U.S. CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD

INVESTIGATION REPORT

DONALDSON ENTERPRISES, INC.
FIREWORKS DISPOSAL EXPLOSION AND FIRE
(5 Fatalities, 1 Injury)

WAIKELE SELF STORAGE

WAIPAHU, HAWAII

APRIL 8, 2011

KEY ISSUES:

- HAZARDS OF FIREWORKS DISPOSAL AND THE ACCUMULATION OF EXPLOSIVE FIREWORKS COMPONENTS
- LACK OF REGULATIONS AND INDUSTRY STANDARDS ADDRESSING FIREWORKS DISPOSAL
- INSUFFICIENT CONTRACTOR SELECTION AND OVERSIGHT REQUIREMENTS FOR HAZARDOUS ACTIVITIES

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Table of Contents

Table of Contents 2

Acronyms and Abbreviations 6

Executive Summary 8

Technical Findings 10

Contractor Selection and Oversight Findings 10

Regulatory and Industry Safety Standard Findings 11

1.0 The Incident 13

2.0 Fireworks 15

2.1 Explosive Classification of Fireworks 15

2.2 Importing Fireworks 17

2.3 Seized Fireworks Disposal 18

2.3.1 History 18

2.3.2 Present Fireworks Disposal Framework 19

2.4 Federal Government Seizure Programs 19

3.0 Pre-Incident 21

3.1 Federal Seized Property Management Contract 21

3.2 Federal Fireworks Disposal Subcontract 21

3.3 Donaldson Enterprises, Inc. 23

3.4 Waikele Self Storage 24

3.5 DEI Initial Fireworks Disposal Activities 25

3.6 Modifications to the Fireworks Disposal Process 26

3.6.1 Initial Modification 26

3.6.2 Second Modification 30

3.7 Morning of the Incident 30

4.0 Technical Analysis 34
4.1 Site Inspection and Evaluation 34
4.2 Disassembly Activities 39
4.3 Testing 40
4.3.1 ATF Testing of Firework Samples 40
4.3.2 CSB Testing of Firework Samples 40
4.3.3 HIOSH Testing of Tools 40
4.4 Conclusions on Ignition 41
5.0 Incident Analysis 43
5.1 Process Safety Management Standard 43
5.1.1 Process Hazard Analysis 44
5.1.1.1 Process Safety Information 44
5.1.1.2 Identifying, Evaluating, and Controlling Hazards 45
5.1.2 Management of Change (MOC) Review 46
5.2 Principles of Inherent Safety 46
5.3 Relevant Training and Experience 47
5.3.1 DEI Management 47
5.3.2 Experience 47
5.3.3 Training 47
5.4 Relevant Incidents 48
5.4.1 Enschede Fireworks Incident 48
5.4.2 Lansing, Kansas Incident 49
6.0 Contractor Selection and Oversight 51
6.1 Federal Acquisition Regulation 51
6.1.1 Determining Responsibility 51
6.2 Supplements to the FAR 52

6.2.1 Department of the Treasury 53
6.2.2 Department of Defense 53
6.3 Subcontractor Selection 55
6.3.1 VSE Procurement Selection Methodology for Subcontractors 55
6.3.1.1 Initial Solicitation 55
6.3.1.2 Subcontractor Selection – Determining Responsibility 56
6.4 Fireworks Disposal Subcontract Provisions 57
6.5 Subcontractor Oversight 57
6.5.1 Initial DEI Fireworks Disposal Plan 57
6.5.2 Property Destruction Plan Review and Approval 58
6.5.3 VSE Regional Office 59
6.5.4 BAI 59
6.6 Conclusion 59
7.0 Regulatory and Industry Standards Analysis 61
7.1 Hawaii Occupational Safety and Health Division 61
7.1.1 Jurisdiction 61
7.1.2 HIOSH Investigation of the Incident 62
7.2 ATF 62
7.3 Regulation of Hazardous Waste 63
7.3.1 Resource Conservation and Recovery Act 63
7.3.2 State of Hawaii Department of Health (DOH) 65
7.4 Industry Standards 67
7.4.1 National Fire Protection Association 67
7.4.1.1 NFPA 495 67
7.4.1.2 NFPA 1123 67
7.4.1.3 NFPA 1124 68

7.4.2 Review of Current Fireworks Disposal Practices 68

7.4.2.1 Fireworks Operators 68

7.4.2.2 Local Law Enforcement Agencies 69

7.5 Conclusion 69

8.0 Causal Analysis 70

8.1 Physical Events, Conditions, and Outcomes 70

8.2 DEI 70

8.3 VSE 71

8.4 Industry Codes and Standards 71

8.5 Government 71

9.0 Recommendations 73

Federal Acquisition Regulatory (FAR) Council 73

Department of the Treasury Office of the Procurement Executive (OPE) 73

Treasury Executive Office for Asset Forfeiture (TEOAF) 74

VSE Corporation 74

National Fire Protection Association (NFPA) 75

U.S. Environmental Protection Agency (EPA) 75

Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) 76

References 78

Appendix A: Hawaii Firework Seizures 80

Appendix B. Department of Defense *Contractor's Safety Manual* 85

Acronyms and Abbreviations

AE	Ammunition and Explosives
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
APA	American Pyrotechnics Association
ATF	Bureau of Alcohol, Tobacco, Firearms and Explosives
BAI	Thomas E. Blanchard & Associates, Inc.
CBP	U.S. Customs and Border Protection
CCR	Central Contractor Registration
CLIN	Contract Line Item Number
CO	Contracting Officer
CSB	U.S. Chemical Safety and Hazard Investigation Board
CURT	Construction Users Roundtable
DAR	Daily Activity Report
DDESB	Department of Defense Explosives Safety Board
DEI	Donaldson Enterprises, Inc.
DFARS	Department of Defense Acquisition Regulation Supplement
DHS	U.S. Department of Homeland Security
DLIR	Department of Labor and Industry Relations
DoD	Department of Defense
DOH	State of Hawaii Department of Health
DOT	U.S. Department of Transportation
DTAP	Department of Treasury Acquisition Procedures
DTAR	Department of Treasury Acquisition Regulation System
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ESD	Electrostatic Discharge
FAR	Federal Acquisition Regulation
HAR	Hawaii Administrative Rules
HAZWOPER	Hazardous Waste Operations and Emergency Response
HFD	Honolulu Fire Department
HIOSH	Hawaii Occupational Safety and Health Division

HPD	Honolulu Police Department
HSPM	Health and Safety Program Manager
ICC	International Code Council
ICE	U.S. Immigration and Customs Enforcement
ICE/HSI	U.S. Immigration and Customs Enforcement Homeland Security Investigations
MOC	Management of Change
NFPA	National Fire Protection Association
OPE	Department of the Treasury Office of the Procurement Executive
OSHA	Occupational Safety and Health Administration
PHA	Process Hazard Analysis
PPE	Personal Protective Equipment
PSM	Process Safety Management
RCRA	Resource Conservation and Recovery Act
QCM	Quality Control Manager
SBA	Small Business Association
SOP	Standard Operating Procedure
SPE	Senior Procurement Executive
SSHO	Site Safety and Health Officer
SOW	Statement of Work
TEOAF	Treasury Executive Office for Asset Forfeiture
TEP	Temporary Emergency Permit
TFU	Thermal Flash Unit
TFF	Treasury Forfeiture Fund
TSDF	Treatment, Storage, and Disposal Facility
VSE	VSE Corporation
UXO	Unexploded Ordnance

Executive Summary

On April 8, 2011, at approximately 8:50 am, an explosion and fire occurred at a magazine[1] located at Waikele Self Storage in Waipahu, Hawaii, that was leased and used by Donaldson Enterprises, Inc. (DEI) for seized fireworks storage and disposal-related activities. Five DEI personnel in the magazine at the time of the incident were fatally injured.

DEI is an unexploded ordnance[2] (UXO) remediation company based on Oahu that employs fewer than 20 full-time workers. Pursuant to a federal seized property management contract with the Treasury Executive Office for Asset Forfeiture (TEOAF), federal government contractor VSE Corporation (VSE) awarded DEI a subcontract in early 2010 to dispose of imported fireworks seized in Honolulu, Hawaii, by federal law enforcement personnel. Three fireworks shipments were seized as contraband[3] because they were labeled as consumer grade fireworks but, upon inspection, appeared physically consistent with more hazardous commercial display grade fireworks.

Federal contractor selection regulations did not require VSE procurement personnel to conduct a safety-related review of DEI prior to awarding the company the subcontract, nor did VSE procurement personnel involved in awarding this subcontract have training and experience related to fireworks disposal. VSE's procurement office selected DEI as the fireworks disposal subcontractor because DEI was already storing the seized fireworks at the time under a separate subcontract with VSE, and because DEI submitted the lowest-cost and most time-efficient bid, which VSE determined to be the best overall value for the government. VSE procurement personnel were unaware that DEI had no prior fireworks disposal experience when it awarded the subcontract.

Because seized fireworks requiring disposal are considered hazardous waste in the United States, DEI was required to obtain an environmental permit from the State of Hawaii Department of Health (DOH). In June 2010, DOH issued DEI a 90-day emergency hazardous waste permit authorizing "thermal treatment"[4] of the fireworks at a local shooting range, and DEI began its disposal work soon after. The permit did not evaluate or address fireworks disassembly or diesel soaking. To dispose of the first seizure of fireworks, DEI personnel separated individual firework tubes from their original configuration and soaked the firework tubes whole in 55-gallon diesel-filled steel drums inside the magazine. DEI then transported the soaked fireworks to a local shooting range to burn them in either drums or a portable incinerator.

The U.S. Chemical Safety Board (CSB) learned that because DEI was experiencing minor explosions with some types of fireworks while burning the initial shipment of seized fireworks, the company altered

[1] A "magazine" is "any building or structure, other than an explosives manufacturing building, used for storage of explosive materials." Commerce in Explosives, 27 CFR §555.11 (2003).
[2] "Unexploded ordnance" is an explosive weapon such as a grenade, bomb, or land mine that has not exploded and poses a risk of detonation. It can be located on the ground, partially buried in the ground, under bushes or other vegetation, and in water.
[3] Goods that have been imported illegally.
[4] Burning.

its fireworks disposal methodology in summer 2010. As a result of the altered methodology, DEI personnel began cutting open, or disassembling, individual firework tubes by hand on a loading dock just outside the magazine entrance and separating out the individual explosive fireworks components, the black powder[5] and aerial shells,[6] which are both susceptible to ignition from sparks, friction, and static electricity. The accumulated explosive powder from the fireworks, referred to as "black powder," was stored in a plastic container lined with a plastic garbage bag. To improve diesel permeation of the shells and minimize explosions, DEI personnel cut one-inch slits in the aerial shells. They then soaked the shells in diesel and burned them at the shooting range. VSE personnel were aware of this procedure change, but did not question or express concern about it. DEI completed disposal of the initial seizure in late fall 2010 without incident.

DEI began work on the next fireworks seizure in December 2010. In early 2011, DEI again altered the fireworks disposal process to increase the fireworks destruction rate by maximizing the amount of aerial shells that could be burned at once. Expanding upon the modification DEI developed when disposing of the initial seizure, DEI personnel disassembled the firework tubes outside the magazine by hand and separated the individual explosive components, the black powder and aerial shells, into cardboard boxes. The cardboard boxes containing the black powder were lined with plastic garbage bags to minimize leakage. DEI personnel stacked and stored boxes containing aerial shells and black powder within the magazine and simultaneously soaked aerial shells in diesel. DEI notified VSE of this change in methodology via email in March 2011, but VSE again did not question the change.

Although DEI wrote a brief document presenting a hazard review of its fireworks disposal activities when it was awarded the subcontract, this analysis did not consider the safety implications of cutting into the fireworks and accumulating their explosive components. Because the Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard does not apply to activities conducted under the umbrella of fireworks disposal,[7] DEI was not required to conduct a formal Process Hazard Analysis (PHA) of its fireworks disposal activities or a formal Management of Change (MOC) analysis when it modified its disposal process.

At the time of the incident, DEI personnel had abruptly halted their disassembly work due to rain and had taken the materials involved in the process to just inside the magazine entrance. Boxes containing aerial shells, black powder, and partially disassembled firework tubes were stacked inside the magazine near the entrance along with tools, a metal hand truck, and chairs. Once the materials were moved into the

[5] Black powder is a mixture of charcoal, sulfur, and potassium nitrate. The standard composition typically contains 75% potassium nitrate, 10% sulfur, and 15% charcoal. Turcotte, R., Turcotte, A.M., Fouchard, R., and Jones, D.E.G. Thermal Analysis of Black Powder. *Journal of Thermal Analysis and Calorimetry.* Canadian Explosives Research Laboratory, Natural Resources Canada, Ottawa, Ontario, Canada. 2003; Vol. 73, p 105.

[6] An "aerial shell" is "a cartridge containing pyrotechnic composition, a burst charge, and an internal time fuse or module, that is propelled into the air from a mortar and that is intended to burst at or near apogee [highest point]." National Fire Protection Association (NFPA) 1124. *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles,* Section 3.3.1, 2006.

[7] PSM only applies to activities associated with fireworks manufacturing; it does not apply to fireworks disposal. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=22524 (accessed December 29, 2012)

magazine, the DEI project supervisor stepped outside to make a phone call. While he was on the phone, a large explosion occurred inside the magazine near its entrance.

The CSB determined that changes in DEI's fireworks disposal process resulted in the accumulation of a large quantity of explosive components just inside the magazine entrance, creating the essential elements for a mass explosion.[8] Insufficient federal contractor selection and safety oversight requirements for hazardous activities, a significant gap in regulatory and industry standards pertaining to fireworks disposal, and a lack of hazard management by DEI personnel, enabled DEI to introduce significant hazards to its fireworks disposal process without those hazards being adequately identified or effectively controlled.

The CSB investigation into this incident identified the following key findings:

Technical Findings

1. DEI's hazard analysis of its fireworks disposal process was insufficient. The company failed to identify key hazards of handling, disassembling, and storing contraband commercial display fireworks, and did not adequately control the identified and evaluated hazards.

2. DEI personnel disposing of the fireworks lacked the training, experience, and knowledge of procedural safeguards for the safe conduct of the fireworks disposal.

3. DEI's modifications to the fireworks disposal process accumulated substantially large quantities of explosive material in boxes, greatly increasing the potential explosion hazard. This change to the disposal process was not adequately reviewed for safety implications.

4. The CSB, along with the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) and the Hawaii Occupational Safety and Health Division (HIOSH), identified a number of possible ignition sources in the magazine at the time of the incident, including sparking tools, a metal hand truck, a rolling office chair, and plastic bags capable of producing static discharge.

Contractor Selection and Oversight Findings

5. The Federal Acquisition Regulation (FAR), which governs federal agencies' acquisition of goods and services, does not specifically require a federal contracting officer to consider safety performance measures and qualifications when determining the "responsibility" of a potential government contractor or subcontractor to handle, store, and dispose of hazardous materials such as fireworks.

[8] A mass explosion is "one which affects almost the entire load instantaneously." 49 CFR §173.50 (b)(1) (2003).

6. The Department of the Treasury Acquisition Regulation (DTAR), the Department of the Treasury's supplement to the FAR, does not impose sufficient requirements for safe practices and subcontractor selection and oversight with respect to the unique hazards associated with handling, storing, and disposing of hazardous materials.

7. VSE's procurement office conducted a non-technical review of DEI and the competing offeror for the fireworks disposal subcontract that did not address health and safety.

8. VSE did not use personnel with the technical background or expertise to properly select and oversee subcontractors performing work with hazardous materials such as fireworks, nor did it consult with or hire anyone with that expertise.

Regulatory and Industry Safety Standard Findings

9. The CSB found a lack of regulations or industry standards that adequately address safe fireworks disposal. Federal or local codes, regulations, or industry standards do not establish safety requirements, provide guidance on proper ways to dispose of fireworks, or address the hazards associated with the disassembly of fireworks and the accumulation of explosive fireworks components.

10. While OSHA's PSM standard applies to fireworks manufacturing, OSHA has determined that the regulation does not apply to work activities related to fireworks disposal. Therefore, DEI was not required to implement a more robust PSM system for its fireworks disposal process. For example, DEI's change to its disposal process led to the accumulation of material that created a mass explosion hazard. PSM elements such as Management of Change (MOC) would have required a safety review of this change.

11. Emergency hazardous waste disposal permits are granted in Hawaii and throughout the country to entities seeking to dispose of seized contraband fireworks because they are considered an imminent threat to human health and the environment. However, the Resource Conservation and Recovery Act (RCRA) does not incorporate PSM-type elements in its hazardous waste permitting process, despite the extremely hazardous nature of the materials covered by these permits.

As a result of this investigation, the CSB makes recommendations to

- The Federal Acquisition Regulatory Council
- The Department of the Treasury Office of the Procurement Executive (OPE)
- Treasury Executive Office for Asset Forfeiture (TEOAF)
- VSE Corporation
- The National Fire Protection Association (NFPA)
- The U.S. Environmental Protection Agency (EPA)
- The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF)

Section 9.0 of this report details the recommendations.

1.0 The Incident

On April 8, 2011, at approximately 8:50 am, an explosion and fire occurred at a magazine known as "A-21" located at Waikele Self Storage in Waipahu, Hawaii. Five Donaldson Enterprises, Inc. (DEI) employees were fatally injured and a sixth sustained minor injuries.

DEI, a small unexploded ordnance (UXO) clearance company based on the island of Oahu, was using the magazine to store seized contraband fireworks and prepare them for disposal. On the morning of the incident, five DEI personnel were disassembling one-inch contraband firework tubes on a cement loading dock located directly in front of the magazine entrance, while a sixth remained inside the magazine cleaning and organizing (Figure 1). To accomplish the disassembly work, DEI personnel cut into the individual firework tubes by hand using a PVC pipe cutter or knife and separated the individual explosive components contained within each tube, the aerial shells and the black powder (which functions as a lift charge[9]) into cardboard boxes.

According to witness statements, around 8:30 am it began to rain heavily, and the DEI workers quickly moved materials involved in the disassembly process – including tools, chairs, and boxes containing aerial shells, black powder, and partially disassembled firework tubes – to just inside the magazine entrance. While five of the workers remained inside, the project supervisor went outside to the front left corner of the loading dock to make a phone call. While he was on the phone, an explosion occurred inside the magazine, and a fire ensued.

The five individuals located inside the magazine at the time of the incident did not survive. Three DEI employees sustained fatal burn injuries while two succumbed to carbon monoxide poisoning. The project supervisor sustained minor injuries.

[9] A lift charge is a "pyrotechnic composition used to propel a component of a mine or shell device into the air. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel." APA Standard 87-1. *Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*, Section 2.10, 2001.

Figure 1. DEI work area outside of the A-21 magazine at Waikele Self Storage

2.0 Fireworks

2.1 Explosive Classification of Fireworks

The American Pyrotechnics Association[10] (APA) defines fireworks as "[a]ny device, other than a novelty or theatrical pyrotechnic article, intended to produce visible and/or audible effects by combustion, deflagration,[11] or detonation."[12,13] Fireworks require a source of combustible material for energy such as black powder, which acts as a lift charge to propel the device into the air. A chemical substance known as a burst charge[14] contained within the aerial shell emits brightly colored light once the firework is propelled into the air. According to industry literature, black powder is extremely sensitive to ignition from small sparks, which can be emitted from static electricity, friction, and electrical contacts, and may explode violently when ignited.[15]

The U.S. Department of Transportation (DOT) hazard classification system regulations classify fireworks as Class 1 explosives due to the hazardous nature of the chemical compositions they contain.[16] Under DOT regulations, all explosives must be formally approved for transportation and assigned an EX Number before they can be transported within the U.S.[17]

The DOT system classifies explosives into divisions 1.1 through 1.6, of which fireworks typically fall into two: 1.3 and 1.4.[18] Division 1.1 has the largest potential hazard, with each subsequent division representing a lower hazard category. Division 1.3 (1.3G[19] Display Fireworks – UN0335) "consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but

[10] The American Pyrotechnics Association (APA), founded in 1948, is a fireworks industry trade association whose goal is to promote safe design and use of all types of fireworks and responsible regulation of the fireworks industry. www.americanpyro.com (accessed July 14, 2012).
[11] Deflagration is a reaction in which the speed of the reaction front propagates through the unreacted mass at a speed less than the speed of sound in the unreacted medium. Crowl, Daniel A. *Understanding Explosions*, A CCPS Concept Book, 2003; p. 204.
[12] A detonation is a reaction in which the speed of the reaction front propagates through the unreacted mass at a speed greater than the speed of sound in the unreacted medium. *Ibid*.
[13] APA Standard 87-1, Section 2.7, 2001.
[14] According to APA Standard 87-1 Section 2.5, a burst charge is a "chemical composition used to break open a fireworks device after it has been propelled into the air, producing a secondary effect such as a shower of stars. Burst charge is also sometimes referred to as expelling charge or break charge…[b]urst charge for use in 1.3G fireworks is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel for approval under provisions of this standard."
[15] Malitz, I. "Black Powder Manufacturing, Testing & Optimizing." *American Fireworks News* (AFN), Dingmans Ferry, PA, 2003; p. 16.
[16] 49 CFR §173.50(a) (2003).
[17] 49 CFR §173.56 (2003).
[18] 49 CFR §172.101 provides a Hazardous Materials Table that includes Identification Numbers for fireworks under each appropriate hazard classification/Division. 1.3 fireworks have the Identification Number of UN0335, and 1.4 fireworks have the identification number UN0336. Identification Numbers that start with the prefix "UN" are appropriate for both domestic and international transportation.
[19] The "G" following the explosive classification number pertains to the compatibility group of the substance. 49 CFR §173.52(a) (2011). Compatibility group "G" indicates pyrotechnic substances. 49 CFR §173.52(b) (2011).

not a mass explosion hazard."[20,21] The Bureau of Alcohol, Tobacco, Firearms and Explosives[22] (ATF) regulates 1.3G fireworks under 27 CFR Part 555, Commerce in Explosives, which subjects the fireworks to significant controls regarding storage, permitting, and marking requirements.

To be considered a 1.3G UN0335 device, an aerial shell contained within the firework cannot exceed 10 inches in diameter.[23] Otherwise, the firework would be considered a division 1.1 explosive with the ability to mass explode.[24] In addition, black powder, an explosive mixture of charcoal, sulfur, and potassium nitrate that is often a component of aerial shells and the primary explosive for the lift charge inside each firework tube, is considered to be a 1.1 explosive on its own under the DOT classification system. [25]

Division 1.4 (1.4G Consumer Fireworks – UN0336) "consists of explosives that present a minor explosion hazard."[26] The DOT rates the transportation hazard of these materials as "minimum." Because of the limited amount of pyrotechnic composition permitted in each individual piece, their explosive effects are expected to be largely confined to the package, and they are consequently exempt from regulations under 27 CFR Part 555.[27] Consumer fireworks intended for use by the general public are typically Division 1.4G UN0336 explosives.[28]

APA Standard 87-1, *Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*, provides manufacturers, importers, and distributors of fireworks and novelties with relevant information to manufacture, test, ship, and label their products in accordance with federal law and good manufacturing practices. This standard requires that aerial mine and shell devices that are classified as Division 1.4 (i.e., consist of a single heavy cardboard or paper tube attached to a base and filled with pyrotechnic composition) should not contain more than 60 grams of total chemical composition, including the lift charge, burst charge, and the visible/audible composition, and the components that create a noise should be limited to 130 mg.[29] When a device comprises multiple tubes, the total weight of all explosive or pyrotechnic components within the device cannot exceed 200 grams. Fireworks containing greater amounts of explosives are classified as either Division 1.3G UN0335 or Division 1.1G UN0333.[30]

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[20] 49 CFR §173.50(b)(3) (2003).
[21] A mass explosion is "one which affects almost the entire load instantaneously." 49 CFR §173.50 (b)(1) (2003).
[22] ATF works to protect communities from violent criminals and criminal organizations by investigating and preventing the illegal use and trafficking of firearms, the illegal use and improper storage of explosives, acts of arson and bombings, and the illegal diversion of alcohol and tobacco products. www.atf.gov (accessed November 26, 2012). ATF regulates the importation, manufacturing, dealing in, receiving, and storage of display fireworks under 27 CFR Part 555.
[23] APA Standard 87-1, Section 4.1.1, 2001
[24] *Ibid.*
[25] 49 CFR §172.101 Table (1990).
[26] 49 CFR §173.50(b)(4) (2003).
[27] 27 CFR §555.141(a)(7) (2006).
[28] Division 1.4 can be further broken down into 1.4G and 1.4S subcategories.
[29] APA Standard 87-1, Section 3.1.2.5, 2001.
[30] 49 CFR §172.101 Table (1990).

2.2 Importing Fireworks

Since the 1970s, the U.S. has greatly increased its importation of fireworks, due in part to lower labor costs overseas and increased federal regulation of fireworks manufacturing.[31] Fiscal year 2011 U.S. International Trade Commission statistics obtained and published by the APA show that 98 percent of all consumer fireworks and 75 to 80 percent of commercial display fireworks used in the U.S. are manufactured in and imported from China. Of the 440 million pounds of consumer and display fireworks consumed in the U.S. in 2010 and 2011, only approximately 1.5 percent (6.7 million pounds) was produced domestically.[32]

The importation of illegal fireworks[33] has also been rising throughout the country.[34] This increase has resulted in efforts by a network of government agencies, not-for profit organizations, and other entities to improve the quality and safety of imported fireworks through screening, inspecting, testing, seizing, and when necessary, disposal. Federal law enforcement agencies, including ATF, U.S. Customs and Border Protection[35] (CBP), and U.S. Immigration and Customs Enforcement[36] (ICE), work to prevent the illegal importation of fireworks by inspecting, seizing, and testing firework shipments at major cities and ports of entry throughout the country. To illustrate the extent of the illegal fireworks importation issue in the U.S., between October 1, 2008, and November 30, 2012, the CBP Office of Field Operations[37] conducted a total of 69 firework seizures at cities considered to be major ports of entry including Boston, Chicago, Houston, Los Angeles, Miami, New York, and San Francisco. The largest individual commercial seizure conducted by CBP during the first half of 2012 contained nearly 18 tons of fireworks.[38] In Honolulu,

[31] Yang, Xiyun. China's Fireworks: A Trusted Import. *Washington Post*, [Online] **2007,** http://www.washingtonpost.com/wp-dyn/content/article/2007/07/03/AR2007070302188.html (accessed July 12, 2012).
[32] American Pyrotechnics Association (APA). *APA U.S. Fireworks Consumption Figures 2000-2011*. http://www.americanpyro.com/pdf/Fireworks-Consump-Figures-2000-11.pdf *(*accessed July 14, 2012).
[33] Imported fireworks may be deemed "illegal" or "contraband" under federal law if they have been imported without the requisite license or permit; if they have been mislabeled; if they have been smuggled or attempted to be smuggled into the U.S.; or if they exceed the maximum allowable explosive filler weight or charge weight, or maximum grams of explosives permitted.
[34] Yang, Xiyun. China's Fireworks: A Trusted Import. *Washington Post*, [Online] **2007,** http://www.washingtonpost.com/wp-dyn/content/article/2007/07/03/AR2007070302188.html (accessed July 12, 2012).
[35] CBP exists within the U.S. Department of Homeland Security and works to secure U.S. borders and facilitate trade to and from the U.S. www.cbp.gov (accessed November 27, 2012).
[36] ICE is the principal investigative arm of the U.S. Department of Homeland Security. Its primary mission is to "promote homeland security and public safety through the criminal and civil enforcement of federal laws governing border control, customs, trade, and immigration." www.ice.gov (accessed November 27, 2012).
[37] The CBP Office of Field Operations is "the largest component of CBP and is responsible for securing the U.S. border at ports of entry while expediting lawful trade and travel." http://www.cbp.gov/xp/cgov/about/organization/assist_comm_off/field_operations.xml (accessed December 7, 2012).
[38] "Watch Out for Illegally Imported Fireworks: CBP seizes dozens of illegal fireworks shipments on behalf of partner agencies." July 3, 2012. http://www.cbp.gov/xp/cgov/newsroom/news_releases/national/07032012.xml (accessed December 4, 2012).

Hawaii, CBP and ICE Homeland Security Investigations[39] (ICE/HSI) together have conducted nine separate fireworks seizures between 2006 and 2012, including the seizure involved in the incident.

These quantities are significant, as these fireworks pose substantial safety challenges once they are seized. Due to the unknown composition of seized fireworks and the hazards that may be involved, illegally imported and seized fireworks are typically destroyed; a major issue for all entities involved becomes how to properly and safely destroy them.

2.3 Seized Fireworks Disposal

2.3.1 History

Through the early 1980s, the standard practice in the U.S. was to use U.S. Military Explosive Ordnance Disposal[40] (EOD) technicians to dispose of fireworks confiscated by local and federal law enforcement, reflecting the military's mission to support those agencies and their work. However, the CSB learned that a July 29, 1980, explosion and fire at Fort Rosecrans in San Diego, California, that killed three EOD technicians and injured another caused the military to eliminate seized firework disposal activities.

The incident involved disposing of homemade firework "poppers" illegally imported from Mexico. EOD technicians were loading fireworks, which federal law enforcement personnel had seized and stored in plastic bags, from a holding unit onto a military truck for destruction at Fort Irwin, California, when one of the bags on the truck began to pop and fizz. As an EOD technician grabbed the bag to throw it off the truck, it exploded. Three EOD technicians moved to the back of the storage unit and shut the door to isolate themselves from the explosion and resulting fire. However, they became trapped in the unit as the rest of the fireworks within the unit were set off, and all three were killed.

The military's decision not to handle seized fireworks highlights the risk involved in storing, transporting, and disposing of contraband fireworks, because they are unpredictable and hazardous. Typically, no quality assurance controls are used in contraband fireworks manufacture. Mislabeled fireworks are by definition uncharacterized. Their unknown composition makes them dangerous to an EOD technician tasked with their disposal. Ultimately, this change shifted seized firework, storage, transportation and disposal responsibilities from EOD technicians within the military to permitted commercial entities and federal, state, and local law enforcement agencies.

[39] ICE/HSI exists within ICE and is responsible for investigating immigration crime, human rights' violations and smuggling of humans, narcotics, weapons, and other types of contraband. http://www.ice.gov/about/offices/homeland-security-investigations/ (accessed December 4, 2012).

[40] Explosive Ordnance Disposal involves the rendering safe and disposal of all hazardous items containing explosives, including bombs, grenades, and mines.

2.3.2 Present Fireworks Disposal Framework

A small number of commercial[41] treatment, storage, and disposal facilities (TSDFs) across the country have the requisite environmental permitting to accept and dispose of explosives, including commercial and consumer fireworks. These facilities utilize various methods of disposal, including incineration,[42] open burning,[43] and microbiological destruction.[44]

While these commercial facilities are available for disposal work, the CSB learned from local law enforcement agencies throughout the country that many local agencies have undertaken the task of disposing of seized fireworks themselves because contracting the work out to these facilities is too time-consuming and costly. And some state and local law enforcement agencies have had difficulty disposing of seized fireworks due in part to stringent state environmental regulations and policies that prevent them from burning the fireworks. The CSB has learned the extensive time and cost necessary to ship the fireworks elsewhere has, unfortunately, resulted in the growing accumulation of illegal consumer and display fireworks in magazines in states across the country.

2.4 Federal Government Seizure Programs

The approach federal agencies use for storing, transporting, and disposing of illegally imported and seized fireworks involves subcontracting to commercial vendors under an overarching, multi-million dollar federal seized property management contract. The U.S. has two separate and distinct federal forfeiture programs, one within the U.S. Department of Justice and one within the U.S. Department of the Treasury (Treasury).

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[41] Permitted to receive third party waste.

[42] For example, General Dynamics operates a facility located in Joplin, Missouri, that contains two Resource Conservation and Recovery Act (RCRA) permitted incinerators specifically designed to incinerate explosive materials and devices. www.ebveec.com (accessed November 26, 2012). Heritage-WTI, Inc, located in East Liverpool, Ohio, is another incineration system capable of receiving 60,000 tons per year of hazardous waste. www.heritage-wti.com (accessed November 28, 2012).

[43] For example, Clean Harbors operates a RCRA permitted facility that accepts and treats over 300 kinds of explosive and reactive wastes, including consumer and commercial display fireworks. Clean Harbors practices the method of open burning, usually soaking the fireworks in diesel and burning them on concrete slabs in a large open space the size of a football field. www.cleanharbors.com (accessed November 27, 2012).

[44] Heritage Disposal and Storage (HDS) operates a 24,000 square foot recycling facility for energetic materials, including fireworks. The HDS energetic materials recycling process is a proprietary process utilizing microbiological technology to recycle propellants, energetic materials, and ammunition into agricultural use products. HDS has treated approximately 2 million pounds of explosives for U.S. Government agencies. HDS documents indicate that in 2004, the Nebraska Department of Environmental Quality (NDEQ) evaluated the HDS processes and studied the final products and determined that the HDS process meets the definition of true recycling as outlined in NDEQ Title 128, Nebraska Hazardous Waste Regulations. HDS possesses an ATF Explosive Manufacturing License and is able to modify explosive materials for either safe disposal or resale. HDS considers the energetic materials it recycles to be “Highly Hazardous Materials” and has implemented management systems for all technical operations involving ammunition and explosives in accordance with PSM goals identified in 29 CFR §1910.119 Appendix C, Compliance Guidelines and Recommendations for Process Safety Management (nonmandatory). HDS documents indicate that no separating or disassembling of explosive components is done at this facility. www.heritagedisposalandstorage.com (accessed November 26, 2012).

The program relevant to this investigation is the Treasury Executive Office for Asset Forfeiture (TEOAF) seizure and forfeiture program. TEOAF administers the Treasury Forfeiture Fund[45] (TFF), which is the receipt account for the deposit of non-tax forfeitures made pursuant to laws enforced or administered by participating law enforcement agencies. Under this federal program, TEOAF procures general seized property management services, including storage and disposal, to support the seizure, forfeiture, and blocking programs of the Treasury and U.S. Department of Homeland Security (DHS) participating agencies.[46] Participating agencies seize a broad range of items, such as cars, horses and other livestock, handbags and jeans, perfume, and explosives (including fireworks), as well as other hazardous materials.

[45] The Treasury Forfeiture Fund was established in 1992 as the successor to the Customs Forfeiture Fund. The mission of the Treasury Forfeiture Fund is to "affirmatively influence the consistent and strategic use of asset forfeiture by participating agencies to disrupt and dismantle criminal enterprises." http://www.treasury.gov/about/organizational-structure/offices/Pages/The-Executive-Office-for-Asset-Forfeiture.aspx (accessed June 6, 2012).

[46] TFF participating agencies include the Internal Revenue Service, Criminal Investigation (IRS-CI); ICE; CBP; U.S. Secret Service (USSS); and the U.S. Coast Guard (USCG). http://www.treasury.gov/about/organizational-structure/offices/Pages/The-Executive-Office-for-Asset-Forfeiture.aspx (accessed June 6, 2012).

3.0 Pre-Incident

3.1 Federal Seized Property Management Contract

On August 1, 2006, TEOAF awarded a ten-year contract (federal prime contract) to VSE Corporation (VSE) to support its Seized and Forfeited Property Program. VSE employs roughly 2,500 individuals and provides diverse services to the government and military, including reverse engineering, supply chain management, management consulting, and process improvement.[47] VSE's responsibility under the federal prime contract was to secure services for the receipt, storage, handling, transportation, consignment, or disposal of all seized, blocked, or forfeited general property[48] through the subcontracting of vendors. Among other things, the federal prime contract required VSE, as the contractor, to ensure the safety of the public, workers, and property of others.

The ten-year federal prime contract was protested[49] and terminated by an agreement between Treasury and VSE. On September 28, 2010, TEOAF awarded VSE a seven-month interim contract[50] for the continuation of services being provided under the earlier awarded federal prime contract. This interim contract was in place at the time of the incident.

According to VSE officials, it was instrumental to the company in obtaining the federal prime and interim contracts that it had a separate subcontract with the management company Thomas E. Blanchard & Associates, Inc. (BAI). BAI utilizes a team of retired federal law enforcement personnel located throughout the U.S. who provide VSE with field services such as acceptance, transportation, and inspection of seized property, on an as-needed basis.[51] According to VSE, subcontracting with BAI enabled VSE to submit a lower-cost proposal to TEOAF that provided for national coverage without VSE incurring day-to-day expenses such as travel and per diem. Review of the subcontract shows there was no requirement that BAI make available field representatives with relevant safety experience, as their primary responsibility was tracking of inventory.

3.2 Federal Fireworks Disposal Subcontract

Between 2007 and 2010, federal law enforcement agents conducted three separate firework seizures in Honolulu, Hawaii, intercepting the fireworks during importation from China.[52] These shipments were

[47] www.vsecorp.com (accessed June 20, 2012).
[48] The federal prime contract defined seized, blocked, or forfeited property as "seized, blocked, or forfeited tangible property that is not real property, money or investments, including aircraft; vehicles; vessels; machinery and equipment; antiques and collectables; and livestock."
[49] Pursuant to 4 CFR Part 21 (1996).
[50] The contract was later extended to one year.
[51] BAI provides field services solutions to companies and government agencies throughout the United States. http://blanchardai.com (accessed June 21, 2012).
[52] CBP seized one fireworks shipment on December 10, 2007. ICE/HSI seized one fireworks shipment on February 4, 2009, and one on January 13, 2010.

labeled as 1.4G UN0336 consumer fireworks, but the fireworks contained within the shipments had physical characteristics of more hazardous 1.3G UN0335 display fireworks (See Appendix A). The fireworks involved in the incident[53] (referred to as "primary seizure") were seized in 2010 and consisted of multi-tube devices known as cake fireworks, which are made up of individual firework tubes linked by pyrotechnic fuse. Each firework tube contains a lift charge and aerial shell (Figure 2).

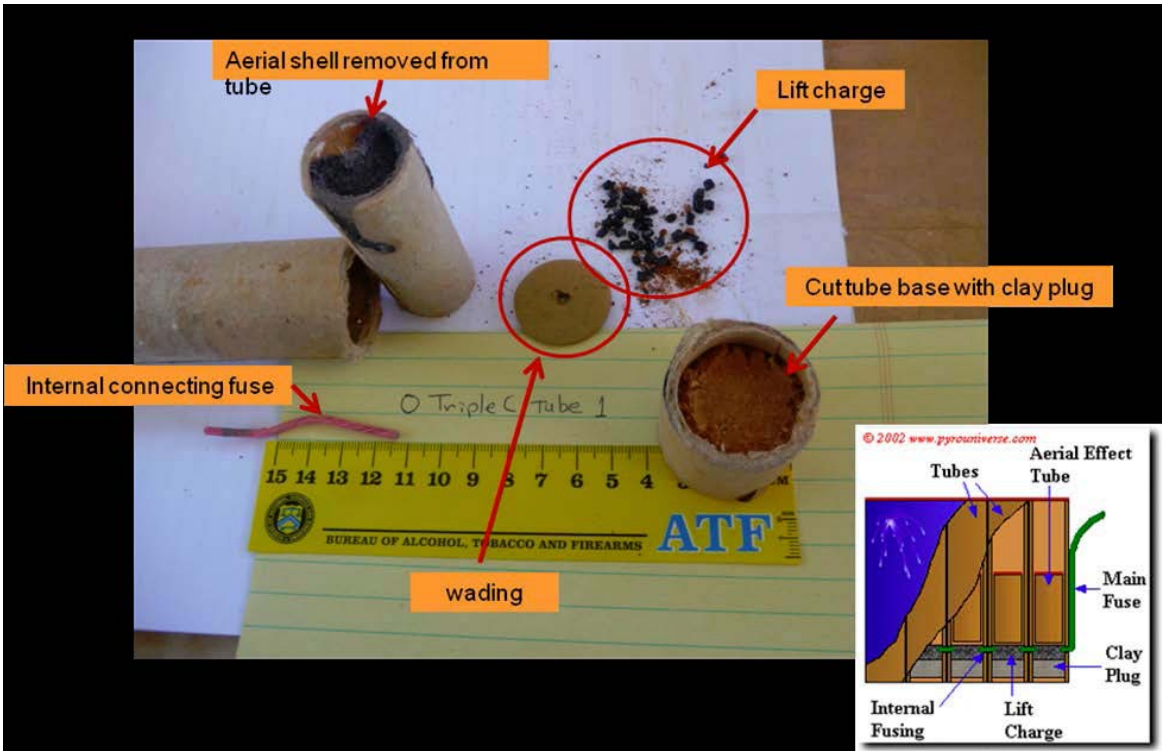

Figure 2. Cake firework tube, lift charge, and aerial shell configuration (photo courtesy of ATF)

Because CBP and ICE/HSI both participate in the Treasury Forfeiture Fund, VSE was responsible, as the prime federal contractor, for locating vendors to transport, store, and ultimately destroy the shipments when instructed to do so by the seizing agency. In March 2010 VSE awarded a subcontract to Donaldson Enterprises, Inc. (DEI) to dispose of the seized fireworks. Figure 3 shows the chain of contractual relationships relevant to this incident (Section 6.0 discusses VSE's selection and oversight of DEI).

[53] The third fireworks seizure (number 2010-3205-000-012-01) was seized on January 13, 2010. This seizure is referred to as the "primary seizure" as it contained the fireworks that resulted in the explosion on the day of the incident.

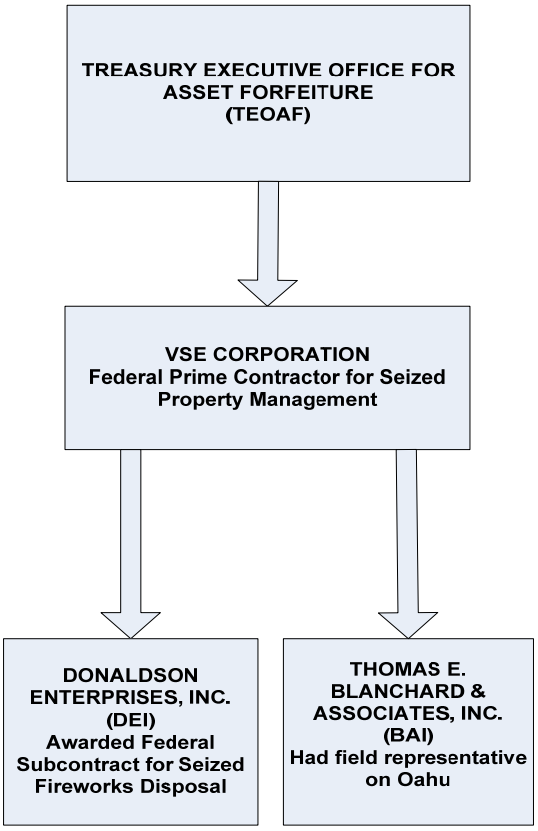

Figure 3. Contractual Relationships

3.3 Donaldson Enterprises, Inc.

DEI is a small company that was founded in 1988 and provides environmental and UXO mitigation services throughout the Pacific basin. DEI employs a staff with experience in both military and civilian UXO clearance operations. During World War II and the Vietnam War, the military used areas throughout Hawaii for live munitions training. Many of these areas have been returned to civilian use, but may still have UXO present. Individuals and companies hire DEI to determine the presence and extent of UXO in an area or at a site and provide UXO escort services.[54] When UXO is located, DEI personnel typically clear the UXO by installing explosives and remotely initiating an explosion to safely destroy the UXO. DEI also assists in the development of UXO clearance plans and provides training to

[54] "The UXO Escort is responsible for the safe escort of non-UXO qualified personnel who are not directly involved in specific UXO clearance site work, but have activities to perform within restricted/exclusion areas…the escort function involves hazard recognition and avoidance only, not the execution of UXO search or clearance actions..." http://www.dol.gov/whd/regs/compliance/wage/p29494.htm#.UN-QFm_BGSo (accessed December 29, 2012).

others in UXO identification and avoidance. Prior to being awarded the subcontract by VSE, DEI's work did not include the disposal of fireworks.

3.4 Waikele Self Storage

DEI leased magazine A-21 at Waikele Self Storage, Ltd. in Waipahu, Hawaii, to store unexploded ordnance.[55] Waikele Self Storage consists of 120 storage units cut into a solid rock hillside that were built during World War II and used by the Navy as ammunition storage bunkers. These magazines are tunnel-like structures, each approximately 250 feet long, with concrete floors, walls, and domed ceilings. Each magazine has a loading dock and ramp leading to one entrance with steel doors.

The A-21 magazine is 250 feet long, 16 feet wide, and 12 to 14 feet high. Its entrance is secured with a steel door that is 6.1 feet wide by 9.4 feet high, and split into two segments (Figure 4).

Figure 4. Magazine A-21 (and loading dock), Waipahu, Hawaii

DEI told the CSB that its personnel stored the three fireworks shipments, which consisted of boxes wrapped in plastic stacked on wood pallets, towards the rear of the magazine. DEI personnel pulled out boxes individually when they were ready to prepare the fireworks for disposal.

[55] According to the lease for the A-21 magazine, it appeared that the storage of fireworks was also permitted. While the lease contained boilerplate language prohibiting the storage of explosives and fireworks, this language had been struck through on the executed contract.

3.5 DEI Initial Fireworks Disposal Activities

DEI began its fireworks disposal work on the initial seized fireworks shipment[56] (initial seizure) in summer 2010. According to DEI's Standard Operating Procedure (SOP), its disposal process involved soaking individual whole firework tubes that had been separated from the cake in diesel-filled 55-gallon steel drums located within the magazine for a minimum of 24 to 48 hours, removing the fireworks from the diesel soaking drum, and transporting the diesel soaked fireworks to the Koko Head firing range (Koko Head) to burn the fireworks in a drum or in DEI's portable incinerator (a Thermal Flash Unit (TFU)). Diesel is sometimes used to soak and burn fireworks because it desensitizes the material to spark, friction, impact, and temperature and should result in a slow burn rather than an explosion.

As Section 7.0 discusses, seized fireworks are considered hazardous waste under the Resource Conservation and Recovery Act (RCRA) and, as such, require a RCRA permit for treatment and disposal. DEI notified the State of Hawaii Department of Health (DOH), Hawaii's state environmental agency responsible for implementing and enforcing federal environmental regulations, of its intended burn operations at Koko Head via letter in May 2010. On June 8, 2010, DOH issued DEI a 90-day Emergency Hazardous Waste Permit[57] authorizing DEI personnel to "conduct specific hazardous waste management activities at a designated site at Koko Head Range and proper storage of the waste fireworks."

According to DOH, the actions authorized in the permit were based on information DEI provided when it requested the permit, and DEI's activities were limited to those the permit authorized. The permit stated that DEI would dispose of approximately 5,000 pounds of confiscated class "C" type[58] illegal fireworks by thermal treatment, using empty 55-gallon containers or a mobile incinerator, at Koko Head. The permit expired 90 days after it was issued. Upon conclusion of the permitted activities, DEI was required to provide a closure report to the DOH Solid and Hazardous Waste Branch and the RCRA Facilities Management Office at EPA Region IX in San Francisco, California. The permit did not discuss diesel soaking or fireworks disassembly.

[56] The initial seizure (number 2008-3201-000-013-01) was seized on December 10, 2007, and consisted of 11 pallets of fireworks and included "Maylar Tubes," "Assortment Shells," and "Singing Oriole/Dancing Swallows."
[57] DOH has the authority under 40 CFR §270.61 and Hawaii Administrative Rules (HAR) §11-270-61 to issue temporary emergency permits to non-RCRA permitted, and RCRA permitted, persons or facilities seeking to engage in hazardous waste treatment, storage, or disposal activities where there is an "imminent and substantial endangerment to human health or the environment." The burden is on the applicant to prove that such an imminent threat exists.
[58] 1.4G fireworks were classified as "Type C" fireworks prior to 1991. 1.3G fireworks were previously classified as "Type B." 49 CFR §173.53 (2001).

3.6 Modifications to the Fireworks Disposal Process

3.6.1 Initial Modification

DEI management later told the CSB that during the disposal of the initial seizure, some of the fireworks were exploding during burning operations, even after the diesel soaking time had been increased to one week. DEI believed this was due to inadequate diesel permeation of the aerial shells contained in these fireworks. To resolve this issue, DEI personnel used blades to disassemble the fireworks by cutting open the individual firework tubes by hand and taking apart their explosive components (the aerial shells and black powder lift charge) (Figures 5 and 6). They then cut a one-inch slit into each aerial shell (Figure 7), soaked the aerial shells in diesel-filled drums (Figures 8 and 9), and burned them at Koko Head (Figures 10 and 11). The black powder lift charge from the tubes was collected in plastic containers lined with plastic garbage bags.

DEI completed its disposal of the initial seizure in December 2010. However, it did not dispose of the black powder lift charge collected from the disassembly work. The powder was being stored in containers in the back of the magazine at the time of the incident.[59]

Figure 5. Photo of DEI personnel disassembling initial fireworks seizure in 2010

[59] DEI completed its disposal work on the initial seizure in December 2010. The DOH 90-day Emergency Hazardous Waste Permit expired on September 5, 2010, and was not renewed. As discussed in Section 7.3.2, the CSB determined that DEI's failure to renew the Emergency Hazardous Waste Permit for its fireworks disposal activities was not causal to the incident.

Figure 6. Fireworks cake being disassembled

Figure 7. Slit aerial shell from DEI's first destruction

Figure 8. 55 gallon steel drum and inner liner used for diesel soaking

Figure 9. Aerial shells removed from the firework tubes and placed in an inner liner for diesel soaking

Figure 10. Fireworks burning in incinerator (TFU)

Figure 11. Fireworks burning in drums

3.6.2 Second Modification

DEI began work on its second disposal job under the subcontract in December 2010 and in early 2011 again altered its fireworks disposal process. According to an email from DEI management to VSE, this modification was designed to increase the destruction rate of the third shipment of seized fireworks (later referred to as the "primary seizure," as this was the seizure involved in the incident). To maximize the quantity of explosives that could be burned at one time, DEI personnel again disassembled the fireworks by cutting open individual firework tubes by hand and separating the individual explosive firework components, black powder lift charge and aerial shells, into cardboard boxes. The boxes containing black powder were lined with plastic garbage bags to minimize leakage.

More precisely, DEI took three boxes of fireworks at a time out of the magazine and broke them down into three boxes of firework components: one box, lined with a plastic garbage bag, contained the black powder lift charge; one box contained the accumulated aerial shells; and one box contained the cardboard tubes and packaging material. Periodically, the plastic bags containing black powder were relocated from the cardboard boxes into plastic containers and were stored towards the middle of the magazine.

DEI's plan was to soak the aerial shells in diesel in the steel drums and burn them; however, the company had no plan to dispose of the accumulated black powder.

3.7 Morning of the Incident

On April 8, 2011, at approximately 7:15 am, a team of six DEI personnel (a project supervisor, four UXO Level I Technicians,[60] and one general laborer) arrived at the magazine to begin their disassembly work for the day. They prepared their outside work area by setting up a pop-up tent, table, and chairs on the magazine loading dock located directly in front of the magazine entrance.

According to witness testimony, DEI personnel previously stacked fifteen remaining boxes of whole one-inch firework tubes from the primary seizure in the front left corner of the magazine (Figure 14). Each box contained 152 one-inch Sky Festival tubes that had been separated from a cake (Figure 12).[61] DEI

[60] A UXO Level I Technician (UXO Tech I) has successfully completed 200 hours of training on Munitions and Explosives of Concern (MEC) and Material Potentially Presenting an Explosive Hazard (MPPEH), and 40 hours of Hazardous Waste Operations and Emergency Response (HAZWOPER). A UXO Technician is qualified for and fills a Department of Labor, Service Contract Act, Directory of Occupations contractor position of UXO Technician I, II, and III. See the Department of Defense Explosives Safety Board (DDESB). *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel*; Technical Paper (TP) 18, Section 3.1.1, 2004; this paper provides the minimum qualification standards for personnel conducting UXO-related operations in support of the Department of Defense. According to the DDESB, a UXO Tech I may not handle or transport UXO or discarded military munitions, including military pyrotechnic items, without the direction and supervision of UXO-qualified personnel, which include UXO Tech IIs, UXO Tech IIIs, UXO Safety Officers, UXO Quality Control Specialists, and Senior UXO Supervisors. *Ibid* at Section C2.1.2, 2004.

[61] ATF evaluated the Sky Festival fireworks as part of the seizure enforcement process. Each of the 96 seized boxes of contraband Sky Festival fireworks contained 4 individual cakes containing 156 firework tubes, or shots. An individual cake contained 150 small tubes, and 6 large tubes. ATF kept one box to sample and test for evidence purposes, leaving 95 boxes. DEI removed all of the tubes from the cakes and boxed the 2,280 large tubes and

personnel initially transferred three boxes of whole firework tubes to the outside working area. They then began their normal disassembly process: two UXO technicians cut the tubes using a PVC cutter or knife, while the project supervisor and the two additional technicians broke the tubes apart and separated the internal explosive components into one of the three cardboard boxes.

The general laborer remained inside the magazine during this work, performing cleaning and organizing tasks. When the DEI personnel were finished disassembling and separating this first round of firework tubes, they then pulled out three more boxes of whole firework tubes and took them to the outside work area to disassemble.

Figure 12. Sky Festival cake firework (from the primary seizure) contains 150 small tubes and 6 large tubes; large tubes located on the right side of the box were being disassembled on the day of the incident.

The team was able to disassemble six to seven boxes of fireworks before 8:30 am when according to the project supervisor, it began to rain heavily. The team stopped work and used a metal hand truck to move the boxes containing black powder, aerial shells, and partially disassembled tubes, and stack them just

57,000 small tubes separately. DEI determined that individual disassembly of the small tubes to remove the explosive components did not offer a sufficient advantage during the diesel soaking and burning process, so these tubes were not disassembled, and remained intact. According to witness statements, this resulted in 15 boxes of large tubes. According to CSB calculations, each box contained 152 large Sky Festival tubes.

inside the magazine entrance. They also brought in the table, camp chairs, and a rolling office chair, leaving the pop-up tent outside on the dock. Figures 13 and 14 show the approximate location of materials within the magazine just prior to the incident. This information is based on witness statements to the CSB.

While the team of personnel remained inside the magazine, the project supervisor left and got his phone from his truck, which was parked in front of the magazine dock. He then walked to the front left corner of the magazine dock to make a phone call. While he was on the phone, a large explosion occurred inside the magazine and a fire ensued, fatally injuring all five DEI personnel who were located inside the magazine at the time of the incident. Only one of those five was able to escape the magazine during the event, and he succumbed to his burn injuries later that day.

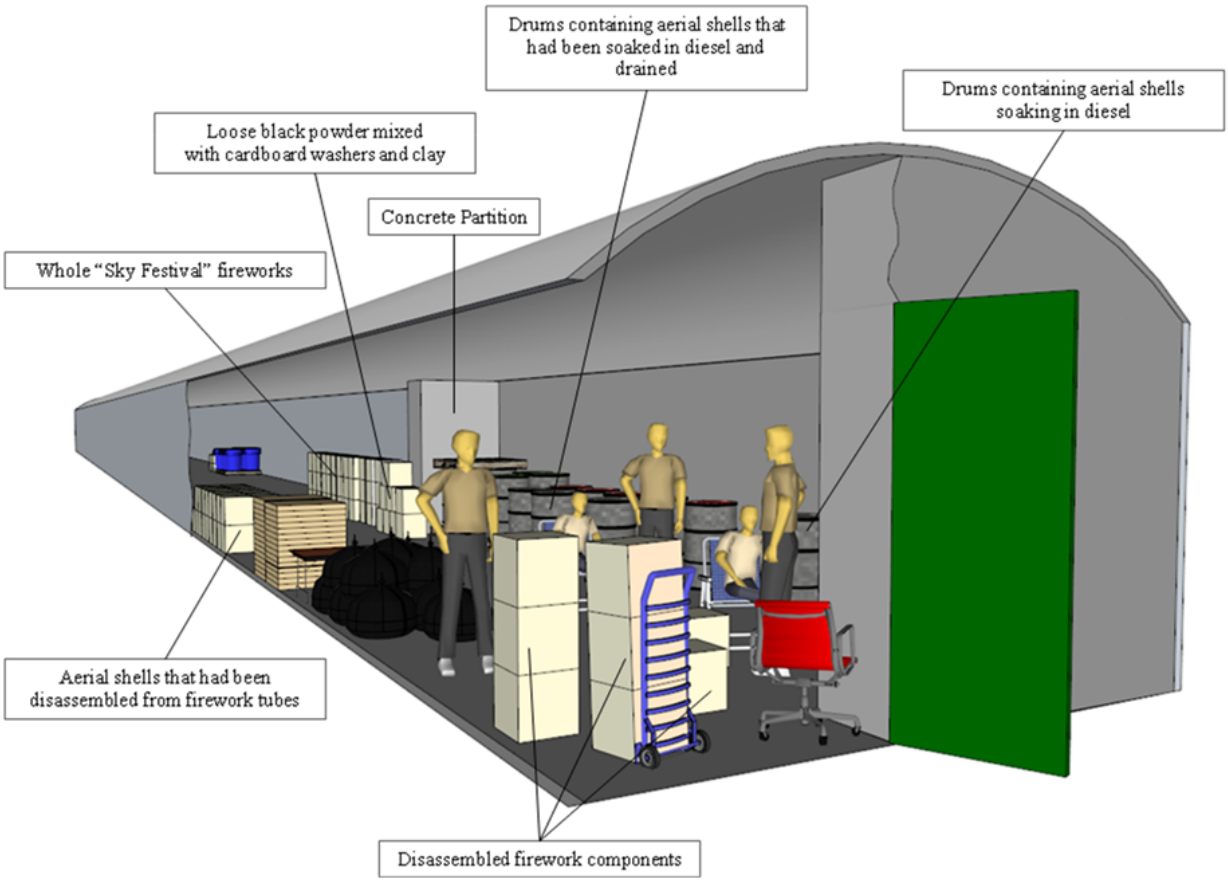

Figure 13. Magazine layout at the time of the incident

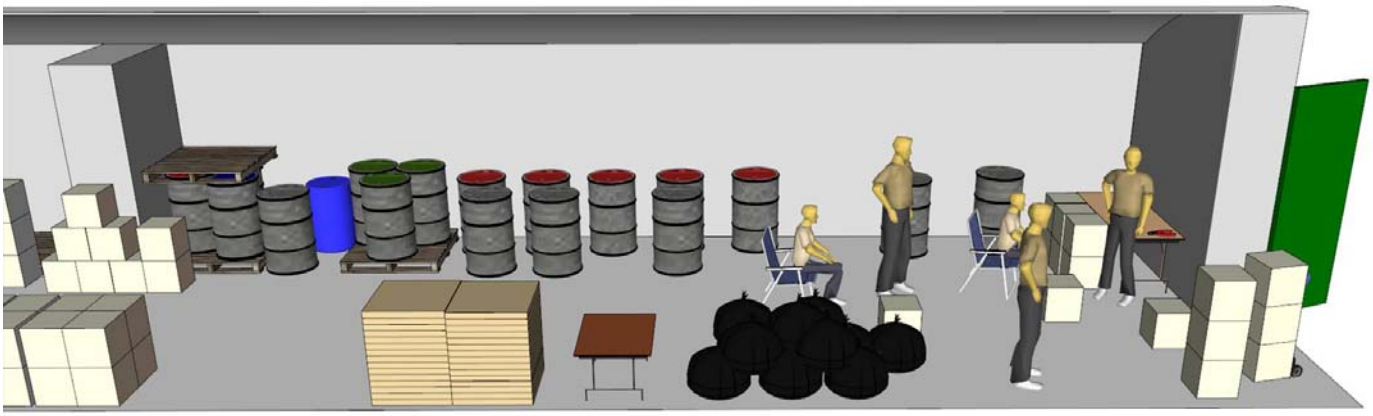

Figure 14. Side aerial view of magazine at the time of the incident

4.0 Technical Analysis

The CSB investigation team arrived at the incident scene the morning of April 11, 2011. The team interviewed DEI personnel, examined the incident scene and physical evidence, and collected and reviewed relevant documentation.

Investigation activity was coordinated with a number of other organizations:

- ATF
- Hawaii Occupational Safety and Health Division (HIOSH)
- U.S. Occupational Safety and Health Administration (OSHA)
- Honolulu Police Department (HPD)
- Honolulu Fire Department (HFD)

4.1 Site Inspection and Evaluation

Following an examination of the incident scene, the CSB determined the explosion was a deflagration that originated inside the magazine near the entrance. Damage indicators included chipping and scorching of the magazine walls, burned 55-gallon drums, and scorching on the lower portions of the ventilation duct within the magazine near the entrance. The other side of the concrete partition located in the middle portion of the magazine sustained little to no damage and the ventilation duct toward the rear had minimal marking. The very rear of the magazine still contained fully intact fireworks, with slight melting of the plastic wrapping (Figures 15 through 18).

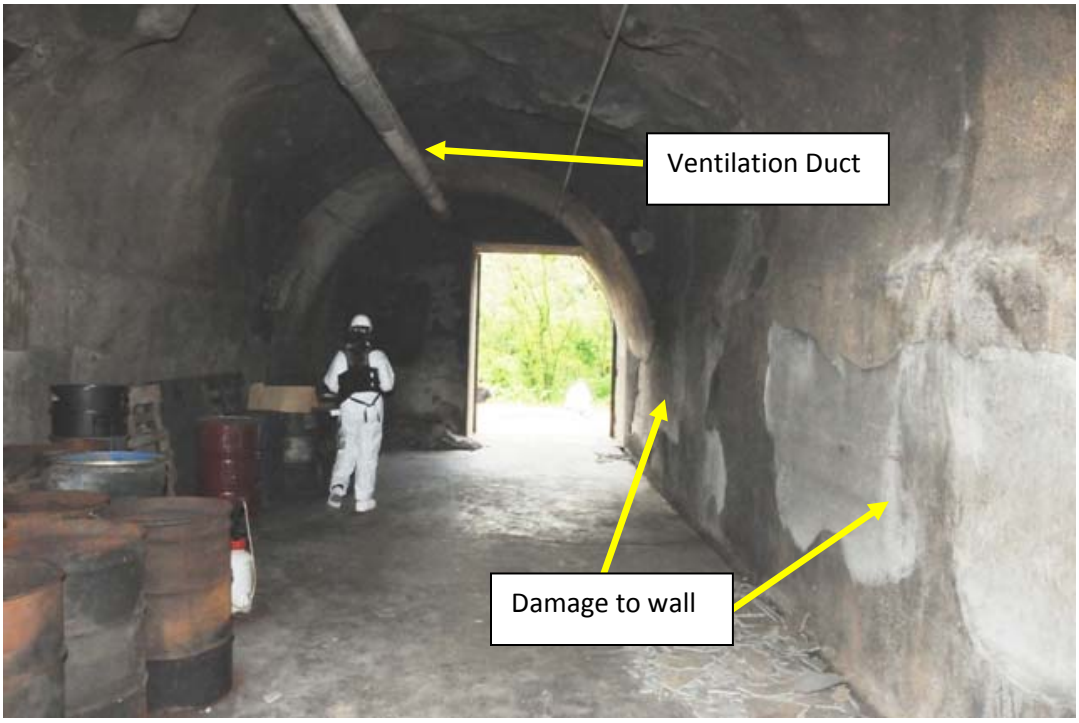

Figure 15. Damage to the magazine wall

Figure 16. Interior of the magazine post-incident

Figure 17. Rear interior of magazine, behind concrete partition, post-incident

Figure 18. 2009 Seizure (second seizure) at rear of magazine, relatively undamaged with some melting of the plastic wrapping following the explosion and fire near the front of the magazine.

The steel hand truck (Figure 19) used to move the boxes in and out of the magazine was propelled more than 100 feet from the magazine door into vegetation located across a road in front of the magazine. The rolling office chair was found in the same area near a stream (Figure 20). The GMC Sierra truck, parked approximately 30 feet in front of the magazine entryway, was forced away from the magazine, its rear cab rotated approximately 10 feet away from its original position (Figure 21). The CSB was told that the truck was not running at the time of the incident.

Figure 19. Steel hand truck found in vegetation (courtesy of Honolulu Fire Department)

Figure 20. Rolling office chair found blown out of the magazine

Figure 21. Prior to incident, this GMC truck was parked just in front of the silver car. The force of the explosion moved the rear of the truck to the right as indicated by the arrow.

4.2 Disassembly Activities

CSB analysis of DEI's activities on the day of the incident indicates that the act of disassembling the Sky Festival firework tubes from the primary seizure and separating out the explosive components into boxes increased the mass of explosive materials within a single container by a factor of 456.[62]

Type of Firework	Mass of lift charge per individual firework tube (grams)	Mass of aerial shell explosives per individual firework tube (grams)	Mass of lift charge DEI accumulated in a single container (grams)	Mass of aerial shell explosives DEI accumulated in a single container (grams)	Scale-Up Factor
Sky Festival Fireworks disassembled by DEI on the Day of the Incident	3.3	4.7	1,505	2,143	456

Table 1. DEI disassembly process on the day of the incident increased the mass of explosives within a container by a factor of 456.

DEI decided to disassemble these larger tubes in order to remove the black powder lift charges and aerial shells. As Table 1 shows, DEI's disassembly activities, which accumulated large quantities of black powder (a 1.1 explosive on its own)[63] and aerial shells into boxes, greatly increased the risk to DEI personnel working that day by creating the potential for a mass explosion.

[62] Factor/Scale-up Factor calculation is based on starting with the amount of explosives in a single large tube from the Sky Festival cake fireworks after DEI workers separated the large tubes from the original cake. ATF determined that each large tube contained approximately 3.3 grams of black powder lift charge and 4.7 grams of a perchlorate explosive pyrotechnic mixture in the aerial shell. The disassembly process had evolved over time, and on the day of the incident was such that 3 boxes of fireworks were removed from the magazine and taken out to the loading dock. The three boxes contained a calculated total of 456 large firework tubes. When DEI personnel disassembled these fireworks, they accumulated all of the black powder lift charge in one box; all of the aerial shells in a second box; and the remaining non-explosive materials in a third box. The CSB calculated that the box of accumulated black powder lift charges contained 1,505 grams of black powder and the box of accumulated aerial shells contained 2,143 grams of explosive pyrotechnics, which was 456 times more than a single large tube from the 1.3(G) contraband Sky Festival fireworks contained.

[63] The table located in 49 CFR §172.101 states that 1.1 explosives have the ability to mass explode.

4.3 Testing

4.3.1 ATF Testing of Firework Samples

On January 16, 2010, ATF officials conducted a detailed examination of four samples[64] collected from the primary seizure (Appendix A). ATF concluded from its analysis that the amount of pyrotechnic material contained within all four samples exceeded the allowable quantities for a 1.4G UN0336 consumer firework. Laboratory analysis of the explosive components from the larger Sky Festival tubes being disassembled on the day of the incident identified the lift charge as black powder and the burst charge (contained within the aerial shells) as a perchlorate explosive mixture.

4.3.2 CSB Testing of Firework Samples

Physical testing of samples from the four types of fireworks contained in the primary seizure, including the Sky Festivals, is being performed to identify the likely means of accidental ignition of the fireworks. The results of this testing were not completed at the time this report was issued; the results will be published on www.csb.gov when available.

Composition testing, conducted to determine which chemical components most likely contributed to the energetic properties of the fireworks and whether any chemicals were added to the fireworks to make them particularly energetic, had not yet been performed at the time of this report's release. The results will be published on www.csb.gov when available.

4.3.3 HIOSH Testing of Tools

National Fire Protection Association (NFPA) good practice industry standards and ATF explosive regulations recognize the importance of minimizing ignition sources near explosives. For example, NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnics Articles* states that "[m]etal tools other than nonferrous conveyors shall not be stored in magazines."[65]

Post-incident, HIOSH collected 12 separate tools found inside the magazine near the entrance: three cutting tools, pruning shears, a shovel/dust pan, loppers,[66] a push broom, a pair of miter saws, scissors, tin snips, and a battery-powered diesel pump. Metallurgical testing was conducted to determine if the tools were sparking and thus likely capable of initiating an explosion within the magazine.

[64] The four sampled fireworks were taken from the following: a. O Triple C 8/1; b. HALAWA 8/1; c. Sky Festival 4/1; and d. Krazy Kids 8/1.
[65] National Fire Protection (NFPA) 1124. *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*, Section 5.4.8.1, 2006.
[66] A "lopper" is a pruning shear with long handles.

Two tests were performed on each of the 12 tools. The first test identified what metal components were made of steel and the type of steel in each component. The second test demonstrated whether the tools' steel components were "spark resistant." A spark-resistant wrench was used as the control. Each tool was applied to a grinding wheel to produce particles of the material being tested; these particles were then directed towards a flammable material to determine if they could be an ignition source. In every case except one (the non-ferrous dust pan), when the metal tested on these tools emitted visible sparks, the flammable material caught fire. The conclusion was that each of the tools, other than the non-ferrous dustpan, was capable of producing a spark, and therefore being an ignition source within the magazine.[67]

4.4 Conclusions on Ignition

ATF concluded in its investigative report on the incident that the explosion was likely triggered when loose explosive pyrotechnic powder, initially generated as the fireworks were disassembled outside, spilled or leaked from the boxes onto the storage magazine floor and was ignited due to friction or a metal-to-metal spark as DEI employees moved materials around inside the magazine. ATF concluded that the ignition likely propagated to one or more of the boxes of the accumulated explosives located near the magazine entrance, resulting in a large explosion.

CSB explosion analysis concurred with ATF's conclusion. The CSB adds that the ignition of the explosive powder could have resulted from any of the following uncontrolled ignition sources: sparks generated by the movement of the metal hand truck (either by knocking it over or dragging the metal lip on the floor); dropping or knocking over a removable steel drum lid onto the floor; or friction from the office chair rolling over explosive pyrotechnic powder.

While less likely, static electricity from the plastic garbage bags used as liners for the cardboard boxes could have also caused the ignition. Ordinary plastic garbage bags are sometimes charged with static electricity as part of the manufacturing process in order for the bags to be tightly folded; as such, they are not appropriate for storing explosives.[68] At the site, ATF investigators used special anti-static plastic bags to contain explosive components they collected as evidence (Figure 22).

[67] OSHA. *Report on Donaldson Enterprises, Inc.;* April 9, 2012.
[68] National Aeronautics and Space Administration (NASA). *Safety Standard for Explosives, Propellants, and Pyrotechnics;* NSS 1740.12, Section 525(b)(2)(b), 1993.

Figure 22. Left photo (courtesy of ATF) shows anti-static bag used by ATF post-incident; right photo shows a roll of plastic garbage bags found following the incident.

While the CSB cannot definitively identify the source of ignition that led to the explosion, the physical evidence shows that the explosion initiated a rapid reaction, consuming significant quantities of explosive firework components, cardboard tubes, and boxes that had been accumulated within the magazine near its only entrance and exit, and prevented escape by a majority of the DEI workers who were inside the magazine at the time of the incident.

5.0 Incident Analysis

The CSB analyzed DEI's firework disposal activities and its Standard Operating Procedure (SOP), an "evergreen"[69] document which contained an "Activity Hazard Analysis" created by DEI management, and determined that DEI would have greatly benefitted from Process Safety Management (PSM) principles and concepts of inherent safety.[70] For instance, rather than minimizing and controlling the amount of hazardous materials present, the DEI fireworks disassembly process increased and concentrated the hazard by removing explosive components from within individual firework cardboard containers and accumulating large quantities of these explosives in boxes. This process greatly compounded the total amount of explosive energy within each box, creating the conditions that allowed for the mass explosion.

5.1 Process Safety Management Standard

OSHA provides at 29 CFR §1910.109(k)(3) that the manufacture of pyrotechnics must meet the requirements of 29 CFR §1910.119, also known as OSHA's PSM standard. The preamble states that "OSHA remains convinced that the hazards associated with the manufacture of explosives and pyrotechnics have the potential of resulting in a catastrophic incident, and pose a significant risk to employees and that the manufacture of explosives and pyrotechnics should be covered by the provisions of the final process safety management rule."[71] Appendix A of the PSM standard lists toxic and reactive highly hazardous chemicals that present a potential for a catastrophic event at or above the threshold quantity. However, OSHA considers explosives and blasting agents to be so hazardous that they have no minimum threshold quantity to trigger the requirements of the PSM standard.

Despite the recognized hazardous nature of fireworks and explosives, a February 4, 1998, OSHA "Letter of Interpretation" narrows OSHA's jurisdiction over those materials and defines the manufacture of explosives to mean the "mixing, blending, extruding, synthesizing, assembling, disassembling and other activities involved in the making of a chemical compound, mixture or device which is intended to explode,"[72] an interpretation further promulgated by the Hawaii Occupational Safety and Health Division (HIOSH), part of the Department of Labor and Industrial Relations (DLIR). Following the DEI incident, HIOSH evaluated DEI's disposal process and determined it would not fall under the standard because DEI's disassembly work was done under the umbrella of fireworks disposal rather than manufacturing.

Had PSM been applicable to DEI's fireworks disposal process, DEI would have been required to conduct a formal Process Hazard Analysis (PHA) on its disassembly procedure that explicitly identified a) the hazards of the disassembly process; b) any previous incidents involving DEI that had a likely potential for

[69] An evergreen document is a document that is updated on an ongoing basis to reflect changes to a system or procedure.
[70] Inherent Safety is a "concept, an approach to safety that focuses on eliminating or reducing the hazards associated with a set of conditions." Center for Chemical Process Safety (CCPS). *Inherently Safer Chemical Processes: A Life Cycle Approach;* 2nd ed., 2009; p.11.
[71] Preamble to 29 CFR Part 1910. Section 3 – III. Summary and Explanation of the Final Rule (1992).
[72] OSHA Letter of Interpretation. *Applicability of PSM Standard to Explosive and Pyrotechnic Manufacturing,* February 4, 1998.

a catastrophic consequence in the workplace; c) engineering and administrative controls applicable to the hazards; d) consequences of the failure of these controls; e) justification and risk assessment associated with facility siting; and f) a human factors analysis of the proposed process.[73] DEI would have also been required to conduct a formal management of change (MOC) analysis of its proposed disposal methodology before changes were made, to identify and control hazards introduced by the change.[74]

5.1.1 Process Hazard Analysis

According to the PSM standard, a PHA is conducted to "identify, evaluate, and control the hazards involved" in a process associated with highly hazardous chemicals.[75] DEI's Corporate Health and Safety Plan required DEI's Quality Control Manager (QCM) and Corporate Health and Safety Program Manager (HSPM) to analyze and control risks associated with DEI activities by identifying explicit risks associated with specific and implied tasks, determining the hazards causing these risks and the magnitude of risks, making risk acceptance decisions by balancing risk benefits against risk assessments, eliminating unnecessary risks, integrating specific controls into plans, and training and enforcing controls and standards. As such, upon developing its original fireworks disposal plan pursuant to the fireworks disposal subcontract, DEI management personnel produced an SOP that contained a two-page "Activity Hazard Analysis" to evaluate its fireworks disposal activities. The Activity Hazard Analysis, however, did not robustly identify hazards associated with the disassembly process and was not evaluated by outside entities such as VSE, or DOH during the permitting process. Furthermore, safeguards DEI management listed to mitigate identified hazards, such as flame-retardant clothing and non-sparking tools, were not implemented, as evidenced by the HIOSH testing of the tools found within the magazine and physical evidence indicating workers were not wearing personal protective equipment (PPE) at the time of the incident.

5.1.1.1 Process Safety Information

To conduct a thorough PHA, DEI personnel would have had to compile certain process safety information to help identify and understand the hazards of their disposal process. Safety information critical to the DEI process would include thermal and chemical stability as well as physical, toxicity, and reactivity data. None of these data were available to DEI workers, however, because these fireworks were brought into the country as contraband, and there were no company, contractual, or regulatory requirements to obtain the data prior to initiating disposal operations. Because contraband fireworks are generally uncharacterized, a better safety approach would have been to assume that they were extremely energetic and highly sensitive to potential ignition and to develop procedures and protocols to dispose of them as if they were at the highest level of potential hazard. This is consistent with the approach OSHA requires for Hazardous Waste and Emergency Response, where workers who may need to enter an insufficiently

[73] 29 CFR §1910.119(e) (2002).
[74] 29 CFR §1910.119(l) (2002).
[75] 29 CFR §1910.119(e) (2002).

characterized environment must prepare as though it presented the highest level of potential hazard, such as wearing a very high level of personal protective equipment (PPE).[76]

5.1.1.2 Identifying, Evaluating, and Controlling Hazards

The Activity Hazard Analysis in place at the time of the incident[77] identified five operations being performed by DEI personnel while conducting fireworks disposal activities:

1. Separating and cutting fireworks
2. Establishing SOPs to desensitize fireworks to prepare for their destruction by burning
3. Destroying fireworks by burning
4. Standing in front of the TFU, and
5. Standing near the TFU

The Activity Hazard Analysis identified heat, shock, and friction as possible hazards of separating and cutting fireworks that could lead to fire, severe burns, detonation, or death. The recommended controls for these activities were to use non-sparking tools, refrain from dragging boxes of fireworks across cement, and prepare fireworks outside the magazine; however, wearing the proper PPE such as flame resistant clothing was not listed. DEI personnel allowed sparking tools, steel drums, a steel hand truck, and a rolling office chair inside the magazine, hazards that could have been eliminated if tools and other items manufactured with non-spark-producing materials had been used.

The Activity Hazard Analysis also did not identify hazards of separating explosive firework components that are sensitive to shock, friction, and static, such as black powder, and accumulating them in large quantities, creating a mass explosion hazard. No safety analysis was done that focused on minimizing the amount of hazardous material that was being accumulated during the disposal process, nor did the analysis identify or evaluate hazards stemming from the use of regular plastic garbage bags to store black powder rather than utilizing anti-static bags.

To prevent possible injury or exposure to fumes from the TFU during burn operations, the Activity Hazard Analysis instructed DEI personnel not to stand downwind of the TFU and to wear proper PPE, but specific PPE requirements were not given. DEI's Corporate Health and Safety Plan states that PPE must be worn when work activities involve known or suspected atmospheric contamination; when vapors, gases, or airborne particulate matter may be generated; or when direct contact with skin-affecting substances may occur. Records show that DEI purchased rubber gloves, face shields, eye protection, and fire-retardant clothing for its personnel conducting the disposal work. But on the day of the incident, workers wore only ordinary street clothes, including cotton shorts and t-shirts, which are not flame resistant.

[76] 29 CFR §1910.120 (C)(5)(iii) (2012).
[77] DEI developed an initial hazard analysis in 2010 prior to disposal of the initial seizure; it was updated on an unknown date prior to the incident to include separating and cutting the fireworks as operations being conducted, and heat, shock, and friction as hazards of this operation, that could result in death.

The magazine had only one means of ingress and egress. Yet DEI work practices allowed for explosive and combustible materials to effectively block this exit. The only life-saving provision afforded DEI workers who might be trapped inside the magazine were three small portable fire extinguishers attached to the magazine wall: one near the entrance, one towards the middle of the magazine, and one in the rear. No provision for emergency breathing air or fire protection clothing was provided. The only worker able to escape from the magazine after the explosion exited with his clothing in flames, and he sustained fatal burn injuries. Two workers succumbed to carbon monoxide poisoning inside the magazine. Had the proper PPE and emergency provisions such as breathing air been available and used, the severity of the injuries might have been reduced and lives could have been saved.

5.1.2 Management of Change (MOC) Review

Under PSM, proposed changes to a process must be analyzed to determine their technical basis, required authorizations, and impact on health and safety.[78] As DEI activities were not covered under PSM, DEI altered its original fireworks disposal process twice without conducting an MOC-type review. The CSB has found no evidence suggesting that DEI conducted a detailed analysis of the risks associated with disassembling the fireworks and creating the potential for a mass explosion by accumulating explosive fireworks components.

5.2 Principles of Inherent Safety

Inherent safety focuses on eliminating or reducing hazards associated with a process. That is, a process can be made inherently safer by eliminating or reducing the hazards associated with materials and operations.[79] The four principles of inherent safety are to minimize, substitute, moderate, and simplify.[80] To minimize is to reduce the quantity of material or energy contained in a process.[81] However, rather than minimize hazards, DEI's fireworks disposal process increased the quantity of hazardous energy and created the potential for a mass explosion when explosive components were removed from individual firework tubes, concentrated in a box, and allowed to accumulate.

One approach to minimizing hazards that DEI could have used would have been to immediately soak the aerial shells in diesel as each firework tube was disassembled. If a process to effectively destroy the black powder lift charge as each tube was disassembled was not feasible, DEI should have developed an alternative disposal process that did not require the disassembly of the individual firework tubes.

[78] 29 CFR §1910.119(l) (2012).
[79] Center for Chemical Process Safety (CCPS). *Inherently Safer Chemical Processes: A Life Cycle Approach;* 2nd ed., 2009; p.11.
[80] *Ibid* at 29.
[81] *Ibid* at 30.

5.3 Relevant Training and Experience

DEI's main practice as a company was to conduct UXO identification and clearance activities through remote ignition (Section 3.3). While the company did employ individuals with military explosives backgrounds, many of whom held management-type positions, this experience was not sufficient to safely handle or disassemble contraband commercial display fireworks.

5.3.1 DEI Management

DEI's firework disposal team included a project manager, a senior supervisor, a site safety and health officer (SSHO), and a project supervisor. This team collaborated to develop DEI's fireworks disposal methodology and the SOP, which included the two-page Activity Hazard Analysis (Section 5.1.1.2). The DEI project manager was responsible for communicating with VSE, executing all instructions, managing all aspects of the project, overseeing the overall performance of those on the project team, coordinating all contract and subcontract work, and resolving any problems. The senior supervisor planned, coordinated, and supervised all operations, and communicated on a regular basis with VSE personnel. The SSHO implemented the overall safety program during the project and was responsible for implementing all Accident Prevention Plan and onsite training requirements, and changes to the level of PPE as site conditions warranted. The project supervisor oversaw the lower-level UXO technicians employed by DEI, performed on-site activities (such as fireworks disassembly), and maintained control of team and daily activities. DEI personnel involved in the fireworks disposal activities under the fireworks disposal subcontract lacked the requisite training and experience needed to safely identify and control the hazards of this type of hazardous work.

5.3.2 Experience

DEI management told the CSB that DEI personnel had significant experience dealing with explosives from their time served in the military as EOD technicians; however, there is no evidence that this experience pertained to disposing of commercial fireworks. As discussed in Section 2.0, military EOD policy does not support military EODs handling contraband commercial fireworks.

5.3.3 Training

The DEI Corporate Health and Safety Plan required that all DEI field personnel undergo the initial 40-hour "Hazardous Waste Operations and Emergency Response" (HAZWOPER) course prior to participating in field activities. This training covers medical surveillance requirements; safety, health, and other hazards present on the site; selection and use of appropriate PPE; work practices to minimize risks from potential hazards; and the safe use of test equipment and engineering controls.[82] In addition, all DEI

[82] 29 CFR §1910.120(e)(2) (2006).

managers and supervisors were required to have at least eight extra hours of specialized OSHA supervisor training prior to job assignment.

Four of the six DEI personnel involved in the incident were certified UXO Level I Technicians and received their UXO training[83] and credentials from commercial schools in Hawaii and Texas; however, this training does not provide information on commercial fireworks or disassembly activities. In addition, according to the Department of Defense Explosives Safety Board (DDESB), a UXO Level I Technician may not handle or transport UXO or discarded military munitions, including pyrotechnics, without the direction and supervision of UXO-qualified personnel.[84] UXO-qualified personnel include UXO Level II Technicians, UXO Level III Technicians, UXO Safety Officers, UXO Quality Control Specialists or Senior UXO Supervisors.[85] The four UXO Level I Technicians involved in the incident had not been adequately trained to handle and dispose of commercial contraband fireworks, and required direction and supervision at the magazine from the project supervisor to conduct the disposal work.

The CSB's interviews with DEI management, and analysis of DEI's disposal process and hazard analysis show that despite their military EOD experience, these individuals were not experienced or adequately trained to comprehend the hazards associated with this kind of work. In addition, the CSB could not identify the existence of training available to civilians covering fireworks disposal.

5.4 Relevant Incidents

The following incidents provide valuable lessons regarding the hazards of handling and disposing of fireworks and the importance of identifying and properly managing those hazards.

5.4.1 Enschede Fireworks Incident

On May 13, 2000, a fireworks explosion and fire at the SE Fireworks[86] Depot in Enschede, Netherlands, killed 23 and injured 947. This incident involved stored fireworks labeled as 1.4G consumer fireworks. As with DEI, an investigation into the incident concluded that although the fireworks were labeled as 1.4G consumer fireworks, these fireworks were consistent with 1.3G display fireworks and the mass explosion was consistent with 1.1G explosives. The report on this incident highlights that aerial shells, when taken from their packaging, must be treated as a 1.1G explosive with the potential to mass

[83] UXO Technician Level I training consists of a four-week course that provides students with training in the safe detection, location, identification, and disposal of unexploded ordnance. http://teex.org/teex.cfm?pageid=training&area=teex&templateid=14&Division=publicsafety&Course=UXO200&navdiv=publicsafety (accessed September 17, 2012).
[84] DDESB. Technical Paper (TP)18, *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel*, Section C2.1.2, 2004.
[85] *Ibid.*
[86] SE Fireworks was a major importer of fireworks from China and a supplier for concerts and events in the Netherlands.

explode.[87] This conclusion is critical for anyone conducting firework disposal activities, as separating and accumulating explosive firework components can introduce the possibility of a mass explosion.

5.4.2 Lansing, Kansas Incident

On July 4, 2012, a volunteer was killed when he and other local volunteers, some of whom worked with the local fire department, were disposing of fireworks that had not discharged during a fireworks display show for the City of Lansing, Kansas. The state-licensed fireworks display operator had been conducting this show annually for more than ten years. He told the CSB that each year during his shows as many as ten percent of the fireworks do not properly discharge and must be disposed of. In this incident, volunteers were disposing of undischarged three-inch diameter aerial shells by digging a pit several feet deep, starting a fire to burn the cardboard containers from cake fireworks, and throwing the defective firework aerial shells into the pit one at a time (Figures 23 and 24). This had been the common disposal method for this display operator for the last several years and was specifically developed to avoid past incidents when unexploded fireworks discharged on the back of a pickup truck during transportation, as well as in a garbage dumpster hours after the show was completed. The display operator had developed this disposal technique based on experience working for a fireworks manufacturing company.

Just prior to this incident, following a verbal instruction for everyone to take cover, a chain of three-inch spherical aerial shells was thrown into the fire pit. At least one of the shells was ejected from the pit and exploded, fatally injuring a volunteer who had taken cover 40 to 50 feet away behind sand troughs constructed to stabilize the mortar tubes during the show.

As Section 7.0 discusses, a significant regulatory and industry standards gap exists surrounding fireworks disposal in the U.S. This incident is yet another reflection of that gap, and illustrates the lack of guidance for disposing of fireworks, both contraband and non-contraband.

[87] National Fire Service of the Netherlands. *Final Consideration.* National Fire Service Documentation Center, p. 8. http://www.nbdc.nl/cms/servlet/nl.gx.nibra.client.http.GetFile?id=498631&file=Final_consideration_(Slotbeschouwing_Engels).pdf (accessed Nov 16, 2012).

Figure 23. Burn pit used for fireworks disposal (courtesy of the Office of the Kansas State Fire Marshal)

Figure 24. Sand troughs built to stabilize mortar tubes for the display show, behind which volunteers took cover during disposal activities as aerial shells were thrown into the burn pit (yellow rectangle) (courtesy of the Office of the Kansas State Fire Marshal)

6.0 Contractor Selection and Oversight

The procurement process TEOAF and VSE utilized, which is governed by the Federal Acquisition Regulation (FAR), the Department of the Treasury Acquisition Regulation System (DTAR), the Department of the Treasury Acquisition Procedures (DTAP), and bureau-level procurement policies and procedures, does not explicitly address safety, and lacks sufficient selection and oversight requirements for the prime contractor VSE and its subcontractors for the unique hazards associated with fireworks disposal.

6.1 Federal Acquisition Regulation

The FAR,[88] a broad set of regulations governing the federal agencies' acquisition of goods and services, covers both the selection of contractors and in many cases the selection of subcontractors under federal contracts. These regulations deal with the types of contracts available to procure and the factors to consider when determining the qualifications of a prospective contractor or subcontractor. As such, the FAR governed the TEOAF federal prime seized property management contract and the process for awarding subcontracts under the prime contract.

6.1.1 Determining Responsibility

FAR Subpart 9.104-4[89] requires prime contractors to determine the "responsibility" of their subcontractors before awarding a subcontract.[90] To be deemed "responsible" under the FAR, a prospective contractor or subcontractor must "a) [h]ave adequate financial resources to perform the contract…[;] b) [b]e able to comply with the required or proposed delivery or performance schedule…[;] c) [h]ave a satisfactory performance record[91]…[;] d) [h]ave a satisfactory record of integrity and business ethics…[;] e) [h]ave the necessary organization, experience, accounting and operational controls, and technical skills, or the ability to obtain them (including…quality assurance measures and safety programs…)[;] f) [h]ave the necessary production, construction, and technical equipment and

[88] 48 CFR Chap. 1 (2012).
[89] 48 CFR §9.104-4 (2005).
[90] 48 CFR §9.104-1 discusses requirements for determining the responsibility of a prospective contractor. 48 CFR §9.104-4 extends those requirements to determining the responsibility of prospective subcontractors.
[91] According to the FAR, "[a] prospective contractor that is or recently has been seriously deficient in contract performance shall be presumed to be nonresponsible…[p]ast failure to apply sufficient tenacity and perseverance to perform acceptably is strong evidence of nonresponsibility. Failure to meet the quality requirements of the contract is a significant factor to consider in determining satisfactory performance." 48 CFR §9-104-3(b). (2005). *See also* 48 CFR §42.15, Contractor Performance Information: "Past performance information is relevant information, for future source selection purposes, regarding a contractor's actions under previously awarded contracts. It includes, for example, the contractor's record of conforming to contract requirements and to standards of good workmanship; the contractor's record of forecasting and controlling costs; the contractor's adherence to contract schedules, including the administrative aspects of performance; the contractor's history of reasonable and cooperative behavior and commitment to customer satisfaction; the contractor's reporting into databases…the contractor's record of integrity and business ethics, and generally, the contractor's business-like concern for the interest of the customer (2002).

facilities…[;] and g) [b]e otherwise qualified and eligible to receive an award under applicable laws and regulations."[92] FAR Subpart 9.104-2 states that, when necessary, a contracting officer (CO) may develop special standards of responsibility, especially when unusual expertise is needed for adequate contract performance.[93] Pursuant to these sections, VSE contract procurement personnel are required to determine a potential subcontractor's "responsibility" before awarding any subcontract; as such, they would have to have the ability to assess any prospective subcontractor's technical qualifications relevant to the work involved.

FAR Subparts 9.104-1 and 9.104-4, however, do not specifically require prime contractors to include any safety performance metrics and qualifications criteria in their review of a prospective subcontractor's responsibility, despite the fact that the work of federal agencies can be hazardous. As discussed in the CSB's Xcel Investigation Report, issued in August 2010, several organizations and industry associations, including the Construction Users Roundtable[94] (CURT), the American National Standards Institute[95] (ANSI), and the American Industrial Hygiene Association (AIHA), have developed guidelines and recommended practices addressing the use of safety criteria for selecting and prequalifying contractors. CURT has stated that demonstrated safety performance is a "critical criterion used in the [contractor] prequalification process."[96] CURT guidance lists staff qualifications, accident history, a contractor's safety program, and an owner's previous experience as potential criteria for safety prequalification of a contractor. ANSI Standard Z-10, "Occupational Health and Safety Management Systems," also recommends that the contractor prequalification process include consideration of safety criteria for successful contractor safety performance management.[97]

6.2 Supplements to the FAR

Over the years, federal agencies have developed supplements to the FAR containing regulations and policies that are more specific to an agency's activities and needs. The courts have ruled that agency supplements, like the FAR itself, have "the force and effect of law."[98] The U.S. Department of Defense

[92] 48 CFR §9.104-1 (2005).
[93] 48 CFR §9.104-2 (2005).
[94] CURT is an industry organization that promotes advocacy by users of construction services on national issues that includes "developing industry standards and owner expectations with respect to safety, training and worker qualifications" http://www.curt.org/2_0_about_curt.html (accessed September 27, 2012). CURT is composed of 66 member companies, organizations, and government entities that represent some of the largest industrial corporations and users of construction services in the U.S. including ExxonMobil, Dow Chemical, Intel, Duke Energy, Shell, the U.S. Army Corp. of Engineers, U.S. Department of State, U.S. Federal Bureau of Prisons, and the U.S. General Services Administration.
[95] ANSI is as private, non-profit organization that "oversees the creation, promulgation and use of thousands of norms and guidelines that directly impact businesses in nearly every sector…[and] is also actively engaged in accrediting programs that assess conformance to standards…" http://www.ansi.org/about_ansi/overview/overview.aspx?menuid=1 (accessed December 20, 2012). ANSI is comprised of nearly 1,000 businesses, professional societies and trade associations, standards developers, government agencies, and consumer and labor organizations.
[96] CURT, *Construction Safety: The Owner's Role, UP-802*, 2004, p.6.
[97] ANSI/AIHA. ANSI/AIHA Z-10, *American National Standard for Occupational Health and Safety Management Systems*, 2012; p.18.
[98] *Davies Precision Machining, Inc. v. U.S.*, 35 Fed Cl. 651 (1995).

(DoD), for example, developed the Defense Federal Acquisition Regulation Supplement (DFARS),[99] which, among other things, reflects the nature of the DoD's hazardous work and its commitment to protecting the public and workers by requiring more rigorous contractor and subcontractor selection and oversight practices to ensure safety is effectively managed. However, the Treasury supplement (the DTAR) does not explicitly require the consideration of health or safety in its selection and oversight provisions, despite the fact that subcontractors are engaging in hazardous work pursuant to the TEOAF federal prime contract.

6.2.1 Department of the Treasury

The DTAR establishes uniform policies for all acquisition activities throughout Treasury, including the TEOAF.[100] The Treasury Office of the Procurement Executive (OPE), which is responsible for evaluating, reviewing, and issuing all departmental acquisition regulations and guidance, directly oversees and controls the DTAR.[101] The Senior Procurement Executive (SPE) is the director of OPE and may approve all individual and class contract FAR and DTAR deviations.[102] The SPE has also published a companion policy guide to the DTAR, the DTAP, which must be used in conjunction with the DTAR and FAR to ensure adherence to all Treasury policy and federal procurement regulations.[103]

Although the TEOAF is responsible for managing participating agencies' seized and forfeited property, which may include explosive and hazardous materials, provisions contained within the DTAR do not reflect the importance of occupational health and safety when conducting hazardous activities. The DTAR and DTAP lack explicit safety provisions, and do not provide for additional contractor and subcontractor selection and oversight procedures when contracting for the handling, storage, or disposal of hazardous materials such as fireworks.

6.2.2 Department of Defense

The DoD's DFARS Section 223, "Environment, Energy and Water Efficiency, Renewable Energy Technologies, Occupational Safety, and Drug-Free Workplace,"[104] considers additional safety and contractor oversight for all DoD acquisitions involving the use of ammunition and explosives[105] (AE), including handling or loading, assembling, transportation, storage, and disposal.[106] Section 223 requires

[99] 48 CFR Chapter 2 (Sections 200 to 299) (last updated May 29, 2012).
[100] 48 CFR Chapter 10 (Sections 1000 to 1052) (2011).
[101] 48 CFR §1001.304 (2011).
[102] 48 CFR §1001.403 and 1001.404 (August 2011).
[103] *See* Department of the Treasury Acquisition Procedures (DTAP) (June 1, 2011) http://www.treasury.gov/about/organizational-structure/offices/Mgt/Documents/DTAP%2006-01-2011.pdf (accessed September 18, 2012).
[104] 48 CFR §223 (May 29, 2012)
[105] "Ammunition and Explosives" is defined as "liquid and solid propellants and explosives, pyrotechnics, incendiaries and smokes in the following forms: (i) Bulk; (ii) Ammunition; (iii) Rockets; (iv) Missiles; (v) Warheads; (vi) Devices; and (vii) Components of (i) through (vi), except for wholly inert items." 48 CFR §252.223-7002, Safety Precautions for Ammunition and Explosives (May 1994).
[106] 48 CFR §223.370-1(a) (May 29, 2012).

contracting officers to incorporate DoD Manual 4145.26M, *DoD Contractor's Safety Manual For Ammunition and Explosives* (*DoD Safety Manual*),[107] into all contracts under which AE are handled (AE procurement actions).[108]

The *DoD Safety Manual* provides safety requirements, guidance, and information to minimize potential accidents that "could interrupt DoD operations, delay DoD contract production, damage DoD property, cause injury to DoD personnel, or endanger the public during DoD contract work or services involving AE."[109] These requirements apply to DoD contractors and subcontractors handling AE and provide additional contractor selection and safety oversight information.

For example, Section C1.5 requires that DoD safety personnel conduct pre-award safety surveys to evaluate each potential contractor's ability to comply with contract safety requirements. A potential contractor must provide the CO with any site plans; its safety and fire prevention programs; descriptions of proposed facilities; its safety history; proposed operations and equipment (including a process flow narrative/diagram, proposed hazard analysis and proposed procedures for all phases of AE operations); and information on any subcontractor the contractor plans to utilize to perform AE work.[110] The policy states that DoD safety personnel will then assess whether the prospective contractor has sufficient programs in place before awarding an AE contract.

Under Section C1.6, DoD has the authority to conduct an additional "pre-operational survey" under certain circumstances, such as when a contract has been awarded to a contractor with "limited experience," or following a "major modification," both of which were significant factors in the DEI incident.[111]

Section C1.7 states that, post-award, a contractor must comply with all requirements of the *DoD Safety Manual* in addition to following all applicable local, state, and federal codes, standards, and regulations. The contractor also must implement a demonstrable safety program to prevent AE-related accidents, designate qualified individuals to administer the safety program, and prepare and keep available for review all hazard analyses.[112]

Chapter 3 provides general safety requirements for all AE operations addressed within the manual. They reflect the "cardinal principle of AE safety," which is to "limit exposure to a minimum number of personnel, for a minimum amount of time, to the minimum amount of the hazardous material consistent with safe and efficient operations."[113] It includes minimum requirements for 1) SOPs; 2) training and housekeeping; 3) controlling and monitoring subcontractors, including the method the contractor uses to determine whether subcontractors are qualified to perform work safely; [114] and 4) handling and storing

[107] DoD Contractor's Safety Manual for Ammunition and Explosives. DoD 4145.26-M. (March 13, 2008).
[108] 48 CFR §223.370-3(b) (2012).
[109] DoD 4145.26-M Section C1.1. *Purpose*. (March 13, 2008).
[110] *DoD 4145.26-M* Section C1.5. *Pre-Award Safety Survey*. (March 13, 2008).
[111] DoD 4145.26-M Section C1.6. *Pre-Operational Safety Survey*. (March 13, 2008).
[112] DoD 4145.26-M Section C1.7. *Post-Award Contractor Responsibilities*. (March 13, 2008).
[113] DoD 4145.26-M Section C3.2.1. *Personnel and Material Limits.* (March 13, 2008).
[114] DoD 4145.25-M Section C3.3.5. *Control and Monitoring.* (March 13, 2008).

explosives waste in operating areas (including a requirement that black powder must be stored in containers with water).[115]

Chapter 11, which includes a sample matrix used for guidance, [116] requires that all contractors have a risk identification and management system and perform a hazard analysis that evaluates processes, materials, equipment, and personnel hazards.[117] (Appendix B includes excerpts from the *DoD Safety Manual*).

As discussed in Section 6.3, VSE's selection and oversight of DEI as a subcontractor as well as DEI's fireworks disposal process reflect a lack of safety focus throughout the entire contracting process. All parties involved would have greatly benefited from contract safety provisions similar to those found in the *DoD Safety Manual*, including those that required pre- and post-award safety surveys of subcontractors, the creation and review of risk assessments and hazard analyses, the implementation of a safety program, and provisions that emphasize the importance of minimizing hazards.

6.3 Subcontractor Selection

6.3.1 VSE Procurement Selection Methodology for Subcontractors

VSE procurement personnel assigned to work under the TEOAF prime and interim contracts have varied training and technical backgrounds and are responsible for subcontracting to vendors to manage a wide array of projects. While explosives and hazardous materials are periodically seized and must be managed, VSE procurement personnel responsible for selecting and overseeing vendors to conduct these activities, including storage and disposal, lacked the requisite backgrounds or expertise necessary to understand the risks of managing this type of property – nor does VSE employ or consult with experts to assist in selecting vendors capable of properly managing hazardous and explosive materials.

6.3.1.1 Initial Solicitation

In early 2010, VSE procurement personnel assigned to work under the TEOAF federal prime contract began the task of securing a vendor to dispose of the contraband fireworks that CBP and ICE/HSI had seized in Honolulu. Based on initial market research, on February 16, 2010, VSE sent a request for a firm-fixed-price[118] quotation[119] to five vendors, including DEI. VSE requested a quote from DEI for one

[115] DoD 4145.25-M Section 3.6. *Explosives Waste in Operating Areas.* (March 13, 2008).
[116] DoD 4145.25-M Section C11.2.2.2 and Table C11.T1. (March 13, 2008).
[117] DoD 4145.25-M Chapter 11. *Risk Identification and Management*. (March 13, 2008).
[118] According to FAR Subpart 16.202-1, "[a] firm-fixed-price contract provides for a price that is not subject to any adjustment on the basis of the contractor's cost experience in performing the contract. This contract type places upon the contractor maximum risk and full responsibility for all costs and resulting profit or loss. It provides maximum incentive for the contractor to control costs and perform effectively and imposes a minimum administrative burden upon the contracting parties…"
[119] VSE required a firm-fixed-price bid to dispose of the contraband fireworks because VSE procurement personnel understood that the terms of the federal prime contract required a firm-fixed-price for all purchase orders. The CSB learned that VSE understood that firm fixed price contracts are best suited for situations where the subcontractors'

main reason: DEI was already storing the fireworks through a separate subcontract with VSE, and VSE had a stated preference for a "one-stop shopping" subcontractor. Two solicited suppliers, DEI and Liberty Disposal (Liberty), a fireworks disposal company in Michigan,[120] responded with firm fixed-price quotations. DEI's quotation estimated a total of 400 hours of labor and projected a cost of $157,579.73 for disposal of 40 pallets of fireworks. According to DEI management, the price was based on assumptions that certain facilities, such as Koko Head, could be used for burning and that the timelines they provided were accurate. The quotation did not detail how DEI would dispose of the fireworks or include possible permitting requirements. The CSB has found no evidence that VSE procurement personnel discussed these matters with DEI when analyzing the quotation.

Liberty, which provided a more detailed quotation to VSE that explained how the company would dispose of the fireworks (via incineration in Ohio) and what permitting would be necessary, estimated its total to be $268,372.56.

6.3.1.2 Subcontractor Selection – Determining Responsibility

Once VSE procurement specialists received the two price quotations from DEI and Liberty they began their analysis by researching both companies on the Central Contractor Registration[121] (CCR) website to ensure that neither was on the excluded parties list, and then compared each company's Small Business Administration[122] (SBA) profile. VSE procurement specialists also perused company websites to get an idea of the type of work each vendor did. No additional analysis was done to determine prior work history, proposed disposal methodology, or the vendor's technical skills to safely and responsibly dispose of explosives. VSE procurement personnel also failed to discover if DEI had prior fireworks disposal experience; instead, VSE procurement personnel told the CSB that because they were not the subject matter experts, they deferred to DEI as the expert based on the company's website and what DEI said its capabilities were.

VSE procurement analysis found DEI's proposal to be the lowest-cost and most time-efficient, and therefore determined it to be the best overall value for the government. According to VSE, this, along with the fact that DEI was a local company already storing the fireworks, led VSE procurement to select DEI as the subcontractor. VSE procurement's lack of health and safety focus during the procurement process resulted in a flawed responsibility determination and the award of the subcontract to DEI on March 17, 2010.

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scope of work is fully understood. The protocols associated with seized property do not allow a subcontractor bidding on the seized fireworks disposal subcontract to open boxes containing the fireworks and verify their contents to help in their cost estimation process.

[120] http://libertydisposalinc.com (accessed July 6, 2012).

[121] The Central Contractor Registration (CCR) is the primary vendor database for the U.S. Federal Government. It collects, validates, stores and disseminates data in support of agency acquisition mission. Government vendors are required to register in CCR in order to be awarded contracts by the government. http://www.osdbu.dot.gov/related/ccr.cfm (accessed September 27, 2012)

[122] The Small Business Administration (SBA) provides financing, contracts, counseling sessions and other forms of assistance to small businesses, http://www.sba.gov/about (accessed September 27, 2012). Both DEI and Liberty are SBA certified.

6.4 Fireworks Disposal Subcontract Provisions

The lack of safety focus is also apparent when reviewing the context of the fireworks disposal subcontract itself. The subcontract awarded to DEI contained a Statement of Work (SOW) and a *Subcontractor Property Management Handbook* (*Property Management Handbook*); both were generic, related to the management of general property, and did not address hazards associated with handling or disposing of explosive hazardous materials, including fireworks.

The SOW's stated intent was to "facilitate the transportation, storage, and destruction of seized general property as well as hazardous waste materials in Hawaii." Its objectives were "General Property Management Services in accordance with the Property Management Handbook" and "destruction of property via the use of a hazardous waste landfill or landfill." Under "description of work" the SOW stated that the vendor must "have the capacity to transport, store, and destroy general property as well as hazardous waste materials…must locate a facility that is a fully-regulated hazardous waste land fill or a land fill…dispose of property in accordance with all federal, state, and local laws, codes, ordinances, and regulations...[and that] a waste-to-energy facility [was] preferable…" Nothing within this SOW provided any technical detail of DEI's proposed fireworks disposal methodology or the risks involved. When asked about the general language contained within the SOW, VSE procurement personnel told the CSB that this was a standard language SOW except for specifics that had been inserted such as the state where the work was being conducted. These individuals told the CSB this was because the person writing the SOW was unfamiliar in terms of what to include specific to fireworks disposal, as that person did not understand the process.

The *Property Management Handbook* included guidance on a seizure's life cycle, property collection, chain of custody, property manipulation, property transportation, property storage, and property removal from storage. However, the language and instructions related to seized general property; explosives, fireworks, or other hazardous materials, or the risks of working with such items, were not discussed.

6.5 Subcontractor Oversight

6.5.1 Initial DEI Fireworks Disposal Plan

After DEI was awarded the fireworks disposal subcontract, DEI submitted a fireworks disposal plan to VSE for review and approval. DEI management personnel developed the fireworks disposal plan and told the CSB that, as they could find no guidance regarding fireworks disposal, they relied solely on military manuals and on-the-job military EOD training and experience to develop the initial disposal methodology. The CSB has been unable to verify the use of those military manuals.

Post-award, the VSE Regional Office in California (Regional Office) became the main VSE day-to-day contact for DEI. While this office received DEI's daily activity reports (DARs) and maintained contact with DEI management, CBP, and the BAI representative in Hawaii, its personnel lacked necessary expertise or training to understand the risks associated with handling and disposing of explosives,

including fireworks. Regional Office Personnel also indicated to the CSB that they did not understand the kind of permitting DEI required to conduct its disposal work and why such permitting was needed.

The initial DEI fireworks disposal plan, "DEI Disposal of Commercial Grade Fireworks Plan," (disposal plan) detailed DEI's intended disposal methodology and was written for the "VSE Regional Office and those who will need to oversee the destruction of the commercial grade fireworks via services provide[d] by DEI." The disposal plan provided for DEI to carry out a series of burn operations using a DEI portable incinerator (TFU) that was capable of holding 40 to 50 pounds of fireworks. DEI noted the following steps in its plan:

1. DEI would ask the VSE Regional Office to reserve the Koko Head range at least two weeks before the actual burn operation,
2. DEI would pre-soak fireworks in diesel fuel for a minimum of 48 hours to ensure "complete desensitization,"
3. Desensitized fireworks would be loaded into 55-gallon steel drums and transported to Koko Head,
4. The TFU would be ignited and preheated for 15 to 20 minutes,
5. The pre-soaked fireworks would be fed down a chute one at a time,
6. Photos would be taken and provided to the VSE Regional Office upon request, and
7. DEI personnel would sign and date CBP Form 7605 block 8[123] and submit to the VSE Regional Office.

The Regional Office used the information to create a VSE Property Destruction Plan for submission to VSE Risk Management for review and approval. The Property Destruction Plan mischaracterized DEI's initial disposal plan by stating that the diesel fuel would "neutralize" rather than "desensitize" the fireworks.[124] As noted, diesel is used to desensitize explosives to spark, friction, impact, and temperature, and should result in a slow burn. The explosives are not "neutralized," and no chemical changes occur when diesel is added. The plan also indicated that a BAI field representative would be present to "oversee destruction." However, the CSB later learned that the BAI field representative lacked the expertise to oversee DEI's practices, and VSE had ultimately approved DEI's conduct of the work without BAI's daily oversight. In short, this plan overstated the safeguards in place to ensure that disposal was being done safely. VSE Risk Management approved the Property Destruction Plan on April 28, 2010.

6.5.2 Property Destruction Plan Review and Approval

The VSE Risk Management analyst who reviewed the Property Destruction Plan lacked the expertise or relevant training to adequately assess a plan for fireworks disposal. After receiving the plan, this analyst told the CSB that he first reviewed the very brief disposal methodology consisting of a few lines, which

[123] Certification of Destruction.
[124] As noted, diesel is used to desensitize explosives to spark, friction, impact, and temperature and should result in a slow burn.

described soaking the fireworks in diesel fuel to "neutralize" them and then destroying them by incineration. The analyst told the CSB that he deferred to DEI's expertise when reviewing this section because of his lack of knowledge about fireworks, and he conducted no further research on DEI's proposed methodology. Section IV of the Property Destruction Plan required the analyst to check either "Yes" or "No" for whether DEI was qualified to destroy the fireworks. Because VSE's Procurement Office had already assessed DEI's qualifications and selected DEI as the subcontractor, the Risk Management analyst checked "Yes" without researching DEI's qualifications, experience, or proposed methodology. The analyst did search for adverse events involving DEI in VSE's adverse incidents database and, finding no such history, approved and returned the Plan to the Regional Office.

6.5.3 VSE Regional Office

The approach taken by the VSE Regional Office echoed the stated position adopted throughout VSE: company personnel lacked expertise in handling fireworks or other explosives and hazardous materials and therefore deferred to DEI as the "expert" on fireworks disposal. The decisions on which VSE deferred to DEI included DEI's two deviations from the original fireworks disposal plan to begin disassembling the fireworks by hand. Regional Office staff confirmed to the CSB that when DEI significantly altered its disposal methodology in March 2011, VSE was simply informed in a notification email. However, VSE Regional Office personnel would not have recognized the hazards associated with disassembling fireworks and accumulating boxes of explosive components. Because VSE trusted that DEI was an expert that would recognize and address any risks involved, VSE did not question any changes or express concern.

6.5.4 BAI

As discussed, VSE relied on BAI field representatives to provide field services such as property inspections and storage on an as-needed basis. A BAI representative in Hawaii came to the magazine occasionally and served as VSE's observer during DEI's disposal process. He also took photos of the disassembly process (Figures 5 and 6). The subcontract between VSE and BAI did not require the BAI representative to oversee safety, which the representative could not have done effectively because he had no experience with fireworks and explosives and therefore would be unable to offer any valuable insight. The CSB concurs with ATF's conclusion that the BAI field representative did witness some disposal work where unsafe practices would have been apparent to observers with expertise in explosive disposal operations.

6.6 Conclusion

Neither VSE nor BAI used personnel with the necessary backgrounds and expertise to recognize the hazards associated with DEI's fireworks disposal work. All deferred to DEI as the "expert" regarding fireworks disposal and were unaware of the hazards of disassembling the fireworks by hand, accumulating explosive materials in cardboard boxes, and storing them in a magazine along with potential spark- and static-producing items.

To improve the subcontractor selection and oversight process under the TEOAF seized property management contract, government acquisition regulations must emphasize safety system management. The FAR should be strengthened to require the analysis of safety performance measures and qualifications when determining the "responsibility" of prospective contractors and subcontractors handling explosive and hazardous materials. Federal agencies such as Treasury, that require contractors and subcontractors to deal with explosives and other hazardous materials, should adopt and implement stringent safety-related contractor and subcontractor selection and oversight provisions similar to those found within the DFARS. In addition, entities tasked with implementing safety-related contracting requirements must have the personnel or consultants in place with the necessary technical expertise to sufficiently evaluate and oversee contractors and subcontractors to ensure the work is being conducted safely.

7.0 Regulatory and Industry Standards Analysis

Within Hawaii, ATF, HIOSH, and the State of Hawaii Department of Health (DOH) all have regulatory oversight over various aspects of fireworks manufacturing, storage, handling, and disposal. National Fire Protection Association (NFPA) industry standards also include good practices pertaining to fireworks manufacturing and storage. However, the CSB found a significant gap with regulatory and industry standards pertaining to the safe disposal of fireworks in the U.S.

7.1 Hawaii Occupational Safety and Health Division

7.1.1 Jurisdiction

Hawaii is one of 26 jurisdictions OSHA approved to operate its own state safety and health program under the Occupational Safety and Health Act (OSH Act) Section 18(b).[125] HIOSH administers Hawaii's OSHA State Plan Program and has adopted Federal OSHA standards in their entirety, contained within the Hawaii Administrative Rules (HAR).

OSHA's Explosives Standard, 29 CFR §1910.109,[126] and HAR Title 12, Subtitle 8, Part 2 (General Industry Standards) cover the storage and handling requirements of explosives and pyrotechnics. However, Section 4(b)(1) of the OSH Act precludes OSHA from any enforcement activity over a working condition if another federal agency exercises its statutory authority.[127] In this case, HIOSH's authority to regulate most manufacturing, distribution, handling, and storage of fireworks in Hawaii, including DEI's activities, would be preempted should ATF have chosen to exercise its statutory authority under ATF's Federal Explosives Law and Regulations, found at 18 U.S.C. Chapter 40 and 27 CFR Part 555.[128]

OSHA Directive Number CPL 02-01-053, Compliance Policy for Manufacture, Storage, Sale, Handling, Use and Display of Pyrotechnics,[129] clarifies situations in which OSHA may issue citations for hazards related to fireworks and conditions during which the OSH Act General Duty Clause can be applied to address hazards not specifically covered by OSHA standards.[130] Because ATF's regulations in 27 CFR Part 555 specifically address working conditions associated with storing explosives, including commercial 1.3G UN0335 display fireworks, they preempt OSHA's storage requirements for explosives in §1910.109(c). However, storing 1.4G UN0336 consumer fireworks in their finished state falls under

[125] 29 U.S.C. §667 (1970).
[126] 29 CFR §1910.109, Explosives and Blasting Agents (1998).
[127] 29 U.S.C. §653 (1970).
[128] Organized Crime Control Act of 1970, Title XI, Chapter 40. Importation, Manufacture, Distribution and Storage of Explosive Materials. (October 22, 1986). 27 CFR Part 555, Commerce in Explosives (2007).
[129] CPL 02-01-053, Policy for Manufacture, Storage, Sale, Handling, Use and Display of Pyrotechnics (October 27, 2011).
[130] CPL 02-01-053, Executive Summary (Oct. 27, 2011).

OSHA's and HIOSH's authority.[131] Hazards such as ignition sources, including static electricity hazards associated with storage and handling of explosive materials not covered by ATF, may also be cited under §1910.109(b)(1) and correlating HAR standards.[132]

7.1.2 HIOSH Investigation of the Incident

On September 30, 2011, HIOSH announced that it had completed its investigation of the DEI incident. HIOSH identified 11 potential causes for the explosion, each of which carries a separate penalty. HIOSH issued four serious, seven willful, and one other citation against DEI, alleging DEI's serious violation of 29 CFR §1910.36(b)(2)[133] and HAR §12-71.1 by blocking the magazine's only exit; willful violation of HAR §12-61-2(a)(3) that exposed employees to explosion hazards (the presence of sources of static electricity as potential ignition sources) while they worked with explosive materials; willful violation of 29 CFR §1910.109(b)(1) and HAR §12-74.1 by separating pyrotechnic materials in close proximity to other explosives, storing ferrous[134] tools inside the magazine, and permitting spark-producing devices near the magazine; and willful violation of 29 CFR §1910.132(d)(1)(i)[135] and HAR §12-64.1 for the lack of appropriate PPE.

As discussed in Section 5.1, because DEI's disassembly activities were under the umbrella of disposal rather than manufacturing, HIOSH was unable to cite DEI for PSM-related violations. In addition, while HIOSH did cite DEI for various alleged health and safety violations, no OSHA or HIOSH guidance specifically relates to fireworks disposal.

7.2 ATF

As discussed above, 27 CFR Part 555, Commerce in Explosives, regulates the importation, manufacturing, distribution, and storage of explosive materials, including commercial display 1.3G UN0335 fireworks. Under Subpart D, anyone intending to import, manufacture, or deal in explosive materials must obtain an ATF license.[136] However, a separate license is not required for storage facilities operated by the licensee as an integral part of one business premises.[137] Because DEI had a

[131] CPL 02-01-053 Section B(2), Enforcement of 29 CFR §1910.109 (Oct. 27, 2011).
[132] CPL 02-01-053 Section B(3), Enforcement of 29 CFR §1910.109 (Oct. 27, 2011).
[133] 29 CFR §1910.36(b)(2) states "[m]ore than two exit routes must be available in a workplace if the number of employees, the size of the building, its occupancy, or the arrangement of the workplace is such that all employees would not be able to evacuate safely during an emergency." 29 CFR §1910.36(b)(2). The number of exit routes must be adequate (Nov. 7, 2002).
[134] Of or containing iron.
[135] 29 CFR §1910.132(d)(1) states that an employer must "assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall… (i) Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment…" 29 CFR §1910.132(d)(1)(i) (June 8, 2011).
[136] 27 CFR §555.41(a)(1) (2005).
[137] 27 CFR §555.41(a)(2)(i) (2005).

manufacturing license from ATF as a result of its UXO activities, its personnel were approved to store the three fireworks seizures in the A-21 magazine without ATF inspection. At the time of the incident, no ATF staff had inspected the magazine although, according to DEI management, a day and time were being set up for this; the goal was to have it classified under ATF regulations as a Type 1 magazine,[138] which is authorized under ATF regulations to store high explosives.[139]

ATF storage regulations include requirements for storage within Types 1, 2, 3, and 4 magazines. These regulations state that explosive materials cannot be placed directly against interior walls and, except for fiberboard or other nonmetal containers, containers of explosive materials cannot be unpacked or repacked inside a magazine or within 50 feet of a magazine.[140] Tools used to open containers of explosives must be of non-sparking materials, except that metal slitters can be used to open fiberboard containers.[141] Magazines are required to be kept clean and dry; free of grit, paper, empty packages, trash, and containers; and floors are to be regularly swept with brooms or other items with non-sparking parts. Volatile materials are required to be kept at least 50 feet from outdoor magazines.[142] ATF regulations do not provide guidance on fireworks disposal or disassembly activities.

7.3 Regulation of Hazardous Waste

7.3.1 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) is a federal law that regulates non-hazardous and hazardous solid waste. RCRA Subtitle C implements the Hazardous Waste Permit Program, which regulates the generation, handling, transportation, storage, and disposal of hazardous waste from cradle to grave. RCRA requires a permit[143] for the treatment,[144] storage,[145] and disposal[146] of any hazardous waste as identified or listed in 40 CFR Part 261.[147]

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[138] 27 CFR §555.203(a). (1981).
[139] "High Explosives" are explosive materials which can be caused to detonate by means of a blasting cap when unconfined." 27 CFR §555.2-2(a) (1998).
[140] 27 CFR §555.214 (a) and (c) (1981).
[141] 27 CFR §555.214 (d) (1981).
[142] 27 CFR §555. 215 (1981).
[143] A permit includes a permit by rule (270.60), emergency permit (270.61), and standardized permit (subpart J of this part). 40 CFR §270.2 (2006).
[144] Treatment means "any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such wastes, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume." 40 CFR §270.2 (2006).
[145] Storage means "the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed, or stored elsewhere." 40 CFR §270.2 (2006).
[146] Disposal means "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any hazardous waste into or on any land or water so that such hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground water." 40 CFR §270.2 (2006).
[147] 40 CFR §270.1(c) (2006).

Under RCRA, no material is a hazardous waste unless it is first deemed a solid waste.[148] RCRA places hazardous waste into two categories: 1) listed wastes, which appear on one of the four hazardous waste lists established by regulations;[149] or 2) characteristic wastes, which exhibit one or more of four features: ignitability;[150] corrosivity;[151] reactivity;[152] and/or toxicity.[153] Confiscated, seized, or forfeited fireworks (when a solid waste) are considered regulated hazardous waste under RCRA because they are ignitable,[154] reactive,[155] and potentially toxic solid wastes.[156]

Standard RCRA operating permit applications include two parts (A and B)[157] and are comprehensive. Permit application requirements include a description of the facility and procedures, structures, or equipment used at the facility to prevent hazards in unloading operations, and to prevent undue exposure to hazardous waste (for example, protective clothing);[158] a description of precautions to prevent accidental ignition or reaction of ignitable, reactive, or incompatible wastes as required to demonstrate compliance with 40 CFR §264.17;[159] and an outline of training programs by owners or operators to prepare workers to operate in a safe manner.[160] RCRA permit applicants must also comply with the facility standards in 40 CFR Part 264, including personnel training requirements[161] and requirements for handling ignitable,

[148] "Solid waste" is defined under 40 CFR §261.2 as a "discarded material which is A) Abandoned…or; B) Recycled…; or C) Considered inherently waste-like…; or D) A military munition…" 40 CFR §261.2 (2010). "Hazardous waste" is defined under 40 CFR §261.3 as a solid waste that exhibits any of the characteristics of hazardous waste identified in subpart C or that is listed in subpart D of this part. 40 CFR §261.3 (2006).
[149] 40 CFR §261.31-33 (2011).
[150] 40 CFR §261.21 (2011).
[151] 40 CFR §261.22 (2011).
[152] 40 CFR §261.23 (2011).
[153] 40 CFR §261.24 (2011).
[154] Characteristic of ignitability: "(a) A solid waste exhibits the characteristic of ignitability if a representative sample of the waste has any of the following properties: (2) It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard…" 40 CFR §261.21(a)(2) (2011).
[155] Characteristic of reactivity: "(a) A solid waste exhibits the characteristic of reactivity if a representative sample of the waste has *any* of the following properties: (1) It is normally unstable and readily undergoes violent change without detonating. (2) It reacts violently with water. (3) It forms potentially explosive mixtures with water. (6) It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement. (7) It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure. (8) It is…a Division 1.1, 1.2, or 1.3 explosive as defined in 49 CFR §§ 173.50 and 173.53." 40 CFR §261.23(a) (2011).
[156] Toxicity characteristic: "(a) A solid waste…exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, test Method 1311 in 'Test Methods for Evaluating Solid Waste, Physical/Chemical Methods'…the extract from a representative sample of the waste contains any of the contaminants listed in table 1 at the concentration equal to or greater than the respective value given in that table." 40 CFR §261.24(a) (2011).
[157] RCRA application Part A and Part B requirements are contained within 40 CFR §§270.13 and 270.14, respectively.
[158] 40 CFR §270.14(b)(8)(v) (1983).
[159] 40 CFR 270.14(b)(9) (1983).
[160] 40 CFR §270.14(b)(12) (1983).
[161] 40 CFR §264.16 (2006).

reactive, or incompatible wastes.[162] RCRA permits are effective for a fixed term not to exceed 10 years.[163]

Under 40 CFR §270.61,[164] persons or facilities seeking to engage in hazardous waste treatment, storage, or disposal activities may obtain an emergency hazardous waste permit if the waste is determined to be an "imminent and substantial endangerment to human health or the environment."[165] Emergency permits may be oral or written and are effective for 90 days once issued.[166] They are significantly less detailed and robust than traditional RCRA permits and require substantially less work on the part of the applicant and the permit writer. Throughout the U.S., seized fireworks are sometimes disposed of pursuant to these emergency permits due to the hazardous characteristics of firework components.

Although not applicable to this incident, RCRA regulations also have a complete exemption from all permits, including emergency permits, for all qualified responders to "an immediate threat to human health, public safety, property, or the environment, from the known or suspected presence of military munitions, other explosive material, or an explosive device, as determined by an explosive or munitions emergency response specialist as defined in 40 CFR §260.10."[167]

7.3.2 State of Hawaii Department of Health (DOH)

DOH is Hawaii's state environmental agency, and implements federal environmental regulations that have been adopted under the HAR, including RCRA regulations. As such, DOH has the authority under 40 CFR §270.61 and HAR §11-270-61(a) to issue emergency hazardous waste permits to RCRA and non-RCRA permitted persons or facilities. According to DOH policy, DOH views "illegal fireworks as hazardous wastes that exhibit an unusual risk to the public and the environment"[168] and therefore issues emergency permits to those who wish to treat or dispose of contraband fireworks.

As discussed in Section 3.4, DOH issued DEI an emergency hazardous waste disposal permit on June 8, 2010, for fireworks disposal activities. 40 CFR §270.61(b)(3) requires that the emergency permit "clearly specify the hazardous wastes to be received, and the manner and location of their treatment, storage, or disposal." According to DOH policy, the specific conditions authorized in an emergency permit depend on analysis of facts provided by the applicant. However, the policy also provides that DOH's "basic

[162] 40 CFR §264.17 states that an owner or operator must take precautions to prevent accidental ignition or reaction of ignitable or reactive waste. This waste must be separated and protected from sources of ignition or reaction, including but not limited to open flames, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, or mechanical), spontaneous ignition (e.g., from heat-producing chemical reactions), and radiant heat. (2006).
[163] 40 CFR §270.50 (1985).
[164] 40 CFR §270.61 (1996).
[165] 40 CFR §270.61 (1996).
[166] 40 CFR §270.61 (b)(1) and (2) (1996).
[167] 40 CFR §§264.1(g)(8)(i)(D) (2006) and 40 CFR 270.1(c)(3)(i)(D) (1997).
[168] State of Hawaii Department of Health, Environmental Management Division, Solid and Hazardous Waste Branch. *Temporary Emergency Permits to Treat, Store or Dispose of Hazardous Waste*, November 29, 2010. http://hawaii.gov/health/environmental/waste/hw/pdf/tempemergpermit.pdf (accessed July 10, 2012).

template for TEP [temporary emergency permit] conditions is designed with the temporary, emergency nature of the situation in mind and under no circumstances should it be overly burdensome on the permittee."[169]

The emergency hazardous waste disposal permit that DOH issued to DEI required that DEI complete the disposal within 90 days of the date issued. DOH instructed DEI via email that no extensions would be provided. This time limit proved to play a significant role in the incident, as DEI's first disposal job exceeded the 90-day time limit, and emails written by DEI management in fall 2010 indicated that for all future fireworks disposal jobs, DEI would disassemble the firework tubes prior to obtaining a permit in order to maximize the available time for burning. These efficiency improvements resulted in the accumulation of large quantities of explosive firework components, which created a mass explosion hazard.

In its permit application letter, DEI stated it intended to destroy approximately 5,000 pounds of illegal "Class 1.3 and 1.4 fireworks" including "firecrackers, poppers, sparklers, and aerials," through burning activities at Koko Head. Emails show that DOH requested DEI's fireworks disposal plan, which detailed diesel soaking and burning activities, prior to awarding the permit. However, DOH wrote the permit to include only the burn activities. The CSB has found no evidence that DOH personnel conducted additional analysis to better understand DEI's disposal plan. In fact, evidence suggests that safety was not a factor in DOH's review process, and DOH personnel told the CSB that their focus was on environmental protection, not safety. In addition, DOH personnel lacked the requisite background to analyze DEI's proposed disposal methodology, experience, and qualifications when issuing this permit.

Safety is an important aspect of hazardous waste disposal; the legislative history supports the argument that RCRA is intended to address environmental implications of hazardous waste treatment and disposal and also those of health and safety. In fact, RCRA was created in part to provide "for the safe disposal of discarded materials…"[170] (Emphasis added). Congress also noted in enacting RCRA that "disposal of solid waste and hazardous waste in or on the land without careful planning and management can present a danger to human health and the environment…"[171]

RCRA regulations also support the consideration of safety. For example, 40 CFR §264.17 requires that an owner or operator take precautions to prevent accidental ignition or reaction of ignitable or reactive waste. In addition, 40 CFR §264.16 requires that facility personnel complete classroom or on-the-job hazardous waste training that at a minimum ensures they are able to respond effectively to emergencies.[172] These regulations illustrate that RCRA and comparable state regulations, such as the HAR, can and should address environmental protection as well as the safety and health of workers and the public. This is especially important for the emergency permitting process, which requires a much less

[169] State of Hawaii Department of Health, Environmental Management Division, Solid and Hazardous Waste Branch. *Temporary Emergency Permits to Treat, Store or Dispose of Hazardous Waste*, November 29, 2010. http://hawaii.gov/health/environmental/waste/hw/pdf/tempemergpermit.pdf (accessed July 10, 2012).
[170] A Legislative History of the Solid Waste Disposal Act. Pub. L. no. 94-580, 90 Stat 2795 (1976).
[171] A Legislative History of the Solid Waste Disposal Act. Pub. L. no. 94-580, 90 Stat 2797 (1976).
[172] 40 CFR §264.16 (2006).

substantial review of permit applicants even though the materials involved are extremely hazardous and pose an imminent safety, health, and environmental threat.

To reflect the importance of public and worker safety, an emergency permit applicant seeking to dispose of explosive hazardous materials such as fireworks should be reviewed extensively. RCRA should incorporate PSM-type elements such as PHA and MOC into its regulations to provide for a more robust safety program for entities conducting activities that are not covered by OSHA's PSM standard, such as fireworks disposal. Increasing the focus on safety will help ensure that activities being performed pursuant to a RCRA emergency hazardous waste permit are done so safely and responsibly.

7.4 Industry Standards

7.4.1 National Fire Protection Association

The NFPA works to prevent fire-related hazards and advocates for public safety by developing, publishing, and disseminating good practice standards intended to minimize risks. This includes fireworks and explosives-related standards, which are developed by NFPA's Pyrotechnics Committee. However, NFPA has no standard or guidance for the safe disposal of fireworks. NFPA standards are voluntary unless adopted by federal, state, or local agencies as part of regulations.

7.4.1.1 NFPA 495

NFPA 495, *Explosive Materials Code*, covers the manufacture, transportation, storage, sale, and use of explosive materials and emphasizes the importance of training for persons handling explosive materials and developing a hazards analysis for processes involving manufacturing, movement, storage, testing, or developing energetic materials.[173] However, this standard does not apply to any type of fireworks.[174]

7.4.1.2 NFPA 1123

NFPA 1123, *Code for Fireworks Display*, applies to constructing, handling, and using fireworks and equipment intended for outdoor fireworks display and operation of the display.[175] This standard provides for the flooding of a fireworks mortar shell with water within 15 minutes if the firework fails to fire.[176] The standard also states that any storage, handling, assembly, testing, or transportation of fireworks materials and devices intended for outdoor display – prior to their delivery to the display site – must comply with NFPA 1124, 18 U.S.C. Chapter 40; and 27 CFR Part 55. For fireworks disposal, Section 8.2.10.2 states that suppliers will provide disposal instructions and those instructions will be followed.

[173] NFPA 495. *Explosive Materials Code*. 2010 ed.
[174] NFPA 495, Section 1.3.4.
[175] NFPA 1123. *Code for Fireworks Display*. 2010 ed.; Section 1.1.1.
[176] NFPA 1123, Section 8.2.10.1.1.

This would not be applicable to seized contraband fireworks, and it does not appear that NFPA 1123 provides any other guidance on fireworks disposal.

7.4.1.3 NFPA 1124

NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*, applies to manufacturing facilities and to the storage of display fireworks and black powder at facilities other than display sites – but the standard does not apply to disposal.[177] This standard requires that all tools used to open containers of explosive materials be non-sparking,[178] and that magazines must be used exclusively for storage of explosive and pyrotechnic materials.[179] As noted, DEI did not utilize the magazine exclusively for storage: DEI also soaked fireworks in diesel-filled steel drums, which the CSB would consider to be part of a process. In addition, a number of sparking items were found within the magazine or blown out of the magazine post-incident, including steel drums, a metal hand truck, metal chair, and metal tools.

While some sections within NFPA 1124 provide relevant safety guidance for fireworks storage activities, this standard does not provide any guidance on fireworks disposal. In addition, nowhere are the hazards of fireworks disassembly and the accumulation of explosive fireworks components discussed.

7.4.2 Review of Current Fireworks Disposal Practices

The CSB had informal discussions with a number of fireworks manufacturers and state and local law enforcement agencies to better understand their firework disposal methodologies. The responses varied, illustrating that manufacturers have developed their own disposal procedures in the absence of industry guidance.

7.4.2.1 Fireworks Operators

Disposal methods were inconsistent across these operators and ranged from procedures that incorporate stringent PSM guidelines to those that simply burn the fireworks in a pit, sometimes after soaking them in diesel. Several operators indicated that the best method to dispose of undamaged fireworks is to shoot them off as intended and strongly stated their opposition to disassembling or soaking fireworks in diesel prior to burning. Some operators said that they contract the disposal of 1.3G UN0335 fireworks to third-party companies (in Louisiana, Pennsylvania or Ohio) or turn them over to the local fire marshal or law enforcement.

[177] NFPA 1124. *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*, 2006 ed.; Section 1.1.
[178] NFPA 1124, Section 5.4.7.
[179] NFPA 1124, Section 5.4.8.

7.4.2.2 Local Law Enforcement Agencies

Fire departments and local law enforcement agencies are also inconsistent in their handling, storage, and disposal of fireworks. For example, the State of California Office of the State Fire Marshal seizes and takes possession of all contraband fireworks in the state. Its personnel told the CSB that they do not disassemble seized fireworks or soak them in diesel prior to burning them. The Office sometimes provides 1.3G UN0335 display fireworks to bomb technicians for training, and disposes of 1.4G UNO336 consumer fireworks in approved burn pits or ships them to an authorized disposal contractor in Louisiana. However, its personnel concede that cost and budget constraints have resulted in a large inventory of hundreds of thousands of pounds of seized fireworks being stored in magazines within California.

The San Francisco Fire Department confiscates mostly type 1.4G UNO336 fireworks, wets them down, grinds them, and then discards them. They do not have a procedure for 1.3G UN0335 fireworks.

Finally, the Houston Fire Department confiscates primarily type 1.4 G UNO336 fireworks, stores them in magazines, and then either sends them to the bomb squad for disposal, turns them over to the local police department for training, or burns them without first soaking them in diesel.

7.5 Conclusion

The wide array of disposal techniques across the country; incidents such as the one in Lansing, Kansas; and the lack of existing regulations and standards that provide safety requirements and guidance to those disposing of fireworks, all support the conclusion that a regulatory gap exists in this country pertaining to fireworks disposal. Closing this gap to prevent fatal incidents requires a combined effort by ATF, EPA, NFPA, state and local agencies, and the fireworks industry to create standards and guidance that clearly indicate the dangers of handling and disposing of fireworks, and discuss how to properly and effectively manage the hazards and safely conduct this work.

8.0 Causal Analysis

For the DEI Investigation, the CSB team developed an accident map (AcciMap) (Figure 24), a multi-layered causal diagram that allows for the evaluation of higher level causes at the governmental, regulatory, and societal levels. This diagram is especially useful for developing broadly applicable recommendations for accident prevention,[180] and includes five levels:

1. *Physical Events, Conditions, and Outcomes:* the immediate causes of the incident as displayed in a traditional logic tree;
2. *DEI:* company rules and policies; and conduct of fireworks disposal work;
3. *VSE*: primary government contractor responsible for subcontractor selection and oversight;
4. *Industry Codes and Standards:* good practice guidelines provide safety standards; and
5. *Government:* laws and legislation are developed to regulate federal contracting and the handling, storage, and disposal of explosive hazardous materials.

8.1 Physical Events, Conditions, and Outcomes

Five workers were fatally injured due to a fire and explosion inside a magazine. The fire and explosion were a result of the accumulation of explosive black powder and aerial shells inside the magazine near its only entrance, and multiple ignition sources were present. The fire developed near the only entrance and exit, and prevented workers' escape from the magazine. All of these physical outcomes and conditions were the result of DEI's high-risk fireworks disposal activities.

8.2 DEI

DEI developed a fireworks disposal methodology that evolved into disassembling seized fireworks and separating and accumulating their explosive components – black powder and aerial shells – into cardboard boxes. By accumulating these explosive components, the DEI process created a much larger explosive hazard than the original fireworks represented. In addition, DEI's Activity Hazard Analysis and procedures failed to identify and control the key explosive hazards involved in this process. DEI personnel also had a lack of fireworks training and experience.

[180] The AcciMap tool was developed by Jens Rasmussen and popularized by Andrew Hopkins. Rasmussen, J., &. A. Hopkins. "Risk Management in a Dynamic Society: A Modeling Problem." *Safety Science*, 27 (2.3), 1997; pp 183-213.

8.3 VSE

The main federal seized-property management contractor, VSE, did not use individuals with the requisite technical and explosives expertise in its subcontractor selection and oversight process. VSE procurement personnel lacked explosives and fireworks experience and were not qualified to assess the technical differences between the two proposals they received to dispose of the fireworks. Even though DEI had never conducted a firework disposal operation, VSE procurement staff selected DEI as the subcontractor to dispose of contraband fireworks because DEI was already storing the fireworks, and its proposal was determined to be the lowest-cost and most time-efficient bid for the government, resulting in attractive "one-stop shopping." In addition, no VSE personnel or representatives aware of DEI's disposal process had the expertise to identify or evaluate any hazards associated with the activities being conducted.

8.4 Industry Codes and Standards

No Industry Codes or Standards exist that provide safety guidance on fireworks disposal.

8.5 Government

There is a regulatory gap that exists pertaining to fireworks disposal in the United States.

RCRA emergency permits lack safety management provisions. The State of Hawaii DOH awarded DEI an emergency hazardous waste permit to dispose of the contraband fireworks without reviewing its qualifications or proposed disposal methodology. As the DEI firework disposal operation evolved and major hazards were introduced from disassembling and accumulating firework components, the emergency hazardous waste permit included no requirements to review the safety aspects of these critical changes.

Neither the FAR, the DTAR, nor the DTAP explicitly address safety, and lack sufficient selection and oversight requirements for the prime contractor and its subcontractors with respect to the unique hazards associated with the disposal of hazardous materials, including fireworks.

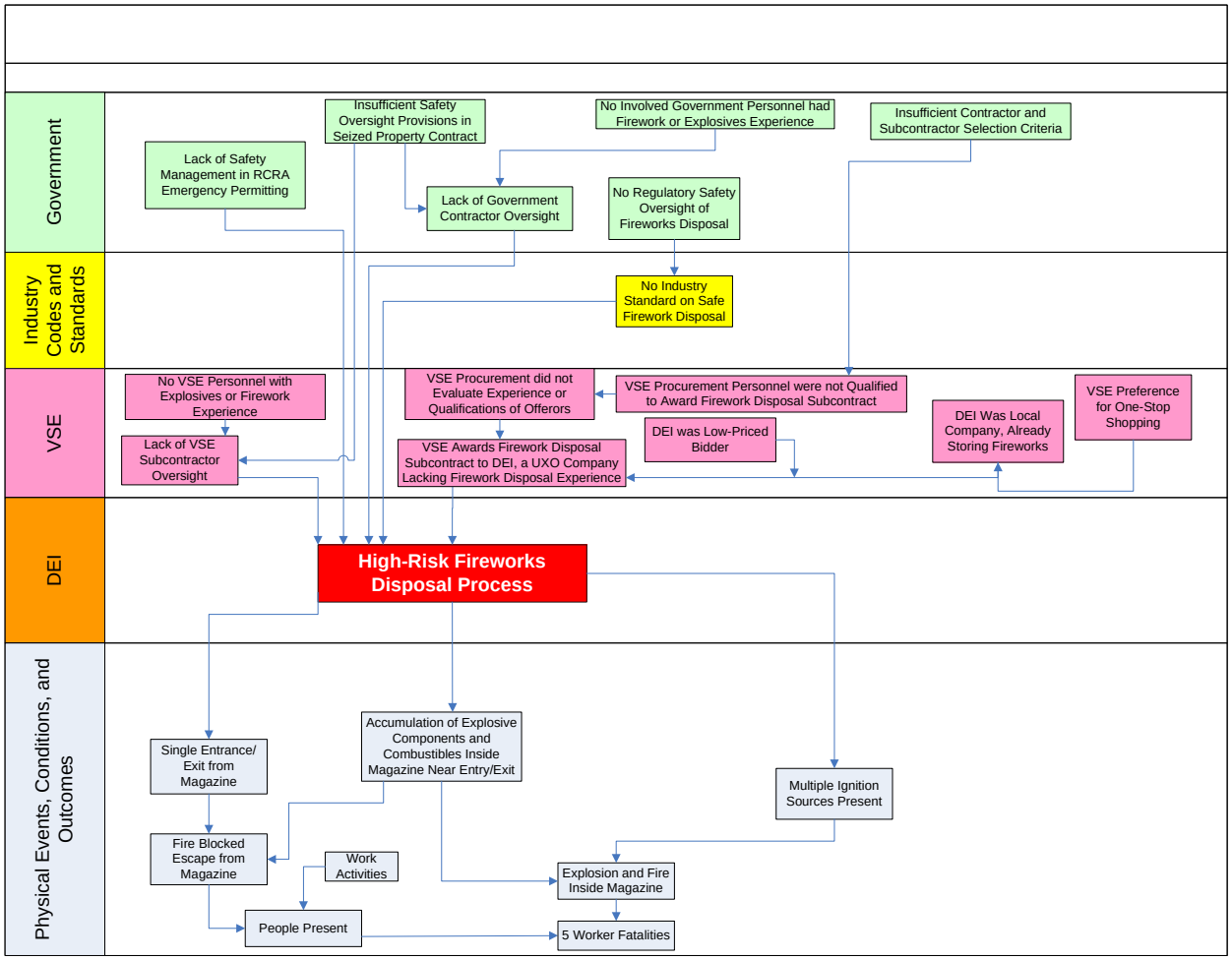

Figure 24. DEI Investigation AcciMap

9.0 Recommendations

The CSB makes recommendations based on the findings and conclusions of the investigation. Recommendations are made to parties that can affect change to prevent future incidents, which may include the company, contractors, industry organizations responsible for developing good practice guidelines, regulatory bodies, and/or organizations that have the ability to broadly communicate lessons learned from the incident, such as trade associations.

Federal Acquisition Regulatory (FAR) Council

2011-06-I-HI-R1

Establish an additional contractor responsibility determination requirement under Subpart 9.104-1 of the Federal Acquisition Regulation (FAR) addressing contractor safety performance. The analysis under this requirement should focus on incident prevention, and environmental and system safety. At a minimum, the language should specifically require the review of a prospective contractor's:

- Environmental and safety programs;
- Safety record and incident history;
- Ability to use safe methods for any work involving hazardous materials (including explosives); and
- Suitable training and qualifications for the personnel involved in the work including prior relevant safety experience.

Department of the Treasury Office of the Procurement Executive (OPE)

2011-06-I-HI-R2

Establish formal policy requiring that:

- Solicitations for contracts dealing with the storage, handling, and disposal of explosive hazardous materials, including fireworks, incorporate rigorous safety-related contractor selection provisions such as those provided in the DoD's Contractor's Safety Manual for Ammunition and Explosives, Section C1.5, "Pre-Award Safety Survey"; and
- Contracts dealing with the storage, handling, and disposal of explosive hazardous materials, including fireworks, include a provision requiring that any subcontract (regardless of tier) for the storage, handling, and disposal of explosives (including fireworks) be selected based on rigorous

safety-related contractor selection provisions such as those provided in the DoD's *Contractor's Safety Manual for Ammunition and Explosives*, Section C1.5, "Pre-Award Safety Survey."

2011-06-I-HI-R3

Establish a formal policy requiring that contracts and subcontracts dealing with the storage, handling, and disposal of explosive hazardous materials, including fireworks, incorporate rigorous safety-related contractor oversight provisions such as those provided in the DoD's *Contractor's Safety Manual for Ammunition and Explosives*, Section C1.6, "Pre-Operational Safety Survey" and C1.7, "Post-Award Contractor Responsibilities" to provide effective oversight of subcontractors handling and disposing of explosives and hazardous materials.

2011-06-I-HI-R4

When the NFPA guidance developed by the National Fire Protection Association for the safe disposal of fireworks as recommended under recommendation 2011-06-I-HI-R7 is completed, incorporate this document by reference into the formal policies established by 2011-06-I-HI-R2 and 2011-06-I-HI-R3.

Treasury Executive Office for Asset Forfeiture (TEOAF)

2011-06-I-HI-R5

Require additional provisions within the TEOAF seized property management contract, such as a contract line item number (CLIN), that provide for the prime contractor to use expert(s) to assist the prime contractor's personnel in the selection and oversight of subcontractors who handle, store, or dispose of explosive hazardous materials, including fireworks, pursuant to the main contract.

VSE Corporation

2011-06-I-HI-R6

Use experts to:

- Assist VSE procurement in selecting vendors to properly handle, store, and dispose of explosive hazardous materials, including fireworks, pursuant to prime contract requirements; and,
- Assist VSE personnel in overseeing the work to ensure it is being conducted safely.

National Fire Protection Association (NFPA)

2011-06-I-HI-R7

Develop a new standard, or incorporate within an existing standard, best practices for the safe disposal of waste fireworks that are consistent with environmental requirements. At a minimum this guidance or standard should:

- Discourage the disassembly of waste fireworks as a step in the disposal process;
- Minimize the accumulation of waste explosive materials, and encourage practices that reduce, recycle, reuse, or repurpose fireworks; and
- Incorporate input from ATF, EPA, and other agencies, experts, and available resources on fireworks disposal methodologies.

2011-06-I-HI-R8

Once fireworks disposal best practices under recommendation 2011-06-I-HI-R7 is completed, develop and implement an outreach plan to promptly communicate the new NFPA practices to relevant government agencies and private entities that dispose of waste fireworks.

U.S. Environmental Protection Agency (EPA)

2011-06-I-HI-R9

Revise the Resource Conservation and Recovery Act (RCRA) Subtitle C regulations to require a permitting process with rigorous safety reviews to replace the use of emergency permits under 40 CFR §270.61 for the disposal of explosive hazardous materials, including fireworks. At a minimum, the new process should require the use of best available technology, safe disposal methodologies, as well as safety management practices, such as those required by OSHA's Process Safety Management Standard (PSM), 29 CFR §1910.119 (e.g., hazard analysis and control, management of change).

2011-06-I-HI-R10

Until recommendation 2011-06-I-HI-R9 can be implemented, develop and issue a policy guidance document to provide a regulatory process with rigorous safety reviews to replace the use of emergency permits under 40 CFR §270.61 for the disposal of explosive hazardous materials, including fireworks. At a minimum, the new process should require the use of best available technology, safe disposal methodologies, as well as safety management practices, such as those required by OSHA's Process Safety Management Standard (PSM), 29 CFR §1910.119 (e.g., hazard analysis and control, management of change). Ensure its effective communication to all EPA regional administrators, state environmental agencies, and organizations within the fireworks industry.

2011-06-I-HI-R11

Effectively participate in the National Fire Protection Association's standard development process to develop guidance on the safe and environmentally sound disposal of fireworks, as recommended under recommendation 2011-06-I-HI-R7.

Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF)

2011-06-I-HI-R12

Effectively participate in the National Fire Protection Association's standard development process to develop guidance on the safe disposal of fireworks, as recommended under recommendation 2011-06-I-HI-R7.

BY THE

U.S. Chemical Safety and Hazard Investigation Board

Rafael Moure-Eraso
Chair

Mark Griffon
Member

Beth Rosenberg
Member

Date of Approval January 17, 2013.

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Appendix A: Hawaii Firework Seizures

Between 2007 and 2010, CBP and ICE/HSI agents in Hawaii conducted three separate seizures of fireworks that were being imported from China into Honolulu, due to suspicion that they were illegally labeled for consumer use.

Seizures

Initial Seizure

On December 10, 2007, CBP seized a shipment of fireworks (initial seizure) in Honolulu[181] and declared these fireworks forfeited on February 12, 2008.[182] This shipment consisted of 11 pallets of fireworks and included "Maylar Tubes," "Assortment Shells," and "Singing Oriole/Dancing Swallows."

Second Seizure

On February 4, 2009, ICE/HSI seized a second shipment of fireworks in Honolulu[183] (second seizure) illegally imported from China. The property, consisting of 5,480 pieces contained in 1,370 cartons/39 pallets, was forfeited on July 6, 2009, for knowingly smuggling goods into the United States.[184] This seizure was being stored in the rear of the magazine at the time of the incident.

Primary Seizure

On January 13, 2010, ICE/HSI seized a third shipment of fireworks in Honolulu[185] (primary seizure) during its importation from China. The property was forfeited on March 22, 2010, for introducing merchandise contrary to law[186] and knowingly smuggling goods into the U.S.[187] DEI was in the process of disassembling the primary seizure on the day of the incident.

This shipment consisted of eight cardboard containers holding 296 boxes or 17 pallets of fireworks marked "Fireworks 1.4G" with the Identification Number UN0336 and DOT approval number EX2008060273. The four different products contained within this shipment were 65 boxes/519 pieces of "O Triple C"; 65 boxes/519 pieces of "Halawa"; 96 boxes/383 pieces of "Sky Festival"; and 70 boxes/559 pieces of "Krazy Kids." The total value of this shipment was over $30,000.00. Table 2 below details specific fireworks in the seizure and samples requested by CBP.

[181] Seizure Number 2008-3201-000-013-01.
[182] For introducing merchandise contrary to law under 19 U.S.C. §1595A(c) and knowingly receiving explosive materials without a license or permit under 18 U.S.C. §842(a)(3)(A).
[183] Seizure Number 2009-3201-000-052-01.
[184] Under 18 U.S.C. §545 (1996).
[185] Seizure Number 2010-3205-000-012-01.
[186] 19 U.S.C. §1595a(c) (2008).
[187] 18 U.S.C. §545 (1996).

U.S. Dept. of Homeland Security (Disposition Order)				VSE (Chain of Custody)		
Line Item#	**Description**	**Unit of Measure**	**Quantity**	**Count was:**	**Count now:**	**Sample pulled**
001-A001	CC Halawa	CTNS	64	65 (519 pieces)	64	1
002-A001	KK Krazy Kids	CTNS	69	70 (559 pieces)	69	1
003-A001	RR O Triple C	CTNS	64	65 (519 pieces)	64	1
004-A001	SF Sky Festival	CTNS	95	96 (383 pieces)	95	1

Table 2. Seizures and Samples[188]

All four of these fireworks are multi-shot devices, often referred to as "cakes" in the industry, [189] and are designed to produce a succession of effects. According to the APA, each tube in a multi-shot device is typically 0.6" – 1.38" in diameter. A single igniter is generally used to initiate the first effect; a timed fuse, the spacing of the tubes, and the total number of tubes determine subsequent ignition of the tubes and the overall duration of the device. The tubes typically incorporated in these devices can include comets, mines, small aerial devices, audible effects, and any combination thereof.[190] In the instantaneous version of these devices, all tubes ignite simultaneously.

ATF testing and analysis of Primary Seizure

ATF conducted a detailed analysis of the primary seizure and concluded that

1. The *CC Halawa* fireworks consisted of a multi-tube device (shot cake) comprising 25 tubes. The shot cakes were packaged eight per carton and the tubes within each device were spaced less than 0.5 inches apart. Each shot cake contained two types of tubes, half of which contained shells with stars. For laboratory analysis, one of each type of tube was randomly selected, weighed, and disassembled. The lift charge for the tubes (with and without stars) consisted of 5.15 grams of black powder. The shells contained a 1-gram lift charge; 10.83 grams of pyrotechnic stars; and a burst charge, identified as perchlorate explosive mixture, of either 2.47 or 5.79 grams. The cake contained a total of 374.32 grams of explosives and pyrotechnics material. The ATF observed that, while the carton displayed a marking

[188] CTNS = Cartons (boxes).
[189] http://www.fireworks.us/Fireworks-Multi-Shots-Cakes-s/7.htm (accessed April 22, 2012).
[190] American Pyrotechnics Association (APA). *Generic Close Proximity Product Types: Pyrotechnics Used Before a Proximate Audience*, March 1, 2009; p 12. http://www.americanpyro.com/pdf/APACloseProxDescriptionsFinal.pdf (accessed November 1, 2012).

indicating that it contained 1.4G UN0336 fireworks, the individual shot cakes were unmarked; the ATF therefore concluded that the product violated APA 87-1, paragraph 3.5.2. The DOT hazard classification for multiple tube devices with less than 0.5-inch tube separation is limited to 200 grams. This product also exceeded the maximum allowable explosive filler weight of 130 milligrams permitted in consumer fireworks by 27 CFR §555.151 (a)(7) and the maximum permitted charge weight of 130 milligrams for devices that are intended for sale to the public and produce an audible charge effect (APA 87-1, paragraph 3.373). The ATF therefore opined that the *CC Halawa* fireworks were classified as explosives (Class 1.3 or higher) and subject to regulations under 27 CFR Part 555, Commerce in Explosives.

2. The *KK Krazy Kids* fireworks also consisted of a 25-tube shot cake packaged eight per carton, with the tubes spaced less than 0.5 inches apart. Each tube contained 3.75 grams of a black powder lift charge. The shell contained 1-gram black powder lift charge; 9.01 grams of pyrotechnic stars; and 2.28 grams perchlorate explosive lift charge. The entire multi-tube assembly contained a total of 400.25 grams of explosives and pyrotechnics material. The ATF observed that, while the carton displayed a marking indicating that it contained 1.4G UN0336 fireworks, the individual shot cakes were unmarked and therefore concluded that the product violated APA 87-1, paragraph 3.5.2. The DOT hazard classification for multiple tube devices with less than 0.5-inch tube separation is limited to 200 grams. This product also exceeded the maximum allowable explosive filler weight of 130 milligrams permitted in consumer fireworks by 27 CFR §555.141(a)(7) and the maximum permitted charge weight of 130 milligrams for devices that are intended for sale to the public and produce an audible charge effect (APA 87-1, paragraph 3.7.3). The ATF therefore opined that the *KK Krazy Kids* fireworks were classified as explosives (Class 1.3 or higher) and subject to regulations under 27 CFR Part 555, Commerce in Explosives.

3. The *RR O Triple C* fireworks also consisted of a multi-tube device (shot cake) comprising 25 tubes packaged eight per carton. The tubes were spaced less than 0.5-inch apart. A tube was selected randomly from a single multi-tube device, weighed, disassembled, and submitted to the laboratory for analysis. Each tube contained 5.15 grams of a black powder lift charge; 10.5 grams of pyrotechnic stars; and 6.18 grams of a perchlorate explosive burst charge. Each shot cake contained a total of 570.25 grams of explosives and pyrotechnics material. The ATF observed that, while the carton displayed a marking indicating that it contained 1.4G UN0336 fireworks, the individual shot cakes were unmarked; thus, ATF concluded that the product violated APA 87-1, paragraph 3.5.2. The DOT hazard classification for multiple tube devices with less than 0.5-inch tube separation is limited to 200 grams. This product also exceeded the maximum allowable explosive filler weight of 130 milligrams permitted in consumer fireworks by 27 CFR §555.141 (a)(7) and the maximum permitted charge weight of 130 milligrams for devices that are intended for sale to the public and produce an audible charge effect (APA 87-1, paragraph 3.7.3). The ATF therefore opined that the *RR O Triple C* fireworks were classified as explosives (Class 1.3 or higher) and subject to regulations under 27 CFR Part 555, Commerce in Explosives.

4. The *SF Sky Festival* fireworks consisted of a 156-tube shot cake packaged four per carton. The cake contained six large tubes, and 150 smaller tubes spaced less than 0.5 inches apart. One of each type of tube was randomly selected, weighed, disassembled, and submitted for analysis. The large tubes contained 3.3 grams of a black powder lift charge and 4.7 grams of a perchlorate explosive burst charge, while the small tubes contained 0.96 gram of black powder lift charge and 1.22 grams of pyrotechnic

stars. Each shot cake contained a total of 375 grams of explosives and pyrotechnic material. The ATF observed that, while the carton displayed a marking indicating that it contained 1.4G UN0336 fireworks, the individual shot cakes were unmarked; thus, ATF concluded that the product violated APA 87-1, paragraph 3.5.2. The DOT hazard classification for multiple tube devices with less than 0.5-inch tube separation is limited to 200 grams. This product also exceeded the maximum allowable explosive filler weight of 130 milligrams permitted in consumer fireworks by 27 CFR §555.141 (a)(7) and the maximum permitted charge weight of 130 milligrams for devices that are intended for sale to the public and produce an audible charge effect (APA 87-1, paragraph 3.7.3). The ATF therefore opined that the *RR O Triple C* fireworks were classified as explosives (Class 1.3 or higher) and subject to regulations under 27 CFR Part 555, Commerce in Explosives.

ATF analysis of samples from the subject seizure, collected from undamaged cartons found near the rear of the magazine after the subject explosion, provides photographic documentation of individual tubes for each type of these fireworks. The analysis concluded that a) the aerial component within the Halawa cakes were consistent with star shells and contained approximately 13.4 grams of powder; b) the aerial shells within the Krazy Kids cakes contained between 5.7 and 12.1 grams of material that appeared to be consistent with a flash powder; c) the aerial component within the O Triple C cakes contained approximately 5.9 grams of material consistent with flash powder; and d) the aerial shells within the Sky Festival cakes contained comets and approximately 4.3 grams of material that appeared to be consistent with flash powder.

Case Processing and Management

Post-seizure, a CBP Fines, Penalties and Forfeitures Officer (FP&F) at Port of Honolulu oversaw the seized property program and aspects of case processing. CBP issued disposition orders (CBP Form 7605) to VSE as TEOAF's primary federal contractor to secure storage for the seizures, coordinate their destruction, monitor and control storage costs, and inspect the storage facilities.

Storage

Initial Seizure

On December 11, 2007, CBP issued a disposition order to VSE to store the initial seizure. VSE subcontracted to Timberline Environmental Services[191] (Timberline) to locally store the fireworks at Waikele Storage. At some point, Timberline entered into a separate agreement with DEI to store the seizures. For unknown reasons, VSE did not renew their storage contract with Timberline and instead, in late 2008, directly subcontracted with DEI to store the firework seizures. On December 12, 2008, CBP issued a new disposition order to VSE to transfer the initial seizure from Timberline to DEI as the "new vendor for storage." DEI began storing the seizure at Waikele Storage on February 17, 2009.

[191] Timberline provides unexploded ordinance (UXO) services, including vegetation clearance, target removal, scrap management and large scale soil sifting operation on live ranges http://www.uxoservices.com (accessed November 29, 2012).

Second Seizure

On February 19, 2009, CBP issued a disposition order to VSE to store the second seizure. DEI had stored this seizure in the back of the magazine, where it was at the time of the incident.

Primary Seizure

On January 13, 2010, CBP issued a disposition order to VSE to store the primary seizure. On or around March 29, 2010, these fireworks were transferred to the A-21 magazine for storage.

Destruction

Initial Seizure

On February 10, 2010, CBP issued a disposition order to VSE to destroy the initial seizure. CBP issued a second disposition order on April 16, 2010. DEI obtained the requisite permitting to begin the disposal process on June 8, 2010.

CBP Form 7605 states that DEI completed its destruction of the initial seizure on December 1, 2010.

Second Seizure

Post-incident, on July 20, 2011, CBP issued a disposition order to VSE to destroy the second seizure. However, these 39 pallets of cake fireworks have not yet been destroyed and are being stored in the magazine where the incident occurred.

Primary Seizure

On April 16, 2010, CBP issued a disposition order to VSE, set to expire June 16, 2010, for destruction of the primary seizure.

The incident occurred while DEI was completing its disassembly of these fireworks; it had destroyed approximately 35 percent of this seizure at the time of the incident.

Appendix B. Department of Defense *Contractor's Safety Manual*

Pertinent Sections.
DoD 4145.26-M, March 13, 2008

C1.1. PURPOSE

C1.1.1. This Manual provides safety requirements, guidance and information to minimize potential accidents that could interrupt Department of Defense (DoD) operations, delay DoD contract production, damage DoD property, cause injury to DoD personnel, or endanger the public during DoD contract work or services involving ammunition and explosives (AE). The Manual contains the minimum contractual safety requirements to support DoD objectives. These requirements are not a complete safety program, and this Manual does not relieve a contractor from complying with Federal, State, interstate, and local laws and regulations.

C1.2. APPLICABILITY. When included in or properly incorporated into their contracts, subcontracts, purchase orders, or other procurement methods and made applicable to the contractor (or to their subcontractors), these safety requirements apply to contractors and subcontractors handling ammunition or explosives. Nothing in this Manual should be construed as making the Department of Defense a controlling employer under Occupational Safety and Health Administration (OSHA) regulations and standards.

C1.5. PRE-AWARD SAFETY SURVEY

C1.5.1. The PCO will request a DoD pre-award safety survey to help determine contractor capability. DoD safety personnel conduct pre-award surveys to evaluate each prospective contractor's ability to comply with contract safety requirements. While the pre-award safety survey is an opportunity for the contractor to request clarification of any safety requirement or other AE issue that may affect the contractor's ability to comply, any such clarification must be issued by the contracting officer. During pre-award surveys, the contractor shall provide:

C1.5.1.1. Site plans conforming to subparagraphs C1.8.5.1. through C1.8.5.5. for proposed facilities to be used in contract performance.

C1.5.1.2. Evidence of implementation of a safety program containing at least the mandatory requirements described in Chapter 3 of this Manual.

C1.5.1.3. General description of proposed contract facilities, including size, building layouts, construction details, and fire resistive capabilities.

C1.5.1.4. Fire prevention program and available firefighting resources, including local agreements or other documentation demonstrating coordination.

C1.5.1.5. Copies of required licenses and permits or demonstration of the ability to obtain approvals necessary to support the proposed contract.

C1.5.1.6. A safety history including accident experience; safety survey or audit reports by insurance carriers or Federal, State, and local authorities; and any variances, exemptions, or waivers of safety or fire protection requirements issued by Federal, State, or local authorities.

C1.5.1.7. Proposed operations and equipment to include process flow narrative/diagram, proposed facility or equipment changes, proposed hazard analysis, and proposed procedures for all phases of AE operations.

C1.5.1.8. Subcontractor information.

C1.5.8.1. Identification of all subcontractors proposed for the AE work.

C1.5.8.2. Proposed methods used to evaluate the capability of the subcontractor to comply with the requirements of this Manual.

C1.5.8.3. Proposed methods used to ensure subcontractor compliance.

C1.6. PRE-OPERATIONAL SAFETY SURVEY

C1.6.1. The Department of Defense reserves the right to conduct a pre-operational survey after contract award in these situations:

C1.6.1.1. Contractor has limited experience with the item.

C1.6.1.2. After major new construction.

C1.6.1.3. After major modifications.

C1.6.1.4. After an AE accident.

C1.6.2. When these situations occur, the contractor shall provide sufficient notification to the ACO and Defense Contract Management Agency (DCMA) contract safety personnel, to provide adequate time for the Department of Defense to schedule and perform a preoperational survey.

C1.7. POST-AWARD CONTRACTOR RESPONSIBILITIES. The contractor shall:

C1.7.1. Comply with the requirements of this Manual and any other safety requirements contained within the contract.

C1.7.2. Develop and implement a demonstrable safety program, including operational procedures, intended to prevent AE-related accidents.

C1.7.3. Designate qualified individuals to administer and implement this safety program.

C1.7.4. Prepare and keep available for review all hazard analyses used to justify alternative methods of hazards control implemented in order to comply with the mandatory requirements in this Manual.

C1.7.5. Provide access to facilities and safety program documentation to DoD safety representatives.

C1.7.6. Report and investigate AE accidents in accordance with Chapter 2 of this Manual.

C1.7.7. Provide identification and location of subcontractors to the ACO for notification or approval in accordance with terms of the contract.

C1.7.8. Establish and implement management controls to ensure AE subcontractors comply with paragraphs C1.7.1. through C1.7.7. of this section.

C3.5. HOUSEKEEPING IN HAZARDOUS AREAS

C3.5.1. Contractors shall keep structures containing AE clean and orderly.

C3.5.2. Contractors shall establish a regular cleaning program to maintain safe conditions. Personnel shall not perform general cleaning concurrently with hazardous operations.

C3.5.3. Explosives and explosive dusts shall not be allowed to accumulate on structural members, radiators, heating coils, steam, gas, air or water supply pipes, or electrical fixtures.

C3.5.4. Contractors shall use proper design of equipment, training of employees, and catch or splash pans to prevent spillage of explosives and other hazardous materials. Operators shall promptly remove spillage of explosives and hazardous materials following proper procedures established per section C8.4.

C3.5.5. Personnel shall use cleaning methods, such as hot water, steam, etc., that do not create ignition hazards for cleaning floors in buildings containing explosives. When these methods are impractical, personnel may use nonabrasive sweeping compounds that are compatible with the explosives involved. Flammable compounds shall not be used. Combustible sweeping compounds (closed cup flash point less than 230ºF) are acceptable for use. Personnel shall not use sweeping compounds containing wax on conductive floors if the wax can reduce conductivity. Personnel shall not use cleaning agents containing alkalis in areas with nitrated organic explosives, since these materials are incompatible and can form sensitive explosive compounds.

C3.5.6. Cleaning methods may use nonferrous wire brushes to clean explosives-processing equipment only when other methods of cleaning are ineffective. A thorough inspection should follow such cleaning to ensure that no wire bristles remain in the equipment. This also applies to cleaning magnesium ingot or other metal molds used in explosives processing. Cleaning methods should substitute fiber brushes for hairbrushes to reduce generation of static.

C3.5.7. Contractors shall dispose of all loose explosives swept up from floors of operating buildings. Responsible personnel shall thoroughly inspect and determine disposition of explosives recovered from sources other than ammunition breakdown operations and equipment.

C3.9. SAFETY HAND-TOOLS

C3.9.1. Unless a hazard analysis indicates otherwise, only hand tools constructed of wood or non-sparking metals such as bronze, lead, and "K" Monel shall be used for work in locations and on equipment that contain exposed explosives or hazardous concentrations of flammable dusts, gases, or vapors that are susceptible to mechanical spark. Hand tools shall be cleaned and inspected prior to use. Be aware that nonferrous metals used in so-called non-sparking tools may produce sparks. If the use of ferrous metal tools is required because of their strength and wear characteristics, the contractor's safety office shall approve their use.

C3.9.2. If their strength makes the use of ferrous metal hand tools necessary during maintenance and repair operations, exposed explosives and other highly flammable and combustible materials shall be removed from the area. In addition, explosives operations in the immediate vicinity shall be discontinued to guard against accidental ignition of materials by flying sparks, and potential contact surfaces should be oiled or covered to reduce the likelihood of sparks.

C3.11. PROTECTIVE CLOTHING

C3.11.1. All AE operations require a hazard assessment to determine the need for protective clothing and personal protective equipment. The assessment shall include an evaluation of all hazards and factors contained in paragraph C3.11.2.

C3.11.2. The contractor shall provide a changing area for employees who must remove their street clothes to wear protective clothing, such as explosive plant clothing, anti-contamination clothing, or impervious clothing. To minimize the risk of exposure to unrelated personnel, AE operators shall not remove contaminated clothing from the AE areas. Employees shall not wear any static-producing clothing in areas where electrostatic discharge (ESD) is a hazard.

C3.11.3. Explosives plant clothing, generally referred to as powder uniforms, shall have nonmetallic fasteners and be easily removable.

C3.11.4. When sending explosives-contaminated clothing to an off-plant laundry facility, the contractor is responsible for informing the laundry of the hazards associated with the contaminants and any special laundering or disposal requirements.

C7.12. DISASSEMBLY

C7.12.1. Equipment and tooling that require disassembly during the manufacturing process should be designed to prevent metal-to-metal contact and trapping of explosive material.

C7.12.2. Non-routine disassembly of equipment and tooling, such as that necessary for equipment repair, shall not be started until potential hazards from trapped material or process residuals have been evaluated and controls or safeguards have been implemented to mitigate the hazard.

SAFETY REQUIREMENTS FOR MANUFACTURING AND PROCESSING PYROTECHNICS

C8.1. GENERAL. The safety precautions for manufacturing and processing pyrotechnics are similar to those required for many types of explosives and other energetic materials. However, pyrotechnics exhibit many different characteristics because they are formulated for different purposes. Knowledge of the various pyrotechnic properties is critical to the establishment of proper hazard controls. Pyrotechnics can be divided into several general categories including: initiators (igniters), illuminants, smokes, gas generators, sound generators, heat producers, and timing compositions. Each of these categories has its own characteristics and attendant processing requirements. Knowledge of these characteristics is necessary to assure safety in processing. The range of characteristics associated with pyrotechnics includes compositions that are easily initiated, including compositions that burn in seconds at temperatures exceeding 5000 degrees Fahrenheit (°F) [2760 degrees Celsius (°C)] through compositions that require substantial energy for initiation and have relatively low output temperatures. As examples, the auto-ignition temperature for smoke compositions is typically about 356°F [180°C], while for illuminants it is about 932°F [500°C]. Illuminants burn approximately 2.7 times faster than smokes and the heat of reaction is 1.5 times as great. Infrared (IR) flare compositions are both hotter and faster burning than illuminants. Many of the compositions in the igniter or initiator class are as sensitive to ESD, friction, or impact as are initiating explosives such as lead azide and lead styphnate. Initiation thresholds to stimuli such as impact, friction, and ESD and energy output of initiator compositions shall be determined and understood to ensure adequate safety controls are implemented to provide personnel safety in specific processes. In addition to the safety precautions generally required for the handling of explosives and other energetic materials, section C8.2. provides specific guidance pertinent to pyrotechnic operations.

C8.3. PROCESS REQUIREMENTS

C8.3.1. Housekeeping and Cleanliness Guidelines. Pyrotechnic operations require stringent housekeeping and cleanliness due to the sensitive nature of the ingredients and compositions; the dangerous effects of contamination, including cross contamination of oxidizers and fuels; and the amount of open or exposed ingredients and mixtures. Materials control and cleanliness are mandatory not only to reduce the likelihood of accidental initiations, but also to minimize the effects of an accident.

C8.3.1.1. Do not allow ingredient or composition dusts to accumulate, whether on the exterior work surfaces or the interior of process equipment and ventilation systems. Accident investigations frequently identify dust buildups as the source of initiation when items are dropped on or scraped across them. Dust accumulations also can provide a propagation path from the initiation of a small quantity to a much larger quantity, thereby increasing the magnitude of an accident.

C8.3.1.2. Vapor recovery methods or ventilation shall prevent the accumulation of volatile vapors, and ignition sources shall be eliminated or controlled to prevent the initiation of a solvent vapor cloud. Where volatile flammable solvents are part of the process, solvent vapors in ventilation systems, hallways, conduits, or pipes may also provide a propagation path from the initiation of a small quantity to larger quantities.

C8.3.2. Static Control Systems. As many pyrotechnic ingredients, mixtures, or the solvents used in their production are highly susceptible to initiation by static electricity, static control systems are mandatory where hazard analysis indicates a need. Static control systems include conductive floors or mats, shoes, wrist straps, grounding of equipment, etc.

C8.3.3. Hazard Analysis and Risk Assessment. For all pyrotechnic operations, a documented hazard analysis and risk assessment is mandatory to validate the layout of operations, selection of materials and equipment, and process control parameters. (See Chapter 11 of this Manual.)

C9.4. UNPACKAGED AE ITEMS AND DAMAGED CONTAINERS

C9.4.1. Unpackaged AE items shall not be stored in magazines containing AE in their original shipping container, but may be stored in separate magazines.

C9.4.2. Damaged containers of AE should not be stored in a magazine with serviceable containers of AE. Such containers should be repaired or the contents transferred to new or serviceable containers. All containers of AE in magazines shall be closed with covers securely fastened. Containers that have been opened shall be properly closed before restoring them. Stored containers should be free from loose dust and grit.

C9.4.3. Do not permit loose powder, grains, powder dust, or particles of explosive substances from broken AE or explosive substance containers in magazines. In addition, clean up any spilled explosive substance as soon as possible following proper procedures established per section C8.4. and suspend all other work in the magazine until accomplished.

RISK IDENTIFICATION AND MANAGEMENT

C11.1. GENERAL. AE operations involve many hazards and risks. These include the type of hazards associated with any industrial enterprise, e.g., AE reactivity, lifting, slipping, tool use, toxic chemicals, potential exposures to environmental extremes.

C11.1.1. The evaluation of hazards and risk of accidents addressed in this section relate to processes, not end products. The safety of operations is a contractor responsibility.

C11.1.2. A basic risk identification and management system is a necessary element of a comprehensive AE safety program. The purpose of this chapter is to address risk identification and management for all AE processes.

C11.2. RISK MANAGEMENT SYSTEM. Contractors shall have a risk identification and management system and perform a hazard analysis resulting in the evaluation of processes, materials, equipment, and personnel hazards. This analysis will aid in the development of a written SOP for AE contract operations. The analysis may include such factors as: initiation sensitivity; quantity of AE; heat output, burn rate, potential ignition and initiation sources; protection capabilities of shields; personnel protective equipment and clothing; fire protection; and personnel exposure with special considerations (such as toxic or corrosive chemicals). The contractor shall document the analysis and keep it as long as the SOP is active. The risk analysis should identify normal and abnormal (planned and unplanned) energy input into the AE, documenting the comparison between energy input and the sensitivity of the AE.

C11.2.1. The contractor shall perform risk analyses using personnel knowledgeable in the process, materials, equipment, and relevant safety requirements.

C11.2.2. A hazard is any condition, which, by itself or by interacting with other variables, may result in death or injury to personnel or damage to property. Controls only reduce the likelihood or severity of hazards. Controls do not eliminate hazards.

C11.2.2.1. After identifying a hazard, qualified contractor personnel shall determine the associated risk. The risk analysis of a potential accident shall address both the severity and the probability of occurrence of an accident.

C11.2.2.2. Evaluation of the hazard provides information useful for ranking the degree of risk associated with a hazard. The degree of risk indicates which hazardous conditions should receive priority for corrective action when compared to other hazardous conditions. One technique for ranking hazardous conditions is the assignment of a risk assessment code. The evaluation of the hazard results in the assignment of a narrative or numerical risk assessment that enables management to evaluate the seriousness of the risk before and after action is taken to control it.