Running head: Impacts of Electromagnetic Pulse (EMP) attack on Fire/EMS Delivery Services

Identify Potential Impacts of an Electromagnetic Pulse (EMP) Attack On Fire and EMS Delivery Services for the Walpole Fire Department

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: _____

ABSTRACT

The September 11, 2001 terrorist attacks renewed focus among all levels of emergency services on preventing, training for, and responding to terrorism events, including nuclear attacks. By little emphasis has been put on electromagnetic pulse attacks.

The problem was that the Walpole Fire Department did not know the potential impacts of an electromagnetic pulse (EMP) attack on both fire and emergency medical delivery services.

The purpose of this research was to identify potential impacts of an electromagnetic pulse (EMP) attack on both fire and EMS delivery services for the Walpole Fire Department, to decide whether the Walpole Fire Department was vulnerable to such an attack, and to determine whether we needed to develop a plan for EMP awareness and recognition.

The descriptive research method was used to answer the following questions: (a) What is the reality that an electromagnetic pulse attack on the United States would affect the Town of Walpole Fire Department's ability to provide continued fire and emergency services; (b) How does our government view this threat, and what has been done about it; (c) How would EMP attack affect Walpole Fire Department's fire and emergency medical services communications; (d) What would be the effect of an EMP attack on the Walpole Fire Department's emergency vehicles that are electronically and computer dependent; (e) What type of EMP emergency preparedness planning is taking place at the federal and state emergency management agencies that could assist the Walpole Fire Department; and (f) What can the Walpole Fire Department learn from other fire and EMS organizations about potential impacts of an EMP attack?

The procedures were documented to detail each of the ARP's research questions and consisted of the following: literature review, interviews and questionnaires. Adequate research

practicum was utilized for descriptive research, allowing interested readers to replicate this project to meet the needs of their own organizations.

Literature review has found that an electromagnetic pulse against the U.S. is considered a real threat and that such an attack could negatively impact the Walpole Fire Department's ability to provide continued fire and emergency medical services.

The author strongly feels that research indicates the Walpole Fire Department's fire and EMS delivery services would be vulnerable to an EMP attack and recommends that the Walpole Fire Department develop an EMP awareness and recognition program.

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INTRODUCTION

The fire service has witnessed considerable change in the way it does business; at the same time, it has cluing to some long held values and taken a conservative approach to introducing change. The fire service as we know it today is a relatively new profession compared with other government services and agencies. It was not until the 1930s that fire service skills and qualifications were published. It has only been in the last 100 years that the fire service has seen significant advances in methods and technologies at its disposal. Today's fire service is facing significant new threats and considerable additional responsibilities; to meet those challenges, it will need to carefully monitor and adapt to these changes.

The fire service has always reflected the society or community that it protects. The role of the firefighter of the future will be defined as an "all risk" type of service, not just firefighting. Today's fire service manages firefighting operations, fire prevention, emergency medical services, hazardous materials responses, public health emergencies and, after 9/11, domestic and international terrorism. The fire service is now being asked to do more with less staffing, equipment and financial resources.

The Town of Walpole, Massachusetts is a suburban community of 24,543 residents living in 21 square miles. The community comprises a mix of residential, commercial and industrial properties. There are several strip malls, a large shopping mall, two interstate highways and a major rail line that provides transportation for both commuters and freight. We are also the host community for MCI-Cedar Junction, the state's maximum security prison, which has an inmate population of 660. At our southern border, just over the town line, is Gillette Stadium, home of

the New England Patriots, a 72,000 seat stadium for which Walpole Fire Department provides line box coverage.

The Walpole Fire department is a combination fire department, consisting of a chief of department, a deputy chief, 4captains, 4 lieutenants and 20 Firefighters which staffs 4 rotating shifts. In addition, the department has 4-part time paid call fire fighters. Walpole Fire provides 24/7 suppression, prevention, public education, ALS and BLS transport ambulance service. Of our 34 career members, 20 are certified at the EMT basic level and the remaining 14 are paramedic certified. Approximately 80% of our personnel are trained at the Firefighter I/II level through the Massachusetts Fire Academy. Our community presents many challenges for a department of our size.

The problem is that the Walpole Fire Department does not know the potential impacts of an Electromagnetic Pulse (EMP) attack on both fire and emergency medical delivery services. Without researching these potential impacts, the Walpole Fire Department may be vulnerable to such an event.

The purpose of this research is to identify potential impacts of an electromagnetic pulse (EMP) attack on both fire and EMS delivery services for the Walpole Fire Department and to decide whether the Walpole Fire Department needs to develop a plan for EMP awareness and recognition. The research methodology utilized will be descriptive. Through the use of questionnaires, personal interviews, and literature review, data will be analyzed to better understand and clarify electromagnetic pulse and its potential impacts on the Walpole Fire Department.

The descriptive research method was used to answer the following questions: (a) What is the reality that an electromagnetic pulse attack on the United States would affect the Town of

Walpole Fire Department's ability to provide continued fire and emergency services; (b) How does our government view this threat, and what has been done about it; (c) How would an EMP attack affect Walpole Fire Department's fire and emergency medical services communications; (d) What would be the effect of an EMP attack on the Walpole Fire Department's emergency vehicles that are electronically and computer dependent; (e) What type of EMP emergency preparedness planning is taking place at the federal and state emergency management agencies that could assist the Walpole Fire Department; and (f) What can the Walpole Fire Department learn from other fire and EMS organizations about potential impacts of an EMP attack? The answers to these questions will allow the Walpole Fire Department to make an informed decision as to whether or not to move forward with the development of an electromagnetic pulse awareness plan.

Background and Significance

Imagine a world without power, computers, radios, and telephones. More specifically, imagine modern emergency response without any of the above. Americans have come to rely on the prompt and effective delivery of fire, police, rescue, and emergency medical services, and the September 11, 2001 terrorist attacks renewed focus among all levels of emergency services on preventing, training for, and responding to terrorism events, including nuclear attacks. But little emphasis has been put on electromagnetic pulse attacks. And yet, according to the Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, "an electromagnetic pulse generated by high altitude nuclear explosion is one of a small number of threats that can hold our society at risk of catastrophic consequences" (Commission E., Critical National Infrastructures, 2008). The September 11 commission report states that our biggest failure was one of imagination. No one imagined that terrorists would do what they did

on Sept. 11. Similarly, few Americans today can conceive of the possibility that terrorists could bring our society to its knees by destroying everything we rely on that runs on electricity. "But this time we've been warned, and we'd better be prepared to respond" (Kyl, 2005).

As early as 1962 the United States inadvertently observed the effects of EMP during U.S. and Soviet cold war atmospheric test programs. The Starfish program nuclear detonation, which was not intended to generate EMP effects, did just that. When the U.S. detonated a nuclear bomb 400 kilometers above Johnston Island, in the Pacific Ocean, the Hawaiian Islands, located 1400 kilometers from the test location, experienced effects that included failure of street lights, tripping circuit breakers, burglar alarms, and damage to a telecommunications relay facility. That year the Soviets initiated a number of similar tests at altitudes of 60, 150 and 300 kilometers, resulting in damage to overhead and underground electrical cables and to other power supply breakdowns as far as 600 kilometers from their South Central Asia testing site.

The U.S. and Soviet atmospheric test programs initiated nuclear detonations through the use of E-bomb technology. The e-bomb is also known as an electromagnetic pulse (EMP) weapon. In such weapons electric current produces magnetic fields, and changing magnetic fields induce electric current. The e-bomb concept is to create a magnetic field that overwhelms electrical circuitry. The E-bomb was proposed in 1925 by physicist Arthur H. Compton. "When an e-bomb goes off (here's where Compton's effect comes in) the gamma radiation photons from the bomb deflect a lot of electrons from the atmosphere's nitrogen and oxygen atoms. The freed electrons interfere with the Earth's magnetic field and produce a fluctuating electrical current. The current then induces a potent magnetic field. The electromagnetic pulse induces an overwhelming electrical current in conductive materials ultimately destroying them and any electrical devices feeding off them" (Physics 24/7, 2011) Ironically, this nuclear testing led to an

unexpected demonstration of the power of the Compton Effect, and spawned a new type of weapon.

EMP is an electromagnetic radiation typically generated by a nuclear explosion or a solar event. Both produce damaging electrical current or voltage surges capable of temporary or permanently destroying unshielded electrical and electronic systems. Solar events are beyond the scope of this discussion, although such events do occur on an average of once every one hundred years and must be considered a risk in establishing any robust damage prevention protocols. Nuclear caused EMP, on the other hand, is an emerging threat whose potential must be understood.

EMP generated by a nuclear event consist of these three parts E1, E2 and E3. In an article titled 'E1, E2, E3,' the author Jerry Emanuelson of Futurescience LLC defines the three components of EMP as follows: The E1 pulse component of EMP is very fast. It is brief, but intense, and can quickly induce very high voltages in electrical conductors. E1 causes most of its damage by exceeding the electrical voltage of affected equipment, destroying computers and communications equipment. The energy generated by the E1 component changes so rapidly that ordinary lightening protectors are ineffective against it. The E2 component has many similarities to the electromagnetic pulse generated by lightning, and its intensity is defined by the proximity of the pulse to electrical equipment. Due to its similarities to lightning and the available lightning protection technology, the E2 pulse is generally considered to be the easiest to protect against. The main 1 problem with the E2 component is that it immediately follows the E1 component, which may have already damaged the devices that would normally protect against E2. The E3 component is very different from the other two components of nuclear EMP. An E3 pulse is the most damaging because it lasts the longest and can travel long distances along a

power grid, resulting in widespread damage. The E3 component of the pulse is a very slow pulse, lasting tens to hundreds of seconds, that is caused by a nuclear detonation disrupting the Earth's magnetic field. "It has the power to damage power grids that could take six to eighteen months to repair" (Keller, 2009).

Aware of the catastrophic potential of EMP, the U.S. military has developed standards that establish minimum requirements and design objectives for the high-altitude electromagnetic pulse (HEMP) hardening of transportable and fixed ground based facilities and systems that perform critical time-urgent command, control, communications, computer, and intelligence missions.

This project is specifically relative to the EFO-Executive Development curriculum in the following ways: The issue of EMP is an adaptive challenge for the not only the Walpole Fire Department but the fire service in general. In Leadership on the Line, Heifetz and Linsky state, that "leadership would be a safe undertaking if your organization and communities only faced problems for which they already knew the solution--there is a whole host of problems that are not amenable to authoritative expertise or Standing Operations Procedures"(2002). The adaptive challenge to this ARP will be to gather enough research on EMP so that the Walpole Fire Department will be able to plan for, recognize, mitigate, and recover from such an event. A successful adaptive challenge will only result from a change in our organizational fire service culture, starting locally with the Walpole Fire Department. To face present and future EMP challenges, the fire service will have to adapt to internal and, most importantly, external environments. Our fire department will, however, require the partnership of external organizations for an EMP awareness program to be successful.

This applied research project directly relates to and supports the United States Fire Administration strategic goal "To improve the fire and emergency services capability for response to and recovery from all hazards" (USFA). It is also important to note that this ARP indirectly supports the remaining four USFA strategic goals. In this ARP, the topic of electromagnetic pulse attacks on the United States fire and emergency delivery services will be evaluated on a local level for the Walpole Fire Department in the hopes that electromagnetic pulse awareness energizes the fire service across the United States.

Literature Review

In researching the topic of electromagnetic pulse attacks the literature review will first take a broad view of the subject to establish the urgent need for attention to the risks it poses and then focus on the specific impacts potentially felt at a local level by the Walpole Fire Department's fire and EMS delivery services. In 'Leadership on the Line' this concept is known as "Getting on the Balcony" (Linsky, 2002) and taking a look at the whole picture to ask "what's really going on here." The research questions on this ARP have been designed specifically to follow this concept.

What is the reality of an electromagnetic pulse attack on the United States affecting the Town of Walpole Fire Department's ability to provide continued fire and emergency medical services?

This research paper has been designed to first address the issue of an electromagnetic pulse attack and the actual reality of such an attack on the United States affecting the Town of Walpole Fire Department's ability to provide continued fire and emergency medical services. The cold war, high altitude nuclear testing, of the late 1950s and early 1960s demonstrated the unexpected electromagnetic pulse effects at great distances from testing sites. This research question will address the reality of an EMP attack on the United States and to review recent

documentation in which experts debate the theory that high altitude electromagnetic pulse (HEMP) will affects a broad area of the continental U.S. and, subsequently have a local impact on the Walpole Fire Department.

The report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, which was established by Congress, has as its first duty to assess "the nature and magnitude of potential high-altitude EMP threats to the United States from all potentially hostile states or non-state actors that have or could acquire nuclear weapons and ballistic missiles enabling them to perform a high-altitude EMP attack against the United States within the next 15 years." (EMP Commission Charter)

There was a time when only the United States and Russia possessed nuclear weapons. Following the post cold war era, however, countries such as United Kingdom, France and China, followed by India, Pakistan, Israel, North Korea, and South Africa, developed nuclear programs. Most recently, Iran has initiated its own program. Iran and North Korea are declared enemies of the United States and are believed to be supporters of terrorist organizations, such as al-Qaida. The EMP Commission report states that "several potential adversaries have or can acquire the capability to attack the United States with a high-altitude nuclear weapon-generated electromagnetic pulse (EMP)" (Commission, EMP, 2004). A determined adversary can achieve an EMP attack capability without having a high level of sophistication. Strategic EMP attacks on the U.S. have also been considered and discussed recently by China and post Soviet Union Russia, according to the Commission. Yet, the more imminent threat, according to William Graham, a former chairman of the commission, comes from such rogue states as Iran and North Korea and their terrorist allies" (Farah, 2005). According to Representative Roscoe Bartlett, "Potential adversaries are aware of the EMP's strategic attack option. Ninety-nine percent of

Americans may not know very much about EMP, but I will assure you that 100% of our potential enemies know all about EMP" (Farah, 2005). "In the blink of an eye, electromagnetic bombs could throw civilization back 200 years. And terrorists can build them for $400" (Wilson, 2001).

One of the biggest threats to the United States is the possibility of a terrorist EMP attack from a Scud missile deployed from a freighter off of our shorelines or busy seaports. This opens the nuclear door to countries and terror organizations that do not have the sophistication and resources to develop their own nuclear programs. "Evidence exists of keen interest in EMP by terrorists and their allies. Iran has tested versions of its Shahab missiles in trajectories ending in midflight explosions, exactly as would be expected of an EMP strike. Launches have also been made from shipboard, a method useful to attacking the continental United States" (Dunn, 2006). The common theme, in this literature is 'not if, but when' the United States will experience an electromagnetic pulse attack and from whom, a rogue nation or a terrorist organization.

The second part of this question deals with the broad extent of the impact of such an attack over the continental U.S. "North Korea's lasts round of tests, conducted in May 2009, appear to have included a (Super-EMP) weapon, capable of enough gamma rays to disable the electric power grid across most of the lower 48 states, "says Dr. Peter Vincent Pry, a former CIA nuclear weapons analyst" (Timmerman, 2011). The theory behind electromagnetic pulse is that the higher the nuclear detonation in the atmosphere the more widespread the electromagnetic damage of the blast. The diagram illustrates that a high-altitude EMP detonation between 120-300 miles away would impact the Town of Walpole, Massachusetts and the Walpole Fire Department

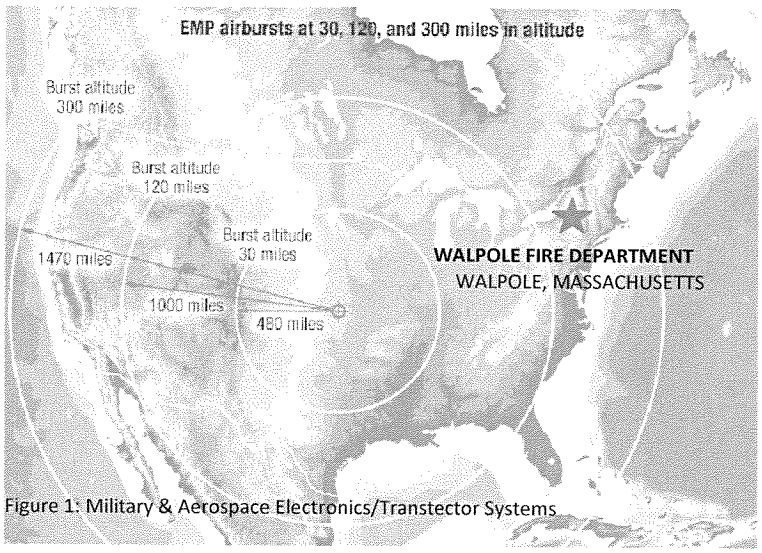


Figure 1: Military & Aerospace Electronics/Transtector Systems

A nuclear weapon detonated at an altitude of 400 kilometers (248 miles) over the central United States would cover the entire United States and part of Canada and Mexico, with its primary electromagnetic pulse. "An implication for operational planning it that a potential EMP threat must be anticipated in every locality during the first minutes and perhaps hours after a nuclear attack is initiated" (FEMA, 1987).

How does our government view this threat and what have they done about it?

In 1958, U.S. nuclear weapons designers detonated hydrogen bombs high over the Pacific Ocean (Wilson, 2001). The results of this testing caused disruption of radio navigation for up to eighteen hours and as far away as Australia. "The United States set out to learn how to harden electronics against this electromagnetic pulse (EMP) and develop EMP weapons" (Wilson, 2001). Wilson also points out that America has remained at the forefront of EMP weapons development. Although much of this work is classified, it's believed that current efforts are based on using high-temperature superconductors to create intense magnetic fields.

A review of the literature reveals a number of existing government reports and acts that are directly or indirectly related to electromagnetic pulse: The Report of the Commission to

Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack 2004 & 2008; House of Republicans Bill H.R.5026, referred to as the "GRID Act;" House of Republicans Bill H.R. 668, referred to as the "SHIELD Act" and House of Republicans Bill H.R. 4842, cited as Homeland Security Science and Technology Authorization Act of 2010.

The EMP Commission was first established under a majority Republican Congress and then reconvened under a majority Democratic Congress. The Commission's 2004 report states that EMP is one of a small number of threats that can hold our society at risk of catastrophic consequences and that it has the capability to produce significant damage to critical infrastructures and thus to the very fabric of US society (Commission, EMP, 2004). The 2004 and 2008 Commission reports, share a similar main theme, the identification of infrastructure in the U.S., and its vulnerability to EMP, and of making recommendations to protect against EMP. Whereas the Commission's 2004 report lays the foundation for the potential use of EMP as a weapon of mass destruction against the U.S., its 2008 report elaborates a more systematic approach to protecting critical infrastructure. In each Commission report, a number of critical infrastructures are identified, such as electric power, transportation, telecommunications, food, water, banking, government and emergency services. The Commission's report on emergency services, referenced throughout this paper, relates directly to the impacts of electromagnetic pulse (EMP) attacks on fire and EMS delivery services for the Walpole Fire Department.

After reading both Commission reports I reached out to the Commission, through email and presented this papers research question and received a reply from Dr. Michael J. Frankel who is the Commission's Executive Director. Mr. Frankel stated that "In the event of an EMP scenario, fire fighting-which relies on the functioning of numerous electronic systems-would indeed be affected. In particular, modern systems which ubiquitously rely on intelligent control

systems to manage pumps and other equipment might be expected to misbehave." (2011) EMPact America is a non-profit organization run by a former Commission staffer for citizens concerned about protecting the American people from a nuclear or natural electromagnetic pulse catastrophe. Dr. Peter Vincent Pry, President of EMPact America states that "EMP and its effects on fire fighting capabilities would be severe" (Appendix A).

The U.S. House of Representatives has before them legislation that acknowledges the threat of EMP and the necessary protection measures needed to protect our nation's critical electrical infrastructure. The following two Bills are before the U.S. House of Representatives for consideration: H.R. 5026 and H.R 668.

House Bill H.R. 5026 (111th Congress 2D Session) is a bill "To amend the Federal Power Act to protect the bulk power system and electric infrastructure critical to the defense of the United States from cyber security and other threats and vulnerabilities" (Congress, H.R. 5026 "Shield Act", 2010) (hereafter referred to as the GRID Act) by adding Section 215A-Critical Electric Infrastructure Security. Within this new section electromagnetic pulse is referenced under the following categories: Defense Critical Electric Infrastructure Vulnerability, Definitions of Electromagnetic Weapon, Geomagnetic Storm, Grid Security Threat, and Grid Security Vulnerability. Most importantly, this bill gives directives to the Commission members, established under the Federal Power Act, to protect and identify grid security vulnerability to the U.S critical electric infrastructure.

House Representatives Bill H.R. 668 (112th Congress 1st Session) is a bill "To amend the Federal Power Act to protect the bulk power system and electric infrastructure critical to the defense of the United States against natural and manmade electromagnetic pulse (EMP) threats and vulnerabilities" (Congress, H.R.668 "Grid Act", 2011) (Hereafter referred to as the GRID

Act). The GRID Act amendments directly reference the findings within the EMP Commission's report and build off the initial work of the Commission.

In response to the September 11, 2001 terrorist' attacks, the Department of Homeland Security (DHS) was established under the Homeland Security Act of 2002. Bill H.R. 5026 is an act "To authorize appropriations for the Directorate of Science and Technology of the Department of Homeland Security for fiscal years 2011 and 2012 and for other purposes" (Security, 2010). Section 404-Cybersecurity Research and Development states that the under secretary shall support "long-term research to improve the ability of the United States to prevent, protect against, detect, respond to, and recover from acts of terrorism and cyber attacks, with an emphasis on research and development relevant to large scale, high-impact attacks." This Act also states that the Commission shall give particular attention to "electromagnetic phenomena such as geomagnetically inducted currents, international electromagnetic interference, and electromagnetic pulses caused by nuclear weapon" (Security, 2010).

How would an EMP attack affect Walpole Fire Department's fire and emergency medical services communications?

The Walpole Fire Department is critically dependent on our communication to receive, respond to and mitigate calls for service. Our department needs to know whether or not our communication systems would experience disruption or failure as a result of an EMP attack. The research to answer this question included military and NFPA standards, the EMP Commissions Report's and related literature review.

An Annex to Homeland Security's National Infrastructure Protection plan (NIPP), the 'Communications Sector-Specific Plan' states that "Across the Communications Sector, risk assessments are an ongoing activity designed to include new asset and network configurations, as well as the evaluation of existing assets in light of new threats" (DHS, 2010). Under the

Communications Sector Specific Plan's risk assessment framework, the first goal is to have a resilient infrastructure for communications that should be able to withstand natural or manmade hazards with minimal interruption or failure. Otherwise, McNeill maintains, "Communication abilities would be limited, preventing federal, state, and local governments from communicating with one another-severely limiting abilities to shift needed resources around the country" (McNeill, 2008).

The main theory behind an EMP attack is that it will severely or catastrophically impact our Nation's electrical system, a system integral to the functioning of all independent infrastructures in the U.S., including emergency communication systems.

The following illustration shows how interdependent each critical infrastructure in on each other and the potential impacts on the Walpole Fire Departments Fire and Emergency Medical Services (EMS) communication systems.

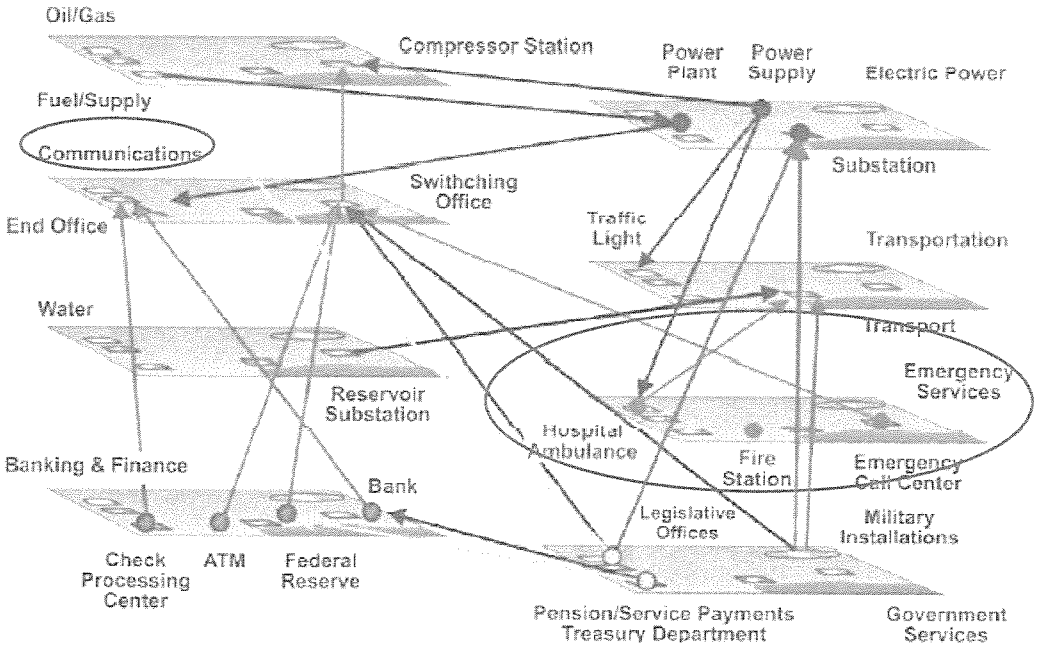


Figure 1: Interdependent Infrastructure Sectors/EMP Commission Report

The illustration clearly shows the United States' reliance on electrical power and the need to protect this critical infrastructure against the threat of EMP or any other natural or manmade attack. As the Commission points out, "Mobile radio communications equipment can be expected to experience disruption and failure at EMP threat levels that are likely to be experienced. Moreover, emergency services are critically dependent on the commercial telephone network, on electric power, and thus on fuel for backup generators" (Commission, 2004).

The military has special standards for technical requirements and design objectives for high-altitude electromagnetic pulse (HEMP) protection for both ground-based and transportable systems. These systems perform critical and time-urgent command, control, communications, computers, and intelligence missions. Similar to the military, but on a much smaller scale, the Walpole Fire Department also performs critical and time-urgent missions. The military standards researched and referenced thus far do not specifically identify impacts to communication systems or military vehicles, but they do recognize the critical need to protect such systems from EMP events. MIL-STD-188-125-1 and 2 address concepts and terminology that are infrequently, if ever, used in the fire service "hardness" and "shielding" of ground-based and transportable communication systems. These standards nonetheless have established requirements for the design, engineering, fabrication, installation and testing of all mission critical equipment.

The National Fire Protection Agency (NFPA) 1221 document is a standard for the 'Installation, Maintenance, and Use of Emergency Service Communications Systems.' The scope of this standard covers the installation, performance, operations and maintenance of public emergency services communications systems and facilities. The application applies to dispatching, telephone, public reporting and one-and two-way radio systems. Even though this

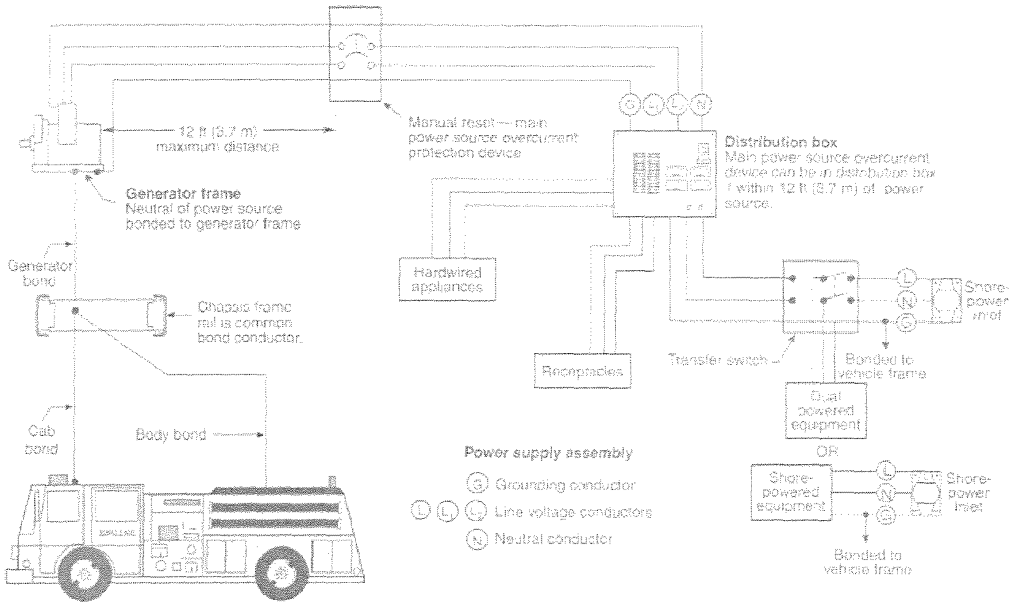
standard does not directly identify the impacts of EMP, it does so indirectly under section 4.6 'Security,' by stating that "The communications center and other buildings that house essential operating equipment shall be protected against damage from vandalism, terrorism, and civil disturbances" (NFPA, 2009). Under NFPA 1221 section 9.3.8.3 electromagnetic interference is identified for microwave systems only in that microwave communication systems need to meet specifications to prevent interference when in the vicinity of AM and FM radio and TV transmitters. NFPA 1221 does not reference hardening or shielding of critical equipment, but it does reference transient voltage surge suppression (TVSS), grounding systems, lightning, and circuit protection.

What would be the effect of an EMP attack on the Walpole Fire Departments emergency vehicles that are electronically and computer driven?

In a report from Transtector/PolyPhaser Protection Technology Group titles "EMP Mitigation-Protecting Land Mobile Vehicles from HEMP Threat Environment", the challenges of protecting land mobile vehicles from EMP for the purposes of maintaining mobility are addressed. The report acknowledges that modern civilian and military vehicles equipped with transistor-driven radio, power and control electronics are highly vulnerable to electromagnetic damage. Transtector/PolyPhaser has developed a wide range of products that effectively protect military C4I systems. "While most hardening efforts focus on mission critical electronics, mainly meaning C41 (Command, Control, Communications, Computer, and intelligence systems, protecting continuous mobility has attracted heightened attention as well" (Hendricks, 2011). Testing to MIL-STD-188-125, simply put, involves the effectiveness of electromagnetic shielding and hardening of system components to include land mobile vehicles. The report goes on to identify three basic design practices for effective hardening of critical system components: construction of Faraday boxes around critical systems, bonding to a single-point ground system,

and surge filter protection of all entry/egress points for electronic connections. A Faraday cage's operation is based on the fact that an external static electrical field will cause the electrical charges within the cage's conducting material to redistribute them, so as to protect the equipment within the cage's interior. According to Hendrick's, "To meet our objective of keeping the vehicle moving through an EMP assault, we will first have to look at an analysis of the electrical system to determine which components are sensitive to damage and should therefore be placed into a Faraday shield environment" (Hendricks, 2011). The following graphic illustrates a typical line voltage electrical system for fire apparatus.

Diagram 1: Typical Line Voltage Electrical System for Fire Apparatus-NFPA 1901: A.22.1



The EMP Commission addresses transportation not as a single infrastructure but rather as a multiple infrastructure of several modes of transportation. The Commission also acknowledges that modern technology has led to a tremendous increase in electronics that are vulnerable to EMP, recommending a strategic plan to "Sponsor development of automobile robustness specifications and testing of EMP and that these specifications should be implemented by

augmenting existing specifications for gaining immunity to transient electromagnetic interference (EMI), rather than by developing separate specifications for EMP" (Commission, 2004). These standards include two standards already discussed: MIL-STD-188-125 and NFPA-1901.

The Walpole Fire Departments emergency vehicle fleet is predominantly Emergency One Apparatus (E-One). E-One is headquartered in Ocala, Florida with our local dealer in North Attleboro, Ma. Their website states that they area worldwide designer, manufacturer and marketer of fire rescue vehicles with more than 23,000 vehicles in operation around the world. In the town of Walpole, we have a Pierce Fire Apparatus dealership owned by OshKosh Corporation, headquartered in OshKosh-WI, one of the top manufacturers of civilian fire and military vehicles.

In a questionnaire given to Fire Chiefs in Norfolk County Massachusetts, respondents were asked "Who is the manufacturer of your department's fire apparatus? Since many fire departments have more than one type of fire apparatus manufacturer, within their fleet of vehicles, they were allowed multiple responses to this question. Of the responses collected 77.8% currently have E-One fire apparatus in their departments, while 44.4% have Pierce fire apparatus. The questionnaire was designed to allow multiple choices since it is common that fire departments have more than one type of fire apparatus manufacturer. (Appendix A)

Although the Walpole Fire Department currently has no Pierce Fire apparatus within our fleet, the company's products underscore the importance of equipping hardening. Oshkosh manufactures military vehicles designed to military standards, such as MIL-STD-188-125, which establishes a minimum design requirement for EMP/HEMP (High Altitude Electromagnetic Pulse) hardening of fixed and transportable ground-based systems, and MIL-STD-464, which

establishes requirements for electromagnetic environmental effects for Department of Defense systems. Pierce's vehicle specifications or vehicle literature does not make any reference to EMP protection design. The company states that "Pierce is the first apparatus manufacturer to be both 3rd parties certified to NFPA 1901-2009 edition and Underwriters Laboratories Canada standards" (Pierce Manufacturing, 2011) Mr. Roger Lackore, the Director of Product Safety for Oshkosh Corporation and a committee member for NFPA 1901 Standard for Automotive Fire Apparatus, states that Oshkosh designs to Military EMP Standards, but their fire apparatus division (Pierce Manufacturing) designs to NFPA 1901 standards (Lackore R., 2011). Mr. Agustin Acosta, a Senior Electrical Engineer with primary responsibilities in Research and Development at E-One Fire Apparatus, stated that E-One also designs their fire apparatus to NFPA 1901 standards (Acosta, 2011). At the company's web site, E-One's vehicle specifications do not reference EMP protection design.

NFPA 1901 does not reference EMP, but it does reference electromagnetic interference (EMI) and radiofrequency interference (RFI). NFPA 1901 states that its "standard defines the requirements for new automotive fire apparatus and trailers designed to be used under emergency conditions to transport personnel and equipment and to support the suppression of fires and mitigation of other hazardous situations" (NFPA, 2009). In section 13.7, NFPA addresses electromagnetic interference, stating that it shall be provided and that it satisfies the radiation limits specified in SAE J551/1: Performance Levels and Methods of Measurement of Electromagnetic Compatibility of Vehicles, Boats (up to 15m) and machines. It is within SAE J551/1 that EMI and RFI are defined. NFPA expands on electromagnetic interferences in Annex A.13.7, highlighting the scope of SAE J551/1 to provide testing procedures to control the amount of radio interference resulting from equipment installed on the fire apparatus.

What type of EMP emergency preparedness planning is taking place at the federal and state emergency management agencies that could assist the Walpole Fire Department?

This question explores the awareness level of EMP as evident in current Department of Homeland Security (DHS), Federal Emergency Management Agency (FEMA), Massachusetts Emergency Management Agency (MEMA), and the Town of Walpole emergency preparedness documentation. It is useful to refer to non-government agencies, such as NFPA, to address this question. The literature available identifies the levels of EMP emergency preparedness planning to educate the Walpole Fire Department at the local level. The literature shows that many federal, state and local preparedness documents frequently use the term "all hazards" or similar terminology to group all natural and man-made disasters together.

In reasearching EMP at the federal preparedness level the following Department of Homeland Security documents will be discussed in relationship to electromagnetic pulse: Homeland Security Presidential Directive (HSPD) 8-National Preparedness, the 2007 National Preparedness Guidelines, and the 2008 National Response Framework.

Homeland Security Presidential Directive 8 has gone through a number of revisions from the original document in 2003. The directive is aimed at strengthening the security and resilience of the United States against threats that pose the greatest risk to the security of the Nation. The risks identified are acts of terrorism, cyber attacks, pandemics, and catastrophic natural disasters. The goals of this directive are to establish a national approach to homeland security preparedness across all levels of government, including private sector and non-government organizations; to establish guidance for specific planning and training to meet this preparedness goal; and too establish national planning frameworks and preparedness guidelines.

The National Preparedness Guidelines of 2007 were established by the Secretary of Homeland Security as directed by HSPD-8 to develop a national domestic all-hazards

preparedness goal. There are four critical elements to this document: National Preparedness Vision, National Planning Scenarios, Universal Task List (UTL), and Target Capabilities Lost (TCL). The following review concentrates entirely on the National Planning Scenarios and their relationship to EMP. The planning scenarios were developed by the Homeland Security Council, DHS and other federal departments and agencies, state, local, and tribal agencies. The planning scenarios place special emphasis on preparing for catastrophic threats with the greatest risk of mass casualties, massive property loss, and immense social disruption. The EMP Commission's 2004 report states that EMP has the capability to produce significant damage to critical infrastructures and thus the very fabric of US society. In a 2005 article written in the Journal of Civil defense, Kyl makes the following recommendation: "Incorporate EMP Attacks into National Planning Scenarios. The National Planning Scenarios are 15 all-hazards planning scenarios used by federal, state, and local officials in disaster response exercises. The exercises can determine capabilities and needs and address problems before a disaster instead of after the fact. Given an EMP attacks unique nature and its ability to paralyze the U.S., individual preparation is necessary. EMP must be added to this list" (Kyl, 2005).

The following table shows all fifteen National Planning Scenarios that have been designed for training purposes.

Table 1: National Planning Scenarios-2007 National Planning Guidelines (DHS)

National Planning Scenarios	
Improvised Nuclear Device	Major Earthquake
Aerosol Anthrax	Major Hurricane
Pandemic Influenza	Radiological Dispersal Device
Plague	Improvised Explosive Device
Blister Agent	Food Contamination
Toxic Industrial Chemicals	Foreign Animal Disease
Nerve Agent	Cyber Attack
Chlorine Tank Explosion	

Literature review has found that the Department of Homeland Security does not consider EMP an immediate threat and thus has not included it within the national planning scenarios. "Meanwhile, the Department of Homeland Security (DHS) has focused on other urgent threats, such as from conventional explosives devices or chlorine bombs, concluding that EMP is simply not a large enough threat for its attention. Even the National Infrastructure Protection Plan (NIPP), the plan dedicated to ensuring that U.S. critical infrastructure is protected from terrorist attack, does not directly address the EMP threat" (McNeil, 2008). Even though EMP is not listed as a scenario, it is important to note that the National Preparedness Guidelines encourage planners from developing their own scenarios to supplement the fifteen National Planning Scenarios.

Homeland Security documents clearly show that the threat of an EMP attack on the United States is not presently addressed nor is there any mention that it will be in the near future. According to Farah, he states that "I think that the American people need to know about EMP because they need to demand that their government do the prudent thing so that we will be less and less susceptible, less and less at risk to an EMP attack year by year. The threat is not adequately addressed in U.S. national and homeland security programs. Not only is it not adequately addressed; it is usually ignored, not even mentioned, and it certainly needs to be considered" (Farah, 2005).

In FEMA's 'Are You Ready' an In-Depth Guide to Citizen Preparedness, electromagnetic pulse is referenced under section 4.5, Nuclear Blast. FEMA talks about damage to communication systems, computers, electrical appliances, and automobile or aircraft ignition systems. Discussing protection from a nuclear blast, FEMA state, "The danger of a massive strategic nuclear attack on the United States is predicted by experts to be less likely today.

However, terrorism, by nature, is unpredictable." Unusual among FEMA documents, this guideline specifically identifies EMP as an actual event.

At the State level, it was difficult to locate any reference to electromagnetic pulse. On the Massachusetts Emergency Management Agency's (MEMA) website or within the Commonwealth of Massachusetts Comprehensive Emergency Management Plan, no mention of EMP is made. Through its planning department, the Massachusetts Emergency Management Agency has worked closely with the Commonwealth's 351 cities and towns to make sure that their 'All Hazards Comprehensive Emergency Management Plan's (CEMP) are up to date. The Town of Walpole's CEMP was recently updated and approved by MEMA in 2011. This plan is currently available through electronic version at the Walpole Town Hall and MEMA. Within the CEM plan is a 'Terrorism Incident Response Plan.' The purpose of this plan is to identify weapons of mass destruction (WMD), which historically have been chemical, biological, radiation, nuclear and explosive (CBRNE). The theory of electromagnetic, pulse, as a nuclear WMD, is neither referenced nor identified in this stand-alone document. What this document does reference is crisis and consequence management. Crisis management refers to measures to identify, acquire, and plan the use of resources needed to anticipate and/or resolve a threat or act of terrorism," and consequence management includes measures to protect public health and safety, restore government services, and provide emergency relief to governments, businesses, and individuals affected by the consequence of terrorism" (Town of Walpole, 2011).

The National Fire Protection Association (NFPA) standard 1600 addresses 'Disaster/Emergency Management and Business Continuity Programs. According to NFPA, "This standard provides fundamental criteria to develop, implement, assess, and maintain the program for prevention, mitigation, preparedness, response, continuity, and recovery" (NFPA

1600, 2010). NFPA 1600 was developed as an all-hazards document and does not identify specific hazards such as EMP. Electromagnetic pulse is referenced within Annex A.5.4.2.1, hazards identification, under the category of an international hazard. Further research of NFPA standards revealed no other references to EMP.

What can the Walpole Fire Department learn from other Fire/EMS organizations on potential impacts of an EMP attack?

This research paper will attempt to identify what other Fire and EMS organizations see as potential impacts of an EMP attack on their delivery services. It will be through this identification process that the Walpole Fire Department will learn about the level of EMP awareness of these organizations at the federal, state and local levels.

An entity of the Department of Homeland Security's Federal Emergency Management Agency, the United States Fire Administration (USFA) mission is to provide national leadership for our fire and emergency service stakeholders in prevention, preparedness, and response. According to the USFA website, America's fire death rate is one of the highest per capita in the industrialized world and the USFA's challenge is to reduce America's fire death rate of its citizens and firefighters. The USFA fire estimated summary of 2010, for residential building fire causes, list the following major causes of fire in order: cooking, heating, electrical malfunction, other unintentional-careless, open flame and intentional. The United States Fire Administration appears to have a specific mission: to reduce America's fire death rate. An extensive search of their website and training programs reveals no indication that the agency addresses EMP awareness or EMP impacts on the fire service.

The Massachusetts Department of Fire Services (DFS) is a public safety division under Massachusetts Executive Office of Public Safety (EOPS). DFS mission is to provide the people of Massachusetts the ability to create safer communities through coordinated training, education,

prevention, investigation, emergency response and leadership. The Massachusetts Firefighting Academy (MFA) provides fire service training, at no cost, to the Commonwealths 351 cities and towns. The Massachusetts Regional Hazardous Material Response Program consists of six strategically located hazardous material teams throughout the Commonwealth. According to DFS's website, the hazardous material response teams provide a specialized response of personnel and equipment to protect the public, the environment, and property during incidents involving a release of hazardous material. Similar to the USFA website, an extensive search of DFS's website and training programs gave no indication that DFS, MFA or the Hazardous Materials Response Program addresses EMP awareness or EMP impacts on the fire service.

The Town of Walpole, Ma is located in Norfolk County Massachusetts. Norfolk County is made up of twenty-eight cities and towns, each with its own fire department. Over the years the Commonwealth has experienced either the abolishment of counties and/or functions transferred from County to State government. In 1966 "The Home Rule" amendment was enacted, allowing towns and cities across the Commonwealth to establish their own local form of government. As a result of this Amendment, we now have 351 cities and towns that act independently of state government while still remaining dependent on state funding. A review at the local fire service level reveals findings similar to those at the federal and state levels, that EMP awareness or EMP impacts on the fire service were not being addressed.

PROCEDURES

The topic of this research paper 'Identify Potential Impacts of an Electromagnetic Pulse (EMP) Attack on Fire and EMS Delivery Services for the Walpole Fire Department' originated after the author read William Forstchen's book <u>One Second After</u>. This book talked about a weapon of mass destruction, electromagnetic pulse, and the terrifying consequences of such an

attack on the United States and society as we know it today. After reading this book the author researched this topic and found even though this book is a work of fiction, electromagnetic pulse is a real threat. To identify the potential impacts of an EMP attack, descriptive researched methodology was selected to evaluate the theory behind EMP, to clarify the current threat of EMP, detail what is being done about this potential threat and its potential impacts, and the attitudes and opinions of others regarding the threat.

Research on this ARP began on July 26, 2011 at the National Fire Academy's Learning Resource Center (LRC) while attending the Executive Fire Officer two week Executive Development course. With the assistance of the LRC staff the author was able to reference a number of in-house documents on the topic of electromagnetic pulse. While attending the NFA, on line research was utilized to research the LRC's extensive applied research projects on file. The author fully understood the value of the LRC center and took every opportunity to utilize this onsite NFA resource.

While attending the Massachusetts Maritime Academy's masters in Emergency Management program I quickly found the value of keeping a journal of all literature research to document dates, websites, interviews, names, journals, reports and books, etc. This practice continued while researching this ARP and proved essential as days turned into months and topics went from abstract to recommendation.

Prior to departing the NFA's Executive Development course the author was required to present a draft of his applied research proposal to his instructor's for review. The instructors, working with the author, helped redefine the ARP's problem and purpose statements as well as the research questions, research method and approach. After leaving the NFA the author sent his

completed ARP proposal to his advisor for review. After some further modifications the advisor gave the green light to move forward.

The following procedures will document sufficient detail for each of the ARP's research questions to show the following: that adequate research practicum was utilized for descriptive research, to allow interested readers to replicate this project to meet the needs of their own organizations, and to show that the procedures were appropriate to achieve that ARP's stated purpose statement.

What is the reality of an electromagnetic pulse attack on the United States affecting the Town of Walpole Fire Department's ability to provide continued fire and emergency medical services?

Earlier research had shown that the theory of electromagnetic pulse, as a nuclear terrorist attack, was a real threat. The research for this question needed to determine who posed this potential threat on the U.S. and the likely hood of such an attack. The research method used to answer the above question was mainly literature review gathered through extensive document research on the reality of an electromagnetic pulse attack on the United States affecting the Walpole Fire Department. Of all the ARP research questions, this question had more documented resources than any of the other research questions. In William Forstechen's book, <u>One Second After</u>, the author references a report called "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack." This report proved to be a valuable research document for this paper but at the times hindered research because it is referenced as a source in a number of other documents.

How does our government view this threat and what have they done about it?

The research methods used to answer the above question utilized literary review of the

following documents: EMP Commission Reports (2004 and 2008), the Congressional Grid and Shields Acts, and Homeland Security's Act to authorize appropriations for the Directorate of Science and Technology. In reaching out to the EMP Commission, I was able to correspond with the Executive Director of the EMP Commission, Dr. Michael Frankel, and a former commission member, Dr. Peter Pry. (Appendix A) Dr. Pry is currently the President of EMPact America, which is a non-government organization established to educate the public on electromagnetic pulse. EMSPact America's web site provided valuable research sources for this paper, including links to the above mentioned congressional bills and acts.

How would an EMP attack effect Walpole Fire Departments fire and emergency medical services' communication?

The research methods used to answer the above question consisted of a questionnaire to fire chiefs in Norfolk County, Massachusetts (Appendix C) and literary reviews that included, but were not limited to, the following documents: Homeland Security's National Infrastructure Protection Plan (NIPP), Military Standards MIL-188-125-1 and 2, and the National Fire Protection Agency (NFPA) 1221. In a 14 item questionnaire sent out to twenty-eight fire chiefs question number eight asked "Are your fire department's communications designed to withstand and EMP event?" Of the 19 respondents, 95.7% responded either 'no' or 'unsure.' When asked what type of communication equipment is currently used for mobile and portable radios, eighteen identified Motorola. Research that identified the effects of an EMP attack on fire/EMS communications was limited. The bulk of research produced documents that addressed how to prevent communication damage from such an attack, but not what the damage would be.

What would be the effect of an EMP attack on the Walpole Fire Department's emergency vehicles that are electronically and computer driven?

The research method used to answer the above question was a literature review of military, NFPA, and private sector standards, the EMP Commission's report, questionnaires, and personal interviews.

The author interviewed Mr. Agustin Acosta, Emergency One Fire Apparatus (E-One), who holds a position of senior electrical engineer with primary responsibilities in research and development for E-One. The author also interviewed Mr. Roger Lackore, the Director of Product Safety for Oshkosh Corporation--owners of Pierce Fire Apparatus. I sent out a pre-interview questionnaire (Appendix B) to Mr. Lackore and Mr. Acosta on November 13, 2011 and followed up on their responses on December 6, 2011 by a phone interview.

A separate questionnaire sent out to Norfolk County Fire Chiefs (Appendix C) they were asked fourteen questions relative to EMP awareness levels. When asked of the following five USFA goals (all five were listed) which would be met by establishing an EMP awareness program, 78.95% responded to "Improve the fire and emergency services capability for response to and recovery from all hazards."

What type of EMP emergency preparedness planning is taking place at the Federal and State Emergency Management Agency's that could assist the Walpole Fire Department?

The research methods used to answer the above question utilized extensive literary review of the following agencies documents: Department of Homeland Security, Federal Emergency Management Agency, Massachusetts Emergency Management Agency, the Town of Walpole's Comprehensive Emergency Management Plan, and the National Fire Protection Association. Research methods also included a personal one-on-one interview with MEMA Regions 2 Director, James Mannion as well as email communication with NFPA-1600

committee chair, Donald Schmidt. Within the literature review I documented these communications with Mr. Mannion and Mr. Schmidt and the level of EMP awareness within their agencies.

What can the Walpole Fire Department learn from other Fire/EMS organizations on potential impacts of an EMP attack?

The research methods used to answer the above question were a combination of literature review, questionnaires, and a personal interview. Research focused on the following federal, state and local fire service organizations: the United States Fire Administration, the Massachusetts Department of Fire Services, the Massachusetts Firefighting Academy, and Norfolk County, Massachusetts fire chiefs. An extensive literature review of each organization's web sites, training, and mission statements was evaluated to determine the level of EMP awareness of each organization. A personal interview with Mr. Mark Parr, Assistant Director of the Massachusetts Fire Academy, and a questionnaire sent out to twenty-eight fire chiefs in Norfolk County (See Appendix C) were also utilized as research methods to answer this question.

RESULTS

The purpose of this research was to identify potential impacts of an electromagnetic pulse (EMP) attack on both fire and EMS delivery services for the Walpole Fire Department and to decide on whether the Walpole Fire Department needs to develop a plan for EMP awareness and recognition. Through well thought out research questions literature review was analyzed to better understand and clarify electromagnetic pulse and its potential impacts on the Walpole Fire Department. This section of the research paper will define specific results to each original research question as they were documented in this papers literature review and procedures sections.

Literature review has found that an electromagnetic pulse against the U.S. is considered a real threat and such an attack could negatively impact the Walpole Fire Departments ability to provide continued fire and emergency medical services. The threat of EMP has been found to be factual as documented, within this paper, scientifically through EMP theory and practically through U.S. and Soviet post war high altitude nuclear test programs. EMP as a threat to the U.S. as a terrorist attack, has been confirmed through acknowledgment of The EMP Commission which has stated that "The electromagnetic pulse generated by high altitude nuclear explosion is one of a small number of threats that can hold our society at risk of catastrophic consequences" (Commission, EMP, 2004). Literature review identified countries such as Iran and North Korea, who are declared enemies of the United States, which have or can acquire the capability to initiate an EMP attack against the U.S. or provide this capability to their terrorist allies. A determined adversary can achieve an EMP attack without having a high level of sophistication or a lot of money. Literature review has shown that the impact of an EMP attack is determined by the altitude the weapon is detonated. A nuclear EMP detonation at about 400 kilometers (248 miles) over the central U.S. could potentially impact the entire U.S. and part of Canada and Mexico. In such an attack the Walpole Fire Department most likely would be impacted.

The results of the Literature review have found that our government is aware of EMP, that they view it as a threat and that they are currently addressing it. Since the early 1960's our government was taking part in high altitude nuclear detonation testing over Johnston Island in the Pacific Ocean. Literature review has shown that even though the U.S. was well aware of the theory and impacts of EMP they appeared not to be overly concerned because at the time the United States only threat was the Soviet Union. Over the years this has changed as rogue nations have developed nuclear technology, which have the capability to acquire it, as previously

discussed. In light of post 9-11 threats, Congress established the Commission to Assess the Threat of the United States from Electromagnetic Pulse (EMP) Attack. The Commission reported its findings, to Congress, in two separate reports defining EMP as a threat, its potential impacts to critical U.S. infrastructure and recommendations to limit or prevent the threat. After the Commissions 2008 report they were disbanded, by Congress, and to date have not reformed. In researching this paper I reached out to former Commission staffers, Dr. Michael Frankel and Dr. Peter Pry. I presented the papers topic and the problem that the Walpole Fire Department was experiencing in not knowing the impacts of an EMP attack on our fire and EMS delivery systems. Each agreed that there would be impacts on these systems and Dr. Pry went as far as saying that our capabilities would be severe. Through EMPact Americas website I was able to reference and research two Bills before the House of Representatives and the Senate that amend the Federal Power Act; the Shield and GRID Acts. The Shield Act added language to protect the bulk power system and electrical infrastructure critical to the defense of the United States from cyber security and other threats and vulnerabilities. The GRID Act added language to protect against natural and manmade electromagnetic pulse threats and vulnerabilities.

The research results confirmed that the threat of EMP exists and that our government is aware of this threat. Knowing that EMP will have an impact on the fire and EMS delivery services the next two research questions address the actual impact's on our communication systems and fire department vehicles. Literature review research found more documentation and standards that address EMP protection rather than on actual impacts to such equipment. This was not the author's intent and became a limitation to the research findings since little has been written on the topic of impacts of EMP on the fire service. Dr. Peter Pry had informed me early on that research on the impacts of EMP on the fire service has not adequately been addressed.

Research has shown that EMP will severely or catastrophically impact our Nations electrical system, a system that is absolutely necessary for our communications to function. An illustration on page twenty was utilized to show just how interdependent each critical infrastructure is on each other. The EMP Commission has even stated that mobile radio communications equipment can be expected to experience disruption or failure. The literature review reference military and NFPA standards that provided valuable research in addressing EMP impact on communications and emergency vehicles. MIL-STD-188-125 provided a great resource on topics such as hardening, shielding and testing critical equipment against EMP. NFPA 1221 utilized terminology such as transient voltage surge suppression (TVSS), grounding systems, lighting and circuit protection. In a report from Transtector Protection Group they acknowledge that modern day civilian and military vehicles are highly vulnerable to electromagnetic damage. In an interview with Mr. Roger Lackore, Director of Product Safety for Pierce Fire Apparatus, and Mr. Agustin Acosta, a Senior Electrical Engineer for Emergency Fire Apparatus, the author determined that neither fire apparatus manufacturer designs to MIL-STD-188-125 which provides for high altitude EMP environments. Each manufacturer designs emergency fire apparatus to NFPA 1901 standards. Even though no civilian fire department has ever requested, through new vehicle specifications, to have their apparatus design to military standards each manufacture could accommodate this request at an additional cost. Even though research did not directly identify EMP affects on the Walpole Fire Department communication and emergency vehicle equipment but it did indirectly identify the need to protect this equipment against EMP environments.

In researching the emergency preparedness training that is taking place at the federal, state and local levels, the author found that in most cases that little to no references were made

directly to EMP that could assist the Walpole Fire Department in developing an EMP awareness program. Many preparedness documents frequently use the term "all-hazards" to group all natural and manmade disasters together. Even though Homeland Security Presidential Directive 8 directs the Department of Homeland Security to strengthen the security and resilience of the U.S. against threats that pose the greatest risks to the security of the nation, a threat determined by the EMP Commission to have catastrophic consequence on our society, EMP still is not listed as a National Planning Scenario.

At the state level, I had the opportunity to interview Mr. James Mannion, MEMA Region 2 Manager, who informed the author that to the best of his knowledge EMP is not included in any planning documents at the state level. The Town of Walpole falls under MEMA Region II. (Appendix D) He stated that he himself was not familiar with EMP as a terrorist attack and most recently learned about the effects of EMP as a solar event only. I informed Mr. Mannion that I had sent out a questionnaire to Norfolk County Fire Chiefs and of the nineteen respondents all stated that they did not have an EMP awareness program. The Fire Chiefs were asked which organization should address an EMP awareness program and 32% stated, MEMA. Mr. Mannion agreed with the fire chiefs and stated that "it should be MEMA's responsibility" (Mannion, 2011). Mr. Mannion also stated that "he was going to hopefully incorporate the topic of EMP into MEMA'S Public Safety conference in 2012, which will serve as a first step towards EMP awareness by MEMA" (Mannion, 2011). He hopes to spear head this topic himself and present it up the chain at MEMA Headquarters.

In review of the Town of Walpole's Comprehensive Emergency Management Plan there is no reference to EMP but it is also important to note that the template to this plan was designed by MEMA for all of its three hundred and fifty one cities and towns. During a phone interview

with Mr. Donald Schmidt Chair person for NFPA 1600, a standard for Disaster/Emergency Management and Business Continuity Programs, he informed me that NFPA 1600 was an all hazards document and that it did not get into specific hazards such as EMP. When asked if the committee will incorporate EMP into the next edition of NFPA 1600, he replied that it currently is listed in Annex A.5.4.2.2 under international hazards. This is the only place that EMP is listed as name only, no definition or background.

Research has found that the Walpole Fire Department will not be able to learn from other fire and/or EMS organizations about the impacts of an EMP attack because the topic of EMP is not currently being addressed in the fire service. What research has found is that the fire service appears to be mission specific and even though we respond to many types of incidents we do not consider ourselves an 'All-hazards' organization. An extensive search of the United States Fire Administration, National Fire Academy, the Massachusetts Department of Fire Services and the Massachusetts Fire Academy found no indication that any of these organizations address EMP awareness or the impacts of EMP on the fire service. In an interview with Mr. Mark Pare, Assistant Director of the Massachusetts Firefighting Academy, he informed me that to the best of his knowledge EMP was not a topic within the academy's training curriculum. In a questionnaire sent out to all twenty eight fire chiefs in Norfolk County Massachusetts, titled "Electromagnetic Pulse (EMP) Impacts on Fire and EMS Delivery Services," (Appendix C)nineteen responded back to the questionnaire. When asked how familiar they were with the theory of electromagnetic pulse 94.7% replied that they had somewhat to no familiarity with EMP. What was important to note is that 100% of the responding fire departments had no current EMP awareness training program. When asked are your fire departments communications designed to withstand an EMP event 94.7% stated 'no' or 'not sure.' When

asked what they thought the effect EMP attack would be on their department's emergency vehicles almost 90% responded that they were unsure. When asked which of the following organizations did they feel should address EMP awareness training for the fire service they responded in this order: Department of Homeland Security; the Massachusetts Department of Fire Services; Federal Emergency Management Agency; and with a tie the National Fire Academy and Massachusetts Emergency Management Agency. What's important to note is that three of the five organizations listed fall under DHS. The final and most important question asked the fire chiefs whether or not they would support an EMP awareness program within their departments and all but one replied, yes.

DISCUSSION

The purpose of this research was to identify potential impacts of an electromagnetic pulse (EMP) attack on both fire and EMS delivery services for the Walpole Fire Department and to decide on whether the Walpole Fire Department needs to develop a plan for EMP awareness and recognition. The following discussion review will identify how the study results compare to the findings of others discussed in the literature review, the implications of the results for the Walpole Fire Department and the authors own personal conclusions.

Literature review clearly showed that EMP is a real threat and that an attack on the U.S. potential could impact the Walpole Fire Departments ability to continue to provide fire and EMS delivery services. The U.S. and Soviet high-altitude nuclear detonation testing that took place in the late 1950's and 1960's appears to be consistent with literature review found in a number of documented sources. Also consistent with documented literature is the number of countries that now have, or can acquire, the capability to attack the U.S. with an EMP weapon or provide this technology to its terrorist's allies. Literature review showed, through illustration, Walpole Fire

Department falling within the potential impact zone of a high-altitude EMP nuclear attack detonated approximately 300 miles above the U.S. The EMP Commission has stated that such an attack is one of a small number of threats that can hold our society at risk of catastrophic consequences. The EMP Commissions reports were cited in other documented literature review and similar findings were found. The author is convinced that EMP is a real threat and that an attack on the U.S. has the potential to impact the Walpole Fire Department ability to provide continued fire and EMS delivery services. Since 9-11 the U.S. has devoted vast numbers of resources to protect our country from another terrorist attack. Every day we turn on the news, or read in the news papers, about terrorist threats against the U.S. and are reminded once again of the events that took place on September 11, 2001. On this day, terrorist actually entered our country to commit these acts of violence against innocent people. Utilizing EMP as a weapon of mass destruction rogue states and their terrorist allies no longer need to enter this country to commit these acts of violence, and society as we know it will never by the same.

Literature review identified existing government reports and acts that address the topic of EMP. After 9-11 Congress established the Commission to Assess the Threat of the United States from Electromagnetic Pulse (EMP) Attack. The Commission reported its findings to Congress, in two separate reports (2004 and 2008) defining EMP as a threat, its potential impacts to critical U.S. infrastructure and recommendations to limit or prevent the threat. After the Commissions 2008 report they were disbanded, by Congress, and to date have not reformed. Literature review addressed the negative impact of an EMP attack to our nation's electrical power grid and the need to protect it. Two bills currently before the House of Representatives and the Senate, the Grid and Shield Acts, amend the Federal Power Act to include language to protect against EMP. Without such electrical system protection the implications to the fire service would be severe.

The author truly believes that our government is aware of EMP and views it as a threat to our country but has not given it further consideration since the abandonment of the EMP Commission. Senator Roscoe Bartlett stated that "Ninety-nine percent of Americans may not know very much about EMP, but I will assure you that 100% of our potential enemies know all about EMP" (Farah, 2005). The author has found this to be an accurate statement because colleagues, friends, and family (of the author) when asked about EMP have never heard of it before.

The following discussion review will identify how the study results compare to the findings of others discussed in the literature review, the implications of the results for the Walpole Fire Department and the authors own personal conclusions.

Even though the literature review findings acknowledged that communication equipment and emergency vehicles could experience disruption or even failure from an EMP attack, literature review failed to identify specific impacts to this equipment. Literature review did identify military standards that could assist the Walpole Fire Department in establishing requirements for the design, engineering, fabrication, installation and testing of newly purchased equipment. Currently civilian fire apparatus is designed to NFPA 1901 standards and according to two fire apparatus manufacture representatives this standard provided adequate protection against EMP. Research has also established that even though fire apparatus manufactures currently do not design to military EMP standards that they could accommodate this request at an additional cost. Literature review addressed terminology that is not frequently used in the fire service: shielding and hardening of equipment that perform time urgent critical missions. Most importantly, research has identified that the Walpole Fire Department needs to be concerned

about the lack of literature review available on the impacts of an EMP attack on our communication systems and emergency vehicles.

Concerning to the author was that literature review revealed that little to no EMP emergency preparedness training has been instituted within federal, state or local emergency management agencies. There are four critical components to the National Preparedness Guidelines, one being the national planning scenarios. The fifteen planning scenarios place emphasis to preparing for catastrophic threats with the greatest risk of mass casualties, property loss, and social disruption. Even though literature review has associated EMP with all of the above, EMP is still not incorporated into the national planning scenarios. Reviewing the national planning scenarios it is important to note that no service utility scenario has been developed. Literature review has identified electrical power grid disruption, and/or failure, for extended periods of time resulting from an EMP attack. The author feels that the threat of EMP is not adequately being addressed by the Department of Homeland Security and even feels that the topic of EMP is being ignored, when it certainly needs to be considered.

Literature review has revealed that the Walpole Fire Department will not be able to utilize the resources of other fire and EMS organizations to assist in the development of an EMP awareness program. An extensive literature review of the United States Fire Administration, Massachusetts Department of Fire Services, and the Massachusetts Firefighting Academy websites and training programs revealed no indication that these agencies address EMP awareness or EMP impacts on the fire service. Literature review identified the fire service as a single mission agency with the goal of reducing fire death rates of civilians and firefighters. It has been stated that he role of the fire service of the future will be defined as an "all risk" type of

service and the author strongly feels that the future is know and that the fire service needs to change its single mission strategy to that of an "all hazards" approach.

RECOMMENDATIONS

The goal of this applied research project was to address the potential impacts of an electromagnetic pulse (EMP) attack on both fire and EMS delivery services for the Walpole Fire Department and to decide on whether the Walpole Fire Department needs to develop a plan for EMP awareness and recognition. Through this ARP's literature review, procedures, results and discussion sections I strongly feel that research has found that the Walpole Fire Department's fire and EMS delivery services would be vulnerable to an EMP attack and recommend that the Walpole Fire Department develops and EMP awareness and recognition program. The development of this EMP awareness program should be through a partnership with the Massachusetts Emergency Management Agency and the Massachusetts Department of Fire Services.

Literature review had identified EMP as a real threat to the U.S. and with potential impacts anticipated in every locality during the first minutes and perhaps hours after a nuclear EMP attack. The author recommends working with the Town of Walpole's Congressional leaders to draft legislation which would re-establish the EMP commission and to recommend that Congress develop a strategic plan to start implementing recommendations by the EMP Commission to lessen the threat against the U.S. from an EMP attack, thus lessening the impact to the Walpole Fire Department.

The author also recommends that an EMP public awareness program be established to educate residents in the Town of Walpole on this potential threat. The literature review indicated that 100% of our enemies know about EMP while 99% of Americans do not. Currently before

Congress are two bills, the Shield and Grid Acts, that amend the Federal Power Act to include EMP language to protect the nations bulk power system and critical electrical infrastructure. The Walpole Fire Department needs to educate and stress to our congressional leaders the importance of supporting these bills and the potential impacts if they do not, and we need our residents to fight this fight with us.

The Walpole Fire Department needs to establish robust communication and emergency vehicle specifications to include EMP protection in the design, engineering, fabrication, installation, and testing of this equipment. The author agrees with the EMP Commission that these specifications should be implemented by augmenting existing standards such as MIL-STD-188-125 and NFPA 1901.

In conclusion, the Walpole Fire Department is facing significant new threats and considerable additional responsibilities; to meet those challenges, they will need to carefully monitor and adapt to these changes. Today's fire service managers firefighting operations, fire prevention, emergency medical services, hazardous materials responses, public health emergencies and, after 9/11, domestic and international terrorism. Literature review has revealed that EMP is a significant threat requiring additional responsibilities and challenges that the Walpole Fire Department needs to adapt to. The fire service has always reflected the society or community that it protects. The Walpole Fire Department must acknowledge that their single mission role has changed into an all risk type of service and that they must incorporate this cultural change into their planning and training programs moving forward.

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APPENDIX A

From: Peter Pry [peterpry@verizon.net]
Sent: Wednesday, July 13, 2011 9:46 AM
To: Michael Laracy; Cindy E USA Ayers; 'Thomas Woods'; cayers@empactamerica.com; bgilinsky@gmail.com
Subject: Re: Effect of EMP on U.S. Fire Services

Mr. Laracy:

Thank you for your interest in EMP and its effects on fire fighting capabilities--which would be severe. We at EMPact America welcome the opportunity to help with your project in any way we can. As Dr. Frankel suggests, you might start by reviewing our website, that has all the most current official U.S. Government reports on EMP, and much more besides. Also feel free to call me at my number below.

Best Regards,
Dr. Peter Vincent Pry
President
EMPact America
301-481-4715
----- Original Message -----

From: michael.frankel@empcommission.org
To: Michael Laracy
Cc: peterpry@verizon.net
Sent: Monday, July 11, 2011 12:22 PM
Subject: Re: Effect of EMP on U.S. Fire Services

Mr. Laracy-

In the event of an EMP scenario, fire fighting - which relies on the functioning of numerous electronic systems - would indeed be affected. In particular, modern systems which ubiquitously rely on intelligent control systems to manage pumps and other equipment might be expected to be misbehave. The best summary reference for the effects of EMP on electronic based systems that I'm aware of is still the unclassified Commission report on critical national infrastructures - linked through the Commission's website. You might also want to pulse the folks at http://www.EMPactamerica.org/ which is an educational/lobbying activity organized by a former EMP Commission staffer and which might be aware, if they exist, of any post-Commission publications that address your interest.

Best, Mike Frankel

Michael J. Frankel, Ph.D
EXECUTIVE DIRECTOR
EMP Commission
(202) 255 -3970
www.EmpCommission.org

-----Original Message-----
From: Michael Laracy [mailto:mlaracy@walpolefire.com]
Sent: Friday, July 8, 2011 04:15 PM
To: michael.frankel@empcommission.org
Cc: 'Michael Laracy'
Subject: Effect of EMP on U.S. Fire Services

Mr. Frankel,

In July I will be attending the National Fire Academy's Executive Fire Officer Program and throughout this four year program we are responsible for writing four thesis papers. After doing some research, about EMP?s, I am seeing the need to educate our fire service personnel on this very topic and the impact it would have on our ability and/or inability to respond in such an attack. The effects that it would have on our fire apparatus that relies on computer and electronic devices to operate; on our communities water supply systems w/reliance on pumps for water distribution; on our emergency medical services-especially the areas of cardiac monitors and most importantly on the fire services communication systems. As a recent graduate, with a Masters Degree in Emergency Management, I believe this topic needs to be addressed in all the four phases of Emergency Management; Mitigation, Preparedness, Response, and Recovery. I would greatly appreciate any references that you could direct me to that would assist in my thesis/capstone paper.

Thank you.

Michael Laracy-Deputy Fire Chief-Walpole, Massachusetts.

APPENDIX B

Summarized Data Report - Survey: Level of Electromagnetic Pulse Protection Designed into Fire Apparatus

1. The information from this questionnaire will be utilized as a pre-interview with the respondent. To get a better idea of your experience and position within your organization please complete the following answers.

	Responses	Percent
What is your name?:	2	100%
What organization do you work for?:	2	100%
How long have you worked for this company?:	2	100%
What is your title and responsibilities?:	2	100%
What is the best way to contact you?:	2	100%
Total Responded to this question:	2	100%
Total who skipped this question:	0	0%
Total:	2	100%

2. Does your organization incorporate Electromagnetic Pulse (EMP) Protection into the design of your fire apparatus?

	Responses	Percent
Yes:	1	50%
No:	1	50%
Total Responded to this question:	2	100%
Total who skipped this question:	0	0%
Total:	2	100%

3. Does your organization incorporate Electromagnetic Pulse (EMP) protection in the design of your Military Vehicles?

	Responses	Percent
Yes:	2	100%
No:	0	0%
Total Responded to this question:	2	100%
Total who skipped this question:	0	0%
Total:	2	100%

4. What standards of electromagnetic interference standards is your company designing and testing too?

	Responses	Percent
MIL-STD-188-125:	1	50%
MIL-STD-464:	0	0%
NFPA-1901:	2	100%
SAE J551/1:	1	50%
Other:	0	0%
If other, please specify:	0	0%
Total Responded to this question:	2	100%
Total who skipped this question:	0	0%
Total:	2	100%

5.

The Electromagnetic Pulse (EMP) Commission, which was established by Congress, recommended that the development of automobile robustness specifications and testing for EMP should be established. More importantly they stated that "specifications should be implemented by augmenting existing specifications for gaining immunity to transient electromagnetic interference (EMI), rather than by developing separate specifications for EMP."

Do you agree that both Military and Civilian vehicles (Fire Apparatus) should be tested to the same standards?

	Responses	Percent
Yes:	0	0%
No:	2	100%
Additional Comments:	1	50%

6. If you answered Yes to the previous question then what standard do you think Military and Civilian Fire Apparatus should be tested too?

	Responses	Percent
MIL-STD-188-125 High Altitude Electromagnetic Pulse (HEMP) Protection:	0	0%
NFPA-1901/SAE J551/1 Electromagnetic Interference (EMI) and Radiofrequency Interference (RFI):	0	0%
Other:	0	0%
If other, please specify:	0	0%
Total Responded to this question:	0	0%
Total who skipped this question:	2	100%
Total:	2	100%

7. If the fire service designed emergency vehicles to Military Standards for EMP protection would this increase the purchase cost?

	Responses	Percent
Not At All:	0	0%
Some What:	0	0%
Substantially:	0	0%
Other:	0	0%
If other, please specify:	2	100%
Total Responded to this question:	2	100%
Total who skipped this question:	0	0%
Total:	2	100%

8. If a fire department requested in their new vehicle specifications to meet MIL-STD-188-125 could your company accommodate this request?

	Responses	Percent
Yes:	2	100%
No:	0	0%
Additional Comments:	2	100%
Total Responded to this question:	2	100%
Total who skipped this question:	0	0%
Total:	2	100%

9. Has any civilian fire department ever made the request to design an emergency vehicle to meet MIL-STD-188-125?

	Responses	Percent
Yes:	0	0%
No:	2	100%

		Responses	Percent
Additional Comments:		2	100%
	Total Responded to this question:	2	100%
	Total who skipped this question:	0	0%
	Total:	2	100%

APPENDIX C

Summarized Data Report - Survey: ELECTROMAGNETIC PULSE (EMP) IMPACTS ON FIRE AND EMS DELIVERY SYSTEMS

1. What is the name of your organization?

	Responses	Percent
Responses:	19	100%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

2. Which of the following positions do you serve?

	Responses	Percent
Fire Chief:	12	63.16%
Emergency Management Director:	0	0%
Both:	5	26.32%
If other, please specify:	2	10.53%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%

	Responses	Percent
Total:	19	100%

3. Are you familiar with the theory of Electromagnetic Pulse and its potential impacts on the delivery of Fire and EMS delivery services?

	Responses	Percent
Very:	1	5.26%
Some what:	11	57.89%
No:	7	36.84%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

4.

If you are not familiar with Electromagnetic Pulse (EMP) please review the provided EMP Commission's Executive Report before moving forward. This report was emailed to you separate from the questionnaire.

	Responses	Percent
Reviewed EMP PowerPoint Presentation:	7	36.84%
Moved to next question without viewing PowerPoint Presentation:	12	63.16%

There have been two reports of the "Commission to Assess the Threat of the United States from Electromagnetic Pulse (EMP) Attack (2004) and (2008), both state that:

"An EMP attack will result in diminished capabilities of emergency services during a time of greatly increased demand upon them."

Are you familiar with the EMP Commissions reports?

	Responses	Percent
Yes:	6	31.58%
No:	13	68.42%
Additional Comments:	1	5.26%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

6. Does your Fire Department have any formal Electromagnetic Pulse awareness training?

	Responses	Percent
Yes:	0	0%
No:	19	100%
Additional Comments:	0	0%
Total Responded to this question:	19	100%

	Responses	Percent
Total who skipped this question:	0	0%
Total:	19	100%

7. Does your Towns Comprehensive Emergency Management Plan acknowledge electromagnetic pulse events?

	Responses	Percent
Yes:	0	0%
No:	17	89.47%
EMP as a Terrorist event only:	1	5.26%
EMP as a Solar event only:	1	5.26%
Both Solar and Terrorist:	0	0%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

8. The EMP Commission has stated that "Mobile radio communications equipment can be expected to experience disruption and failure at EMP threat levels that are likely to be experienced" Is your fire department communications designed to withstand an EMP event?

	Responses	Percent
Yes:	0	0%
No:	9	47.37%
Unsure:	9	47.37%
If other, please specify:	1	5.26%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%

	Responses	Percent
Total:	19	100%

9. What type of communication equipment are you currently using for mobile and portable radios?

	Responses	Percent
Responses:	19	100%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

10. What would be the effect of an Electromagnetic Pulse (EMP) attack on your department's emergency vehicles that are electronically and computer driven?

	Responses	Percent
No Effect:	0	0%
Short Term:	0	0%
Long Term:	2	10.53%
Unsure:	17	89.47%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

11. Who is the manufacturer of your department's fire apparatus?

	Responses	Percent
Crimson:	2	10.53%
E-One:	15	78.95%

	Responses	Percent
KME:	0	0%
Pierce:	8	42.11%
Seagrave:	2	10.53%
Smeal/Spartan:	2	10.53%
Other:	4	21.05%
If other, please specify:	6	31.58%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

12. Which of the following organization(s) do you think should address electromagnetic pulse awareness training for the fire service?

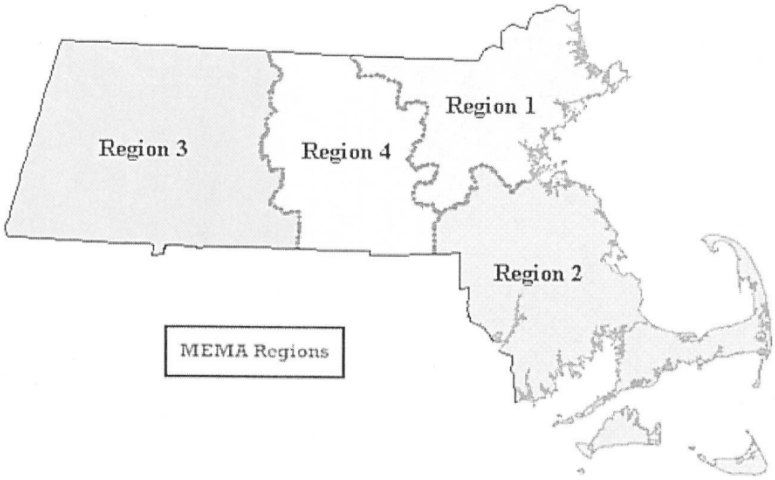
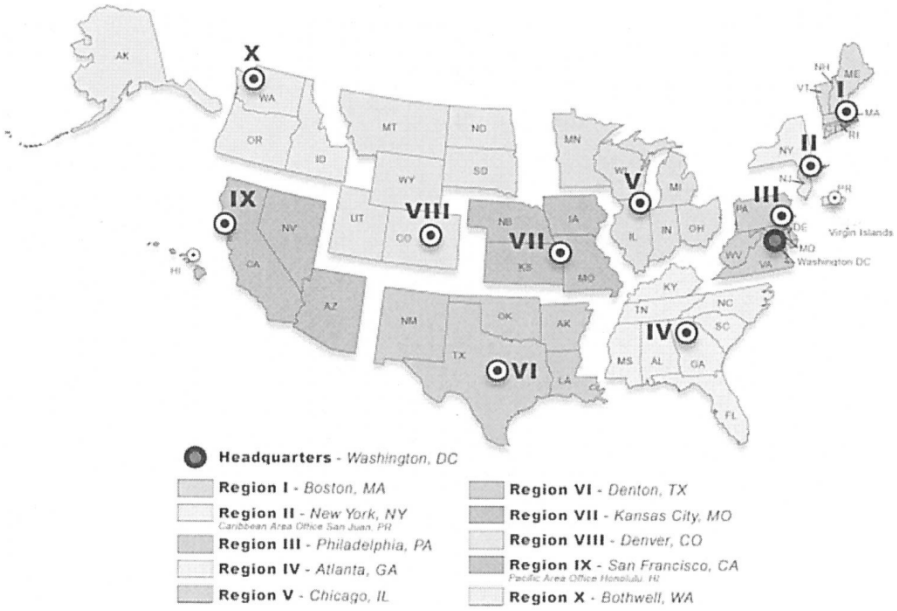
	Responses	Percent
Homeland Security:	11	57.89%
Federal Emergency Management Agency (FEMA):	7	36.84%
Massachusetts Emergency Management Agency (MEMA):	6	31.58%
National Fire Academy:	6	31.58%
Massachusetts Department of Fire Services (DFS):	10	52.63%
Other:	0	0%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

13. Which of the following 5 United States Fire Administration (USFA) goals do you feel would be met by establishing an Electromagnetic Pulse (EMP) Awareness Program?

	Responses	Percent
Reduce the risk at the local level through prevention and mitigation:	6	31.58%
Improve local planning and preparedness:	12	63.16%
Improve the fire and emergency services capability for response to and recovery from all hazards:	15	78.95%
Improve the fire and emergency services professional status:	4	21.05%
Lead the Nations fire and emergency services by establishing and sustaining USFA as a dynamic organization:	4	21.05%
Total Responded to this question:	19	100%
Total who skipped this question:	0	0%
Total:	19	100%

14. Would you support an Electromagnetic Pulse awareness program within your organization?

	Responses	Percent
Yes:	18	94.74%
No:	1	5.26%

APPENDIX D

Emergency Management Regions
Massachusetts Emergency Management Agency (MEMA) and Federal Emergency Agency (FEMA)