THE UNIVERSITY OF SOUTHERN MISSISSIPPI

NATIONAL CENTER FOR SPECTATOR SPORTS SAFETY AND SECURITY (NCS^4)

LABORATORY ASSESSMENT REPORT

FIBERSTRIKE SYSTEM

Foreword

The National Center for Spectator Sports Safety and Security (NCS[4]) at the University of Southern Mississippi has established the National Sports Security Laboratory (NSSL) dedicated to sports safety and security to assist spectator sports venue operators in assessing and validating systems and technologies for safety and security use.

The NSSL provides a mechanism to aggregate specific safety and security requirements for the spectator sports domain as developed by security and venue operator practitioners through participation in a National Advisory Board. This Advisory Board includes participation from all professional sports leagues and select collegiate institutions. The NSSL, using industry requirements and operational needs, develops:

- Impartial, vendor agnostic, and operationally relevant assessments and validations of safety and security solutions (systems) based on the community of interest (COI) requirements.
- Evaluation reports that enable venue operators and security personnel to select and procure suitable solutions; and to deploy and maintain solutions effectively. In some cases, process evaluations will be performed to provide newly devised procedures.

The evaluation program follows principles currently espoused by standing DHS validation programs (such as SAVER[1]) that are meant to assist end operators with objective and quantitative reviews of available commercial systems and solutions. Information obtained in the course of the assessments (including this report) will be made available to subscribers of NCS[4] publications and to the U.S. Department of Homeland Security for their use.

[1] System Assessment and Validation for Emergency Responders (SAVER) was established by DHS to assist emergency responders in making procurement decisions through the publication of objective assessments and validations of commercial equipment. This process was used as a reference guide for the evolution of NCS[4] Lab process.

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1.0 Introduction

1.1 Analysis of the Need

The NCS[4] National Advisory Board identified early threat detection and notification as a major priority for sports safety and security. The integration of switches and sensors in sporting venues allow security managers to maintain situational awareness and rapidly respond to threats. The data collected from integrated sensors allow venues to increase efficiency, automate maintenance records, and monitor for abnormalities.

This report presents a summary of the evaluation and demonstration of the Cleveland Electric Laboratories FiberStrike™ fiber optic interlock switches.

1.2 Overview of Cleveland Electric Laboratories

Cleveland Electric Laboratories (CEL) is a 97-year-old innovative sensing company that serves customers nationally & internationally. Their FiberStrike family of sensor products addresses a host of common weaknesses for three primary areas: Security, Structural Health Monitoring, and Leak Detection.

As part of its research and development process, CEL identified a need for law enforcement to identify the exact location of an attack within five seconds within their assigned area of operations. Cleveland Electric Laboratories considered technology solutions to provide a safe, reliable and durable means of continuously monitoring the position of manholes, vault covers, and any other entrance point in order to detect when they are opened and closed, in order to help protect vital infrastructure and citizens. This monitoring of manholes near public venues where many people gather, provides a means of coherent change detection that can immediately alert authorities to any unauthorized entry; this monitoring can help maintain perimeter security and improve public safety.

1.3 FiberStrike Overview

According to CEL, FiberStrike® fiber optic interlock switches are a solution for monitoring the status of virtually any access portal (manholes, hand holes, doorways, vaults and power grids) today. Benefiting from the nearly limitless working distances allowed by fiber optics, these interlock switches can be networked over a wide perimeter by taking advantage of existing standard communication fiber networks.

FiberStrike® will detect and locate any attempt to cut, break, open, tamper, or intrude into any secure area. Additional advantages include the passive nature of each sensor since they require no power at any sensor location and immunity to environmental problems that plague electrically-based sensors. The system can network almost any number of sensors over non-conductive optical fiber into a single monitoring system that can be tens of kilometers removed from the sensing area.

While FiberStrike® switches have been created for intrusion detection at access portals such as hatchways, manholes and hand-holes, these sensors also are ideal for high Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) industrial environments requiring many open-close measurement points, or other locations where knowledge of many "go/no-go" contact states in a network is required. A multitude of different switch actuator heads (arms, rollers, feeler rods, etc.) are available to meet particular applications.

1.4 FiberStrike Components

Components used in the FiberStrike® system are patented fiber optic sensors, software and an interrogator that will integrate with cameras and any command control system.

Figure 1: FiberStrike Components

An LCM6100 system for monitoring manhole or vault covers consists of:

LCM-610 Sensors

- Environmentally rugged housing that contains a fiber optic sensing element known as a fiber bragg grating (FBG), a toggle mechanism, and ruggedized optical fibers.
- Multiple actuator styles are available for the sensor. Actuators may be easily changed in the field if

necessary.

LCM-2600 Interrogator

- The interrogator polls all sensors in real time and converts optical information from each sensor into position information for each sensor.
- With proper system configuration, each of the 16 interrogator channels will support up to 35 sensors, so an LCM-2600 interrogator can simultaneously poll up to 560 manhole covers.

Software for Monitoring

- Each software capability is expandable to client need; individual capabilities are separately addressable by individual tabs to make customization easier during implementation.
- Can use FiberStrike® IntelliOptics™ monitoring software or incorporate with any Command Control System already in use. API is designed to integrate in each case with the customers command control system.
- Military Security Grade software available per request.

Graphic User Interface

- Graphic user interface (GUI) runs in Windows based environment as a standard (NOTE: GUI can run in Linux-based environment if required by customer). The GUI displays a representation of protected portals in any of several user-selectable formats. Every system is tailored to a customer's installation configuration and requirements.

2.0 Objectives

This report serves the following purposes:

- Describes the methodology employed during the evaluation, the scoring system and the role of evaluators in the evaluation process.
- Outlines the full set of solution requirements identified as functional capabilities by Cleveland Electric Laboratories regarding the FiberStrike™ System.
- Publishes the evaluation scoring results as well as the comments and additional information provided by the evaluators and Cleveland Electric Laboratories.

This evaluation is intended only to validate the FiberStrike™ System capabilities and functionality, as claimed by Cleveland Electric Laboratories. The goal of this assessment report is to validate the FiberStrike™ System based on its advertised features and functions. The evaluation does **not** compare FiberStrike™ System capabilities and functionality with similar technologies or products.

3.0 Methodology

3.1 General Approach

The methodology described herein was developed to be repeatable so that it can be used in the evaluation and assessment of a variety of technologies and processes. By employing this methodology the results become verifiable and quantifiable, and can be used subsequently for an entity's individual analysis and/or procurement decisions.

The methodology for this evaluation began with a discussion between Cleveland Electric Laboratories and NCS^4 to define the capabilities and functional requirements of the FiberStrike™ System for the evaluation. Once Cleveland Electric Laboratories provided a description of capabilities and functions to demonstrate, NCS^4 worked with Cleveland Electric Laboratories to create a list of executable requirements for the evaluation process.

Evaluators assessed the FiberStrike™ System only against the company's chosen requirements. No evaluation criteria were considered outside of Cleveland Electric Laboratories' own operational requirements. The evaluation criteria were composed of functional requirements that were grouped into the three main categories below:

1. Application and Capability
2. Mobility and Communication
3. Software and Installation

3.2 Evaluators

The FiberStrike™ System was evaluated by a select group of subject matter experts (SMEs) from the sports security domain. This group consisted of professionals from public safety, sports and athletic facility operations, and information technology. The collective group of SMEs had a base of experience that encompassed collegiate and professional sports, and major event safety and security operations.

3.3 Collecting Results

Each SME/Evaluator was provided with the FiberStrike™ System requirements matrix and scoring definitions. Facilitators and evaluators were briefed prior to the evaluation to ensure a thorough understanding of the evaluation process and the expectations for each evaluation participant. Immediately following each part of the evaluation, evaluators documented their observations and qualitative comments to supplement the quantitative scoring. At the conclusion of the evaluation process, the facilitator used the quantitative scoring data to tabulate the results in the Scoring and Results section.

4.0 Setup, Demonstration and Evaluation

4.1 Setup

The evaluation took place at the National Sports Safety and Security Laboratory (NSSL) located on the University of Southern Mississippi (USM) campus in Hattiesburg, MS. Prior to the evaluation, Cleveland Electric Laboratories was permitted time to setup all equipment required for the evaluation. Equipment included:

- 1 Panasonic WV-SC385 HD PTZ network camera
- 3 FiberStrike™ multiplexed sensors
- 1 Optical sensing interrogator
- Laptop
- Smart phone

Figure 2: Equipment

Three FiberStrike™ sensors were connected to a single channel on the optical sensing interrogator. Sensors were setup in a daisy chain configuration. Fiber optic wire connected the sensors to the interrogator in a central location. The camera was connected to the interrogator and configured to pan, tilt and zoom to sensor locations upon alarming.

Figure 3: Configuration

4.2 Demonstration and Evaluation

Cleveland Electric Laboratories provided the evaluation team with a brief overview, explaining the system capabilities and setup. Evaluators were then provided with switches to examine connection and multiplexing capabilities. Following the presentation, CEL logged into the user interface to demonstrate the system's ability to:

- Detect Intrusions
- Monitor access points
- Connect to mobile devices
- Integrate maps
- Configure alarms
- Integrate cameras
- Configure switches

FiberStrike™ sensors were triggered individually and simultaneously to validate the system's ability to detect intrusion or track maintenance real-time. Evaluators assessed system alarm notifications in the user interface, integrated mapping, email, and text messaging. Alarms were displayed in the user interface in less than three seconds each time an alarm was triggered. The system was accessed and monitored by laptop and mobile device.

Following an evaluation of system alarms and notifications, evaluators assessed the software's ability to configure alarms and create permission levels. Alarm thresholds were adjusted to demonstrate systems ability to meet unique end-user needs.

The demonstration kit prevented the validation of all product capabilities due to the following limitations:

- The system could only be accessed with administrative permissions
- Alert configurations were limited
- Call notifications were not available

Figure 4: Integrated Maps

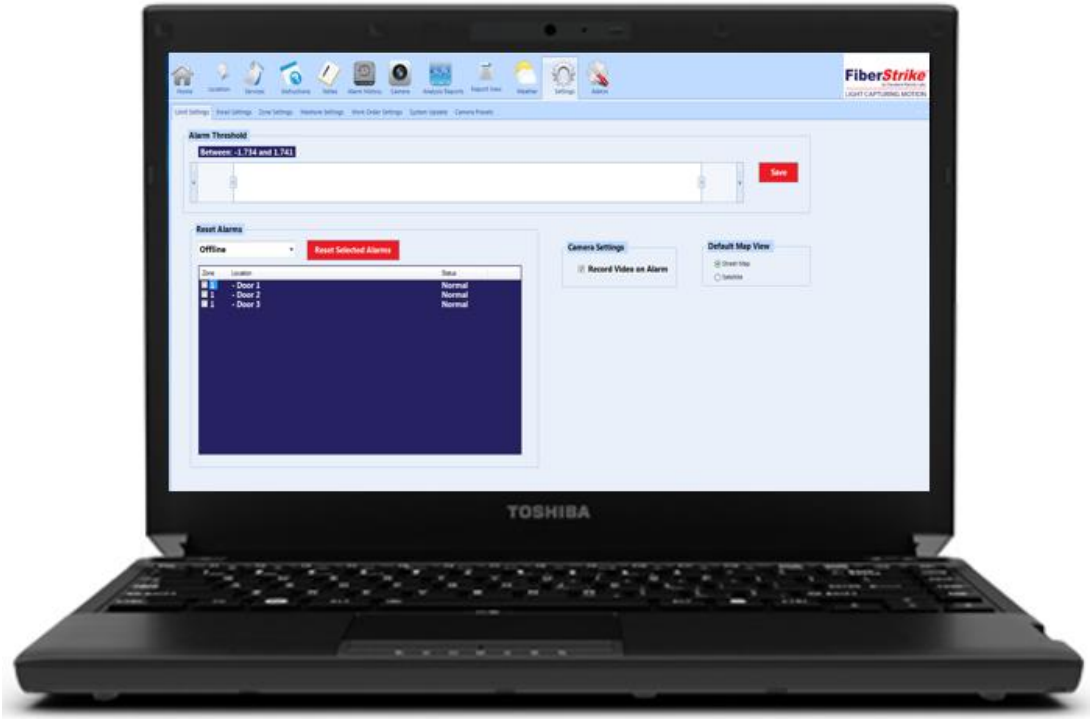

Figure 5: System Configuration

4.3 Analysis

Following the evaluation, the system's audit capability was reviewed. Access times and locations were available in chronological order and could be reviewed or exported. The demonstration kit limited alarm activity to switch information and did not include information collected from the integrated camera.

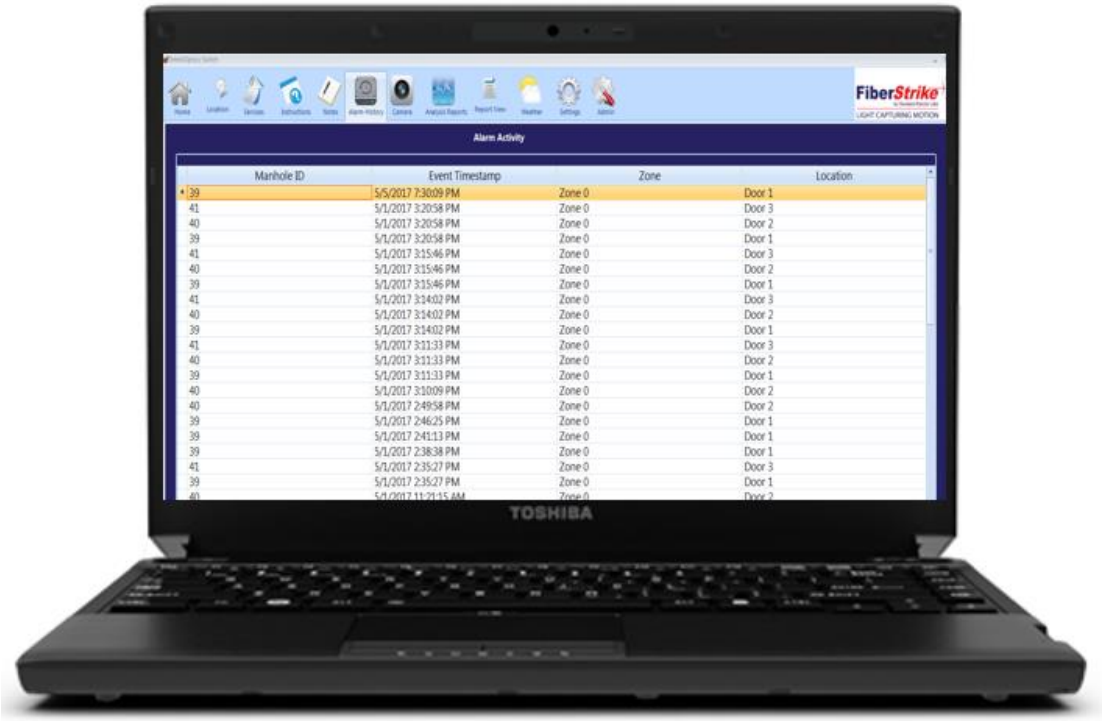

Figure 6: Audit

5.0. Scoring and Results

5.1 Scoring System

As outlined in Section 3.1, the evaluators scored the performance of the FiberStrike™ System based on the specific requirements within four functional areas, as defined by Cleveland Electric Laboratories. Evaluators scored each functional area in three ways: 1) through observation/documentation during training, 2) interaction with the system, and 3) Cleveland Electric Laboratories' demonstration of system functions. In accordance with NSSL policy, evaluators compared the FiberStrike™ System against the requirements and not against other evaluators' results (technical leveling). Table 5.1 below defines the scores used.

Table 5.1: Scoring Definitions

Definition	Score	Equivalent %
Does not meet the requirement	0	0%
Partially meets the requirement	1	50%
Meets the requirement, with comments/recommendations	2	75%
Meets the requirement	3	100%

Each requirement was weighted equally. Prior to January 2016, assessments included separate categories and weightings for capability and feasibility. This allowed evaluators to provide scores that showed a product "exceeded" requirements. The new methodology combines capability and feasibility thus, eliminating dual scoring. Each requirement's score now represents a combined score of capability and feasibility.

5.2 Evaluation Results

5.2.1 Application and Capability

5.2.1 Application and Capability

Function #	Functional Area	Function/ Specification to Score	Score
1. Application and Capability			
1.1	**Real-Time Intrusion Detection**	FiberStrike switches detect physical intrusions at hatchways, manholes, hand-holes, or similar access portals to protected spaces and enclosures.	
1.1.1	Unique Identifiers	Each switch is uniquely identified	3.00
1.1.2	Response Time	Fiberstrike system response time is less than 3 seconds.	3.00
1.2	**Tracking**	FiberStrike switches allow administrators to monitor access points, create permission levels, and track entries.	
1.2.1	Permission Levels	Can be setup for go/no-go, giving knowledge of activity in restricted areas and areas of concern	2.33
1.2.2	Audit	Creates a time-stamped audit trail of entries	3.00
1.3	**Passive Fiber-Optically Based**	Passive sensors use light, not electricity, and are ideal for use in high EMI/RFI environments and/or explosive atmospheres. Sensors are intrinsically safe, eliminating concerns of spark issues or electrical interference.	
1.3.1	Power Source	Sensors use light for power source, there is no electrical requirement at the sensor.	3.00
1.3.2	Bypassing	Sensors cannot be bypassed without detection	2.38
1.4	**Multiplexing**	Many FiberStrike switches may be multiplexed on one optical fiber while remaining individually and uniquely identified.	3.00
		Average score	**2.82**

SME Comments/Recommendations:

1.2.1 – Unable to validate read-only access (or any other permission level except full admin). This was a demo limitation. The evaluation team think this is something that could be easily managed and that the system is capable of other types of access.

1.3.2 – CEL demonstrated that the system would detect a sensor being bypassed. However, an alert or alarm was not available in the demo thus, the evaluators could not fully assess the capability.

5.2.2 Mobility and Communication

Table 5.2.2: Mobility and Communication

Function #	Functional Area	Function/ Specification to Score	Score
2. Mobility and Communication			
2.1	**Mobile Connectivity**	Mobile connectivity applications allow authorized personnel to receive alerts and access actionable data from any remote location where cell or internet connectivity exists.	2.5
2.2	**Apps**	Applications for mobile devices from local client servers or cloud system allow authorized personnel to remotely access the monitoring system.	2.67
2.3	**Alerts**	System can be configured to call and/or text authorized personnel when an entry triggers an event alert.	3.00
2.4	**Alert Configuration**	Alerts can be configured based on the administrator's preferences, in multiple combinations.	
2.4.1	Scheduled Entry	Alerts can be configured for scheduled entries.	2.75
2.4.2	Unscheduled Entry	Alerts can be configured for unscheduled entries.	2.00
2.4.3	Unauthorized Entry	Alerts can be configured for unauthorized entries.	1.25
2.4.4	Selected Locations	Alerts can be configured by selected locations.	2.00
2.5	**Alarms & Triggers**	The reaction to an unscheduled event is customer-configurable and may include alarms, triggering of pan-tilt-zoom cameras to aim at location.	3.00
		Average score	**2.40**

SME Comments/Recommendations:

2.1 – CEL demonstrated alerts being received and system access via a mobile device. However, actionable data was discussed but not demonstrated.

2.2 – Cloud system access was demonstrated. Did not show all capabilities or expound on limitations/capabilities of this feature. App was not easily viewable.

2.4 – Unscheduled and Unauthorized entries were the same alarm; evaluators could not verify that there are independent alert configurations. The end-user or facial recognition software would be responsible for determining this. Sensors were set for zones, which could not be reconfigured in the demo and thus, evaluators cannot verify CEL's capacity to meet the requirements in their entirety.

5.2.3 Software and Installation

Table 5.2.3: End User Functionality

Function #	Functional Area	Function/ Specification to Score	Score
3. Software and Installation			
3.1	**Ease of use**	Graphic user interface displays representation of protected portals in any of several user-selectable formats. Every system is tailored to customer's installation configuration and requirements.	
3.1.1	Maps	Graphic user interface displays correct geographic location of all individual switches at protected portals, overlaid on a map.	3.00
3.1.2	Aerial Imagery	Graphic user interface displays correct geographic location of all individual switches at protected portals, overlaid on aerial imagery of surface and surrounding structures.	3.00
3.1.3	Tabular	Graphic user interface displays geographic coordinates and/or named street locations of all individual switches at protected portal locations.	3.00
3.1.4	Switch status indications	Status of all switches is displayed via color coding in maps, aerial imagery and tabular presentations.	3.00
3.1.5	Switch status updates	Status of all switches is displayed in real-time and is continuously updated.	3.00
3.1.6	Archiving and access to switch status history	All information is archived, and reports for any specified switches within any date/time period are immediately retrievable.	2.63
3.2	**Integrated**	Developed for Windows-based computers using Microsoft .Net Platform, with capability to be integrated with external client systems.	2.5
		Average score	**2.88**

Composite Score	**2.70**

SME Comments/Recommendations:

3.1.6 – Switch information was archived, but video was not. This appears to be a limitation of the demonstration kit.

3.2 – Able to see the integration with the State of Delaware's server. However, the only system involved in demonstration was a Windows PC. Evaluators cannot verify if and how a Linux or Mac OS system will integrate with servers.

5.3 Description of Results

Tables 5.2.1, 5.2.2, and 5.2.3 display the three functional areas and associated requirements that were demonstrated and scored. Each of the three functional areas has an average score at the bottom of each section. A composite score, representing the average of all three functional area scores, is found at the bottom of Table 5.2.3.

The average scores for each of the four functional areas, **Application and Capability**, **Mobility and Communication** and **Software and Installation** were scored as 2.82, 2.40, and 2.88 respectively.

Functional Area 1: Application and Capability had a **mean score** of **2.85**. No single capability failed to meet the requirement.

Functional Area 2: Mobility and Communication had a **mean score** of **2.40**. The Capability outlined in 2.4.3 partially met the requirement. Assessor comments and recommendations are listed by function number within the evaluation matrix.

Functional Area 3: Software and Installation had a **mean score** of **2.88**. No single capability failed to meet the requirement.

6.0 Evaluator Comments

Each evaluator was asked to provide feedback relative to the FiberStrike™ system following the evaluation. Comments are intended to capture overall feedback from each SME, expanding on the evaluated criteria. Emphasis is placed on the incorporation of the product into safety and security operations.

Evaluator 1:

The technology is impressive and has widespread implications for the sporting and special event sector. It provides scalable proactive measures designed to defeat/mitigate many risks identified in the THIRA. Use of fiber without power sources and the integration of the system(s) under one platform makes it a viable option. Recommend creating a more robust demo to meet each capability statement specific to sporting and special events.

Evaluator 2:

The FiberStrike system is an innovative technology that could prove to be valuable in the ever-changing world of security. Society dictates the need to reassess our security practices and implement new measures to address high tech criminal activities aimed at posing a threat to the masses. FiberStrike technology is proactive in its application as it addresses potential threats well before they reach the venue. The ability to detect curtilage breeches with audio/video alerts is cutting-edge. This system is capable of being integrated into existing security systems, which adds another layer of exterior security. However, the world of professional sports would need a few other capabilities to be expounded on or enhanced before this technology would be considered as a welcomed addition to security best practices. Video archiving, additional alert switching to continue monitoring during a breach would be vital to the success of this product in professional sporting venues.

Evaluator 3:

Unfortunately, due to limitations of the demo, we were unable to validate all capabilities. But, for those that were validated, the system performed as claimed. The software, particularly the mobile app, seemed a bit clunky and did not fit the screen size. On the monitoring software (pc), the map view kept zooming out with every page refresh, and the user would have to keep zooming back in. Response to a security event needs to happen quickly and these delays could slow that down. As for the hardware, they seemed to be of high-quality. Each switch tested functioned flawlessly. It would be nice if this system would integrate directly with Active Directory for authorization and permissions.

Evaluator 4:

Not all of the applications/capabilities were able to be demonstrated in this session. Some of the applications/capabilities were improperly stated. There is a need for this product and the protection it provides. However, many capabilities were described as things that “can be done,” rather than what “is being done.”

7.0 Summary

The specific functions and features of this product were observed and evaluated by a team of sport security professionals assembled by the University of Southern Mississippi's National Center for Spectator Sport Safety and Security. The NCS[4] staff facilitated the product evaluation and compiled the evaluation results listed in this report. The NCS[4] staff did not have any input into the scoring of the evaluation criteria or evaluator comments.

The evaluation requirements centered on the three functional areas of **Application and Capability**, **Mobility and Communication** and **Software and Installation**. The **overall composite score**, **2.70** out of a possible 3.0, of the measured functions indicates that this product overall performed at or above the levels considered by the evaluators to meet requirements. Additional evaluator comments and recommendations are captured in section 6.

NSC[4] thanks the subject matter experts and Cleveland Electric Laboratories for their participation in the evaluation and demonstration process.

This report is available on the NSC[4] website at http://www.ncs4.com/lab/evaluated-product-list.