

## Abridgment

## Strobe-Supplemented Red Signal Indications

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## ABSTRACT

A strobe-supplemented red indication (SSRI) is a red indication of a vehicle traffic control signal augmented by a flashing white light. The purpose of this project was to investigate the use of SSRIs. It was thought that SSRIs might be useful in reducing accident frequency at given locations. It was also thought that those jurisdictions that have used SSRIs might have gained some valuable insights from their experiences with SSRIs. Thus, an investigation of these points was undertaken. The results of the project may be summarized as follows. (a) SSRIs have been used in a number of jurisdictions. The confirmed users are the city of Tampa, Florida; Metropolitan Dade County, Florida; the city of Portland, Oregon; Montgomery County, Maryland; the city of Charleston, South Carolina; the state of North Carolina; the state of Maryland; the state of Kansas; the state of New York; and the District of Columbia. There may well be other users that were not identified in this project. (b) SSRIs have been used principally as an attempt to reduce excessive accident rates and to draw driver attention to an unexpected signal. (c) In most cases, the number of accidents and accident rates decreased following SSRI installation. Little statistical significance can be attached to these decreases. However, the lack of statistical significance may be due, at least in part, to the limited amount of data available. (d) In some jurisdictions it is believed that SSRIs have been effective, but officials in others are uncertain. There is no clear consensus on this question.

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Specifically, this effort was directed toward answering the following questions.

1. In which jurisdictions have SSRIs been used?
2. Why have SSRIs been used in those jurisdictions?
3. How have accident rates changed since SSRIs were installed?
4. Do officials in the jurisdictions in question believe that SSRIs have been effective?

## LITERATURE SURVEY

SSRIs have been in use for at least 10 years and quite possibly longer. During that time a number of jurisdictions have experimented with SSRIs, and some continue to use SSRIs. However, little has been written about SSRIs. The information that is available on the topic comes primarily from unpublished reports or memoranda produced by jurisdictions that have used SSRIs [R.G. Edwards, Before and After Study, Strobe Lights, Route 17--Big Flats (Memorandum), New York State Department of Transportation, July 1980; T.G. Swenson, Final Report on Sg-23t-Use of Strobe Light in Traffic Signals, Kansas Department of Transportation; and L.R. Weatherby, The Effect of Raeco's Halo Light on Right-Angle Accidents at Two Intersections in Tampa, Florida, city of Tampa, Florida, June 1975]. Because these reports and memoranda were used as part of the data base for this project, the information in them is not discussed here.

## SSRI USE

Hardware

One type of strobe unit is called a Halo by its manufacturer. The Halo is a circular ring that surrounds a normal 8-in. red traffic signal lens. A second type of strobe is called a Barlo by the manufacturer; the Barlo consists of a bar that is positioned in front of a red lens. A third type of strobe was identified by one of the responding jurisdictions. This type was a "vertical slit in center of lens." No further information about this type of unit was found.

Official Sanctioning of SSRI Experimentation

The Manual on Uniform Traffic Control Devices (MUTCD) (1) does not mention SSRIs. Thus, there is no official sanctioning of general use of SSRIs. However, a number of jurisdictions have received permission to experiment with SSRIs from the National Committee on Uniform Traffic Control Devices (NCUTCD) or the FHWA. Among the jurisdictions receiving such permission are the District of Columbia; Montgomery County, Maryland; the city of Portland, Oregon; the city of Charleston, South Carolina; the state of Kansas; and the state of Indiana. Of course, it is also quite possible that some jurisdictions may have installed SSRIs on their own initiative without seeking official permission.

Current Status of SSRIs

The most recent official statements regarding SSRIs appeared in the Federal Register on February 4, 1982, and January 10, 1983. The February 4, 1982, entry stated that a request to change the MUTCD had been made (Request IV-15), but that no change was being proposed. The following reason was given.

Although results of the experimental projects have shown a significant reduction in accidents, the projects have been limited to single intersections. There is a need for further evaluation of the strobe device and the development of specifications for its design before its standard use might be proposed (p. 5254).

The January 10, 1983, entry simply stated that the "no change" response to Request IV-15 had been adopted as a final rule, "... pending availability of additional research or study data" (p. 1051).

#### PROJECT METHODOLOGY

##### Identification of Jurisdictions that Have Used SSRIs

The first list of jurisdictions that have used SSRIs was compiled from the author's own experience, a conversation with the manufacturer of a strobe unit, a conversation with a representative of the FHWA, and conversations with other interested individuals. Each of the jurisdictions on that list was asked if, to its knowledge, any other jurisdiction used SSRIs. Each addition jurisdiction thus identified was then asked the same question. Because of time constraints, the jurisdictions identified in this second round were not contacted.

##### Data Collection

A cover letter and a questionnaire were mailed to each jurisdiction identified as having used SSRIs (except for those jurisdictions identified in the second round). Data were requested for three accident categories: rear-end accidents, right-angle accidents, and total accidents.

Usable data were not obtained from all of the contacted jurisdictions because

1. Not all jurisdictions responded;
2. Not all of the contacted jurisdictions had experience with SSRIs, despite their identification by others; and
3. Of those jurisdictions that did respond and that did have experience with SSRIs, not all had retrievable accident and volume data.

Usable data were obtained for only 10 intersections, despite the fact that SSRIs have been used at a minimum of 57 locations. It should be noted that it is quite possible that a number of jurisdictions that have used SSRIs were not identified by this project.

#### DATA ANALYSES

##### Reasons for Strobe Installation

The responding jurisdictions gave several reasons for installing SSRIs. In general, the reasons fell into two categories: excessive accident experience and the need to draw driver attention to an unexpected signal. Those jurisdictions that cited a specific type of accident as excessive listed right-angle accidents or rear-end accidents as the excessive category.

##### Statistical Analyses

The usable data were examined by means of statistical tests. The tests used and the results obtained

are documented hereafter. It should be noted that the data from the year of SSRI installation were removed from the data base before the performance of statistical tests. This removal was thought necessary because there was no way to increase those data to represent a full year's data without distortion. This was particularly true in those cases where an SSRI had been installed near the beginning or the end of a year.

##### Sign Tests by Accident Category

The mean number of accidents per year before SSRI installation was compared with the mean number of accidents per year after SSRI installation. It was thought that parametric before and after comparisons for each intersection would have little meaning because each sample had a maximum of three entries. It was also thought that aggregating the data over all intersections would lead to a bias in the data toward intersections with higher accident numbers. For example, a 50 percent reduction in accidents at a location with 50 accidents per year would have been given more statistical weight than a 90 percent reduction in accidents at a location with 10 accidents per year. For these reasons, the sign test was used to compare before and after data.

Strictly speaking, the null hypothesis was that, for each accident category, the after data do not have a different mean value than the before data. Only the "right-angle accidents for the intersection as a whole" category yielded a probability of less than 5 percent, and only one other category (right-angle accidents involving at least one vehicle from an approach with a strobe) yielded a probability of less than 10 percent. Thus, despite the fact that decreases outnumbered increases in five of the six categories, the results are not statistically impressive.

##### Sign Tests by Accident Rate Category

The mean number of accidents per year before SSRI installation was compared with the mean number of accidents per year after SSRI installation. The null hypothesis for these tests was that the after data for each accident rate category do not have a different mean value than the before data for that category.

For the "approach with strobe" categories, the rates were found by dividing the number of accidents by the average daily traffic (ADT) on all approaches with SSRIs and then multiplying the quantity thus obtained by 1 million. For the "intersection as a whole" categories, the rates were found by dividing the number of accidents by the total approach ADT for the intersection and then multiplying the quantity thus obtained by 1 million.

Despite the fact that decreases led increases in all six categories, only one category (rate of rear-end accidents involving at least one vehicle from an approach with a strobe) yielded a probability of less than 10 percent. Thus, as was the case with the preceding tests, the results are not statistically impressive.

##### Sign Tests by Intersection

The mean yearly accidents and accident rates before SSRI installation were compared with mean yearly accidents and accident rates after SSRI installation. It was believed that some individual inter-

sections might have experienced a significant drop in accidents and accident rates following SSRI installation, despite the outcome of the previously described sign tests. For this reason, a sign test was performed for each intersection.

Strictly speaking, the null hypothesis being tested was that mean yearly accident experience following SSRI installation is not different from mean yearly accident experience before SSRI installation. Only four categories were used in these tests: rear-end accidents involving at least one vehicle from an approach with a strobe, rate of rear-end accidents involving at least one vehicle from an approach with a strobe, right-angle accidents involving at least one vehicle from an approach with a strobe, and rate of right-angle accidents involving at least one vehicle from an approach with a strobe. Because at least one of these four categories was a subset of each of the other eight categories, it was necessary to eliminate the other eight categories to maintain independence of the observations in each sample.

Decreases led increases at 7 of the 10 intersections. Furthermore, at six of those seven intersections, no one of the four categories showed an increase. Because of the limited number of observations, however, none of the probabilities yielded by the sign test was below 6.25 percent. Perhaps surprisingly, increases led decreases at two of the intersections.

#### t-Tests

The mean yearly accident rate before SSRI installation was compared with the mean yearly accident rate after SSRI installation. It was hoped that the previously suspected bias in parametric tests toward locations with high accident experience could be reduced by the use of accident rate data. For this reason the data were aggregated over all of the intersections and the mean for each category before SSRI installation was compared with the mean for the same accident category following SSRI installation.

Decreases occurred in five of the six categories, and an increase occurred in the other category. However, none of the differences were significant at the 10 percent level of significance.

#### Jurisdictional Opinions

Officials of some of the responding jurisdictions thought that the SSRI had been effective; others expressed uncertainty. An official in one jurisdiction stated that the SSRI had seemed to be effective at two intersections but ineffective at a third; in another jurisdiction an official thought that effectiveness was reduced as local drivers became accustomed to the SSRI. In summary, there was no clear consensus on this question.

#### Other Comments

A summary of other comments made by officials of the responding jurisdictions follows.

1. Maintenance problems with SSRIs had been experienced in three jurisdictions,
2. In three jurisdictions it was thought that SSRI use should be limited to avoid dilution of SSRI effectiveness, and

3. An official of the jurisdiction that used the "vertical slit in center of lens" type of SSRI stated that the jurisdiction had installed SSRIs on all three signal indications on an approach and that a number of drivers had interpreted the indications as flashing red.

#### SOURCES OF ERROR

There were a number of potential sources of error in this project including the following.

1. Changes in accident reporting criteria may have caused a bias in the data.
2. Volume data were not always provided. When necessary, linear interpolation was performed on volume data. This interpolation was clearly less than desirable, but it was thought to be a reasonable method of increasing the data base. Volume data were never extrapolated.

#### CONCLUSIONS

In answer to the four questions posed earlier, the following answers are provided.

1. SSRIs have been used in a number of jurisdictions. The confirmed users are the city of Tampa, Florida; Metropolitan Dade County, Florida; the city of Portland, Oregon; Montgomery County, Maryland; the city of Charleston, South Carolina; the state of North Carolina; the state of Maryland; the state of Kansas; the state of New York; and the District of Columbia. There may well be other users who were not identified in this project.
2. SSRIs have been used in attempts to reduce excessive accident rates and to draw driver attention to an unexpected signal.
3. In most cases, the number of accidents and accident rates decreased following SSRI installation. Little statistical significance can be attached to these decreases. However, the lack of statistical significance may be due, at least in part, to the limited amount of data available.
4. Officials of some jurisdictions believe that SSRIs have been effective, but others are uncertain. There is no clear consensus on this question.

#### ACKNOWLEDGMENTS

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#### REFERENCE

1. Manual on Uniform Traffic Control Devices for Streets and Highways. National Advisory Committee on Uniform Traffic Control Devices, FHWA, U.S. Department of Transportation, 1978.

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