INSTALLATION OF FIRE PROTECTION SYSTEMS LAKE CITY ARMY AMMUNITION PLANT

By

Lucinda A. Park

Mark A. Wingate

Presented at the Department of Defense
Explosives Safety Seminar
August 19, 1998

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **AUG 1998**	2. REPORT TYPE	3. DATES COVERED **00-00-1998 to 00-00-1998**

4. TITLE AND SUBTITLE **Installation of Fire Protection Systems**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Lake City Army Ammunition Plant,SIDLC-SF,Independence ,MO,64051-0250**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM001002. Proceedings of the Twenty-Eighth DoD Explosives Safety Seminar Held in Orlando, FL on 18-20 August 1998.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**6**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Installation of Fire Protection Systems

Background

Lake City Army Ammunition Plant is the world's largest manufacturer of military small caliber ammunition. The plant is owned by the U.S. Government and is currently operated by Olin Corporation – Winchester Division. The plant is located in Independence Missouri. The plant's mission is to manufacture high quality, cost competitive military small caliber ammunition and associated explosives/pyrotechnic materials.

Due to the nature of manufacturing ammunition, there may be considerable risks associated with manufacturing explosives/pyrotechnics. The Army has been a leader in reducing the risks in these operations. Engineering improvements to reduce hazards includes reviewing fire suppression. The DOD Fire Community questioned whether or not the presently installed high-speed deluge system would respond quickly enough to prevent injuries. False alarms were another concern and they hypothesized that the color spectrum was influencing the capability of detector. A project was pursued by HQ, Industrial Operations Command and Defense Ammunition Logistics Activity to test some pyrotechnics and compositions used at several installations. The plant requested that three explosives materials from Lake City AAP be included in the project. The test purpose was to review the effectiveness of the current systems, increase the speed of response, and reduce false alarms.

The system installed over the pyrotechnics processing units is an ultra high-speed deluge system manufactured by Detronics. The current system used at Lake City AAP is designed to protect employees and equipment by extinguishing fires while processing pyrotechnic material. The deluge system was installed within the last ten years and is considered state of the art. The current system meets or exceeds NFPA 15 standards.

Air Force Fire Research Laboratory at Tyndall AFB recommended that a Fenwall system with appropriate modifications be considered. The Fenwall sphere extinguishing capabilities is limited by the amount of water contained in the sphere. Extinguishing a fire is therefore limited to one discharge. Detection and reaction time is imperative to the success of extinguishing the incipient fire. They suspected that the detectors were not light wavelength specific to non-hydrocarbon fires. The plant participated in the program so that possibility of risk to personnel may be reduced. The plant's safety goal is to have zero incidents.

Materials were supplied to review the effectiveness of the fire suppression systems on high hazard materials that are a mixture of perchlorates and ammonium nitrate mixed with powdered metals.

Selection of Materials

Three mixtures were selected for testing based upon the risks associated with the ingredients. The first two pyrotechnic mixtures selected, RS-40 and RS-41, are used in 20mm HEI ammunition production. The third pyrotechnic mixture, R-440, is an IR burning material that is used in two types of tracer ammunition.

Test Setup

Test setup for Lake City material was identical to the plant's charging station with a Detronics detector system. The Fenwall sphere was installed and comparative testing was conducted using various detectors with high-speed video to verify findings.

Mannequins and heat flux data was utilized to measure thermal rise on exposed personnel. Time responses were measured by viewing high-speed video (1000 fps).

The results of the test data indicated that the water sphere would extinguish the fire at least 80ms faster than the current system with no thermal peaks. The current system requires 95ms for water to travel 30 inches versus the Fenwall system which water travels the same distance in 14ms or 200 feet per second. The Fenwall system would be capable of extinguishing incipient fires in less than 10ms.

False alarms were another systematic problem inherent with the currently used detector system. Sources for false alarm were tested with the following detectors: Spectrex (IR/UV), Duel Spectrum (IR/IR), Fire Sentry (IR/UV), and Dectronic (UV). The currently installed detector system responded to more stimuli than the other three detector systems tested leading to more false activations.

The testing indicates that for the fast burning events, RS40 and RS41, that the current Dectronic system responded in 11ms versus 4ms for Spectrex system. All of the fire detection systems responded more expediently with the Fenwall systems. For slower growing fires for materials such as R440, the Fenwall system with Detronics detector responds the fastest. This detector had the most false alarms at the greatest distances.

The Fenwall Spectrex system for the materials tested was selected based upon response time and firefighting capabilities. After reviewing the data, the plant felt that it was in our best interest to pursue installation of a detector system that had been designed for the plant hazards. All tested detectors did not allow for the rapid growth of explosives events from incipient to deflagration. The proposed sphere was tested with ¾ pound of pyrotechnic materials. Testing indicated that the fire did not exceed the incipient stage.

Summary and Conclusion

Testing confirmed that smoke would interfere with detection response time for Detronics detectors. Wavelengths emitted from the materials tested can change the results experienced in response time. Detector selection, location, and redundancy are the primary considerations for determining the detector systems used. The distance to the materials to be protected, water travel distance, and water pressure can change the response time.

Lake City AAP decided to install a Fenwall sphere that is pressurized with nitrogen to 500psi for fast burning materials (323 ft/s). The Spectrex (UV/IR) detector was selected to be installed with fast response material. Test data indicated that the Detronics detector responded with the greatest speed for slow transition fires (108 ft/s). The Duel Spectrum (IR/IR) detector had the best performance based upon the least number of false alarms for slow transition materials.

Recommendations

That future research includes other explosives operations that currently use high-speed deluge systems to determine which detectors provided the quickest response time. The testing needs to ensure that the system responds as designed in less than 100 milliseconds as stated in NFPA 15. The quantity of explosives materials used in the test setup should be 150% of the quantity of explosives material expected to be protected. The study should include determining what type of fire event occurs, under what conditions will material detonate, transition phase of the material being tested, and the wavelength of the materials. It should be noted that flow testing and detector testing could not currently be tested to NFPA Standard 15.

Other areas that should be explored are operations, which involve high explosives materials, demil operations, and other remote high hazardous operations. Examples of these materials to be considered are RDX, PETN, lead styphnate, primer mix, and flare and smoke composition.

Alternate media should be considered such as halon, CO_2, and liquid nitrogen to suppress/extinguish incipient fires. As part of the testing, the researcher should consider the addition of fixed pipe sprinkler systems as a backup in the event additional water supply is needed.

The Hazardous Component Safety Data Sheets (HCSDS) also need to have testing completed for all explosives used by the military industry. Currently available HCSDS sheets do not indicate whether testing was verified or provide an analysis of the chemical composition was compared against similar materials. HCSDS also do not indicate the type of fire suppression for in-process ammunition operations. Much of the data is based upon previous accident experience or analogy. This would allow the safety risks for explosives operations to be more accurately analyzed.