Designing the First FLASH Installation

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The feasibility has been demonstrated of a technique that relies on passing motorists to report vehicles needing help. The system is named FLASH, which is an acronym for Flash Lights And Send Help. This paper describes the design and operation of the first installation on Interstate 4 between Lakeland and Orlando, Florida.

•THE PROBLEM of quickly detecting, locating, and aiding disabled vehicles on limited-access highways has received considerable emphasis in recent years. In 1962, Airborne Instruments Laboratory (AIL) began an investigation of the extent of the disabled-vehicle problem and a review of the various detection techniques and their economics (1).

COOPERATIVE-MOTORIST FEASIBLITY

In 1966, the Bureau of Public Roads asked AIL to investigate a technique that could be used in detecting and locating vehicles needing help, that was safe and simple, and that could be implemented quickly with minimum equipment cost. The technique was to rely on passing motorists to spot vehicles needing help and to report them at convenient locations along their route. It was desired that these passing motorists remain in their cars without slowing down or deviating from predetermined trip plans. Quick implementation required that no new equipment be installed in the vehicle. The use of familiar instruments, such as lights and horns, also minimized the need for special training of the motorist. Because many miles of rural roads are in desolate areas, it was desired that motorists needing help remain with their vehicles and not abandon them to seek assistance.

AIL conducted experiments on short sections (3 to 6 miles long) of the following routes: Long Island Expressway in New York, I-70 in Kansas, I-80 in Nebraska, I-15 in California, and Richmond-Petersburg Turnpike in Virginia. These roads were selected to cover a cross section of highway types and user charactertistics. Experimental signs were installed requesting motorists to flash their lights (or sound their horns) 3 times if they saw vehicles needing help. A vehicle and driver were staged along each test section, simulating various scenes of disablement. Observers at the reporting location recorded the responses of the passing motorists. The data recorded indicated that passing motorists could be relied on to report motorists needing help and that the cooperative-motorist concept was indeed feasible (2).

THE FIRST OPERATIONAL INSTALLATION

After the operational feasibility of the cooperative motorist technique had been proved, the next logical step was to design and install the equipment and evaluate a fully operational system.

A 50-mile segment of Interstate 4 between Lakeland and Orlando, Florida, was selected because it satisfied the criteria for an initial installation. Factors included in the selection were number of interchanges, interchange spacing, traffic volume, and proximity to major cities at both ends of the test section. The varied availability of motorist services at interchanges along I-4 was a characteristic typical of rural Interstate mileage.

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Local support was a basic requirement for achieving a successful first installation. The Florida Department of Transportation recognized the need for a disabled-vehicle location system and made important contributions to the system design and installation. The Florida Highway Patrol is closing the system loop by operating the terminal equipment and responding to motorists' needs for help. This combined effort will be the means for achieving the goals of public understanding, cooperation, and confidence in the FLASH System.

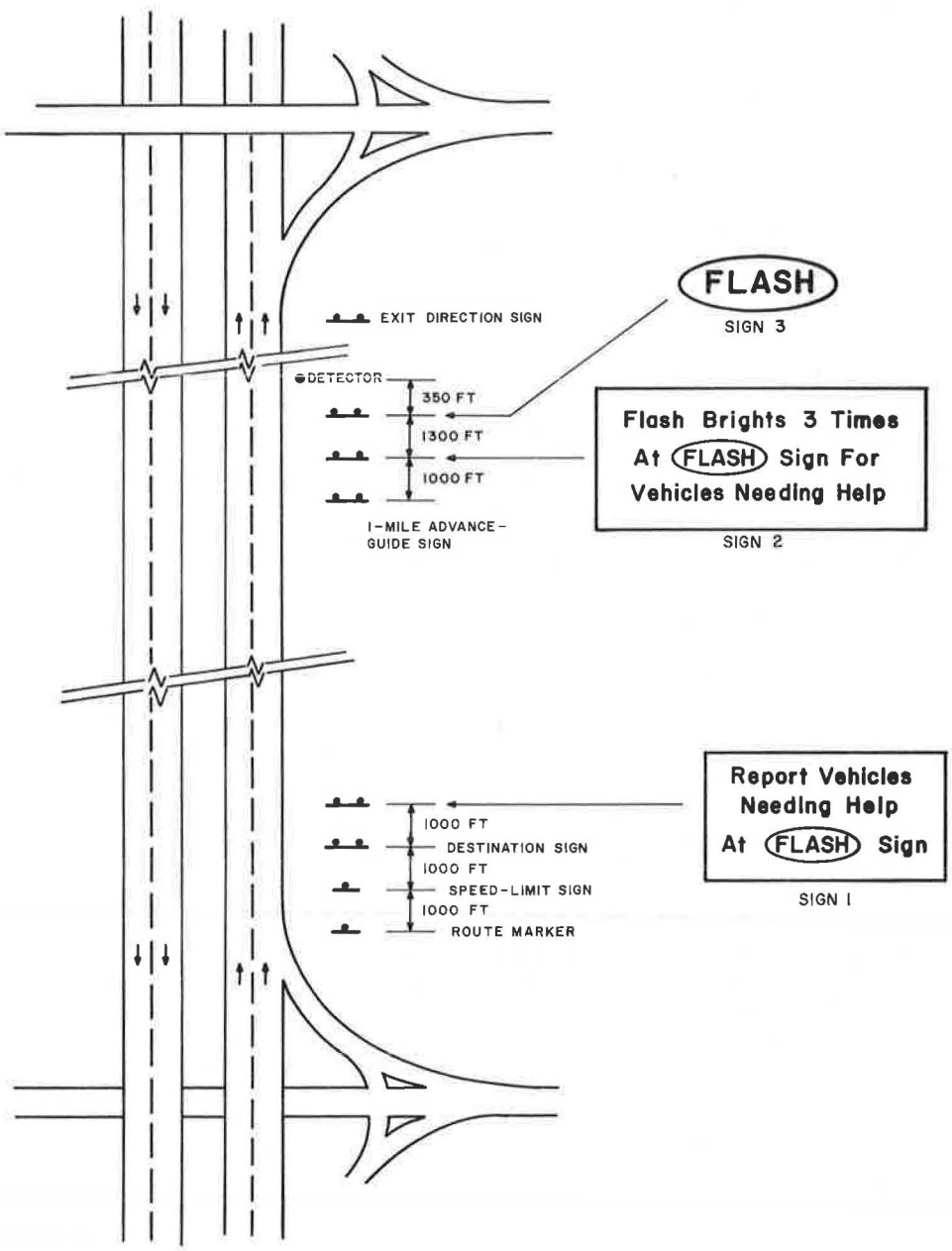

Figure 1. Content and typical locations of roadside signs.

INFORMING MOTORISTS

The successful operation of the FLASH System depends on the participation of the motoring public. Maximum participation of motorists can be achieved only through an extensive public education campaign and through widespread and uniform adoption of the FLASH System. Because this is not practicable for this first demonstration installation, conventional methods for soliciting motorists' participation have been adopted.

Motorists traveling along I-4 are informed how to report by a sequence of roadside signs (Fig. 1). Considerable attention was given to the design of these signs for maximum effectiveness. They are designed fully in accordance with pertinent Interstate signing specifications and current safety standards for placement and construction. The characters are reflectorized, and blue reflective background is used as indicative of motorist services. The signs have 30-ft offsets and breakaway support structures.

Sign 1 is located so that motorists entering I-4 will be quickly informed what to report (Vehicles Needing Help) and where to report (At FLASH Sign). As motorists approach the subsequent interchange, sign 2 relates how they should report (Flash Brights 3 Times) and repeats where and why. Sign 3, the FLASH sign, is located about one-quarter mile beyond sign 2 to allow cooperative motorists sufficient time to prepare to flash their bright lights.

The FLASH sign is intentionally designed to attract attention by its nonuniform shape and color. The sign has 15-in. reflective blue letters on a reflective white elliptical background. The elliptical shape has major and minor diameters of 100 in. and 40 in. respectively. It is intended that widespread application and motorist familiarization with the operation of the FLASH System will require only the presence of FLASH signs to designate the reporting location. Thus, future installations will use instructional signs at infrequent intervals as a reminder or be eliminated entirely.

Signs have been placed selectively (Fig. 2) to permit testing of the motorist's comprehension and retention of the sign instructions. The 50-mile section has 20 FLASH reporting stations—10 in each direction for an average 5-mile spacing. Each reporting station is designated by the presence of a FLASH sign. Instructional signs 1 and 2 are frequent at the beginning of the section. Toward the end of the section, signs 1 and 2 occur only after major interchanges that generate new traffic. Sign 4 (End FLASH Area) is located at each end of the instrumented section.

FLASH EQUIPMENT

In the design of the equipment that transmits motorists' flashes to Highway Patrol Troop Headquarters, maximum consideration was given to reliability, maintainability, compactness, and simplicity of operation. For example, wherever possible, throw-away plug-in modules and integrated-circuit components are used. The basic

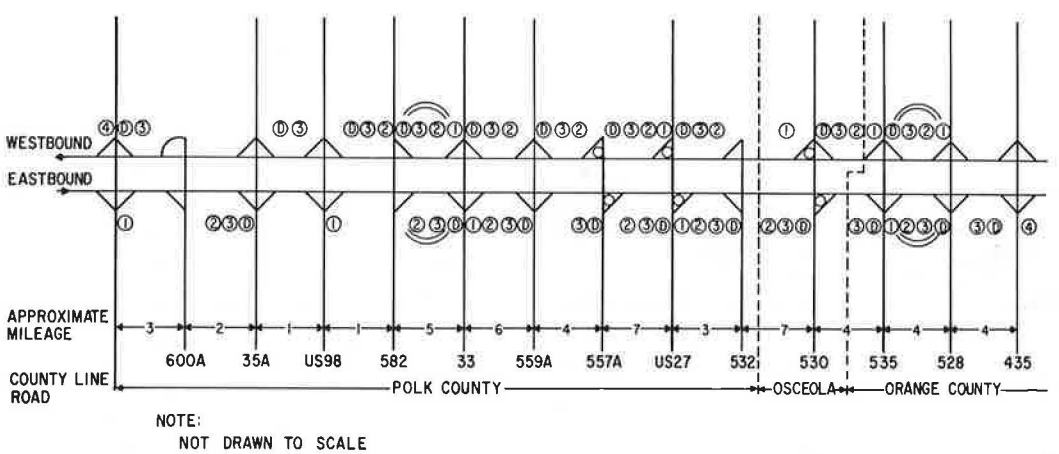

Figure 2. Test section and sign and detector layout.

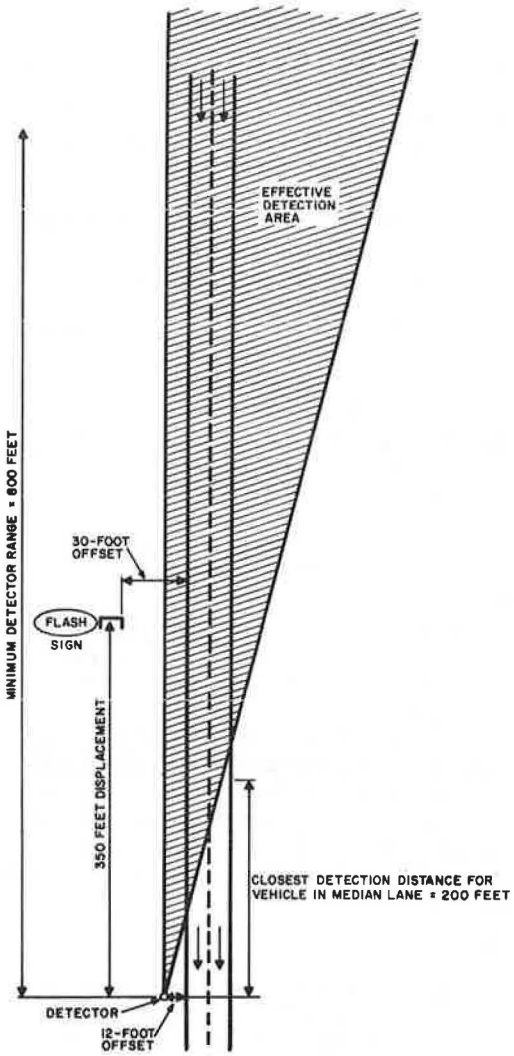

Figure 3. Detector coverage.

Figure 4. Typical installation of roadside detector.

equipment required consists of roadside detectors, roadside computers, a central processor, and a monitor console.

Detectors

Associated with each FLASH station are a detector and roadside computer. Because motorists must be within the effective detection area (Fig. 3) for their flashes to be counted, it is necessary to determine the optimum detector location that would account for variations in motorists' initial flashing positions and their rates of flashing. Preliminary tests conducted on I-4 during August 1968 indicated that this optimum location was 350 ft beyond the FLASH sign.

The detector installation (Fig. 4) is designed and located to be as inconspicuous as possible and to minimize vandalism. Thus, the detector is placed so as to exactly substitute for a delineator and supports the delineator reflector. Because the detector is a line-of-sight device, each location must be carefully selected with consideration given to both horizontal and vertical roadway alignment.

Physically, the detector is a 4-in.-diameter plastic cylinder about 48 in. high. If hit by a vehicle, a notch cut around its perimeter will shear the detector off at the base. At the same time, a connector supplying power to the detector will also separate, and a signal will be transmitted to the monitoring console to inform the observer of the event. If the impact has not damaged the detector tube or its electronic operation, it can be reused by covering the separated pieces with a short plastic sleeve.

Photosensitive cells within the detectors sense motorists' flashes during the day or night and send signals through underground cabling to roadside computers.

Roadside Computers

Roadside computers, located at the edge of the right-of-way near the detectors, discriminate between valid flashes from cooperative motorists and spurious alarms caused by random reflections, lightning flashes, and the like. If a detector receives 3 flashes within a 5-sec interval, its roadside computer will transmit a coded tone signal through telephone lines to a central monitoring station located at the Florida Highway Patrol Troop Head-

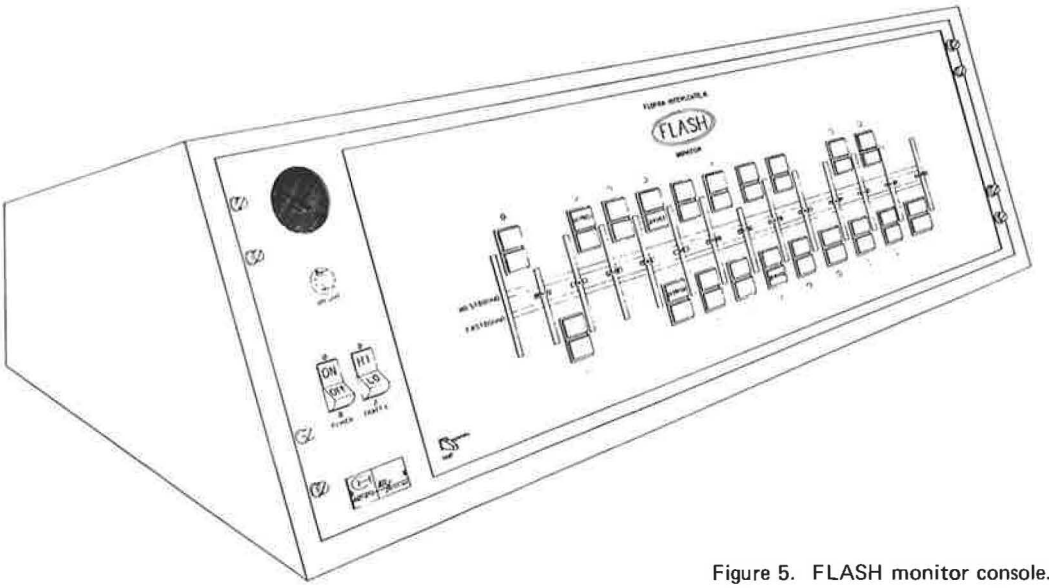

Figure 5. FLASH monitor console.

quarters in Lakeland. Power requirements for each roadside computer and detector combination are less than 40 watts.

Central Processor

The equipment in the Lakeland Headquarters consists of a central processing unit and a monitor console. When the central processor receives a report signal from the roadside computer, an electronic timer is started. False-alarm indications are minimized by the requirement that valid reports be received from more than 1 vehicle before a disable-vehicle alarm is generated. False alarms may be caused by pranksters, curious motorists, and well-meaning motorists who misunderstand instructions.

The number of cooperative vehicles required to generate a disabled-vehicle alarm and the timer interval vary depending on the highway and user characteristics. For example, on high-volume road sections, 4 or 5 vehicles must flash within 3 min to generate a disabled-vehicle alarm; on low-volume roads, 2 or 3 vehicles must flash within 5 min. Each FLASH station can have its own setting; a HI/LO TRAFFIC switch on the monitor console permits the setting to be changed easily to account for volume variations caused by day and night cycles, inclement weather restrictions, and the like.

Monitor Console

The monitor console (Fig. 5) in the Lakeland Troop Headquarters is within arm's reach of the radio operator. On the console face panel, 2 horizontal light strips represent the eastbound and westbound directions of I-4. Vertical plastic strips represent the interchange crossroads. A pair of illuminated pushbutton switches is associated with each section of I-4 having a FLASH station.

When the road is clear of disabled vehicles, the I-4 light strips are illuminated green. When a disabled-vehicle alarm is received, a momentary tone sounds to alert the radio operator, the section of I-4 associated with the alarm signal turns from green to red, and the upper pushbutton adjacent to the highway section illuminates red with the word DISPATCH. After the radio operator dispatches a vehicle to investigate the red section, he presses the DISPATCH pushbutton to extinguish it and illuminate in amber the lower pushbutton with the word SERVICE. When the dispatched vehicle driver reaches the disabled motorist and ascertains the trouble, he informs the radio operator who then presses the SERVICE pushbutton. This extinguishes the SERVICE pushbutton and the roadway section returns to its normal green color.

SYSTEM TEST

The faithful operation of each detector link can be ensured by monitoring the progress of a test vehicle that flashes 3 times as it passes each detector. When the TEST switch on the console is in the TEST position and a valid report is received, a small indicator light adjacent to each pushbutton switch flashes at a fixed rate. This simple test checks out the detector alignment and optics, the underground roadside link, the telephone communications link between the detector and the monitor station, and the monitor station electronics. If a detector is knocked down, the associated indicator light illuminates continuously, informing the observer of the exact detector involved.

EVALUATION EQUIPMENT

During the first 12 months of system operation, AIL will collect data on system effectiveness and operation. Data will be recorded on punched paper tape. The number of vehicles flashing during the preceding 1-min interval will be recorded every minute of the day for each FLASH station together with radio-operator console manipulations.

FLASH SYSTEM EVALUATION

During the 12-month evaluation period, which began on November 14, 1969, we will determine the extent to which the FLASH System is improving service to stranded motorists. This will be accomplished through analysis of the punched paper tapes and also of Highway Patrol reports, staged experiments, and motorist questionnaires and interviews. The system will be refined during the evaluation period as operating experience is developed. As operators of the system, the Florida Department of Transportation and Highway Patrol will be consulted for their suggestions. The cooperation of the mass media will be solicited to assist in indoctrinating the public to the FLASH System through a carefully planned and coordinated publicity effort.

CONCLUSIONS

The greatest advantage of the FLASH System is that all road vehicles are presently equipped to participate and that minimum learning is required of the driver. This system is a tool that will enable the highway patrol to use its equipment more efficiently and thereby provide faster service for assisting the disabled motorist. This indirectly leads to increased highway safety.

This system is suited for use on highways in rural areas, including those with tourist traffic. The tourist, who is unfamiliar with the location of service facilities in the area, simply stays with the disabled vehicle and waits for official assistance to arrive.

Because this is a prototype system, the major effort has been concentrated on the development of reliable detection and monitoring. Future roadside detector stations could have a self-contained power source and communication link. This would facilitate the installation of detector stations in areas where power and telephone service are not available.

In the final analysis, the public will judge the acceptability of the system through its expression of confidence and satisfaction with the improved service provided.

ACKNOWLEDGMENTS

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