

**Maritime Security – Portside and Shipboard Explosions
Special Fire, EMS and Medical Interest**

James P. Denney and Donald H. Hiatt, Jr.

**Homeland Security
National Critical Infrastructure Protection**

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SUMMARY

When examining existing and proposed homeland security critical infrastructure protection measures relative to ports and the shipping industry, it was determined that, in addition to contemporary strategies, the concentration should also center on those historical events that are representative of present-day conventional threats.

The included historical perspectives are based on statements of fact, conclusions, official findings, contemporary observations and anecdotal statements drawn from historical investigations and eyewitness accounts of incidence of significant commercial seaport and shipboard explosions. An effort was also made to focus on the following factors: Life safety, local population density, proximity to event, local geography, structural demographics, hydrodynamic effect, quality, quantity and concentration of explosive material, the potential for long-term disruption of shipping commerce, and ecological impact.¹

Shipboard and seaport explosions were selected over chemical, biological or radiological threats because they represent the majority of disastrous maritime events experienced to date impacting the human element, and have historically resulted in significant mortality, injury patterns, destruction and damage to the immediate and surrounding communities and, they obviously reflect the most common weapon of choice, or likely form of terrorist attack - the improvised explosive device or IED.

¹ Historically, there was very little recorded concern for the ecology in the merchant and naval sea services, particularly during wartime conditions.

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Both foreign and domestic shipboard and seaport disasters involving explosion were reviewed in date ranges from 1833 to present, including periods of warfare, with a focus on forty significant seaport and shipboard incidents, including several foreign and domestic seaport and shipboard explosive disasters that resulted in significant life loss, extensive injury patterns, substantial destruction, widespread damage and temporary shipping disruption. Portions of the conclusion were influenced by findings of fact in the accounts of these disasters.

The U.S. Coast Guards' "Maritime Strategy for Homeland Security²" was also reviewed, as well as various relevant declassified U.S. Navy documents (primarily, the 1944 Port Chicago Naval Base Explosion).

FINDINGS

The maritime domain falls into several categories of the president's report identifying national critical infrastructures and key assets³. Nearly eleven million cargo containers shuttle around the world, transporting over \$740 Billion and 2 Billion tons of domestic and international freight from 178,000 foreign and domestic sources. Foreign vessels make 50,000 port calls annually⁴.

Over 19,000 cargo containers flow into the United States each day and pose a significant challenge to security officials concerned with concealed

² Maritime Strategy for Homeland Security: U.S. Coast Guard, Washington, D.C. – December 2002

³ The Physical Protection of Critical Infrastructures and Key Assets: White House, 2003 – identifies thirteen critical infrastructure components and five key assets.

⁴ Protecting America's Seaports and Securing Cargo Shipments: The White House, February 9, 2004.

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terrorist weapons. Since September 11, 2001, a small army of inspectors at America's 361 seaports have scanned or inspected tens of thousands of containers and examined hundreds of thousands of cargo manifests.

The maritime container network represents the circulatory system of global economy, carrying over 90% of international commerce. Maritime security is essential and critical because 95% of the nation's overseas cargo is carried by ship. Historically, port infrastructure, processes and procedures were designed to facilitate commerce and economic efficiency. Unfortunately, since September 11, 2001, the need is to realign our port system around efficiency and security.

Because of the global scope of terrorism and transnational threats, the International Maritime Organization (IMO) agreed to tough regulations aimed at improving maritime security in December 2002. The International Ship and Port Facility Security (ISPS) code was agreed to as a means of improving ship and port security measures and ensuring the two compliment each other. Tighter security is being brought in to prevent ship hijackings and ships being used as floating bombs by terrorists.

While new international port security measures will come into effect in Bahrain next year the United States must begin implementing port security measures immediately. The International Ship and Port Facility code will come into force on July 1. It applies to both ports and vessels, including passenger ships, cargo ships of over 500 gross tonnage (grt) and mobile offshore drilling rigs.

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COMPLIANCE

To date, little more than half of the nations ports, ferry terminals and fuel-chemical tank farms have met the December 31, 2003 deadline for submitting maritime security plans showing how they will deal with terrorism threats. To date, thousands of active merchant ships, both tanker and container vessels, have failed to submit their plans⁵.

SCOPE

The Maritime Transportation Security Act (MTSA) of 2002 is scheduled for implementation in 2004 with funding of \$102 million⁶. The extent of potential vulnerability is immense and the scope of this component of critical infrastructure protection presents a significant challenge to both those responsible for assessment and security and those who must provide consequence management in instances of security failure or process accident.

The U.S. Maritime Domain⁷ encompasses all U.S. ports, inland waterways, harbors, navigable waters, Great Lakes, territorial seas, contiguous waters, customs waters, coastal seas, littoral areas, the U.S. Exclusive Economic Zone and oceanic regions of U.S. national interest, as well as the sea lanes to the United States, U.S. maritime approaches, and high seas surrounding America.

⁵ Associated Press: Leslie Miller, January 1, 2004

⁶ Protecting America's Seaports and Securing Cargo Shipments: The White House, February 9, 2004

⁷ Maritime Strategy for Homeland Security: U.S. Coast Guard, Washington, D.C. – December 2002

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The U. S. Maritime Transportation System⁸ consists of waterways, ports and their intermodal connections, vessels, vehicles and system users, as well as federal maritime navigation systems. Specifically, it consists of:

- 25,000 miles of navigable channels
- Over 360 ports
- 238 locks at 192 locations
- The Great Lakes
- The St. Lawrence Seaway
- Over 3,700 marine terminals and numerous recreational marinas.

Through 1,400 designated intermodal connections, it connects with over 174,000 miles of rail connecting all contiguous states, (as well as Canada and Mexico); over 45,000 miles of interstate highway, (supported by 115,000 miles of other roadways); and over 400,000 miles of pipelines.

The current maritime security concept envisions a layered defense system that begins well beyond U.S. borders. This defense includes ensuring security before cargo ships reach U.S. ports by improving capabilities within the U.S. Coast Guard. Some of those improvements include⁹:

- Improving the deep water fleet and replacing aging aircraft
- Improving information and intelligence
- Upgrading command and control capability
- Provide underwater detection capability to Maritime Safety and Security

Teams

⁸ Maritime Strategy for Homeland Security: U.S. Coast Guard, Washington, D.C. – December 2002

⁹ Protecting America's Seaports and Securing Cargo Shipments: The White House, February 9, 2004

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- Increased cargo screening
- Increased border security and technology for the screening of containers.

A component of the layered defense system also includes the Customs-Trade Partnership Against Terrorism (C-TPAT), which will leverage public and private partnerships to improve security along the entire supply chain, from the factory floor, to foreign vendors, land borders and seaports, while expediting border processing for legitimate shipments.

ATTRIBUTION v. INTERVENTION

Typical contemporary planning efforts have focused the greater part of their labor, economic and intelligence resources on prevention, interdiction and attribution rather than intervention. The lead agencies that benefit from this consist of local and federal law enforcement agencies. In addition, the U.S. Coast Guard has a well-supported and significant role in prevention, interdiction and emergency response to maritime threats and disaster incidents.

Consequence management providers, such as acute care medical facilities, the local fire service agencies and EMS first responders, often provide their services under austere agency conditions. They consistently operate in disaster-like conditions in many cases, because of patient volume. These providers have yet to experience parity in the transnational threat preparedness environment. They have not experienced the focused attention, economic or intelligence support that is routinely provided to their counterparts within state and local law enforcement agencies.

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While tens of billions of dollars have been spent on homeland security since September of 2001, in FY 2003, the U.S. Fire Administration was only able to provide grants totaling more than \$673 million to the nations fire service agencies and less than \$4 million to a portion of the nations emergency medical service (EMS) providers for preparedness¹⁰.

DISCUSSION and ILLUSTRATION

To put this in perspective, the following recorded and anecdotal accounts of shipboard explosion disasters are offered. These accounts illustrate common elements experienced globally in similar events.

French Steamship Grandcamp - April 1947: The catastrophic explosion of the French Steamship Grandcamp in Texas City, Texas, involved a total of 2,282 tons of ammonium nitrate. 433 people were killed, including 27 firefighters that died in the initial blast, (their four fire apparatus were obliterated). 128 people were reported missing and presumed dead. Ultimately, the piers, near-by warehouses, industrial plants, tank farms and two other ocean going vessels were involved and destroyed¹¹.

Within 7,000 feet of the Grandcamp's berth were located Monsanto Chemical, Humble Oil, Stone Oil, Republic Oil, eleven warehouses, nine piers, a grain elevator and two-thirds of the residential population of Texas City. Within three miles were located the Tin Processing

¹⁰ USFA Assistance to Firefighters Grant announcement – FY03 Totals

¹¹ Record of Proceedings of Board of Investigation inquiring into explosion of the French Steamship Grandcamp– Findings of Fact: Treasury Department United States Coast Guard, Washington, D.C., 24 September 1947.

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Corporation, Pan American Refining, Carbide and Carbon Chemical Company and the remainder of the residential district. Within this congestion were hundreds of oil tanks, stills, connecting pipelines and supply lines to tanker loading and discharge piers.

Halifax Explosion - December 6, 1917: The French munitions carrier Mont Blanc Explosion Halifax 6 Dec 1917, 2766 tons of picric acid, T.N.T. and guncotton. Called the world's greatest man-made explosion before Hiroshima, Over 2.5 km of Halifax's industrial North end was totally leveled, either by the blast, the subsequent tidal wave or the raging fires caused when structures collapsed inward on roaring stoves and furnaces. Homes, offices, churches, factories, vessels, the railway station and freight yards - all were obliterated.

Further from the epicenter, Citadel Hill deflected shock waves away from South and West Halifax, where shattered windows and doors were the predominant damage. Across the harbor, Dartmouth suffered devastation to a lesser degree, since its North section was sparsely developed. The blast shattered windows in Truro, 100 km away, and was heard in Prince Edward Island.

Out of a population of less than 50,000, over 1,600 people died and 9,000 were injured, including 200 blinded by flying glass. Sixteen hundred buildings were destroyed and 12,000 damaged; 6,000 people were homeless and 20,000 lacked adequate shelter. Total damage amounted to \$35 million.

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S.S. Fort Stikine - April 14, 1944: the S.S. Fort Stikine was berthed at the Victoria and Prince's dock. In its hold were 238 tons of highly sensitive 'A' category and 187 tons of 'C' category of explosives. Around 12.35 p.m. on April 14 smoke was noticed billowing out of the ship. Around 1400 some stevedores noticed the smoke and raised the first fire alarm. The crew promptly swung into action. The fire service crew from the dock joined the efforts. Soon two teams of firefighters and equipment from Carnac Bunder Fire Station reached the scene.

Very soon Chief Fire Officer Coombs and his officers and men reached the burning ship. The time was 1440. Despite all efforts the fire could not be located. The fire fighting crew was unable to reach the fire. The deck and sides of Stikine had turned red. Efforts to cut holes in the sides using oxy-acetylene torch had to be given up due to the water cascading down from the deck. Metal cutters were no match for the heavy gauge steel plate.

The army, fire brigade and fire salvage corps personnel began the job of removing explosives and ammunition from the superheated hold. Radiating heat from the ship set a shed on the dock ablaze.

At 1550, Coombs gave orders to abandon the ship. Some brave and daring officers and men however did not leave their posts and continued to fight the prowling flames. At 1606 a tremendous explosion occurred. Molten metal and raining debris killed the crew still at their posts and showered down over a vast area, starting numerous fires in sheds and other ships berthed at the Victoria and Prince's Docks.

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The explosion was so loud that windows rattled and shattered 8 miles away. Buildings shook as if in an earthquake. People ran out only to be showered with deadly slivers of shattered window glass and lethal chunks of metal torn from ships, dock installations and other solid structures. The destruction in the docks and surrounding area was immense and several hundred-dock workers were killed instantly. About 300 acres of the dock was devastated and 12 other ships in the vicinity perished. At 1640, a second and much more powerful explosion occurred. The S.S. Stikine went up in the air, rising an estimated 3000 feet.

A majority of the Bombay Fire Brigade and Bombay Fire Salvage Corps on scene lost their lives in the second explosion. The fire service infrastructure was devastated. But the valiant firemen continued to fight the fire without respite for days and nights.

Molten metal, un-burned ammunition, barrels of burning oil and bales of burning cotton rained down over an area in excess of one square mile. The force generated by the second blast started a tidal wave that lifted the 400 feet, 4000 ton S.S. Jalpadma clear off the water 50 feet high and slammed her down. Of the 23 ships berthed in Victoria and Prince's docks, only six survived the disaster.

The exact number of people who perished in the fire will never be known. Official records show that Bombay Fire Brigade, its auxiliary services and the Fire Salvage Corps sustained 68 casualties with injuries to 87.

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Port Chicago - July 17, 1944: The E. A. Bryan was a 7, 212-ton EC-2 Liberty ship. By 10:00 p.m. on 17 July, the ship was loaded with some 4,600 tons of munitions including 1,780 tons of high explosives. A second ship, the Quinalt Victory, was brand new; it had moored at Port Chicago at about 6:00 p.m. on the evening of 17 July.

Just before 10:20 p.m., a massive explosion occurred at the pier. To some observers it appeared that two explosions, only a few seconds apart, occurred: a first and smaller blast was felt; this was followed quickly by a cataclysmic explosion as the E. A. Bryan went off like one gigantic bomb, sending a column of fire and smoke more than 12,000 feet into the night sky.

Everyone on the pier and aboard the two ships was killed instantly: some 320 men and very few intact bodies were recovered. Another 390 military and civilian personnel were injured. Property damage, military and civilian, was estimated at more than \$12 million.

The E. A. Bryan was literally blown to bits. Very little of its wreckage was ever found. The Quinalt Victory was lifted clear out of the water by the blast, turned around and broken into pieces. The largest piece of the Quinalt Victory which remained after the explosion was a 65-foot section of the keel, its propeller still attached, which protruded from the bay at low tide, 1,000 feet from its original position.

There was at least one 12-ton diesel locomotive operating on the pier at the time of the explosion. Not a single piece of the locomotive car was ever identified: the locomotive simply vanished. In the river stream,

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several small boats half a mile distant from the pier reported being hit by a 30-foot wall of water.

The incredible blast wrecked the naval base and heavily damaged the small town of Port Chicago, located 1.5 miles away. Some 320 American naval personnel were killed instantly. The two ships and the large loading pier were totally annihilated. Several hundred people were injured, and millions of dollars in property damage was caused by the huge blast. Windows were shattered in towns 20 miles away, and the glare of the explosion could be seen in San Francisco, some 35 miles away. The US Government claimed that 1,780 tons of high-explosive TNT-equivalent exploded spontaneously at Port Chicago.

But, that was last century. Surely things are different now - just examine the port facilities in your jurisdiction for confirmation that you are immune to such threats, your hazard assessment and vulnerability analysis will tell the story.

CONCLUSION

Local fire and EMS first responders routinely respond to these venues in order to provide immediate service for maritime emergencies, including offshore incidents. They will be the first to respond and provide incident management and directed interventions should a terrorist attack occur within their jurisdictions. Obviously, emergency fire and EMS first responder services are not only vulnerable to these events, but many times are co-located within their destructive and damage radius because of the associated high-risk operations conducted there; and the frequency of emergency incidents that are common to these venues.

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For emergency service fire and EMS first responders the implications are clear: commercial seaport and shipboard explosions involving the equivalent of 2,000 or more tons of TNT, (threshold limit), will result in conflagrations producing significant life loss, injury, destruction and damage to surrounding populations and their associated structures, (Much less quantity is required if the involved explosive materials are of military grade high explosive¹²). However, the disruption to commerce from a conventional shipboard explosive event will likely be negligible, short term and have little economic impact on the shipping industry or local port commerce.

Conversely, the impact on local critical infrastructure has the potential to be significant. Some shipboard explosions have been so violent and powerful that they have been recorded seismically as far as one thousand miles from the detonations epicenter¹³.

Typically, these events have a destructive radius of 2,500-3,500 feet, with potential debris impacts every two square feet within the destructive radius, (debris may consist of anything from half pound rivets to portions of superstructures weighing fifty or more tons¹⁴), and a damage radius that may extend for several miles and also include falling debris.

¹² The S.S. Fort Strikine was reportedly loaded with 425 tons of explosives, 238 tons of which were high explosive, when it caught fire and detonated in Bombay, India on April 14, 1944, destroying much of the harbor and three other vessels.

¹³ Seismographs in Simla, India, recorded the S.S. Fort Strikine explosion over one thousand miles away

¹⁴ On December 17, 1976, the S.S. Sansinea exploded in Los Angeles Harbor. The tank deck and midship deckhouse were hurled 750 feet into the air and landed 200 feet ashore

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[Based on calculations derived from news media accounts¹⁵, the recent Iranian train derailment and subsequent explosion, which reportedly killed over 180 rescue, EMS and firefighter personnel¹⁶, had a destructive radius of 1600-2000 feet¹⁷, a debris field radius of 1600 feet and a damage radius of 6-10 miles. The lethal thermal radius was approximately 600-800 feet. It left a reported crater 500 feet wide and 65 feet deep. It registered 3.6 on the Richter scale (400 miles away in the city of Tehran), and was heard as far away as 45 miles.]

In confined harbor spaces, according to anecdotal and physical evidence, shipboard explosion events are frequently complicated by associated explosion-generated tsunamis, which can range in size from eight to more than fifty feet in height¹⁸. In the Texas City incident, witnesses reported the 150-foot steel barge bulk carrier "Longhorn II" was lifted and moved with minimal damage 100 feet onto the shore¹⁹ (probably by an explosion-generated tsunami).

Therefore, it is reasonable to expect that a variety of "collateral damage" events similar to those experienced in conventional theaters of war will likely occur as a result of overpressure and debris rain. This is of

¹⁵ AP, Reuters, IRNA

¹⁶ 320 deaths and 460 injuries have been attributed to the incident, including emergency service workers.

¹⁷ This destructive radius may be the result of a combination of poor construction methods and material quality rather than blast force alone.

¹⁸ A fifty-foot "tidal wave" was reported following the explosion of the S.S. Fort Strikine in Bombay, India on April 14, 1944. "The force generated by the second blast started a tidal wave that lifted the 400-foot, 4,000 ton S.S. Jalpadma clear off the water fifty feet high and slammed her down."

¹⁹ Record of Proceedings of Board of Investigation inquiring into losses by fires and explosions of the French Steamship Grandcamp and U.S. Steamships Highflyer and Wilson B. Keene at Texas City, Texas 16 and 17 April 1947 – Findings of Fact: Treasury Department United States Coast Guard, Washington, D.C., 24 September 1947.

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particular importance to stationary or fixed elements of the local critical infrastructure such as acute care medical facilities, emergency service structures, fire stations or fireboat houses, EMS stations or other government buildings, which may be located within the destructive, damage or tsunami radius of such an event.

Because of the nature of the problem of terrorism, local plan development has been accelerated with little thought for actuality in some cases, while in others, virtually no planning effort has been made to augment existing generic plans. Consequently, we have created a reality wherein practiced but untested plans are assumed to be, and accepted as, sufficient to meet the emergency needs of any given community in all environments under any conditions.

In the all hazards emergency response environment, if a major shipboard or port incident were to occur today, the local fire and EMS first responders would represent the forward body line (FBL), standing there with their hoses or first aid kits in their hands waiting for the shock wave, chemical, biologic or radiological threat to hit them. Acute care facilities would simply brace for a convergent victim load that may be overwhelming.

Unfortunately, acute care medical facilities, local fire service agencies and EMS first responders cannot wait for assistance. If they were to receive victims or are dispatched to an incident while you are reading this, they are going to respond to whatever is presented them. They have to prepare in advance of proffered money, equipment and training. They must begin the process by preparing themselves and their organizations

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for this eventuality. They must begin by allocating funds from within their already stretched budgets for equipment acquisition, training and sustainment.

They must also act in concert with their local government to develop and prepare inclusive response plans that incorporate law enforcement organizations, local health agencies, the medical community and any other critical infrastructure elements with a vested interest in preparedness. Not just a simple generic plan, which is deemed sufficient to meet the needs of any given community in all environments under any conditions, but reality-based plans derived from contemporary threats and the communities true ability to react to them, or they will become victims of their own inaction.

Strategies that are reliant on immediate state and/or federal response will experience increased mortality and morbidity in the event of an attack. For all emergency service providers, the choice is simple. In all cases, it is infinitely better to manage consequence than to suffer consequence while waiting for help to arrive.