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NJ-2010-004

Work Zone Intrusion Alarm Effectiveness

FINAL REPORT
September 2010

Submitted by

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In cooperation with

New Jersey
Department of Transportation
Bureau of Research

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16. Abstract

The New Jersey Department of Transportation (NJDOT) commissioned a study to evaluate how effective a work zone safety device known as the "SonoBlaster!® Work Zone Intrusion Alarm" would be in protecting maintenance workers from injury caused by vehicles that breach the work zone, and how well it would be accepted by workers. The device is mounted on a traffic cone and when impacted by a vehicle, emits an alarm that provides advance warning to allow workers to react to avoid the intruding vehicle. The device also alerts the driver who may be drowsy or distracted, who can respond by braking or steering out of the work zone, or both actions.

In a pilot test of the device, SonoBlaster!®-equipped traffic cones were used with standard cones to close a lane of traffic for maintenance work. Two impact simulations were performed resulting in sounding of the alarm, as no impacts occurred from traveling vehicles. The alarm's sound volume and duration were satisfactory during normal traffic conditions for distances of at least 200 ft, including when ear protection was worn, but no conclusion could be made about hearing the alarm during jack hammer operations. Employees indicated that several set-up procedures were difficult. Moreover, in multiple instances the alarm fired when the control knob was in the locked, unarmed position. Additional field trials could not be scheduled. However, NJDOT believes that problems with quality control and reliability, combined with the cost of the alarm, raise doubts about the desirability of and benefits to be gained from deploying the device on NJDOT maintenance jobs.

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EXECUTIVE SUMMARY

In an effort to better protect work zone personnel from injury, the New Jersey Department of Transportation (NJDOT) commissioned a study in March 2010 to evaluate the effectiveness of the "SonoBlaster!® Work Zone Intrusion Alarm" in protecting maintenance workers from injury caused by vehicles that breach the work zone, and its acceptance by work zone personnel. The device is mounted on work zone barriers such as traffic cones and drums, and when activated by direct impact of a vehicle, it emits an alarm that warns workers of danger and alerts the driver of the vehicle who may be drowsy or distracted. New Jersey received SonoBlaster!® units from the Federal Highway Administration (FHWA), which provided them to jurisdictions for trial deployment in its continuing efforts to improve work zone safety. The device used by NJDOT was a retooled version of an earlier unit distributed by FHWA.

The work plan comprised three tasks designed to collect background information, collect primary information from test deployment of the alarm on routine NJDOT maintenance projects, and synthesize the information for inclusion in a Final Report. Cambridge Systematics, Inc. (CS) was retained by NJDOT to conduct the study. CS developed the study design, collected field information, and wrote the Final Report.

A pilot test was conducted of a lane closure operation on a busy four-lane divided highway in South Brunswick, New Jersey. SonoBlaster!®-equipped traffic cones were used with standard cones to close the southbound shoulder lane. No traveling vehicles impacted any of the alarmed cones during the observation period. However, two impact simulations were performed resulting in sounding of the alarm. Because no breach of the work zone occurred during the field test, many observations and interview questions defined in the work plan could not be answered.

The simulations showed that the alarm's sound volume and duration were satisfactory during normal traffic conditions for distances of at least 200 ft, including when ear protection was worn. The alarm could be heard by the operator of a small roller. No conclusion could be made concerning the ability to hear the alarm while loud equipment is used, as the simulations did not occur during jack hammer operation. Set-up procedures such as cocking the unit and verifying that the unit was cocked were difficult. Of most concern were instances in which the alarm fired when the control knob was in the locked, unarmed position. These problems brought the quality control process and reliability of the device into question.

Following the pilot test, NJDOT determined that no additional lane closure operations could be scheduled, and ended the field testing. Contributing to the decision was NJDOT's view that problems with quality control and reliability, combined with the cost of the alarm, raise doubts about the desirability of and benefits to be gained from deploying the device on NJDOT maintenance jobs. It was not believed that conducting any additional test deployments would substantially change the conclusions. Questions concerning the effectiveness of the device in protecting workers from injury caused by errant vehicles that breach the work zone and its acceptance by workers could not be directly answered by this abbreviated study.

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BACKGROUND

Work zone safety is a significant safety problem. In 2008, 720 fatalities occurred in work zones nationwide, representing two percent of all roadway fatalities. In addition, more than 40,000 injuries occurred in work zones. As vehicle miles traveled, driver distraction, work zone activity, and night work increase, safety incidents can be expected to rise.

In order to reduce the incidence of and potential for fatalities/injuries at highway construction and maintenance sites, jurisdictions have deployed safety devices and systems to safeguard employees. One of the safety approaches is the use of intrusion alarms, which are designed to protect workers from injury caused by errant vehicles that breach the work zone. Intrusion alarms detect vehicles entering the buffer zone between work crews in the work zone and vehicles driving past the work zone, and sound an alarm to warn workers in the proximate area. The warning allows workers to react to avoid the intruding vehicle. Various technologies are used to detect an intruding vehicle, including infrared, microwave, laser, pneumatic, and direct impact. These alarms also serve to alert drivers that they are breaching the work zone. The driver can respond by braking or steering out of the work zone, or both actions. A key benefit of all intrusion alarms is their rapid deployment compared to most other work zone protection systems.

FHWA actively promotes work zone safety by providing transportation practitioners with quality products, tools, and information to plan, implement, and manage safe, efficient, and less congested work zones. FHWA's goal is to reduce work zone fatalities by reducing congestion and crashes due to work zones.

Recently, FHWA conducted a demonstration project in which state and local government entities field tested a nonelectronic, mechanical intrusion alarm in order to ascertain its effectiveness in protecting workers in active work zones. In 2006 FHWA purchased 2,500 units of the "SonoBlaster!® Work Zone Intrusion Alarm" (also called "SonoBlaster!® Dual Alert™ Work Zone Intrusion Alarm") supplied by Transpo Industries, Inc. of New Rochelle, New York, for distribution to interested state departments of transportation and city or county public works, police, and related departments.

The SonoBlaster!® Work Zone Intrusion Alarm is an impact- or tilt-activated safety device that is mounted on work zone barriers such as traffic cones, drums, and delineators. When activated by direct impact of an errant vehicle, the device emits an alarm that warns roadway workers and the driver of an errant vehicle that the buffer zone has been violated.[1] FHWA has accepted the SonoBlaster!® as a National Cooperative Highway Research Program (NCHRP) 350 Category II Safety Device, acceptable for use when attached to the base of conventional traffic cones, plastic drums, or large base road tubes or delineators. Test results emphasized that in all

[1] Complete information on the SonoBlaster!® Work Zone Intrusion Alarm can be found on the vendor website, http://www.transpo.com/sonoblaster.htm.

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trials, SonoBlaster!®-equipped cones passed under test vehicles with no windshield contact.

The demonstration participants began field testing the units in 2008. Evaluations (forms, e-mailed comments, or phone calls) were synthesized by FHWA into a Demonstration Project Interim Report issued in July 2009.[2] The evaluations led to a retooling of the device to improve sound, set-up, and mounting aspects. The retooled units were made available to original and new participants for testing and evaluation. FHWA will issue a Final Demonstration Report in 2010.

NJDOT was one of 19 state agencies nationwide that received the SonoBlaster!® Work Zone Intrusion Alarm for test deployment. In November 2009 the department's Bureau of Employee Safety submitted a research request to the Bureau of Research for an evaluation of the device for use on routine maintenance jobs.[3] In March 2010 the Bureau of Research commissioned Cambridge Systematics, Inc. (CS) to conduct the evaluation and report the results. The evaluation would be based on deployment of the SonoBlaster!® alarm on routine NJDOT highway maintenance projects on a trial basis.

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2 Bernie Kuta, *Work Zone Intrusion Alarm Demonstration Interim Report*, Federal Highway Administration, U.S. Department of Transportation, July 2009.

3 New Jersey reported seven work zone fatalities in 2008. A total of 720 fatalities occurred nationwide. Source: National Highway Traffic Safety Administration, Fatality Analysis Reporting System, 2008.

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OBJECTIVES

The goal of the Work Zone Intrusion Alarm Effectiveness study was to provide NJDOT with information to ensure that the SonoBlaster!® Work Zone Intrusion Alarm would be used successfully on maintenance jobs.

In support of this goal, the following objectives were established for the study:

1. Evaluate the acceptance of the SonoBlaster!® Work Zone Intrusion Alarm by NJDOT maintenance workers and its effectiveness in protecting the workers from injury caused by errant vehicles that breach the work zone.

2. Prepare a Final Report summarizing the research conducted.

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INTRODUCTION

The Work Zone Intrusion Alarm Effectiveness study was designed to answer several key questions to determine the acceptance and effectiveness of the SonoBlaster!® Work Zone Intrusion Alarm:

- Is the intrusion alarm effective in warning workers of vehicles that breach the work zone in such a manner as to allow them to take action to avoid being struck by the vehicle?

- Does the intrusion alarm afford a feeling of protection and safety?

- Is the intrusion alarm easy to install, activate, and replace; and when mounted in place is it convenient to deploy and store? Is it durable?

The perceived and actual levels of protection and the ease of use influence the acceptance of the devices by work zone employees.

The work plan for the study consisted of three tasks, centering on the collection and synthesis of primary (collected specifically for this study) information from test deployments of the SonoBlaster!® alarm in New Jersey. The three tasks were:

1. Study Design – Task 1 comprised obtaining information on several other jurisdictions' experiences with the device, scheduling on-site field observations and in-person interviews with field crews, development of field and interview guides, and project management activities such as participation in project review meetings and completion of progress reports.

2. Information Collection **–** Task 2 comprised gathering primary information through field observations and in-person interviews.

3. Synthesis and Final Report – Task 3 comprised synthesizing the information collected in Task 2 and preparing a Final Report summarizing the findings.

The research approach included obtaining information from other jurisdictions that have deployed the alarm in order to inform the field observations and in-person interviews. In an effort to identify other jurisdictions that had deployed the SonoBlaster!® alarm, CS contacted the vendor, Transpo Industries, which indicated that FHWA's Resource Center in Colorado was conducting a demonstration project with the alarm and provided a contact name. When contacted, the Resource Center described the project and provided its Demonstration Project Interim Report. The FHWA Work Zone Mobility and Safety Team provided additional material.(4) Basic information about the demonstration is found in the Background section of this document.

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4 Bernie Kuta, *Work Zone Intrusion Alarm Demonstration SonoBlaster!®* (slide presentation), Federal Highway Administration, U.S. Department of Transportation, August 10, 2009.

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The initial evaluations from demonstration participants indicated problems with sound, set-up, and mounting. The Interim Report listed the following suggested improvements in accordance with the evaluations:

- Increase the alarm's sound volume and duration.
- Make cocking the unit easier.
- Modify the method of attachment of the alarm to the cone to allow cones to be stacked, thereby facilitating storage.

In response to these suggestions, Transpo Industries retooled the alarm, and coordinated with FHWA to make them available to participants for new testing and deployment.

Because NJDOT had an older, unimproved version, CS requested that new alarms be sent to NJDOT for this study. By arrangement of FHWA with Transpo, in late April 2010 NJDOT received 40 units of the retooled alarm to use in its trial deployment.

The FHWA resource materials contained other "lessons learned" with respect to alarm set-up and operation, which could be useful in New Jersey's tests.

As noted previously, FHWA will issue a Final Demonstration Report in 2010.

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SUMMARY OF THE WORK PERFORMED

Technical Approach

The work approach was based on collecting primary information through field observations and in-person interviews focused on multiple maintenance crews. Initially, it was expected that the specific maintenance crews, the specific maintenance jobs, and other scheduling decisions would be largely predetermined. It was estimated that two crews would be monitored, and two or three on-site field observations would be conducted per crew. Group interviews (one per job) would be held at the maintenance yard where the crew assembles at the beginning and end of the work day. In addition, interviews with individual workers were to be held during the field observations (these opportunities would be carefully selected for safety reasons).

However, the fluidity and dearth of appropriate maintenance jobs made focusing on specific crews and jobs difficult. "Appropriate" jobs involve lane closure operations, which utilize work zone barriers such as traffic cones to which SonoBlaster!® alarms are attached. Many springtime operations address pothole repairs, for which full safety zones are not set up and which are conducted as mobile operations. Jobs performed by contractors who must submit work plans also cannot be considered.

Although two specific crews were initially identified for the study, the study team (NJDOT and CS) agreed that the maintenance jobs needed to be spread over a larger number of crews in order to ensure the target number of field observations, and would of necessity be impromptu. NJDOT Employee Safety management and staff working with maintenance operations personnel were responsible for identifying crews/jobs for test deployments.

Field and interview guides were developed to support the field observations and interviews. Field guides focus attention on key observations to be made during the field visits, while interview guides collect information during individual interviews held at the work site and group interviews conducted at the maintenance yard where the crew assembles at the beginning and end of the work day.

The final guides were approved by the NJDOT Research Project Manager. The field guide is included as Appendix B; the interview guide is included as Appendix C.

Implementation

Pilot testing took place on May 11, 2010 with the Sand Hill Maintenance Crew assigned to perform permanent patching on a stretch of U.S. Route 1 in South Brunswick near Beekman Road. This location is a divided roadway with two lanes of traffic in each direction. Traffic volume is generally high. The southbound shoulder lane in the vicinity of a large turnout was closed to traffic for the maintenance work. SonoBlaster!®-equipped traffic cones were used with standard (bare) cones to close the lane. The public was advised of the lane closure via highway advisory radio.

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The CS Principal Investigator was on-site during the maintenance job. The Principal Investigator's objectives were to directly observe the operation of the alarm in real-world conditions and to talk to employees about their experiences with the alarm's operation, their impressions of its efficacy, and their conclusions about when it could be deployed (e.g., on a routine basis, on certain kinds of jobs).

Employee Safety management and staff mounted 22 units on cones, cocked the units, and test fired the units without the CO_2 power cartridge installed (which powers the alarm horn), prior to arriving at the maintenance yard. The cones were transported by the staff to the yard and to the work site.

At the yard, the crew supervisor, assistant supervisor, and six crew members were briefed on the purpose of the study, how the alarm operates, and what was expected of them. They were told that this was the first deployment of the alarm at the roadside by NJDOT. The crew was informed that simulated intrusions would occur and they were to treat all alarms as "real" events. At the roadside, the Employee Safety Manager and three Employee Safety representatives provided direction on deploying the alarmed cones and were on hand to help ensure the safety of the workers during the test.

At the work site, a stationary lane closure sign and a truck-mounted attenuator (TMA) provided advance indication of the lane closure using standard cones. Fourteen SonoBlaster!®-equipped cones were substituted for standard cones in the activity area. They were positioned about 20 ft apart, with the alarm facing the shoulder and the horn – located on the bottom left side of the alarm – oriented toward oncoming traffic (figure 1).[5] If more cones are used, they would be spaced 10 ft apart to reduce the likelihood that an intruding vehicle could enter the work zone without impacting an alarmed cone.

[5] Eight alarms were defective and could not be used. Defects are described in the next section. Note that the alarm shown in the figure is an older version with a different mounting method. The alarm used by NJDOT has an improved mounting bracket that allows the cones to be stacked with the device mounted in place.

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Figure 1. Close-Up of SonoBlaster!® Work Zone Intrusion Alarm.

Source: Kuta, *Work Zone Intrusion Alarm Demonstration Interim Report*, July 2009.

The maintenance crew began work with the alarmed cones in place at approximately 9:00 a.m. Work was completed at approximately 12:00 p.m. The crew observed that traffic volumes were atypically light. No traveling vehicles impacted any of the alarmed cones during the observation period. The Employee Safety Manager and the Principal Investigator agreed in advance that, as long as safety is not compromised, vehicle impact would be simulated in order to test the alarm under working conditions.

Two impact simulations were performed resulting in unit activation (alarm sound). First, an Employee Safety vehicle traveling at low speed deliberately grazed two alarmed cones. Second, an Employee Safety representative deliberately pushed over an alarmed cone. In both instances, none of the crew members or the Principal Investigator had advance warning of the impact.

A group interview was not held at the conclusion of the job. The Principal Investigator held informal interviews at the roadside with crew members.

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The SonoBlaster!®-equipped cones were left with the crew after the pilot test for the crew to use in future work operations.

Efforts were made by NJDOT to identify and schedule additional lane closure operations where the SonoBlaster!® alarm could be deployed. In July 2010 the Employee Safety Manager indicated that no more jobs could be identified for this study, and he informed the NJDOT Research Project Manager that CS should proceed to the final task of writing the Final Report, based on the existing information. As will be described in the rest of the report, experience with the SonoBlaster!® alarm during the pilot test and by the same crew following the pilot test contributed heavily to the decision to end the field testing.

Pilot Test Findings

The study team's primary interest during the initial deployment of the SonoBlaster!® Work Zone Intrusion Alarm in May 2010 was the sound volume and duration of the alarm due to previous serious concerns about the sound by earlier users in FHWA's demonstration project, concerns that were addressed by the vendor, resulting in a retooled alarm. Because no breach of the work zone occurred during the pilot test, many observations defined in the field guide could not be made, and questions in the interview guide could not be answered.

The key areas of evaluation and pilot test findings are presented below.

Operation

During the vehicle impact simulation, crew members heard the two alarms readily at 200 ft away. The two alarms in combination sounded for almost 30 s (there was a stagger effect because the two cones were impacted one after the other).[6] Crew members were not wearing ear protection at this time.

During the manual impact simulation, crew members were wearing ear protection, and the alarm was audible at 200 ft away. The sound was not as startling as when ear protection was not used, but it was noticeable. The alarm sounded for more than 15 s.

Loud equipment, such as a jack hammer, was not being used during either simulation. This factor was planned for the next test. A small roller was used during one simulation. The roller operator said he could hear the alarm.

Mounting

The mounting bracket supplied with the unit allows alarmed cones to stack for storage with the device mounted in place. The mounting bracket is installed on a standard traffic cone using supplied screws in holes that are drilled by the user in the cone base.

Employee Safety personnel reported that mounting was time-consuming and tedious.

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[6] Transpo Industries, Inc. materials available on its website, accessed in August 2010 report that the SonoBlaster!®'s horn produces a sound measuring 125 dB for 15 s.

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Set-up Procedures

Several procedures must be completed to ready the unit for use. The unit must be cocked; it must be tested without the CO_2 power cartridge installed; and the cartridge must be installed. At the roadside, the control knob must be moved from the locked position to the unlocked position to arm the unit.[7] This requires an employee to bend over in close proximity to traffic.

Employee Safety personnel encountered problems preparing the device prior to arriving at the maintenance yard. They had considerable difficulty pushing the cocking rod into the cocking rod hole to cock the firing mechanism. Once the cocking was believed to be completed (from the clicking of the cocking rod), the visual cocking indicator did not consistently show the red indicator in the clear window, which signifies that the unit is properly cocked. As a result, the cocking process needed to be repeated.

The inability of the device to hold the locked position was especially troublesome. Employee Safety staff attempted to test the alarm in the maintenance yard prior to leaving for the work site. Before it was unlocked and armed (i.e., it was in the locked position), the alarm fired, surprising staff and crew assembled in the yard. Another alarm fired as the cone was being moved from the trailer to the work zone. The unit was in the locked position, but a low-sounding alarm was heard. The CO_2 cartridge was examined, and was found to be pierced.

As a result of the two misfires, Employee Safety personnel checked all of the alarms at the work site. In all, 8 of 22 alarms prepared and planned for the test were not usable due to problems with the cocking indicator or pierced (discharged) cartridges.

Storage and Portability

Cones equipped with the device are readily stackable, facilitating storage and transport to the work site. Portability, however, is compromised by the potential for misfiring.

Durability

The Employee Safety Manager deliberately dropped an alarmed cone on the ground from a height of 3 ft. The bracket that attaches the alarm to the cone broke.

Post Test Feedback

The SonoBlaster!®-equipped cones and additional CO_2 cartridges were left for the crew to use. The crew took the alarmed cones to a subsequent job site. However, the alarms activated while being transported from the yard to the site in the locked position.

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[7] Details of the operating procedures may be found in the Operation Manual available on the vendor web site.

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CONCLUSIONS

Keeping in mind that conclusions based on one deployment should be considered with caution, the following conclusions are drawn from the U.S. Route 1 pilot deployment of the SonoBlaster!® Work Zone Intrusion Alarm in New Jersey:

- Operation – Volume and duration are satisfactory during normal traffic conditions for distances of at least 200 ft, including when ear protection is worn. No conclusion can be made concerning the ability to hear the alarm during jack hammer operations. The unit activates upon light, sideways vehicle impact.

- Mounting – Mounting is time-consuming and tedious. Presumably, mounting will not be frequently necessary for existing units unless the bracket or alarm needs to be replaced. Mounting is necessary, of course, for additional units put into use.

- Set-up procedures – Three different problems were detected during set-up procedures, as follows:

    1. Pushing the cocking rod into the cocking hole to cock the firing mechanism is difficult.

    2. Verification that the unit is cocked is difficult because the visual cocking indicator does not always show the unit to be cocked even when cocking evidently has been completed (i.e., cocking rod clicks).

    3. The unit is very sensitive and must be handled carefully. In the locked, unarmed position (with the CO_2 cartridge installed) the unit may fire. This may cause crews to delay loading the CO_2 cartridges until the cones are placed on the roadway to avoid premature firing. Employee Safety personnel indicated that it is highly unlikely that crew members will install cartridges at the roadside. This procedure also would unnecessarily expose employees to traffic. An alternative is to load the cartridge at the maintenance yard before leaving for the work site. However, units in the locked position have fired in transit.

- Storage and portability – Units stack well, but the potential for misfires creates problems for moving units to the work site with cartridges in place.

- Durability – Mounting bracket in particular is susceptible to breakage under normal use.

Overall, quality control is questionable due to problems with setting up the device and its durability, as described above. Reliability as a safety-promoting device also is an issue because of misfires.

Lane closure operations are considered by NJDOT to be the most appropriate setting for deploying the device. However, its utility by NJDOT is indeterminate in view of the relatively small number of NJDOT maintenance jobs involving lane closures that were identified during the study period. SonoBlaster!®-equipped cones may be more

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practical for lower speed and volume roads, such as municipal roads. It may be beneficial to use the cones in the activity area in a diagonal or staggered pattern. If an errant vehicle were to breach the safety zone, the alarm would sound. However, the problems identified above and the need to transport and place an adequate number of alarmed cones make the SonoBlaster!® alarm impractical for smaller lane closure jobs.

Unit costs were obtained from the vendor in June 2010.[8] Alarms, replacement cartridges, and mounting brackets are individually priced, per unit (cartridges are available 10 in a box). The vendor indicated that quantity prices are offered, with price breaks at 100, 1,000, and 3,000 units.

In ending the study early, the Employee Safety Manager expressed the view that problems with quality control and reliability, combined with the cost of the alarm, raise doubts about the desirability of and benefits to be gained from deploying the device on NJDOT maintenance jobs. It is not believed that conducting any additional test deployments will substantially change the conclusions.

Study questions concerning the effectiveness of the device in protecting workers from injury caused by errant vehicles that breach the work zone and its acceptance by workers cannot be directly answered by this abbreviated study.

[8] Transpo Industries, Inc. provided cost quotations, which were forwarded to the Employee Safety Manager and Research Project Manager.

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APPENDIX A – KEY REFERENCES

Bernie Kuta. *Work Zone Intrusion Alarm Demonstration Interim Report.* Federal Highway Administration, U.S. Department of Transportation, July 2009.

Bernie Kuta. *Work Zone Intrusion Alarm Demonstration SonoBlaster!®* (slide presentation). Federal Highway Administration, U.S. Department of Transportation, August 10, 2009.

Transpo Industries, Inc. August 2010. http://www.transpo.com/sonoblaster.htm.

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APPENDIX B – FIELD GUIDE

New Jersey DOT Work Zones
SonoBlaster!® Intrusion Alarm Acceptance and Effectiveness

Crew:

Work Site/Maintenance Job:

Date: Time:

Project Purpose

New Jersey DOT is deploying the SonoBlaster!® Work Zone Intrusion Alarm on routine highway maintenance projects on a trial basis to determine the acceptance and effectiveness of this device. Cambridge Systematics will conduct an evaluation of the acceptance of the device by NJDOT maintenance workers and its effectiveness in protecting the workers from injury.

The study will answer the following high-level questions:

1. Is the alarm effective in warning workers of vehicles that breach the work zone in such as a manner as to allow them to take action to avoid being struck by the vehicle?

2. Does the alarm afford a feeling of protection and safety?

3. Is the alarm easy to install, activate, and replace; is it durable; and when mounted in place is it convenient to deploy and store?

Field observations and in-person interviews focused on multiple maintenance crews will be employed to collect primary information. Field guides will be used to focus attention on key observations to be made during the field visits, while interview guides will be used to collect information during individual interviews held at the work site and group interviews conducted at the maintenance yard where the crew assembles at the beginning and end of the work day. The collected information will be synthesized and described in a Final Report summarizing the findings.

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Observations by Cambridge Systematics

1. Describe the work site (type of roadway, lanes of traffic, rough amount of traffic, kind of maintenance work, equipment, number of crew persons).

2. Identify other traffic management or safety systems in use (e.g., flagger, message signs).

3. Describe the placement of the intrusion alarms (number, spacing, total length, placement in relation to work activity).

4. Relate breach incidents that occurred.

5. Describe the reactions of the crew when the alarm sounded:

    - Who moved?
    - How quickly they moved?
    - Where they went?

6. Describe the reactions of the person(s) most directly in the line of danger.

7. Tell how deeply the intruding vehicle breached the work zone.

8. Describe any damage done or injury sustained.

9. Tell whether the alarm appeared to have prevented (or reduced) injury.

10. Relate occurrences of false alarms.

11. Tell about alarm mounting and operation.

12. Tell about alarm portability and storage.

13. Give impressions of alarm durability.

14. Describe any identified or perceived operational drawbacks.

15. Give impressions of how well workers accept the alarm.

16. Give impressions of how well the alarm performs in warning workers and allowing them to seek safety.

17. Any other comments.

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APPENDIX C – INTERVIEW GUIDE

New Jersey DOT Work Zones
SonoBlaster!® Intrusion Alarm Acceptance and Effectiveness

Group or Individual Interview:

Crew:

Work Site/Maintenance Job:

Individual (if Individual Interview):

Interview Location:

Date: Time:

Project Purpose

New Jersey DOT is deploying the SonoBlaster!® Work Zone Intrusion Alarm on routine highway maintenance projects on a trial basis to determine the acceptance and effectiveness of this device. Cambridge Systematics will conduct an evaluation of the acceptance of the device by NJDOT maintenance workers and its effectiveness in protecting the workers from injury.

The study will answer the following high-level questions:

1. Is the alarm effective in warning workers of vehicles that breach the work zone in such as a manner as to allow them to take action to avoid being struck by the vehicle?

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Field observations and in-person interviews focused on multiple maintenance crews will be employed to collect primary information. Field guides will be used to focus attention on key observations to be made during the field visits, while interview guides will be used to collect information during individual interviews held at the work site and group interviews conducted at the maintenance yard where the crew assembles at the beginning and end of the work day. The collected information will be synthesized and described in a Final Report summarizing the findings.

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Questions for Maintenance Crew

1. Does the intrusion alarm protect you from injury at the work site?
2. How many breach incidents did you experience today (or other time period)?
3. What was the proximity of the intrusion alarms to you and your coworkers?
4. As far as you know, were you able to hear the alarm each time it sounded?
5. When the alarm sounded, did you know where the danger came from?
6. When the alarm sounded, what did you do?
7. Did you have sufficient time to physically move to avoid the intruding vehicle?
8. What would have happened if the alarm was not used?
9. Would you rate the alarm as better or not as good as other safety systems?
10. Do you have any issues with the use of the alarm?
11. Have you experienced any false alarms?
12. What do you like about the intrusion alarm?
13. Do you feel protected and safe when the alarm is used?
14. Would you like the alarm to be used on a routine basis?
15. Would you like the alarm to be used on certain kinds of jobs?
16. Is the alarm easy to mount and operate?
17. Are the alarms mounted on cones easy to “stack” and store?
18. Did you receive training related to the alarm?
19. Do you wish to make any additional comments about the alarm?