85	89

Figure 4. Assisted motorist questionnaire.

Budget Bureau No. 04 569035
Approval Expires January 31, 1971

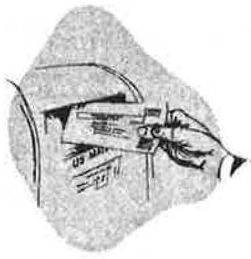
PLEASE HELP US HELP YOU

A new system called **FLASH** has been installed on this road. When passing motorists flash their bright lights at a **FLASH** location, the **FLASH** System quickly alerts the authorities so that they can dispatch service to the motorist needing help.

You can help us improve the **FLASH** System by filling out this questionnaire. Please answer the following questions and mail this card at your earliest convenience. No stamp is necessary.

Do not sign your name.

Thank you



1. Why was your vehicle stopped?
☐ mechanical problem
☐ flat tire
☐ out of gas
☐ low on oil
☐ overheated
☐ other (describe)

2. Did you try to fix your vehicle yourself?
☐ Yes
☐ No

3. Did you leave your vehicle to get help?
☐ Yes
☐ No

4. Did you know that this highway was equipped with a disabled vehicle aiding system (**FLASH**)?
☐ Yes
☐ No

5. How long did you wait before the patrol vehicle arrived?
☐ Less than 15 minutes
☐ 15 minutes-1/2 hour
☐ 1/2-1 hour
☐ More than 1 hour

6. Were you satisfied with the service you received?
☐ Yes
☐ No (Explain)

7. I am a
☐ Male
☐ Female

8. My age is
☐ Under 20
☐ 20-40
☐ 40-60
☐ 60 or over

9. The number of passengers traveling with me is
☐ None
☐ One
☐ Two
☐ Three or more

10. Comments

Table 3. Responses to assisted motorist questionnaire (Fig. 4).

Question	Alternatives	Response (percent)	Question	Alternatives	Response (percent)
1	Mechanical problem	34	6	Yes	97
	Flat tire	29		No	3
	Out of gas	12	7	Male	85
	Low on oil	1		Female	15
	Overheated	10	8	Under 20	2
	Other	14		20 to 40	51
2	Yes	60		40 to 60	36
	No	40		60 or more	9
3	Yes	17	9	None	31
	No	83		One	31
4	Yes	81		Two	18
	No	19		Three or more	19
5	<15 min	67			
	15 min to 1/2 hour	18			
	1/2 hour to 1 hour	10			
	>1 hour	5			

and did not to seek aid. This corresponds very closely with the number (81 percent) who expressed previous knowledge of the FLASH installation. The desire is that, when the public has knowledge of, and confidence in, a reliable motorist-aid reporting system, they will remain with their disabled vehicles, thus reducing both the hazard to themselves and to their fellow motorists and the time in which they can expect to receive aid.

The answers to question 5 were used to arrive at a mean waiting time of nearly 18 min for motorists serviced by FLASH. This more than satisfied a system design goal of 30 min. Because the waiting time was so short, it was not surprising to find that over 96 percent of the drivers were satisfied with the service received. The mean age of drivers was found to be 40 years, which is to be expected inasmuch as there are many retirement communities nearby. A high mean vehicle occupancy of 2.3 people was similarly expected because of considerable tourist traffic on I-4.

OPERATING NEEDS

The principle requirement placed on the operating agency is manpower. In addition to providing a small amount of space for the equipment, manpower is needed to monitor the board, dispatch troopers, and investigate service reports 24 hours a day, 7 days a week.

Radio operator requirements have not proved to be a problem because the operators can normally intersperse the dispatching function with their other activities. Inasmuch as it requires about 7 min to process each report fully, the need for at least one dispatcher is indicated at very busy headquarters during peak periods when four or more reports are expected within 1 hour. This corresponds with a peak traffic load of 80,000 vehicle-miles per hour of congested traffic.

When the Florida highway patrol assists stranded motorists as they do on I-4, additional manpower is required. Just how much depends on several factors, including assistance in locating stranded motorists through a communication system such as the FLASH system. Previous Federal Highway Administration studies (1, 3) showed that one motorist needs assistance for every 40,000 vehicle-miles traveled under the traffic conditions that exist on I-4. A peak season ADT of 14,000 yields an estimated 700,000 peak vehicle-miles of travel per day for an estimated hourly peak of 70,000. Thus, as many as 18 motorists may need help on a peak day. Because it may require 25 min for each assist, about 8 hours per day must be devoted to disabled vehicle assistance on this 50-mile segment of highway. It is therefore reasonable to assume that at least one additional state trooper per day will be required by the highway patrol just to assist the distressed motorists (not including the time spent getting to the stranded motorist). This does not mean that an additional trooper should be brought on just to handle disabled vehicles; this can be shared by all the men on duty, depending on which trooper is nearest the disabled vehicle. It does mean that the total patrol work load over a 24-hour day is increased by an additional one-man shift for this 50-mile segment of I-4.

FLASH cannot reduce the time required to service stranded motorists, but it can reduce the patrol time required to find them. In addition, the 1969 study (3), before FLASH was installed, showed a 134-min average waiting time before help arrived. Thus, the 18-min average waiting time, after FLASH was installed, shows an almost order-of-magnitude improvement.

OPERATOR PARTICIPATION

The Florida Highway Patrol in Lakeland operates the FLASH system. The monitor equipment in the radio communications room receives the incoming reports from all detector stations and processes, records, and displays the disabled vehicle status.

The Florida Highway Patrol recorded any function that they performed related to FLASH. Data from the radio operator's log were used to evaluate the operational status of the system. From October 1970 through January 1971, each alarm was examined to determine whether it was valid. Of the total number of 497 alarms, 131 were due to spurious telephone signals. This large number of spurious signals resulted in a thorough investigation into their nature and methods of resolution. A recommendation

was made and accepted to replace the original communications technique with a frequency-shift-keyed (FSK) system. The FSK system, which was installed and has been operating since September 1971, has almost eliminated spurious signals of all origins, permits the Florida Highway Patrol to more easily monitor the system operation, and allows the system to operate in a more sensitive region, thereby detecting more distressed motorists more quickly.

The average number of alarms per day has been 4.4 with the initial communications technique. This compares quite favorably with the design goal of between 8 and 12 for this section of highway. These factors either equal or exceed the performance figures that have been reported for either of the more expensive telephone or call-box systems (4).

To accurately gauge the extent of the disabled vehicle problem as it exists on Florida I-4, state troopers who investigate any source of disablement within the test section filled out a Highway Patrol log. Entries on the form provided information on the time of day of disablement, day of week, vehicle location method, location, and cause of vehicle disablement. The causes of vehicle disablement, as entered on the log forms, are similar to the disabled questionnaire results and are as follows:

<u>Cause</u>	<u>Percentage of Disabled Vehicles</u>
Mechanical	42
Flat tire	22
Overheated	14
Out of gas	12
Low on oil	1
Abandoned	5
Other	4

MAINTENANCE

During the evaluation period of the FLASH system, continuous records of equipment failure causes were maintained. The major contributing factors to system outage have been lightning and telephone service problems. The effects of lightning are listed under two categories: events in which components of the roadside equipment were damaged and occasions on which fuses or circuit breakers were blown but no other damage was suffered. Measures to protect the roadside equipment from lightning damage were completed in September 1970. Present routine checkout is performed once a week by a person driving the 50-mile loop and flashing at each detector. After automatic-system checkout equipment is installed, routine checkout will automatically be performed daily. Maintenance functions will then be limited to response and, possibly, to a monthly visual system check. Because the roadside detectors are situated in the same place as roadside delineators, they are similarly subject to being knocked over by vehicles running off the shoulder and onto the grass. In the 21 months of system operation, 11 detectors have been damaged in such a manner. If the damage is no more serious than a knockdown, the detector can be placed back in operation by epoxying the two pieces together. All but 3 of the 20 original detectors installed are still in operation.

CONCLUSIONS

Evaluation of the FLASH system has demonstrated that a motorist-aid system that relies on the flashing headlights of passing vehicles to report stranded motorists is viable. Acceptance and participation by the motoring public has been both enthusiastic and significantly higher than required to maintain a viable system.

The Florida Highway Patrol, operator of the system, has responded diligently to distressed motorists' needs and has helped identify needed system improvements, such as additional lightning protection, more reliable communications, and improved detector response to varying ambient light conditions.

The Florida Department of Transportation assisted with the system design and installation and is currently working on highway sign content to improve motorists'

knowledge of how to use the FLASH system. This has two aspects: Passing motorists need to know how, when, and where to flash, and distressed motorists should know how to convey their need for help, such as by using standard distress signals (e.g., raise hood and display white handkerchief or use flares). Although present response rate is adequate, increased response will further reduce response time and improve system accuracy. It is anticipated that, as the FLASH system application becomes more widespread, motorists' knowledge and participation will increase.

This program has demonstrated that FLASH can be the most economical (4) and effective system for the detection and location of stranded motorists.

REFERENCES

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