

PSAP Disaster and Emergency Preparedness:  
Resiliency Analysis of Pierce County 9-1-1 Communications

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**Certification Statement**

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### Abstract

The problem within Pierce County, WA was there had been no recent review or analysis of public safety communications resiliency. This lack of analysis left Pierce County emergency communications inadequately prepared, should one or more of the public safety answering points fail to function. If the 9-1-1 system failed to function appropriately, the public would be in jeopardy of losing access to emergency services, placing their health and safety at risk. The author performed descriptive research to analyze the current level of resiliency in Pierce County emergency communications to determine what steps should be considered in order to provide an appropriate level of resiliency. The author carried out the research by performing a literature review, conducting a survey, performing data analysis, attending several meetings of the PSAP Managers' Backup Development Committee, and conducting personal interviews. The author used the research to address four questions. (a) What are the current risks facing Pierce County PSAPs? (b) What is the current condition of Pierce County PSAPs in relation to current industry standards and best practices? (c) Are adequate backup plans in place to provide an appropriate level of resiliency? (d) What limitations are there to the PSAPs sustaining backup operations? The results indicated that Pierce County was not currently meeting industry standards and best practices for critical infrastructure resiliency. Recommendations were provided to the Pierce County public safety answering points to improve resiliency through a coordinated effort of planning, implementation, training, evaluation, and funding. Through this effort, a foundation can be established to provide a greater level of resiliency in Pierce County emergency communications.

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PSAP Disaster and Emergency Preparedness: Resiliency Analysis of  
Pierce County 9-1-1 Communications

The Department of Homeland Security (DHS) has determined that protecting and ensuring the resiliency of critical infrastructure and key resources (CIKR) is vital to our national security. A variety of natural and manmade hazards such as terrorist attacks, accidents, and natural disasters threaten our CIKR (U. S. Department of Homeland Security [DHS], 2009). In the 2009 update of the National Infrastructure Protection Plan (NIPP), an increased emphasis was placed on resiliency of CIKR (Congressional House Committee on Homeland Security, 2010). 9-1-1 is the public's primary link to emergency services, while radio communications are utilized to notify and coordinate fire department resources. Without these two vital links, providing fire protection and emergency medical services (EMS) to the public would be fundamentally hindered. Within Pierce County Washington, there are currently eight public safety answering points (PSAPs). One of these PSAPs, Fire Comm, is a regional fire and EMS dispatch center managed by West Pierce Fire & Rescue. The problem is that there has been no recent review or analysis of public safety communications resiliency, leaving Pierce County emergency communications inadequately prepared, should one or more of the PSAP's fail to function. If the 9-1-1 system fails to function appropriately, the public would be in jeopardy of losing access to emergency services, placing their health and safety at risk. The purpose of the research was to evaluate the current level of resiliency in Pierce County emergency communications and determine what steps should be considered in order to provide an appropriate level of resiliency. A descriptive research method was used to answer four research questions. (a) What are the current risks facing Pierce County PSAPs? (b) What is the current condition of Pierce County PSAPs in relation to current industry standards and best practices? (c)

Are adequate backup plans in place to provide an appropriate level of resiliency? (d) What limitations are there to the PSAPs sustaining backup operations?

### **Background and Significance**

West Pierce Fire & Rescue (WPFR) was established in March of 2011. WPFR was created from the merger of Pierce County Fire District # 2 (PCFD 2), the Lakewood Fire Department and Pierce County Fire District #3 (PCFD 3), the University Place Fire Department. WPFR provides service to the communities of Lakewood and University Place, Washington, located in western Pierce County on the southeastern shore of Puget Sound. Pierce County Fire District #2 was established in 1940 and PCFD #3 was established in 1941. The city of University Place was incorporated in 1995 and the City of Lakewood was incorporated in 1996. Both cities are annexed into the fire district, making WPFR an independent taxing authority within Pierce County government, rather than a city governed municipal fire department.

West Pierce Fire & Rescue covers approximately 31 square miles (West Pierce Fire & Rescue website, n.d.). The service area covers two urbanized communities. The city of University Place is the smaller of the two communities with a population of approximately 31,500 (City of University Place website, 2011). The city of Lakewood is about twice as large as University Place with a population of approximately 60,000, making it the second largest city in Pierce County (City of Lakewood website, 2011). West Pierce Fire & Rescue is an all hazards department that provides fire suppression, EMS services, 9-1-1 service, patient transport, hazardous materials response, technical rescue, dive rescue, marine services, fire investigations, and public education programs. WPFR is an all career department with 150 firefighters and EMS responders (Paramedic and EMT), six command staff officers, 20 dispatchers, eight fire

prevention and education staff, and 32 support staff providing services such as vehicle maintenance, facilities maintenance, HR, payroll, administrative services and IT support.

In 1983, the Lakewood, University Place and Fircrest fire departments came together to form, Fire Comm, a regional dispatch center. As the largest agency, Lakewood became the lead agency and took responsibility for the fiscal and operational management of Fire Comm. Over the years, Fire Comm continued to grow, and in 2010 provided service for 15 fire districts in Pierce County. In 2010, Fire Comm received approximately 90,000 calls for service and dispatched over 40,000 fire and EMS incidents. Fire Comm's service area covers approximately 1,200 square miles of Pierce County from the entrance of the Mount Rainier National Park in the southeast, to the western Puget Sound border of Key Peninsula, as well as overlapping into King County in the north and Lewis County in the south. Fire Comm provides service to a population of approximately 370,000 (West Pierce Fire & Rescue [WPFR], 2011).

Fire Comm is one of eight PSAPs in Pierce County including the Law Enforcement Support Agency (LESA), Washington State Patrol (WSP), Joint Base Lewis McChord (JBLM), Tacoma Fire Department Fire Communication Center (FCC), Puyallup, Fife and Buckley. All of the PSAPs are primary PSAPs, receiving 9-1-1 calls directly, with the exception of FCC and Fire Comm, which are secondary PSAPs. The secondary PSAPs receive their calls as a transfer from one of the other primary PSAPs.

As the primary PSAP for the majority of Pierce County, LESA is the largest of the County PSAPs. A total of 15 agencies are dispatched by LESA, including the three largest law enforcement agencies, the Pierce County Sheriff, the Tacoma Police Department and the Lakewood Police Department. In 2009, LESA handled over 418,572 9-1-1 calls and 306,313

routine calls (Law Enforcement Support Agency website, n.d). The services provided by LESA have a direct impact on nearly every citizen living within Pierce County.

The Washington State Patrol acts as the primary PSAP for all state highways. All 9-1-1 calls for service in these areas are either retained by the state patrol for law enforcement or transferred to the appropriate secondary PSAP for fire or EMS response. The Washington State Patrol maintains a statewide communications network that includes eight communication centers (Washington State Patrol website, 2008).

Joint Base Lewis-McChord provides primary call receiving for all law enforcement, fire suppression and EMS on the military base. While JBLM works closely with other Pierce County PSAPs, they are somewhat unique since they are part of a federal military installation. Joint Base Lewis-McChord was established in 2010 after merging the Fort Lewis Army Base and the McChord Air Force Base.

Tacoma Fire Department FCC is the only other secondary PSAP in Pierce County, along with Fire Comm. Tacoma Fire Department FCC provides fire and EMS call receiving for the Tacoma Fire Department and Central Pierce Fire & Rescue. Collectively, Fire Comm and FCC dispatch 99% of the fire and EMS response within Pierce County (9-1-1 Emergency Communications Task Force, 2009).

Puyallup and Fife are both primary PSAPs that perform law enforcement call receiving and dispatch for several smaller cities and towns throughout Pierce County. Buckley, the smallest of all the PSAPs, is a primary PSAP for law enforcement, fire and EMS in several small rural towns in the northeastern portion of Pierce County.

Each PSAP in Pierce County operates on a different radio network with varying degrees of interoperability. The radio frequencies utilized for emergency services include VHF, 400

MHz and 800 MHz. With the exception of Buckley and JBLM, all of the PSAPs are part of a common Gold Elite Console Network (GECN) that provides radio resource interconnectivity between the PSAPs at the dispatch console. Additionally, the GECN is connected to a larger tri-county radio interoperability system (TRIS). The TRIS network provides interoperability between the primary radio systems of King, Pierce and Snohomish Counties, the Port of Seattle and Federal agencies operating on the Federal IWN radio system (R. Totten, personal communication, May 9, 2011).

With no recent resiliency analysis of the emergency communication systems in Pierce County, there is no way to determine how well the 9-1-1 systems and radio communications networks will operate during an emergency or disaster. If the 9-1-1 system fails to function appropriately, the public would be in jeopardy of losing access to emergency services, placing their health and safety at risk. Performing a resiliency analysis provides an understanding of what steps need to be taken in order to develop appropriate contingency plans and assure effective emergency communications during a major event.

Historically, the PSAPs in Pierce County have had limited formal coordination between agencies and have remained largely independent in the development of contingency plans. A significant portion of the Executive Development course in the National Fire Academy's Executive Fire Officer Program deals with the concepts of change. In a post 9/11 era, understanding and sharing information, building partnerships, implementing long-term risk management programs and efficient use of resources are key tenants of national infrastructure protection. Achieving these goals in Pierce County will necessitate a coordinated undertaking of cooperation between each of the PSAPs, requiring an adaptive change from the current methods of managing and coordinating efforts. "Without learning new ways-changing attitudes,

values and behaviors-people cannot make the adaptive leap necessary to thrive in the new environment." (Heifetz & Linsky, 2002, p. 13)

By working collaboratively to evaluate and improve the resiliency of Pierce County emergency communications, the PSAPs within Pierce County will be aligning themselves with three of the operational goals of United State Fire Administration.

- Reduce risk at the local level through prevention and mitigation.
- Improve local planning and preparedness.
- Improve the fire and emergency services' capability for response to and recovery from all hazards.

### **Literature Review**

Protecting critical infrastructure has been a high government priority for many years. During this time, the definition of critical infrastructure has continued to evolve. Over the past 20 years, the number of sectors contained within the definition of critical infrastructure has broadened. Critical infrastructure was once considered to be a small group of the most basic public works agencies, but is now an extremely diverse cross section of economic, defense, government, social and institutional facilities throughout the public and private sectors (Moteff & Parfomak, 2004).

On July 17, 1996 President Clinton signed Executive Order 13010 (EO 13010) on critical infrastructure. In this document it was noted that the loss or debilitation of certain infrastructure would have a significant impact on defense, the economy and the ability of government to function effectively. Executive Order 13010 identified seven critical infrastructures, two of which were communications and emergency services. In an effort to provide adequate protection

to the nation's critical infrastructure, EO 13010 established the President's Commission on Critical Infrastructure Protection (Exec. Order No. 13010, 1996).

In response to the October 1997 final report from the President's Commission on Critical Infrastructure Protection, Presidential Decision Directive/NCS-63 (PDD 63) was adopted by President Clinton on May 28, 1998. In PDD 63, the definition of critical infrastructure remained essentially as it was in EO 13010 with one key exception. In PDD 63, critical infrastructure was defined as both physical and cyber based systems (Clinton, 1998). This was the first time cyber based systems had been identified as serving a key role in maintaining critical infrastructure. Information technology had seen rapid advancement and created great operational efficiencies. However, through greater automation and interconnectivity, critical infrastructure was becoming increasingly vulnerable to system failures, human error, natural disasters and cyber attacks.

Presidential Decision Directive/NCS-63 set a five year goal to achieve and maintain the ability to protect the nation's critical infrastructure from intentional acts that would significantly diminish national security, public health and safety, delivery of essential public services, orderly functioning of the economy and the delivery of essential telecommunications, energy, financial and transportation services. A key guideline in achieving this goal was identified as frequent assessment of the existing reliability, vulnerability and existing threats to critical infrastructure (The Department of Justice [DOJ], 1998). In response to the terrorist attacks of 9/11, congress passed the USA Patriot Act on October 26, 2001 (United States Congress, 2001). Within the Patriot Act was the Critical Infrastructure Protection Act of 2001. Section (b)(2) continues to recognize the interconnectivity of information systems as identified in PDD 63, specifically in the telecommunications sector. Section (e) adds additional emphasis on cyber systems, by defining critical infrastructure as being either a physical or virtual asset (Critical Infrastructures

Protection Act, 2001). Also in response to the terrorist attacks of 9/11, President Bush signed Executive Order 13228 (EO 13228) on October 8, 2001. This executive order established the Office of Homeland Security and the Homeland Security Council. Among several duties and responsibilities, the office was charged with protecting critical infrastructure, including telecommunications and information systems, from terrorist attacks (Exec. Order No. 13228, 2001).

On November 2002, Congress passed the Homeland Security Act of 2002, establishing the Department of Homeland Security (United States Congress, 2002). Section 2(4) of the Homeland Security Act referred directly to the Patriot Act when defining critical infrastructure, while Section 2(9) introduced the concept of key resources. Key resources were defined as “publicly or privately controlled resources essential to the minimal operations of the economy and government” (Homeland Security Organization, 2002).

On December 17, 2003, President Bush signed Homeland Security Presidential Directive 7 (HSPD7) superseding PDD 63. The main purpose of HSPD7 was to establish a national policy for identifying CIKR and protecting them from terrorist attacks. HSPD7 used the existing definitions of “critical infrastructure” from section 1016(e) of the USA Patriot Act of 2001 (42 U.S.C. 5195c(e)) and the definition of “key resources” from section 2(9) of the Homeland Security Act of 2002 (6 U.S.C. 101(9)) (Bush, 2003).

In February of 2005, DHS released an interim version of the National Infrastructure Protection Plan (NIPP). In June of 2006, the first complete version of the NIPP was released by DHS, providing a comprehensive framework for protecting critical infrastructure and key resources (CIKR), and fulfilling the requirements outlined in HSPD7 (Suburban Emergency Management Project [SEMP], 2009).

In February of 2009, an updated 188 page version of the NIPP was released. This version reflected several key changes and updates to previous versions. No longer was the NIPP focused simply on protecting CIKR from terrorist threats. In the preface of the NIPP, Michael Chertoff, Secretary of Homeland Security, identifies the threat to CIKR as “manmade and naturally occurring threats and hazards, including terrorist attacks, accidents, natural disasters, and other emergencies” (DHS, 2009, p. i). In addition to broadening the focus to an all hazards environment, the 2009 version of the NIPP introduces the concept of resiliency through preparedness, response and recovery.

As defined in the NIPP, threats to critical infrastructure can be divided into two primary categories, either manmade or naturally occurring. Examples of manmade threats would be intentional acts of terrorism or mechanical/system failures. Examples of naturally occurring threats would be a natural disaster or pandemic. Any of these singular threats could potentially disable a PSAP or worse cause a cascading failure within multiple PSAPs.

Terrorism has long been the driving force defining national policy on CIKR protection. Section 2 (15)(A)(i) of the Homeland Security Act defines terrorism as “any activity that involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources” (United States Congress, 2002). While terrorist attacks are not as likely as other manmade threats or natural disasters, as a targeted threat, they are much more likely to cause significant devastation. Over the past two decades, international and domestic terrorists have proven themselves to be highly organized, methodical and effective in accomplishing their objectives, choosing CIKR as their prime targets. As protection around high profile targets increases, they are likely to seek out less protected targets (DHS, 2009). The only effective method in deterring a terrorist attack is through adequate protection.

In order to operate effectively and efficiently, PSAPs rely on a significant amount of interconnected mechanical, electrical and cyber systems and infrastructure. While increased technology provides improved efficiency, it comes at a price. As the complexity of the networked systems increases, so do the number of potential points of failure. Additionally, these networked systems rely on a stable power supply to operate. However, utility distribution systems are interrupted on a daily basis throughout the country. In 2009, there were 115,232 documented excavation accidents involving underground utilities reported to the Damage Information Reporting Tool (DIRT) (Common Ground Alliance [CGA], 2010). With the addition of undocumented excavation accidents as well as above ground utility failures, the number is significantly higher. With significant risk from single points of failure as well as potential power interruptions, reducing the risk of system failures requires an emphasis on reliability, redundancy and diversity.

One of the critical resources needed to maintain effective operations within a PSAP is power. Unfortunately, in most parts of the country, power fluctuations can be expected on a daily basis, causing problems with equipment, data corruption, data transmission failures, equipment failures or even a complete system failure (Leibert Corporation, 2000). In order to meet mission critical goals, the uptime for PSAP network systems needs to be as close to 100% as possible. Every fraction of a percent below 100% represents significant degradation of service. Even with an uptime of 99%, a 24/7 operation would suffer 3 days, 15 hours, 35 minutes and 59 seconds of down time annually (Hall, 2006).

Along with reliability, network systems need to have effective redundancy and diversity. One of the key lessons learned from the attacks of 9/11 was the need for physical redundancy of equipment through multiple forms of communication technology (Kerben, 2002). The city of

New York learned that true redundancy also required having route diversity by locating networked systems and equipment in geographically diverse locations, with as much separation of primary and backup systems as possible (Delio, 2003). Route diversity for PSAP connectivity is not simply redundancy, but redundancy over separate geographical or physical paths with no common points (Public Safety and Homeland Security Bureau, n.d.).

Natural disasters exist in a variety of forms around the world. The Pacific Northwest and specifically Pierce County are not immune to the impacts of natural disasters. The Washington Military Department Emergency Management Division (WMD-EMD) identifies nine natural disaster threats to Washington State from avalanches to wild land fires. The most common disaster risk to Pierce County is from storms and flooding. Every presidentially declared disaster in Pierce County, from March 2001 to March 2011, involved either severe storms, flooding or both (Washington Military Department Emergency Management Division website, 2011). The singular exception to this was the Nisqually Earthquake in 2001. According to the Pierce County Department of Emergency Management (PC-DEM), 70% of the presidentially declared natural disasters in Pierce County, over the past 20 years, have involved either storms, flooding or both (Pierce County Department of Emergency Management website, 2011).

While much less frequent, the impact of large scale natural disasters such as earthquakes and volcanoes cannot be minimized. According to the Ready Business campaign sponsored by DHS, the number of declared major disasters in the United States nearly doubled in the 1990's compared to the previous decade (FEMA Ready Business website, 2010). According to the United States Geological Survey (USGS), Pierce County is located on the Pacific Ring of Fire, an area that experiences frequent earthquakes and volcanoes (U. S. Geological Survey website, 1999). The catastrophic eruption of Mt. St. Helens in 1980 and the 6.8 Nisqually Earthquake in

2001, caused wide spread devastation throughout the region. More recent events such as the 2011 earthquake in Sendai Japan and the tornados in the Midwest during the first half of 2011 underscore the role natural disasters can have in crippling critical infrastructure.

Pandemics, like all natural disasters, are expected to happen, yet it is difficult if not impossible to predict when and to what degree. Buxbaum (2006) defines an influenza pandemic as “a global outbreak of disease that occurs when a new virus appears in the human population, causes serious illness and then spreads globally from person to person” (p. 14). There have been 10 influenza pandemics over the last 300 years (Osterholm, 2005). It has been over 40 years since the last influenza pandemic, which occurred in 1968 (Kalt, 2006). The extended period of time from the last pandemic has led many experts to feel we are overdue, and that a pandemic will happen in the near future.

Should a pandemic occur, Staples (2006) warns that it will become the “single greatest threat to business continuity” (p. 21). A pandemic outbreak will not be limited to a single focused geographic area or business sector. Multiple jurisdictions will be impacted simultaneously (Holdeman & Loehr, 2006). This will limit the amount of outside resources and mutual aid businesses can expect. For PSAPs this will not be limited to operational personnel. Support personnel and outside vendors which provide supplies, services, repairs and maintenance will be equally affected. Meyers (2006) predicts 40% of the workforce will be out at any given time. Absenteeism will be from a variety of factors including illness of the employee, caring for family members or a fear of going to work. A pandemic will not resolve rapidly, most likely coming in successive waves lasting six to eight weeks (Holdeman & Loehr, 2006). Due to the time required to gain FDA approval and allow for production and distribution, an effective vaccine will probably not be widely available for up to 18 months (Buck, 2006).

Minimizing threats to critical infrastructure starts with the standards inherent to the design of the infrastructure itself. Public safety answering points, like all other forms of infrastructure are subject to aging. As they age, facilities designed for a specific purpose begin to lose their ability to maintain effective operations (National Emergency Numbers Association [NENA], 2007). Over time, rapidly changing operational needs and technology advancements begin to exceed the capabilities of the facility. This problem is often emphasized by the fact that the PSAP is located within a facility not originally designed to function as a communications center.

In defining a standard for PSAPs, the most widely recognized standard in the United States is National Fire Protection Association (NFPA) 1221 (Loomis & McClure, 2007). The NFPA 1221 Standard was first adopted in 1904. It has been revised 30 times and the most current version is the 2010 Edition (National Fire Protection Association [NFPA], 2010). The revisions made to NFPA 1221, over the years, reflect the changing operational needs of communication centers. In 1999, changes were made to recognize the increase in technology-based information systems. In 2002, an increased emphasis was placed on the interoperability of systems. For the 2007 edition, a new chapter was added to address network security. Mitigation of man-made disruptions were increasingly emphasized in the 2010 edition through the addition of standards on emergency fire plans and by requiring PSAPs to limit vehicle access near the facility or be blast resistant (NFPA, 2010). Meeting the ever changing standards of NFPA 1221 is challenging in older facilities designed under previous standards.

There are several natural and man-made risks that could jeopardize the operations of a PSAP. The first step in reducing these risks is identifying an appropriate location for the facility. Although an effective threat assessment may have been performed initially, there is often little

opportunity to control development that takes place around the facility once it is established. When determining an appropriate location for a PSAP, the Department of Homeland Security recommends performing a threat assessment in a 10 mile radius around the site for hazards such as aerial, rail, roadway, and naturally occurring threats as well as appropriately reliable utility supplies (Woods, 2009).

Even with the best threat assessment during site selection, not all hazards can be avoided. Within the South Puget Sound region, natural disasters, such as earthquakes, are a significant threat to critical infrastructure. However, predicting the location of an earthquake is not possible. Therefore, design features, such as base isolators, need to be incorporated into the structure. Base isolators act as shock absorbers for the structure, allowing it to move upwards of 18” in any direction (Loomis, 2005).

Acts of violence and terrorism are another factor that cannot be deterred by location alone. Crime prevention through environmental design (CPTED) is defined by the International CPTED Association as “a multi-disciplinary approach to deterring criminal behavior through environmental design” (International CPTED Association, 2011, para. 2). Through CPTED design features, modern structures minimize the threat of criminal activity through methods of natural surveillance, territorial reinforcement, natural access control and target hardening. Communication centers that have incorporated CPTED concepts into new construction and remodels have decreased criminal activity by as much as 40% in some communities (Smith, 2007).

Along with design standards, NFPA 1221 outlines operational standards as well. Within NFPA 1221, the basic operational needs of the communications center are identified as sufficient staffing of adequately trained telecommunicators with identified management in place (Berdan,

2000). In an event such as a pandemic, PSAPs will fail to operate effectively without adequate staffing and management, regardless of the quality of the site location and design standards.

Adequately preparing a PSAP for emergencies requires a combination of planning, implementation, training, evaluation, and funding. In a national survey of businesses conducted by The Ad Council in December 2007, 91% of respondents said that it is “very” or “somewhat” important for businesses to take steps to prepare for a catastrophic disaster, such as an earthquake, hurricane or terrorist attack. However, only 59% assessed their own business as “very” or “somewhat” prepared in the event of a disaster and only 38% said their company has an emergency plan in place in the event of a disaster (Federal Emergency Management Agency [FEMA], 2011).

In the 2010 edition of NFPA 1600, Standard on Disaster/Emergency Management and Business Continuity Programs, Chapters 5-8 are dedicated to the concepts of planning, implementation, testing and exercises, and program improvement (National Fire Protection Association [NFPA], 2010).

The first step in preparing a PSAP for an emergency or disaster is with an effective planning process. Furey (2003) has found that many disasters stem from seemingly disconnected events that lead to cascading and escalating consequences. Therefore, contingency plans must be thoroughly comprehensive. Contingency planning needs to address several different possible scenarios which could impact a PSAP, from smaller emergencies like the loss of power or a small fire, to large scale, region-wide disasters such as an earthquake. How operations will be performed and to what level they can be provided can vary greatly under different circumstances.

Redundancy of operations and geographical separation of back up facilities also needs to be considered in contingency planning. Randall (1992) notes that if a single catastrophic event

can disable both the primary and back up facilities, there is nothing gained by having a back up facility. And, while geographic separation minimizes some risks, it is not a guarantee of survival. In order to attain the highest probability of survival, both the primary and backup facility need to be geographically separated as well designed with appropriate levels of physical protection.

Along with facilities, the redundancy of operational systems needs to be addressed as well. Determining minimum requirements for information and communication systems is critical to the design of disaster recovery and business continuity plans. With appropriate preparation and effective planning of redundant systems, transfer from primary to backup systems can become nearly seamless (Brotherton, 2010).

Boin and McConnell (2007) express the need to involve regional partners in the planning process. They further identify the need to maintain a permanent coordinated effort that encourages cooperation across functional and hierarchical boundaries, in order to address the ever evolving nature of the planning process. In November 2010, the Pierce County PSAP Manager's Group formed the PSAP Backup Development Committee to begin the process of developing regional plans for PSAP backup and redundancy in the event of minor emergencies to major catastrophes requiring a PSAP evacuation. (Ackerman, 2010)

Once the plans have been implemented, it is necessary to test and evaluate their efficacy through training. As with the planning process, training should not be limited to individual PSAPs, but rather implemented regionally. Agencies who participate in joint exercises benefit by building mutual trust and understanding as well as gaining a better understanding of each other's capabilities (Boin & McConnell, 2007).

Along with regional planning and ongoing training, mobilization of resources and implementation of action plans can be expedited through the adoption of memorandum of understanding and interagency agreements (Oliver, 2011). Unfortunately, there are often numerous obstructions limiting collaboration between agencies. Differences of organizational goals, professional cultures, lines of accountability, political control styles and decision-making cycles are some of the barriers identified by Boin and McConnell (2007).

The effectiveness of any planning process is limited by the amount of financial backing directed to the effort. Appropriate levels of expenditures need to be allocated in order to effectively prepare for critical infrastructure resiliency (Sinai, 2006). There is a significant cost involved in making any planning process a reality. Training of employees and implementing large scale exercises on a regular basis can become extremely costly. Efforts to implement disaster planning are often delayed or permanently stalled by factors such as complacency, procrastination, resource limitations and shifting organizational priorities (Boin & McConnell, 2007).

In summary, literature indicates that protecting and maintaining effective resiliency in CIKR is a necessity of national significance. The PSAPs and communication systems within Pierce County are at risk from a variety of naturally occurring and man made threats. The nature of these threats is extremely diverse, ranging from mechanical failures and terrorist attacks to natural disasters and pandemics. Providing adequate protection and resiliency to these varied threats requires communication systems designed on a platform of reliability, redundancy and diversity. To best achieve this level of performance requires infrastructure and systems in line with current industry standards and best practices; something extremely difficult to achieve with infrastructure designed under previous standards. Adequately preparing Pierce County

emergency communications will require a combination of effective planning, implementation, training and evaluation supported with sufficient funding. Based on these factors, the author sought to determine the risks facing Pierce County PSAPs and their ability to sustain appropriate levels of resiliency in line with current industry standards.

### **Procedures**

The purpose of this applied research project was to complete a resiliency analysis of the Pierce County public safety communications network. Descriptive research was utilized to gather information and perform data analysis in order to answer four research questions.

- What are the current risks facing Pierce County PSAPs?
- What is the current condition of Pierce County PSAPs in relation to current industry standards and best practices?
- Are adequate backup plans in place to provide an appropriate level of resiliency?
- What limitations are there to the PSAPs sustaining backup operations?

Research for this applied research project initially began, in November of 2010, at the Learning Resource Center (LRC) on the campus of the National Fire Academy (NFA), in Emmitsburg, Maryland. Subsequent research continued through June of 2011 in University Place, Washington.

On April 11, 2011, online questionnaires were distributed to each of the eight Pierce County PSAPs. The internet based survey tool, Survey Monkey, was utilized to design and distribute the questionnaire. All eight questionnaires were returned. Questions focused primarily on three issues.

- Agency size and staffing levels.

- Agency operational policies related to disaster preparedness and continuity of operations.
- NFPA 1221 standards. Not all standards defined in NFPA 1221 were included in the questionnaire. Only a portion of the standards defined in Chapter 4, Communication Centers were utilized. Only standards which reflected core design features for communication centers were selected, focusing primarily on vulnerabilities associated with facility security, access to facility air handling systems, and the ability to deter or withstand a blast or explosion.

Responses to the questionnaire were compiled into a Microsoft Word document, Pierce County PSAP Questionnaire Summary (Appendix A). Data analysis was performed on the responses for the purpose of conducting original research to answer the following research questions.

- What is the current condition of Pierce County PSAPs in relation to current industry standards and best practices?
- Are adequate backup plans in place to provide an appropriate level of resiliency?

Between January and April 2011, the author attended several meetings of the PSAP Backup Development Committee. Meetings were held in the Tacoma/Pierce County EOC, in Tacoma, Washington. The author attended meetings held on January 11, February 8, March 8 and April 12, 2011. The purpose of attending these meetings was to conduct original research to help answer the following research questions:

- Are adequate backup plans in place to provide an appropriate level of resiliency?
- What limitations are there to the PSAPs sustaining backup operations?

An interview was conducted with Colleen Adler, the Disaster Preparedness Coordinator for West Pierce Fire & Rescue. Prior to being in her current position, she was the Assistant Director for Fire Comm for seven years. This interview was held on May 4, 2011 in an office at WPFR station 21. This interview lasted from 09:00 until 09:40. The following questions were asked during the interview.

1. What disaster risks are of the biggest concern in Pierce County?
2. What is the potential impact to West Pierce?
3. How well prepared is West Pierce to continue operations in the event of a disaster?
4. What impact did the Nisqually Earthquake have on Fire Comm's operations?
5. What is the potential for a pandemic?

The purpose of the interview was to conduct original research to help answer the following research questions:

- What are the current risks facing Pierce County PSAPs?

An interview was conducted with Tim Lenk, the Program Manager for the E-911 Radio Communications Division of Pierce County DEM. Additionally, he has been deployed as part of a FEMA Incident Support Team to numerous national disasters including the World Trade Center in 2001, Hurricane Katrina in 2005 and Hurricanes Gustav and Ike in 2008. This interview was held on May 4, 2011, in his office at DEM. This interview lasted from 1:20 until 2:30. The following questions were asked during the interview.

1. What deployments have your been involved with?
2. What do you expect to be the biggest problems for emergency communications if there were a major disaster in Pierce County?

3. What limitations do you foresee in maintaining radio operations during a major disaster?
4. What do you see as the biggest vulnerability in redundancy of Pierce County communications?
5. What agencies does the Pierce County Radio Division perform service for?
6. What is the hierarchy of equipment repair in the event of a county wide disaster that affects all systems?
7. Is there a defined back up plan if there were to be a catastrophic failure of the Pierce County radio network?

The purpose of the interview was to conduct original research to help answer the following research questions:

- Are adequate backup plans in place to provide an appropriate level of resiliency?
- What limitations are there to the PSAPs sustaining backup operations?

An interview was conducted with Jean Nealy, the Telecommunications Coordinator for Pierce County DEM. This interview was held on May 6, 2011 in her office at DEM. This interview lasted from 10:40 until 11:20. The following questions were asked during the interview.

1. What is the most common cause of phone system failures in Pierce County PSAPs?
2. How frequently does a PSAP have a phone outage?
3. How are phone system failures managed?
4. What resources are available to fix phone system failures?
5. What is the backup plan to the current system?
6. How do the CAD, phone and radio systems compare between each PSAP?

The purpose of the interview was to conduct original research to help answer the following research questions:

- Are adequate backup plans in place to provide an appropriate level of resiliency?
- What limitations are there to the PSAPs sustaining backup operations?

An interview was conducted with Michael Dobbs, the Battalion Chief of Communications for West Pierce Fire & Rescue. As Battalion Chief of Communications, he serves as the Operations Manager for Fire Comm. This interview was held on May 6, 2011, in his office at Fire Comm. This interview lasted from 12:30 until 1:10. The following questions were asked during the interview.

1. What is the most common cause of a system failure (radio/phone/CAD) in Fire Comm?
2. How frequently does Fire Comm suffer an isolated failure in one of its systems?
3. How frequently does Fire Comm suffer a system-wide failure?
4. What resources are available to address system failures?
5. Do you do any cross training with FCC to prepare for system failures?
6. What backup plans are in place to manage system failures?
7. What is your biggest concern from the standpoint of maintaining operations during a significant event?

The purpose of the interview was to conduct original research to help answer the following research questions:

- Are adequate backup plans in place to provide an appropriate level of resiliency?
- What limitations are there to the PSAPs sustaining backup operations?

An interview was conducted with Rob Totten, the Operations Supervisor for Public Safety Radio Communications for the City of Tacoma. This interview was held On May 9, 2011, at a restaurant located in Tacoma. This interview lasted from 11:30 until 12:45. The following questions were asked during the interview.

1. Can you define the GECN?
2. Can you define the TRIS network?
3. Explain the difference in impact from a PSAP evacuation with equipment in tact vs. abandonment of a PSAP with no infrastructure intact.
4. If a center was lost, how long would it take to re-route radio communications?
5. What do you see as the biggest vulnerability in redundancy of Pierce County communications?
6. What is the back up for radio system?
7. What is the most critical component of the radio networks?

The purpose of the interview was to conduct original research to help answer the following research questions:

- Are adequate backup plans in place to provide an appropriate level of resiliency?
- What limitations are there to the PSAPs sustaining backup operations?

There were several limitations encountered during this research. The first limitation was the questionnaire. In order to maintain a manageable size questionnaire, the questions were limited to three general topics; agency size and staffing levels, agency operational policies related to disaster preparedness and continuity of operations, and limited portions of NFPA 1221, Chapter 4, Communication Centers.

Additional limitations were due to the complex nature of emergency communications within Pierce County. The 9-1-1 communications system in Pierce County consists of a variety of overlapping technology infrastructure including, but not limited to CAD, radio and phone systems. With few exceptions, most systems differ in model, version, radio frequency, etc. from PSAP to PSAP. Additionally, each of these systems are managed through a variety of public and private ownership arrangements as well as public/private and public/public partnerships.

In addition to the complex nature of the technological infrastructure, there is a significant amount of complexity in the geopolitical ownership and operations of the Pierce County PSAPs as well as the various radio networks they rely on to provide service. While some PSAPs own their radio systems others, such as LESA, operate on several different radio systems owned by different political entities. Because of this, each PSAP has a different level of influence over the resiliency of their radio network.

PSAP governance is another complex issue with direct influence on the overall resiliency of each PSAP as well as the overall Pierce County network. Every PSAP has a different governing authority with varying degrees of operational influence and authority. This diversity creates significant challenges in adopting region-wide strategies for improving resiliency.

Due to the limited time available to complete this research and the complex nature of technology infrastructure, radio system ownership, and PSAP governance, the author chose to limit the scope of the research performed on these three issues.

### **Definition of Terms**

Backhaul: Method of transport used to connect a dispatch center to remote radio sites.

|                          |                                                                                                                                                                                                   |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CEB:                     | Central Electronics Bank. Location where all radio resources for a PSAP reside. Point where connectivity exists between the PSAPs on the GECN.                                                    |
| CPTED:                   | Crime Prevention Through Environmental Design. A method of deterring criminal behavior through environmental design.                                                                              |
| Critical infrastructure: | Assets and facilities essential for the functioning of a society and economy.                                                                                                                     |
| ESInet:                  | Emergency Services IP network. A statewide network that routes 9-1-1 calls over an IP network.                                                                                                    |
| FCC:                     | Fire Communications Center. A division of the Tacoma Fire Department. A secondary public safety answering point for fire and EMS for the Tacoma Fire Department and Central Pierce Fire & Rescue. |
| Fire Comm:               | A division within West Pierce Fire & Rescue. A secondary public safety answering point for fire and EMS in Pierce County.                                                                         |
| GECN:                    | Gold Elite Console Network. A networked system interconnecting the dispatch consoles between multiple PSAPs.                                                                                      |
| Key Resources:           | Resources considered essential to the minimal operations of the economy and government.                                                                                                           |
| Lahar:                   | A mudflow or debris flow created from volcanic activity.                                                                                                                                          |
| LESA:                    | Law Enforcement Support Agency. A primary public safety answering point for law enforcement in Pierce County.                                                                                     |

|                      |                                                                                                                                                                |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NG 911:              | Next Generation 9-1-1. A nationwide initiative to design an architecture that allows a 9-1-1 "call" to be placed from any wired, wireless, or IP based device. |
| Natural Disaster:    | An event or force of nature with catastrophic consequences.                                                                                                    |
| PSAP:                | Public Safety Answering Point. An emergency dispatch facility that receives 9-1-1 calls.                                                                       |
| Pandemic:            | A global outbreak of disease within the human population.                                                                                                      |
| Pierce County Alert: | An emergency alerting system providing emergency notifications via telephone, text or e-mail.                                                                  |
| Primary PSAP:        | A PSAP which receives 9-1-1 calls directly from the calling party.                                                                                             |
| Secondary PSAP:      | A PSAP which receives 9-1-1 calls as a transfer from a primary PSAP.                                                                                           |
| TRIS:                | Tri-county Radio Interoperability System. A networked system providing interoperability between the primary radio systems of the tri-county region.            |
| Telecommunicator:    | An employee within a PSAP who is trained as a Call Receiver, Dispatcher or cross trained as both.                                                              |
| Terrorism:           | The calculated use of violence to intimidate or coerce governments or citizens for religious, political or ideological goals.                                  |
| Tri-County Region    | A designated geo-political region within Western Washington, consisting of King, Pierce and Snohomish counties.                                                |

## Results

Through descriptive research which utilized a questionnaire, personal interviews, data analysis and attendance at several PSAP Backup Development Committee meetings the author was able to establish sufficient information to answer all four research questions.

Research question one: What are the current risks facing Pierce County PSAPs?

The risks facing Pierce County are numerous and extremely diverse, from utility disruptions and equipment failures to terrorist attacks, pandemics and natural disasters. In Pierce County, the most common threats are localized incidents related to storms and flooding (C. Adler, personal communication, May 4, 2011). These events are typically handled well and have minimal impact on communications systems since they are fairly common and usually affect only a localized area. While there are numerous systems in place to take care of more common threats, these systems tend to become overwhelmed and break down in a major, widespread disaster (C. Adler, personal communication, May 4, 2011). Due to this, large scale disasters such as an earthquake or Lahar are a significant threat in Pierce County, even though they are much less common. Pierce County has had four presidentially declared disasters in the past 10 years and 20 in the past 18 years (Pierce County Department of Emergency Management website, 2011). The last presidentially declared disaster was in December of 2007. Based on these statistics, the region is overdue for a significant disaster.

Some of the most common events affecting PSAPs are utility disruptions and equipment failures. Usually these are isolated incidents and affect only a limited piece of the communications system. Fire Comm experiences 3-4 partial system failures annually (M. Dobbs, personal communication, May 6, 2011). Partial system failures are limited in size and scope such as a partial loss of CAD, failure of a piece of equipment that takes down a radio site,

or a limited phone outage. The most common reason for system failures within Fire Comm are due to power related issues (M. Dobbs, personal communication, May 6, 2011). Overloading the uninterrupted power supply (UPS) from power surges on the commercial power grid as well as internally overloaded circuits can significantly damage or fail old and outdated infrastructure and systems.

There are several recent examples of power issues affecting communications systems in Fire Comm. In 2010, a power surge from the commercial grid overloaded the UPS briefly shutting down all systems in the PSAP. Fortunately, all systems came back online after a full reboot of all systems. Also in 2010, there was another incident in which there was a brief interruption in the commercial power. This brief outage should have been managed by the UPS, however there was a bad battery in the UPS battery string, causing a cascading power failure that shut the center down. The UPS had to be taken offline and all systems rebooted. The most significant power related problem was in 2009. A transformer explosion on the commercial power grid caused a power surge at Fire Comm that shut down the power and caused a cascading failure taking down all of the 9-1-1 trunk lines. Electrical systems were brought back on line and the center continued to operate on generator power, but the 9-1-1 trunk lines were severely damaged. In order to take 9-1-1 calls, Fire Comm Dispatchers had to be moved to FCC for nearly 36 hours, until repairs could be completed on the system (M. Dobbs, personal communication, May 6, 2011).

Large scale phone system failures, such as the one experienced by Fire Comm in 2009, are extremely unusual. Overall, the 9-1-1 phone systems in Pierce County are fairly stable; however there are significant challenges in supporting the current phone systems due to the age of the equipment. (J. Nealy, personal communication, May 6, 2011). Attaining replacement

parts for old, faulty equipment can be very challenging. Currently, the phone systems in the County are being upgraded to meet Next Generation 9-1-1 (NG 911) standards. Through this process, older legacy equipment is being replaced with modern technology making the overall system more stable. The biggest challenge with the newer systems is dealing with software glitches, which are much easier to manage than replacing outdated equipment (J. Nealy, personal communication, May 6, 2011).

Terrorism and pandemics, like natural disasters, are much less likely than system failures; however their impact would be potentially devastating to Pierce County communications. While both have the ability to cripple communications within the county, it would be through very different mechanisms. Terrorism would most likely be a targeted event designed to cripple or destroy specific CIKR. A pandemic, on the other hand, would have system-wide impacts on personnel and support staff.

The effect on communications from these two events would be drastically different. In the event of a terrorist attack, there is a high likelihood that infrastructure will be damaged or destroyed. Which infrastructure is impacted and to what degree it is damaged will determine how severely emergency communications are affected.

With the exception of Buckley and JBLM, all of the PSAP radio systems are connected through the GECN (Appendix B). This network allows any dispatch console on the network to access another PSAP's resources. This network connectivity is achieved through a Central Electronics Bank (CEB) located in each PSAP on the network. In the event of a terrorist threat to a PSAP, the PSAP could be evacuated and resources could be accessed from another PSAP as long as the CEB is still intact in the evacuated PSAP. However, if the CEB is destroyed or the backhaul connectivity between the centers is interrupted, there is no way to access the resources

of the damaged PSAP from a backup location (R. Totten, personal communication, May 9, 2011).

Another potential target would be a radio site. In this case, the degree to which communications will be impacted is greatly dependant on which site is targeted. With the loss of a single site, some capabilities are going to be reduced or lost. If a site such as the Fire Comm Anderson Island site was lost, there would be little impact to communications since it services a small geographic area and other sites could still provide adequate coverage. Losing a site such as LESA or Graham Hill would have a much more significant impact. Since the LESA site is the hub for several other sites, the Three Sisters, Gold Mountain and Graham Hill sites would all be lost if the LESA site were to go down. Additionally, since several agencies utilize the Graham Hill site, Fire Comm, Pierce Transit, Central Pierce Fire & Rescue, Pierce County Sheriff and Tacoma Public Utilities would all be affected if the site was damaged (T. Lenk, personal communication, May 4, 2011).

In the event of a pandemic, it is unlikely any infrastructure will be affected. The biggest impact will be the loss of staffing. In order to manage a pandemic, PSAPs will need to implement strategies to manage the increasing workload and avoid employee burnout with the significantly decreased level of staffing that will be available to work (C. Adler, personal communication, May 4, 2011). Staffing of the communications centers will be one of the biggest problems facing Pierce County communications in the event of a major disaster, either natural or manmade (T. Lenk, personal communication, May 4, 2011).

As a general rule, the ability of the PSAPs to manage the risks facing Pierce County will be highly dependent on the magnitude and duration of the event. Overall, the PSAPs in Pierce County are much better prepared to deal with emergencies that happen more frequently and can

be mitigated in less than 48 hours. All of the PSAPs described their agency as being "well prepared or fully prepared" to handle a power outage lasting more than 24 hours. On the other hand, only 60% described themselves as "adequately prepared or well prepared" to evacuate their PSAP for up to 48 hours and 60% described themselves as "fully unprepared" to evacuate for more than 30 days. On average, the self assessment rating the PSAPs gave on their state of readiness steadily decreased as the nature of the emergency increased in complexity and duration (see Figure 1).

Research question two: What is the current condition of Pierce County PSAPS in relation to current industry standards?

The PSAPs in Pierce County are very diverse in their level of preparedness as well as their condition as it relates to current standards. Much of this is related to the age and design of the various PSAPs as well as their individual levels of operational planning and preparedness.

In 2011, the average PSAP facility in Pierce County was 36 years old, while the median age was 20.5 years. The range in age was extremely wide spread. The oldest PSAP was 82 years old, while the newest was only five years old. Several PSAPs were built prior to significant building code requirements being established in the 1970's, significantly decreasing their ability to survive a major disaster (C. Adler, personal communication, May 4, 2011). Due to the age of some structures, it can be extremely difficult if not financially prohibitive to upgrade them to meet current industry standards and codes.

Out of the eight PSAPs in Pierce County, only 4 were designed as standalone communications facilities. A variety of services were co-located within the PSAP facilities, such as police and fire stations, jails, police records, crime labs, licensing departments, administrative offices, etc. This combination of services within the same building can create diverse

operational standards for the overall facility, limiting the PSAPs ability to meet appropriate resiliency standards for CIKR, specifically communications centers.

The PSAPs in Pierce County have met the standards for the protection of CIKR to varying degrees from PSAP to PSAP. Four key elements of security were analyzed for compliance with NFPA 1221: entry, HVAC systems, windows and blast resistance.

- Entry: NFPA 1221 requires a security vestibule for all entryways that lead directly into the communications center, however only 62.5% of the PSAPs met this standard.
- HVAC systems: PSAPs are expected to have an independent HVAC system that only services the communications center, however only 50% of the PSAPs had an independent system. Additionally, less than half of the PSAPs had an HVAC system designed to minimize smoke intake from a fire or intentional introductions of irritating or poisonous substances. None of the PSAPs had the ability to close outside air intakes from the operations room.
- Windows: Out of the eight PSAPs, five had windows in the communications center, but 40% had their windows located below four feet above the ground, as required. Of the five PSAPs with windows, three had windows that can be accessed by the public, but only two were equipped with bullet resistant glass.
- Blast resistance: Only one PSAP in Pierce County was designed to be blast resistant. None of the remaining PSAPs had the ability to restrict unauthorized vehicles from approaching within 82.5 feet (25 m) of the building.

Each PSAP's emergency response capabilities were analyzed based on four types of emergencies: natural flooding, power outage, fire and systems failure.

- Natural flooding: No PSAPs were identified to be located in an area that was less than 100 feet below the 100 year flood plain.
- Power outage: Every PSAP was well prepared to manage a power outage. Each PSAP had a standby generator that automatically supported services in the event of a power failure. The generators utilized a variety of fuel sources, but each agency had sufficient fuel on site to support operations for a minimum of 24 hours.
- Fire: With only one exception, all of the PSAPs were equipped with a fire alarm system, however only half of the PSAPs were protected with an automatic sprinkler system. Only 25% of the PSAPs had a written, dated emergency fire plan that was tested annually.
- Systems failure: As a general rule, the PSAPs were better prepared to manage an outage of their phone systems than an outage of their radio systems. There was only one PSAP that didn't have a formal written plan for transferring incoming calls to their designated backup facility, however only half of the PSAPs had a formal written plan for transferring dispatch and radio communications to their designated backup facility. Although several PSAPs had written policies for transferring phones and radios, not all of them routinely trained on the procedures. Of those PSAPs that had a written policy in place, only 71.4% routinely trained on their phone transfer policy, while 75% routinely trained on their radio transfer policy.

Four key areas of disaster preparedness were analyzed: disaster plans, pandemic plans, Continuity of Operation Plans (COOP), and evacuation plans.

- Disaster plans: None of the PSAPs had a written damage control plan, and only half of them had a formal written disaster plan. Of the four PSAPs with a formal written disaster plan only one routinely trained on the plan.
- Pandemic plans: In the event of a pandemic, 62.5% of the PSAPs had a formal written plan in place for maintaining operations, however less than half of them routinely trained on the plan.
- Continuity of operations plans: Two PSAPs had COOP plans and both routinely trained on the plans.
- Evacuation plans: To determine the PSAPs ability to sustain operations during an event that requires evacuation of their PSAP, three levels of evacuation were analyzed: short term evacuation of less than 24 hours, transitional operations for up to seven days and long term operations lasting from seven days to several months. Out of the eight PSAPs, only three had a formal written plan for managing a short term evacuation, and only two of the three routinely trained on the procedure. Only one agency had a formal written procedure they routinely trained on for transitional operations, and none of the PSAPs had a formal written plan for managing operations during a long term evacuation of their PSAP. Additionally, less than half of the PSAPs performed any ongoing training with their designated backup facility.

Research question three: Are adequate backup plans in place to provide an appropriate level of resiliency?

There were a variety of backup plans and redundancies in place within the Pierce County 9-1-1 system. Historically, each of the PSAPs had addressed their backup and redundancy needs independently with little coordination between PSAPs. There was an ongoing effort, through the

PSAP Backup Development Committee, to improve the backup planning between the PSAPs and bring all of the PSAPs under a more common platform of redundancy. In order to effectively evaluate the backup planning effort in Pierce County, key systems such as phones, radios and personnel were analyzed.

Each of the PSAPs in Pierce County used either a Positron Life Line 100 or Positron VIPER phone system, supported by Qwest. Having all of the phone systems under a single vendor allows for a fairly streamlined process of repairing phone outages as well as transferring phones from one PSAP to another (J. Nealy, personal communication, May 6, 2011). Each PSAP had another PSAP designated as their backup to receive their calls in the event the phones needed to be transferred. A diagram outlining this backup plan was provided at the December 14, 2010 PSAP Backup Development Committee meeting (Appendix C).

In an effort to prepare for NG 911, all of the PSAPs in Pierce County were in the process of replacing their analog phone systems and routing their 9-1-1 calls through a statewide Emergency Service IP network (ESInet). Once all of the PSAPs in Pierce County are on the ESInet, they will have the ability to reroute calls to any other center on the network or to reroute calls geographically to several different PSAPS. The State is expected to have the ESInet completed statewide by July of 2011. Once the ESInet is established statewide, calls can be rerouted to any center on the network statewide (J. Nealy, personal communication, May 6, 2011). This will allow for much greater flexibility in rerouting calls in the event of a major disaster impacting the entire county or region.

The methods in place for managing a failure of the phone system can vary depending on the nature of the outage. If there is a localized outage of the phone system in a specific geographic area, it is managed by the telephone system provider for that specific area.

Ultimately, there is little that can be done to manage or control an outage on a private network. For a phone outage or failure in a PSAP, Qwest is contacted immediately and the local Pierce County technician is dispatched. If the Pierce County technician is unavailable, resources are brought in from King County (J. Nealy, personal communication, May 6, 2011).

Similar to phone systems, radio systems can be moved from one PSAP to another through the GECN. Before the radios can be transferred, the resources must first be placed on the console at the backup PSAP. This is something that was being addressed by the PSAP Backup Development Committee. For example, although Fire Comm is on the GECN they cannot move radios to their backup facility since the resources have not been put on the consoles at FCC. If Fire Comm had a loss of radios, they would most likely resort to a telephone notification system and field units would be limited to communicating portable to portable (M. Dobbs, personal communication, May 6, 2011).

Even if the resources are available at the backup PSAP, rerouting radios is still limited by connectivity to the GECN. Maintaining connectivity requires the CEB in the transferring PSAP to be operational as well as having an intact backhaul between PSAPs. In the event of a major disaster that destroys the CEB or breaks connectivity of the backhaul, there would be no way to transfer radios to the backup PSAP, since there is no redundant connectivity outside of the GECN.

In the event of a CEB failure, the various radio systems in the county would be affected in very different ways. In a trunked repeated system like the Tacoma/Puyallup network, there are three different levels of operation, wide area trunking, site trunking, and fail soft. Wide area trunking is considered to be normal operations. If there is a failure of the master site, each subsystem operates independently through site trunking. In a catastrophic loss of the master site as

well as a sub-system controller, the system operates in fail soft. During fail soft, the repeater at each site functions independently as a conventional repeater (R. Totten, personal communication, May 9, 2011). Fire Comm however, operates on a non-repeated simplex system. If the CEB fails at Fire Comm, there is no ability to repeat or rebroadcast any radio traffic, and field units would be limited to portable to portable communications (M. Dobbs, personal communication, May 6, 2011).

Outside of the GECN, none of the PSAPs have redundant radio connectivity between their radio network and their backup facility. If a major disaster or terrorist strike destroyed a PSAP, including the CEB, it could take a significant amount of time and resources to re-establish radio communications. In order to re-establish some level of communications, some form of backhaul would need to be established between a radio site or several sites and the new dispatch location. Doing this during a disaster could be extremely difficult if not impossible.

In the event of a region wide disaster, getting radio communications back online is critically important. The Pierce County Radio Division provides service for several agencies throughout Pierce County, including the Pierce County Sheriff and Fire Comm. In the event of a major disaster, getting infrastructure back online is priority one for the Pierce County Radio Division (T. Lenk, personal communication, May 4, 2011). The Pierce County Radio Division uses a three tiered approach to restoring infrastructure.

1. The first priority is placed on restoring radio sites shared by multiple systems. A site such as Graham Hill that supports resources for Fire Comm, Pierce Transit, Central Pierce Fire & Rescue, Pierce County Sheriff and Tacoma Public Utilities would have a much higher priority than a site like Anderson Island which is only used by Fire Comm.

2. The second priority is placed on restoring radio sites directly in the impacted area. Radio communications are a critical component of deploying resources within the affected area making the sites in these areas a high priority.
3. The third priority is to strategically move out from the epicenter of the impacted area, with an emphasis on re-establishing fire department radio sites. In a disaster, it is vital that EMS and rescue resources can be deployed rapidly into the damaged area, making fire/EMS communications a higher priority over law enforcement (T. Lenk, personal communication, May 4, 2011).

Resources such as Pierce County Alert, smart phones, text messaging and e-mail would also be utilized as alternate communication methods in the event of a failure of the Pierce County radio network. Additionally, mobile resources such as tower trailers and the Mobile Operations Command Center 1 (MOCC1) would be utilized to support damaged infrastructure.

In the event of a disaster affecting Fire Comm or any of its radio infrastructure, numerous resources would be utilized to manage the various problems that could impact communications (M. Dobbs, personal communication, May 6, 2011). Pierce County Radio would be utilized for radio service and Qwest would be utilized for telephone issues. Internal resources such as WPFRR command staff and IT staff could also be accessed as needed. Pierce County DEM would be heavily relied upon for such things as mobile communication resources, disaster response resources, access to the emergency operations center as well as a possible backup facility for communications.

One of the biggest vulnerabilities for Pierce County communications is the lack of a defined plan for operational redundancy during a large scale event or if a PSAP is the event (T. Lenk, personal communication, May 4, 2011). Effective operational redundancy is not limited to

radio and phone systems. Adequate staffing will be a significant challenge during a major disaster. There are numerous reasons staffing will be limited during a major disaster. In a natural disaster, staff could be killed or injured in the initial event, transportation routes can be limited, they may need to care for family, etc. In the event of a terrorist attack, there may be significant fear on the part of employees to return to work, and during a pandemic, workers will be too ill or afraid of becoming ill to leave their homes.

In a major disaster, effectively managing human resources is critical to maintaining effective operations. Not only should the health and safety of employees be a priority, but also the health and safety of their families as well. Employees cannot be expected to perform well if they don't know about the well being of their family (C. Adler, personal communication, May 4, 2011). Implementing a program such as a Critical Employee Emergency Plan (CEEP) can assist in minimizing this problem. The CEEP program came out of the aftermath of Katrina. In the CEEP program, agencies establish emergency planning and contact information for family members of agency employees and establish a relationship with a sister city that can provide shelter and support for family members of employees. The goal of a CEEP is to provide assurance to employees that their families are taken care of, so they can stay at their post during a major event.

During a major event, it has to be assumed that every PSAP will be operating with a reduced level of staffing. The biggest challenge will be the need to handle the increase in call volume with a decreased level of staffing (C. Adler, personal communication, May 4, 2011). In Pierce County, there has been no coordinated effort to cross train employees between the various PSAPs, in order to develop a backup plan for personnel during a major disaster. Maintaining appropriate staffing levels and key positions is critical to the continuity of operations. However,

only one PSAP was familiar with NFPA 1600, Standard on Disaster/Emergency Management and Business Continuity Programs.

Research question four: What limitations are there to the PSAPs sustaining backup operations?

The worst case scenario for emergency communications in Pierce County is the loss of one or more PSAPs during a major disaster. Losing an entire PSAP facility would require not only transferring radio and phone communications to the backup PSAP, but all operations and personnel. Only one PSAP had a written procedure for managing operations in their backup facility for several days, and none of the PSAPs had a plan for maintaining long term operations in their backup facility should a catastrophic event take out their primary facility. With no defined procedure, a plan would need to be developed on the fly greatly delaying notification of emergency responders (M. Dobbs, personal communication, May 6, 2011).

If a PSAP failed to survive an event, they would move to the designated backup facility. The ability of a PSAP to support an operational move varies greatly depending on the size of the moving PSAP as well as the size of the backup PSAP. As a general rule, it would be much less challenging to move a small PSAP into a larger one. On the other hand, it may be impossible to move a larger PSAP into a smaller one. The two exceptions to this are WSP and JBLM. They have unique access to State and Federal resources that provide them with unique opportunities to manage backup operations.

In most backup scenarios, the backup facility is of equal or larger size and therefore can support the additional capacity. However, in two scenarios the backup agency is smaller than the agency being relocated, creating a shortage of console resources (see Figure 2).

Puyallup had a minimum staffing of four telecommunicators and Fife had a minimum of two. Collectively the two PSAPs required a minimum of six telecommunicators to effectively manage operations. However Fife only had four available consoles. If Puyallup had to move to Fife it would be difficult to operate with even a minimum level of staffing.

The worst case scenario would be for LESA to evacuate to Fire Comm. LESA had a minimum of 10 telecommunicators, while Fire Comm had a minimum of four. Collectively they had a minimum of 14 telecommunicators, but access to only 11 console positions, at Fire Comm. During a disaster it is assumed the PSAPs will have to operate with fewer resources. However, 14 telecommunicators was the minimum staffing level of the combined agencies. During peak hours, the two agencies had a combined staffing of 25 telecommunicators.

Fire Comm, FCC or LESA could provide adequate console positions to support Puyallup's operations. With 11 console positions, Fire Comm could support both agencies at peak staffing. With anywhere from 10-20 telecommunicators, supporting LESA's operations with any one PSAP is unlikely. After LESA, the three agencies with the most available console resources were Fire Comm, FCC and Puyallup. At minimum staffing, these three agencies had 19 available console positions collectively and at peak staffing they had 12.

Sustaining communications during a disaster will require a significant amount of effort from the PSAPs, radio system technicians and emergency responders. Without maintaining adequate resources such as chargers, batteries, and fuel for generators, communication systems will begin to break down. During Hurricane Ike, getting fuel to generators to power portable repeaters became one of the highest priorities (T. Lenk, personal communication, May 4, 2011). Numerous radio sites within Pierce County are located in remote locations such as high elevation forests and on islands. Maintaining generators at these sites, in the event of commercial power

failures, is extremely time consuming and in some cases may not be possible. A choice will have to be made to either commit significant resources to maintaining the sites or accepting a degradation of coverage over time, as the sites begin to fail.

In addition to sustaining radio communications, there will be significant challenges to sustaining adequate staffing levels. Due to the event, there will be a significant increase in workload for all of the PSAPs. Paradoxically, each PSAP will have fewer employees available or willing to work. The longer the event continues the more challenging it will become to maintain effective levels of staffing without creating significant burnout among the limited number of available employees (C. Adler, personal communication, May 4, 2011).

### **Discussion**

Protecting and insuring the resiliency of CIKR has long been a national priority. The Nation's CIKR are essential to security and economic vitality as well as public health and safety (DHS, 2009). In a post 9/11 era, the emphasis on protecting and ensuring the resiliency of CIKR, specifically in the communications and emergency services sectors, is vital to public health and safety. Without effective resiliency in the communications and emergency services sectors, providing critical emergency service response to the public would be substantially restricted.

Literature review and research identify numerous risks to the PSAPs and emergency communication systems in Pierce County. The risks to CIKR comes from both naturally and manmade events such as natural disasters, pandemics, terrorists attacks and other accidents and emergencies (DHS, 2009). In Pierce County, the most common naturally occurring threats are from storms and flooding (C. Adler, personal communication, May 4, 2011). Since these types of events are fairly common and often geographically isolated, the PSAPs are better prepared to

manage them. The bigger concern for Pierce County is a major region wide event such as an earthquake, volcanic eruption or lahar; all of which have occurred in the region within the last 30 years. On average, over the past 20 years, Pierce County has experienced 1.11 presidentially declared disasters per year (Pierce County Department of Emergency Management website, n.d).

Much less common, but still of significant risk to the communications systems in Pierce County, is the threat of a Pandemic. A pandemic, would have system-wide impacts on personnel, and support staff such as technicians, repair people, suppliers, etc, with no ability to mobilize national resources for assistance (Holdeman & Loehr, 2006). Historically, a pandemic has occurred every 30 years on average for the past 300 years (Osterholm, 2005). With the last pandemic occurring in 1968, literature strongly suggests that a pandemic is likely to occur in the near future. Due to the infrequency of pandemics, most agencies fail to prepare adequately. Only two PSAPs had a written procedure they routinely trained on for managing operations during a pandemic. Additionally, neither PSAP had any real experience in testing their contingency plans during an actual pandemic. Unfortunately, existing programs and procedures are usually only ramped up when the CDC releases warnings of a potential pandemic. In the interim, the plans are shelved (C. Adler, personal communication, May 4, 2011).

Man made threats to the Pierce County PSAPs includes a variety of potential system failures as well as terrorist attacks. Research showed many of the system failures within Pierce County revolved around equipment which had exceeded its life expectancy. Old and outdated equipment was identified as one of the leading causes of system failures in Fire Comm (M. Dobbs, personal communication, May 6, 2011). Additionally, faulty, over aged equipment with no readily available parts was identified as one of the biggest challenges in supporting the phone systems in Pierce County PSAPs (J. Nealy, personal communication, May 6, 2011). The affects

of aging are not limited to the equipment inside the PSAPs, but apply equally to the PSAPs themselves. With rapidly changing operational needs and technological advancements, PSAPs begin to lose their ability to maintain effective operations over time (NENA, 2007). With an average age of 36 years, the majority of the PSAPs are challenged to meet current industry standards for CIKR.

Terrorism, like a pandemic, is much less likely, but the effects on communications could be catastrophic. Terrorism has been one of the driving forces in defining the Nation's CIKR protection policies. In response to the events of 9/11, sweeping changes were made to CIKR protection plans. In Pierce County, only one PSAP was built after the events of 9/11. All of the remaining PSAPs were designed and built to meet much less stringent CIKR protection standards, increasing their vulnerability to a terrorist attack.

The most widely recognized standard for PSAP design is NFPA 1221 (Loomis & McClure, 2007). Research showed the PSAPs in Pierce County meeting the requirements of NFPA 1221 to varying degrees. PSAPs met requirements for entry security only 62.5% of the time. Only half of the PSAPs had an independent HVAC system and none could close outside intakes from inside the operations room. Of the PSAPs with windows, only one met all the security requirements for windows. Additionally, only one Pierce County PSAP was designed to be blast resistant. Clearly, the age of the various PSAPs as well as the design standards in effect when they were built has a direct effect on how well they can meet current CIKR protection standards.

The PSAPs were able to meet standards for emergency response much better. All of the PSAPs were located well above the 100 year flood plain, and all had the ability to run on backup

power for a minimum of 24 hours. All but one PSAP was equipped with a fire alarm system, but only half of them had an automatic sprinkler system.

Literature strongly supports the need for sufficient planning to support effective resiliency. In Pierce County, each of the PSAPs had differing levels of planning in place. None of the PSAPs met all of the NFPA 1221 standards for planning. Several PSAPs had formal written plans in place to address various emergencies, but not all of them trained on the plans. Within Pierce County, the percentage of PSAPs that had an established plan and routinely trained on it was almost always lower than the percentage of PSAPs with an established plan and no routine training (see Table 1).

Backup planning in Pierce County has traditionally been performed independently by each PSAP. Coordinated efforts were limited prior to the implementation of the PSAP Backup Development Committee. The committee is made up of representatives from each of the PSAPs and DEM. The stated goal of the committee is to "create a back-up plan to cover centers in the event of a minor interruption to a major catastrophe and total evacuation" (Ackerman, 2010, p. 1). Established in late 2010, the committee is still in the early stages of implementing countywide backup plans. While operational capabilities and requirements of the PSAPs are somewhat diverse, each PSAP needs an effective backup plan for critical resources such as phones, radios and personnel at a minimum.

Each of the PSAPs had Positron phone systems; however several still relied on the older Life Line 100 platform. While having a single vendor and maintenance contract streamlines service issues, the older legacy equipment is difficult to maintain due to the limited availability of replacement parts. Maintaining phone systems is increasingly challenged by the limited number of technicians readily available in Pierce County. The number of service technicians in

Pierce County has been reduced from four to only one over the past four years (J. Nealy, personal communication, May 6, 2011).

Each of the PSAPs had the ability to transfer phones to their backup facility, however only 62.5% of the PSAPs actually trained routinely on this procedure. As outlined in the backup plan (Appendix C), each PSAP had only one designated backup where they could transfer their phones. If the backup facility was lost, during a major disaster, there would be no secondary option for call routing. In order to minimize risks of a system failure and maximize PSAP uptime, literature suggests the need for maintaining reliable networks and systems through effective redundancy and diversity. Moving the phone systems of Pierce County off of their legacy systems and onto the ESInet will reduce the problems created by old equipment as well as provide greater route diversity options should a PSAP need to transfer their phones (J. Nealy, personal communication, May 6, 2011).

As with telephone systems, radio systems need to provide sufficient redundancy to meet the mission critical goals of the PSAPs. Literature supports the need to maintain system uptimes as close to 100% as possible. As with moving telephones, there are limitations to a PSAPs ability to transfer radios, potentially jeopardizing system uptimes. At 37.5%, far fewer PSAPs routinely trained on a formal plan for transferring radios. Only six of the PSAPs were on the GECN, requiring Buckley and JBLM to develop unique radio backup plans. Improving radio transfers was a key objective being worked on by the PSAP Backup Development Committee.

Transferring radio resources through the GECN requires the CEB and backhaul remain intact as well as having the resources available on the consoles at the backup facility. If either the CEB or the backhaul is lost due to a major disaster, radios could not be transferred to the backup facility. The Fire Comm resources were not available on the consoles at FCC, therefore

radios could not be transferred even if the CEB and backhaul were unaffected (M. Dobbs, personal communication, May 6, 2011).

The ability to maintain radio system uptime with the loss of a CEB will be highly dependent on the architecture of the affected radio network. The 800 MHz Tacoma/Puyallup radio network has three levels of operation, wide area trunking, site trunking and fail soft (R. Totten, personal communication, May 9, 2011). In each level of failure, some features are lost, but overall radio communications are maintained. However, a non-repeated simplex radio network such as Fire Comm's will fail completely with the loss of the CEB.

There were no identified plans for transferring radios redundant to the GECN, in the event of a CEB being destroyed. The best strategy for providing back up communications for this type of scenario would be to have pre-established backhaul from designated radio sites to the backup communications location (R. Totten, personal communication, May 9, 2011). With a redundant, pre-established method of transferring radio operations, flip of the switch type transfers could be made regardless of connectivity to the GECN.

Maintaining PSAP operations is not the only factor necessary to maintain an effective radio system within Pierce County. Maintaining the radio infrastructure itself is equally important. If key components of the radio infrastructure are lost, significant areas of the county could be left without communications. In the event of a major disaster that cripples the radio networks, reestablishing the infrastructure will be the first objective for the Pierce County Radio Division (T. Lenk, personal communication, May 4, 2011). The plan for re-establishing failed radio networks consisted of a hierarchy of needs: first, repair sites that support multiple radio networks or users, second, repair sites closest to the epicenter of the emergency and finally, strategically move outward from the epicenter.

While this approach provides an effective disaster recovery plan, literature strongly suggests the need to have an appropriate level of diversity and redundancy to all networked systems, including radio and data networks. In Pierce County each radio system had varying degrees of redundancy. Within Fire Comm's network, there were numerous areas of potential single point failures that would significantly reduce overall radio coverage. A failure of the microwave link between Fire Comm and the Spar Pole Hill site would negatively affect coverage to over half the fire districts in the county (M. Dobbs, personal communication, May 6, 2011). Clearly economic and geographical considerations have an impact on determining appropriate levels of diversity, however route diversity and system redundancy has to be considered a critical design factor and industry best practice in terms of providing adequate resiliency (Federal Communications Commission Public Safety and Homeland Security Bureau, n.d.).

Backup planning is not limited to telephone and radio networks. Establishing effective operational redundancy requires backup plans that factor in human resources. During a catastrophic event, it is critical to have enough people to manage communications, but during a disaster or terrorist event there is no guarantee personnel will be able or willing to come in to work. This was by far the biggest problem at Katrina (T. Lenk, personal communication, May 4, 2011). During a major disaster, staffing will be affected in every PSAP. Specifically in a pandemic, the literature identifies the potential for significant staffing shortages. During a pandemic, PSAPs could be placed in significant jeopardy if contingency plans aren't implemented to deal with excessive absenteeism (McKay, 2007). Research showed that only 62.5% of the Pierce County PSAPs had a pandemic plan, while only 25% of the PSAPs had a plan they routinely trained on.

Research strongly supports the need to address human continuity in any disaster planning. Braverman (2006) points out that "every crisis is a human crisis" (p. 38). He goes on to stress that providing a sufficient level of safety is critical in maintaining an adequate number of employees at work to maintain business continuity. Additionally, it must be assumed that employees will be limited in their ability to function effectively due to the effects of traumatic stress, fear, grief and physical exhaustion from understaffed conditions. For many employees these effects will be multiplied due to their fear for their families' safety. Employees will be unable to function effectively at their job if they don't know about the safety and health of their own family (C. Adler, personal communication, May 4, 2011). Implementing CEEP programs are fundamental in addressing these needs. The standards in NFPA 1600 clearly outline standards and procedures for maintaining continuity of human resources; however research showed that only one PSAP had any familiarity with this NFPA standard.

The ability to sustain effective communications during an emergency or disaster will depend heavily on the scale of the incident. Research shows the Pierce County PSAPs are much better prepared to handle high frequency, low impact events than they are to handle low frequency, high impact events. Emergencies such as the loss of commercial power can be managed almost seamlessly for virtually an indefinite period of time. However, larger scale disasters that damage infrastructure and require the evacuation of a PSAP are much more challenging to address. Sinai (2006) identifies planning and preparation as a crucial component for effective response to multi-hazard disasters. Only one PSAP had a plan established for evacuating their center and moving operations beyond 24 hours, and none of the PSAPs had a plan to address moving their operations for a period beyond one week. In the event a PSAP was lost, relocation of operations would be extremely difficult without having pre-established plans.

While there was a backup PSAP identified for each PSAP, it is questionable if actually moving operations in all of these scenarios is possible. In two scenarios, moving Puyallup to Fife and moving LESA to Fire Comm, a smaller PSAP is backing up a larger PSAP. Both scenarios leave a shortage of dispatch consoles for managing operations. Even with minimum staffing, moving Puyallup into Fife leaves the combined center two consoles short, while moving LESA into Fire Comm leaves a shortage of three. If Puyallup was moved to a larger PSAP such as LESA, Fire Comm or FCC, consoles could be maintained for all positions.

As the largest primary PSAP in Pierce County, LESA will see a significant increase in call volume during any region-wide event. It is unlikely they will be able to maintain effective operations with staffing levels at minimum. However, without having an adequate number of consoles to begin with, adding staffing would not provide any additional resources for managing call volume.

In the event of a major disaster, the responsibility for maintaining effective emergency communications will not be limited to the PSAPs. Maintaining effective communications will require a coordinated effort between the PSAPs, radio system technicians and emergency responders. Supplies and resources that are taken for granted during normal operations can become scarce or completely unavailable during a major disaster. Significant effort will need to be put towards sustaining critical resources such as personnel, food, water, generators, fuel, batteries, etc., in order to maintain a basic level of operations. Providing adequate security toward this effort will also be critical. With no food or water available, people become desperate and normal rules of society start to break down (T. Lenk, personal communication, May 4, 2011).

Literature strongly supports the need to plan and train in a coordinated effort with all responsible agencies, in order to effectively manage communication needs during a disaster. Building partnerships to share information and implement CIKR protection programs are key requirements to achieving the goals outlined in the NIPP (DHS, 2009). In Pierce County, coordinated planning efforts were uncommon. Additionally, joint training between PSAPs on backup plans was limited. Research showed only 37.5% of the PSAPs performed ongoing joint training with its designated backup facility. The PSAP Backup Development Committee was formed to begin addressing these issues.

Pierce County will continue to sustain emergencies and disasters that will impact emergency communications to various degrees. Providing adequate resiliency for these emergencies will require a coordinated effort of planning, implementation and training among all of the stakeholders.

### **Recommendations**

Based on literature review, original research and data analysis it was determined that through a coordinated effort of planning, implementation, training, evaluation, and funding, resiliency in Pierce County emergency communications could be improved to better meet industry standards and best practices for CIKR protection.

The following recommendations are made to the PSAPs in Pierce County.

- Utilize the PSAP Backup Development Committee to coordinate planning and training efforts within the County and to implement the following recommendations.
- Expand preparation and training to an all hazards training model inclusive of small scale emergencies and region-wide disasters such as an earthquake, volcano or lahar.

- Seek funding methods to provide upgrades to the current PSAPs in order to bring them up to current industry standards for CIKR and NFPA 1221 standards.
- Develop joint plans between the PSAPs for moving phones, radios and operations both short term and long term.
- Coordinate efforts in developing disaster, pandemic and COOP plans in an effort to provide consistency in the planning efforts.
- Develop joint training programs for all implemented emergency/disaster plans.
- Seek out funding mechanisms to support joint training efforts.
- Continue implementing ESInet and replace all legacy phone equipment.
- Develop a radio backup plan that provides redundant backhaul from key communication sites back to designated backup communications centers.
- Implement NFPA 1600 standards in all of the PSAPs.
- Develop a standardized method for implementing a CEEP program in each PSAP.
- Re-evaluate the PSAP backup plan and move smaller centers into larger ones. In the case of LESA, develop a backup plan that distributes resources between multiple PSAPs.
- Consider the need to perform further research into the potential limitations and restrictions diverse technology infrastructure, radio system ownership, and PSAP governance have on implementing these recommendations.

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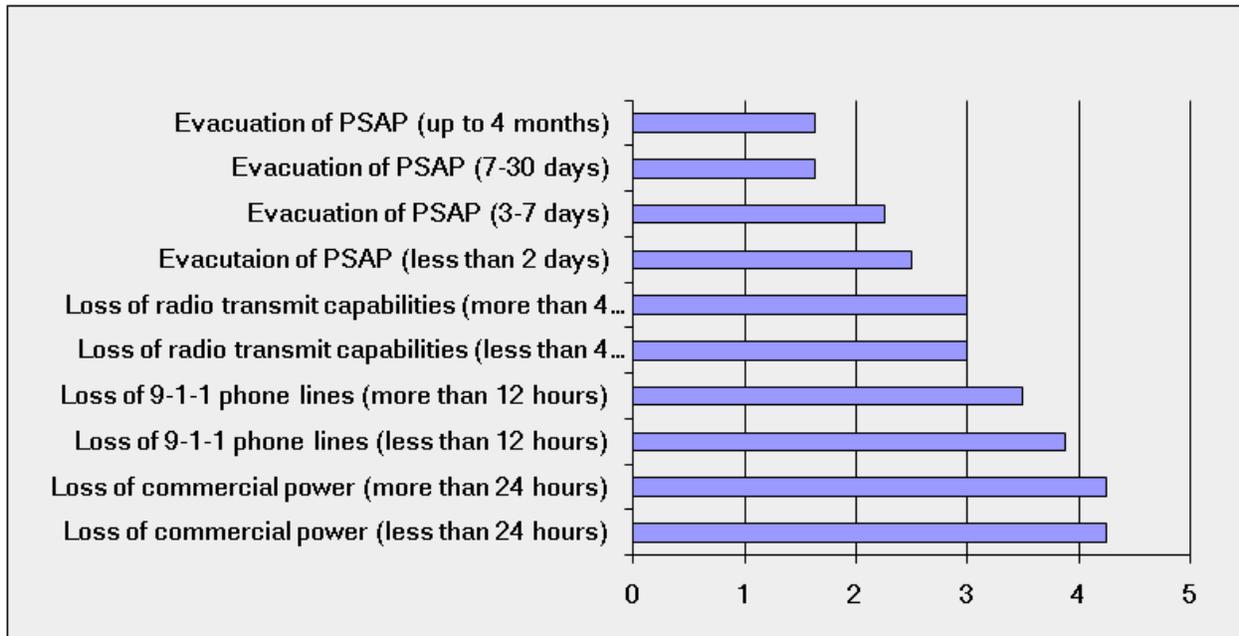
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Table 1.

*PSAP Disaster Preparedness Planning and Training*

| Type of Plan                                        | Percentage of Pierce County PSAPs with an established, formal written plan | Percentage of Pierce County PSAPs who routinely train on a formal written plan |
|-----------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Transfer telephones to backup PSAP                  | <b>87.5%</b>                                                               | <b>62.5%</b>                                                                   |
| Transfer radios to backup PSAP                      | <b>50.0%</b>                                                               | <b>37.5%</b>                                                                   |
| Move operations to backup PSAP (less than 24 hours) | <b>37.5%</b>                                                               | <b>25.0%</b>                                                                   |
| Move operations to backup PSAP (24 hours - 7 days)  | 12.5%                                                                      | 12.5%                                                                          |
| Move operations to backup PSAP (7 days - 4 months)  | 0.0%                                                                       | 0.0%                                                                           |
| Disaster Plan                                       | <b>50.0%</b>                                                               | <b>12.5%</b>                                                                   |
| Pandemic Plan                                       | <b>62.5%</b>                                                               | <b>25.0%</b>                                                                   |
| Continuity of Operations Plan                       | 25.0%                                                                      | 25.0%                                                                          |

*Note.* Reductions in the number of PSAPs that have a plan and train on it over the number that only have a plan without training are marked in boldface.



*Figure 1.* Aggregate average of the state of PSAP readiness as assessed by each individual PSAP. The state of readiness was rated from 1-5 for each event. 1-completely unprepared, 2-somewhat prepared, 3-adequately prepared, 4-well prepared, 5-fully prepared.

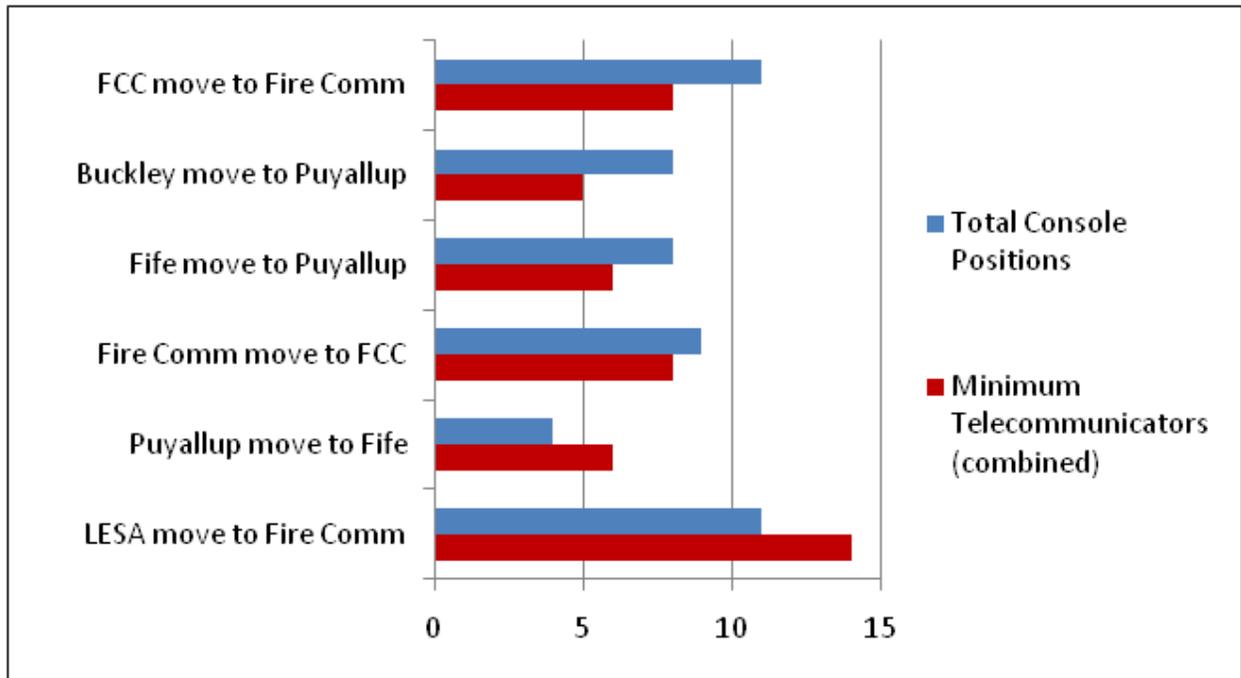


Figure 2. Comparison of available console positions to the minimum number of required positions in the event a PSAP was required to evacuate and operate in their designated backup facility.

## Appendix A

## Pierce County PSAP Questionnaire Summary

**Question 1.**

| Total number of agency employees and number of employees assigned as Call Receivers and/or Dispatchers. |                  |                |                |
|---------------------------------------------------------------------------------------------------------|------------------|----------------|----------------|
| Answer Options                                                                                          | Response Average | Response Total | Response Count |
| Total Agency Employees                                                                                  | 36.50            | 292            | 8              |
| Total Call Receivers                                                                                    | 43.00            | 43             | 1              |
| Total Dispatchers                                                                                       | 37.00            | 37             | 1              |
| Total Cross-trained Call Receiver/Dispatchers                                                           | 15.25            | 122            | 8              |
| Total Telecommunicators                                                                                 | 26.13            | 209            | 8              |

**Question 2.**

| Total number of console positions. |   |   |   |   |   |   |   |   |   |    |    |    |                |
|------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----------------|
| Number of Consoles                 |   |   |   |   |   |   |   |   |   |    |    |    |                |
| Answer Options                     | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Response Count |
| Telephone Only Position            | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 1  | 6              |
| Radio Only Position                | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 2              |
| Telephone and Radio Position       | 0 | 1 | 1 | 0 | 2 | 1 | 2 | 0 | 1 | 0  | 0  | 0  | 8              |

**Question 3.**

| Normal minimum and maximum staffing for call receivers and/or dispatchers. (Excluding days when staffing is increased for a special event or holiday) |   |   |   |   |   |   |   |   |   |    |    |    |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----------------|
| Number of Positions                                                                                                                                   |   |   |   |   |   |   |   |   |   |    |    |    |                |
| Answer Options                                                                                                                                        | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Response Count |
| Minimum Call Receiver(s)                                                                                                                              | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 1              |
| Maximum Call Receiver(s)                                                                                                                              | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 1  | 1              |
| Minimum Dispatcher(s)                                                                                                                                 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0  | 0  | 0  | 1              |
| Maximum Dispatcher(s)                                                                                                                                 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0  | 0  | 0  | 1              |
| Minimum Cross Trained Call Receiver/Dispatcher(s)                                                                                                     | 1 | 1 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 7              |
| Maximum Cross Trained Call Receiver/Dispatcher(s)                                                                                                     | 0 | 1 | 0 | 2 | 3 | 1 | 0 | 0 | 0 | 0  | 0  | 0  | 7              |

**Question 4.**

| <b>Does your agency have a formal written procedure for transferring incoming calls to your designated backup facility?</b> |                         |                       |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                       | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                         | 87.5%                   | 7                     |
| No                                                                                                                          | 12.5%                   | 1                     |
| Unknown                                                                                                                     | 0.0%                    | 0                     |

**Question 5.**

| <b>Does your agency routinely train on this procedure?</b> |                         |                       |
|------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                      | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                        | 71.4%                   | 5                     |
| No                                                         | 28.6%                   | 2                     |
| Unknown                                                    | 0.0%                    | 0                     |

**Question 6.**

| <b>Does your agency have a formal written procedure for transferring dispatching and radio communications to your designated backup facility?</b> |                         |                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                                             | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                               | 50.0%                   | 4                     |
| No                                                                                                                                                | 50.0%                   | 4                     |
| Unknown                                                                                                                                           | 0.0%                    | 0                     |

**Question 7.**

| <b>Does your agency routinely train on this procedure?</b> |                         |                       |
|------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                      | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                        | 75.0%                   | 3                     |
| No                                                         | 25.0%                   | 1                     |
| Unknown                                                    | 0.0%                    | 0                     |

**Question 8.**

| <b>Does your agency have a formal written procedure for sustaining short term operations at your designated backup facility? (less than 24 hours)</b> |                         |                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                                                 | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                                   | 37.5%                   | 3                     |
| No                                                                                                                                                    | 62.5%                   | 5                     |
| Unknown                                                                                                                                               | 0.0%                    | 0                     |

**Question 9.**

| <b>Does your agency routinely train on this procedure?</b> |                         |                       |
|------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                      | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                        | 66.7%                   | 2                     |
| No                                                         | 0.0%                    | 0                     |
| Unknown                                                    | 33.3%                   | 1                     |

**Question 10.**

| <b>Does your agency have a formal written procedure for sustaining transitional operations at your designated backup facility? (up to several days)</b> |                         |                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                                                   | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                                     | 12.5%                   | 1                     |
| No                                                                                                                                                      | 87.5%                   | 7                     |
| Unknown                                                                                                                                                 | 0.0%                    | 0                     |

**Question 11.**

| <b>Does your agency routinely train on this procedure?</b> |                         |                       |
|------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                      | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                        | 100.0%                  | 1                     |
| No                                                         | 0.0%                    | 0                     |
| Unknown                                                    | 0.0%                    | 0                     |

**Question 12.**

| Does your agency have a formal written procedure for sustaining long term operations at your designated backup facility? (beyond a week and up to several months) |                  |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                                                                                                    | Response Percent | Response Count |
| Yes                                                                                                                                                               | 0.0%             | 0              |
| No                                                                                                                                                                | 100.0%           | 8              |
| Unknown                                                                                                                                                           | 0.0%             | 0              |

**Question 13.**

| Does your agency routinely train on this procedure? |                  |                |
|-----------------------------------------------------|------------------|----------------|
| Answer Options                                      | Response Percent | Response Count |
| Yes                                                 | 0.0%             | 0              |
| No                                                  | 0.0%             | 0              |
| Unknown                                             | 0.0%             | 0              |

**Question 14.**

| Does your communication center perform ongoing joint training with its designated backup facility? |                  |                |
|----------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                                     | Response Percent | Response Count |
| Yes                                                                                                | 37.5%            | 3              |
| No                                                                                                 | 62.5%            | 5              |
| Unknown                                                                                            | 0.0%             | 0              |

**Question 15**

| Does your agency have a formal written disaster plan? |                  |                |
|-------------------------------------------------------|------------------|----------------|
| Answer Options                                        | Response Percent | Response Count |
| Yes                                                   | 50.0%            | 4              |
| No                                                    | 25.0%            | 2              |
| Unknown                                               | 25.0%            | 2              |

**Question 16.**

| Does your agency routinely train on this plan? |                  |                |
|------------------------------------------------|------------------|----------------|
| Answer Options                                 | Response Percent | Response Count |
| Yes                                            | 25.0%            | 1              |
| No                                             | 50.0%            | 2              |
| Unknown                                        | 25.0%            | 1              |

**Question 17.**

| Does your agency have a formal written procedure for managing operations during a pandemic? |                  |                |
|---------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                              | Response Percent | Response Count |
| Yes                                                                                         | 62.5%            | 5              |
| No                                                                                          | 12.5%            | 1              |
| Unknown                                                                                     | 25.0%            | 2              |

**Question 18.**

| Does your agency routinely train on this procedure? |                  |                |
|-----------------------------------------------------|------------------|----------------|
| Answer Options                                      | Response Percent | Response Count |
| Yes                                                 | 40.0%            | 2              |
| No                                                  | 20.0%            | 1              |
| Unknown                                             | 40.0%            | 2              |

**Question 19.**

| Does your agency have a formal written Continuity of Operations Plan (COOP)? |                  |                |
|------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                               | Response Percent | Response Count |
| Yes                                                                          | 25.0%            | 2              |
| No                                                                           | 50.0%            | 4              |
| Unknown                                                                      | 25.0%            | 2              |

**Question 20.**

| <b>Does your agency routinely train on this plan?</b> |                         |                       |
|-------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                 | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                   | 100.0%                  | 2                     |
| No                                                    | 0.0%                    | 0                     |
| Unknown                                               | 0.0%                    | 0                     |

**Question 21.**

| <b>Are you familiar with NFPA 1600 Standard on Disaster/Emergency and Business Continuity Programs?</b> |                         |                       |
|---------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                   | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                     | 12.5%                   | 1                     |
| No                                                                                                      | 87.5%                   | 7                     |

**Question 22.**

| <b>How would you rate your agencies preparedness to maintain operations in the following emergency/disaster situations?</b> |                              |                          |                            |                      |                       |                       |                       |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------|----------------------------|----------------------|-----------------------|-----------------------|-----------------------|
| <b>Answer Options</b>                                                                                                       | <b>Completely unprepared</b> | <b>Somewhat prepared</b> | <b>Adequately prepared</b> | <b>Well prepared</b> | <b>Fully prepared</b> | <b>Rating Average</b> | <b>Response Count</b> |
| Loss of commercial power (less than 24 hours)                                                                               | 0                            | 1                        | 0                          | 3                    | 4                     | 4.25                  | 8                     |
| Loss of commercial power (more than 24 hours)                                                                               | 0                            | 1                        | 0                          | 3                    | 4                     | 4.25                  | 8                     |
| Loss of 9-1-1 phone lines (less than 12 hours)                                                                              | 0                            | 0                        | 2                          | 5                    | 1                     | 3.88                  | 8                     |
| Loss of 9-1-1 phone lines (more than 12 hours)                                                                              | 0                            | 1                        | 2                          | 5                    | 0                     | 3.50                  | 8                     |
| Loss of radio transmit capabilities (less than 4 hours)                                                                     | 0                            | 2                        | 5                          | 0                    | 1                     | 3.00                  | 8                     |
| Loss of radio transmit capabilities (more than 4 hours)                                                                     | 0                            | 2                        | 5                          | 0                    | 1                     | 3.00                  | 8                     |
| Evacuation of PSAP (less than 2 days)                                                                                       | 1                            | 4                        | 1                          | 2                    | 0                     | 2.50                  | 8                     |
| Evacuation of PSAP (3-7 days)                                                                                               | 2                            | 4                        | 0                          | 2                    | 0                     | 2.25                  | 8                     |
| Evacuation of PSAP (7-30 days)                                                                                              | 4                            | 3                        | 1                          | 0                    | 0                     | 1.63                  | 8                     |
| Evacuation of PSAP (up to 4 months)                                                                                         | 4                            | 3                        | 1                          | 0                    | 0                     | 1.63                  | 8                     |

**Question 23.**

|                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------|
| In what year was the building your communications center is located in built? (If the exact year is unknown, try to identify the decade.) |
| 1929                                                                                                                                      |
| 1940                                                                                                                                      |
| 1950                                                                                                                                      |
| 1990                                                                                                                                      |
| 1991                                                                                                                                      |
| 1995                                                                                                                                      |
| 1998                                                                                                                                      |
| 2006                                                                                                                                      |

**Question 24.**

|                                                                      |                         |                       |
|----------------------------------------------------------------------|-------------------------|-----------------------|
| Was your facility originally designed to be a communications center? |                         |                       |
| <b>Answer Options</b>                                                | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                  | 75.0%                   | 6                     |
| No                                                                   | 25.0%                   | 2                     |
| Unknown                                                              | 0.0%                    | 0                     |

**Question 25.**

|                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------|
| In what year was it repurposed to be a communications center? (If the exact year is unknown, try to identify the decade.) |
| unknown                                                                                                                   |
| 1980                                                                                                                      |

**Question 26.**

|                                                                                                                                            |                         |                       |
|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| Is your communication center a standalone facility or is the building occupied for other purposes in addition to emergency communications? |                         |                       |
| <b>Answer Options</b>                                                                                                                      | <b>Response Percent</b> | <b>Response Count</b> |
| Standalone (only the comm center is in the building)                                                                                       | 50.0%                   | 4                     |
| Multi-purpose (building is shared with other services)                                                                                     | 50.0%                   | 4                     |
| Unknown                                                                                                                                    | 0.0%                    | 0                     |

**Question 27.**

|                                                                     |
|---------------------------------------------------------------------|
| <b>What other type of services are co-located in your building?</b> |
| Patrol, Evidence, Jail, Command Staff, Records                      |
| Jail Facility                                                       |
| DOL, WSDOT, Crime Lab, VIN                                          |
| Fire Department                                                     |

**Question 28.**

|                                                                                                                                                                                    |                         |                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Is the emergency communications center separated from other areas and services housed in the building by fire barriers having a fire resistance rating of at least 2 hours?</b> |                         |                       |
| <b>Answer Options</b>                                                                                                                                                              | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                                                                | 75.0%                   | 3                     |
| No                                                                                                                                                                                 | 0.0%                    | 0                     |
| Unknown                                                                                                                                                                            | 25.0%                   | 1                     |

**Question 29.**

|                                                                                                                               |                         |                       |
|-------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Is your communication center seismically protected in compliance with NFPA 5000 Building Construction and Safety Code?</b> |                         |                       |
| <b>Answer Options</b>                                                                                                         | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                           | 50.0%                   | 4                     |
| No                                                                                                                            | 12.5%                   | 1                     |
| Unknown                                                                                                                       | 37.5%                   | 3                     |

**Question 30.**

|                                                                                                    |                         |                       |
|----------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Is your PSAP facility within 150 feet of the potential collapse zone of a taller structure?</b> |                         |                       |
| <b>Answer Options</b>                                                                              | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                | 12.5%                   | 1                     |
| No                                                                                                 | 75.0%                   | 6                     |
| Unknown                                                                                            | 12.5%                   | 1                     |

**Question 31.**

| <b>Is the roof of the communications center designed to resist damage from collapse of the exposing structure?</b> |                         |                       |
|--------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                              | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                | 0.0%                    | 0                     |
| No                                                                                                                 | 0.0%                    | 0                     |
| Unknown                                                                                                            | 100.0%                  | 2                     |

**Question 32.**

| <b>Is the lowest level of your communications center 100 feet above the 100-year flood plain established by FEMA?</b> |                         |                       |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                 | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                   | 75.0%                   | 6                     |
| No                                                                                                                    | 0.0%                    | 0                     |
| Unknown                                                                                                               | 25.0%                   | 2                     |

**Question 33.**

| <b>Is the HVAC system for your communication center independent and designed to only service the communication center?</b> |                         |                       |
|----------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                      | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                        | 50.0%                   | 4                     |
| No                                                                                                                         | 50.0%                   | 4                     |
| Unknown                                                                                                                    | 0.0%                    | 0                     |

**Question 34.**

| <b>Are the HVAC system intakes for fresh air arranged to minimize smoke intake from a fire inside or outside the building and to resist intentional introduction of irritating, noxious, toxic, or poisonous substances into the HVAC system?</b> |                         |                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                                                                                                                                             | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                                                                                                                               | 37.5%                   | 3                     |
| No                                                                                                                                                                                                                                                | 50.0%                   | 4                     |
| Unknown                                                                                                                                                                                                                                           | 12.5%                   | 1                     |

**Question 35.**

| <b>Does your center have emergency controls to permit closing of outside air intakes?</b> |                         |                       |
|-------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                     | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                       | 0.0%                    | 0                     |
| No                                                                                        | 75.0%                   | 6                     |
| Unknown                                                                                   | 25.0%                   | 2                     |

**Question 36.**

| <b>Does your center have backup HVAC systems for the operations room and other spaces housing electronic equipment essential to the operations?</b> |                         |                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                                               | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                                 | 50.0%                   | 4                     |
| No                                                                                                                                                  | 37.5%                   | 3                     |
| Unknown                                                                                                                                             | 12.5%                   | 1                     |

**Question 37.**

| <b>Is your center capable of maintaining uninterrupted operations with the largest single HVAC unit or component out of service? (year round summer or winter)</b> |                         |                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                                                              | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                                                | 50.0%                   | 4                     |
| No                                                                                                                                                                 | 0.0%                    | 0                     |
| Unknown                                                                                                                                                            | 50.0%                   | 4                     |

**Question 38.**

| <b>Does your communication center have two independent and reliable power sources, one primary (commercial) and one secondary (generator), each of which provide adequate capacity for operation of the communication center?</b> |                         |                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                                                                                                                             | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                                                                                                               | 100.0%                  | 8                     |
| No                                                                                                                                                                                                                                | 0.0%                    | 0                     |
| Unknown                                                                                                                                                                                                                           | 0.0%                    | 0                     |

**Question 39.**

| Upon failure of the primary power, is power transferred to the secondary source automatically? |                  |                |
|------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                                 | Response Percent | Response Count |
| Yes                                                                                            | 100.0%           | 8              |
| No                                                                                             | 0.0%             | 0              |
| Unknown                                                                                        | 0.0%             | 0              |

**Question 40.**

| Is the generator for your communication center located inside or outside of the communications center building? |                  |                |
|-----------------------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                                                  | Response Percent | Response Count |
| Inside                                                                                                          | 37.5%            | 3              |
| Outside                                                                                                         | 62.5%            | 5              |

**Question 41.**

| Is the generator located in a ventilated and secured area that is separated from the communication center by fire barriers having a fire resistance rating of at least 2 hours? |                  |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                                                                                                                  | Response Percent | Response Count |
| Yes                                                                                                                                                                             | 100.0%           | 3              |
| No                                                                                                                                                                              | 0.0%             | 0              |
| Unknown                                                                                                                                                                         | 0.0%             | 0              |

**Question 42.**

| Is the generator located in a secure enclosure? |                  |                |
|-------------------------------------------------|------------------|----------------|
| Answer Options                                  | Response Percent | Response Count |
| Yes                                             | 100.0%           | 5              |
| No                                              | 0.0%             | 0              |
| Unknown                                         | 0.0%             | 0              |

**Question 43.**

| Is the enclosure capable of resisting the entrance of precipitation at the maximum wind velocities referenced in NFPA 5000 Building Construction and Safety Code? |                  |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                                                                                                    | Response Percent | Response Count |
| Yes                                                                                                                                                               | 40.0%            | 2              |
| No                                                                                                                                                                | 0.0%             | 0              |
| Unknown                                                                                                                                                           | 60.0%            | 3              |

**Question 44.**

| Is the area that houses the generator used to store any other spare parts or equipment? |                  |                |
|-----------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                          | Response Percent | Response Count |
| Yes                                                                                     | 0.0%             | 0              |
| No                                                                                      | 87.5%            | 7              |
| Unknown                                                                                 | 12.5%            | 1              |

**Question 45.**

| What type of fuel source is utilized to run the generator? |                  |                |
|------------------------------------------------------------|------------------|----------------|
| Answer Options                                             | Response Percent | Response Count |
| Gasoline                                                   | 37.5%            | 3              |
| Natural Gas                                                | 0.0%             | 0              |
| Liquefied Petroleum Gas                                    | 0.0%             | 0              |
| Other                                                      | 50.0%            | 4              |
| Unknown                                                    | 12.5%            | 1              |

**Question 46.**

| Do you have enough fuel onsite to operate the generator at full load for 24 hours? |                  |                |
|------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                     | Response Percent | Response Count |
| Yes                                                                                | 87.5%            | 7              |
| No                                                                                 | 0.0%             | 0              |
| Unknown                                                                            | 12.5%            | 1              |

**Question 47.**

| <b>Are power sources for the communication center monitored for integrity with annunciation provided in the operations room?</b> |                         |                       |
|----------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                            | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                              | 75.0%                   | 6                     |
| No                                                                                                                               | 0.0%                    | 0                     |
| Unknown                                                                                                                          | 25.0%                   | 2                     |

**Question 48.**

| <b>Is your center equipped with a fire detection, alarm and notification system?</b> |                         |                       |
|--------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                  | 87.5%                   | 7                     |
| No                                                                                   | 12.5%                   | 1                     |
| Unknown                                                                              | 0.0%                    | 0                     |

**Question 49.**

| <b>Is the fire detection, alarm and notification system, monitored in the operations room?</b> |                         |                       |
|------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                          | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                            | 71.4%                   | 5                     |
| No                                                                                             | 28.6%                   | 2                     |
| Unknown                                                                                        | 0.0%                    | 0                     |

**Question 50.**

| <b>Is the building that houses your communications center protected throughout by an approved, supervised automatic sprinkler system?</b> |                         |                       |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                                     | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                                       | 50.0%                   | 4                     |
| No                                                                                                                                        | 50.0%                   | 4                     |
| Unknown                                                                                                                                   | 0.0%                    | 0                     |

**Question 51.**

| Is the electronic computer and data processing equipment in your center protected in accordance with NFPA 75 Standard for the Protection of Information Technology Equipment? |                  |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                                                                                                                | Response Percent | Response Count |
| Yes                                                                                                                                                                           | 25.0%            | 2              |
| No                                                                                                                                                                            | 0.0%             | 0              |
| Unknown                                                                                                                                                                       | 75.0%            | 6              |

**Question 52.**

| Does your center have a written, dated emergency fire plan that is tested annually? |                  |                |
|-------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                      | Response Percent | Response Count |
| Yes                                                                                 | 25.0%            | 2              |
| No                                                                                  | 50.0%            | 4              |
| Unknown                                                                             | 25.0%            | 2              |

**Question 53.**

| Does your center have a written, dated damage control plan that is tested annually? |                  |                |
|-------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                      | Response Percent | Response Count |
| Yes                                                                                 | 0.0%             | 0              |
| No                                                                                  | 62.5%            | 5              |
| Unknown                                                                             | 37.5%            | 3              |

**Question 54.**

| Are all entryways to the communication center that leads directly from the exterior protected by a security vestibule? |                  |                |
|------------------------------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options                                                                                                         | Response Percent | Response Count |
| Yes                                                                                                                    | 62.5%            | 5              |
| No                                                                                                                     | 37.5%            | 3              |
| Unknown                                                                                                                | 0.0%             | 0              |

**Question 55.**

| <b>Does your communication center have windows?</b> |                         |                       |
|-----------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                               | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                 | 62.5%                   | 5                     |
| No                                                  | 37.5%                   | 3                     |

**Question 56.**

| <b>Are the windows a minimum of 4 feet above the floor?</b> |                         |                       |
|-------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                       | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                         | 60.0%                   | 3                     |
| No                                                          | 40.0%                   | 2                     |
| Unknown                                                     | 0.0%                    | 0                     |

**Question 57.**

| <b>Does your communications center have windows that face an area that can be accessed or viewed by the general public?</b> |                         |                       |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                       | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                         | 60.0%                   | 3                     |
| No                                                                                                                          | 40.0%                   | 2                     |

**Question 58.**

| <b>Are the windows bullet resistant?</b> |                         |                       |
|------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                    | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                      | 66.7%                   | 2                     |
| No                                       | 33.3%                   | 1                     |
| Unknown                                  | 0.0%                    | 0                     |

**Question 59.**

| <b>Do the walls in which the bullet resistant windows are placed have the same level of protection as the windows?</b> |                         |                       |
|------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                                  | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                                    | 50.0%                   | 1                     |
| No                                                                                                                     | 0.0%                    | 0                     |
| Unknown                                                                                                                | 50.0%                   | 1                     |

**Question 60.**

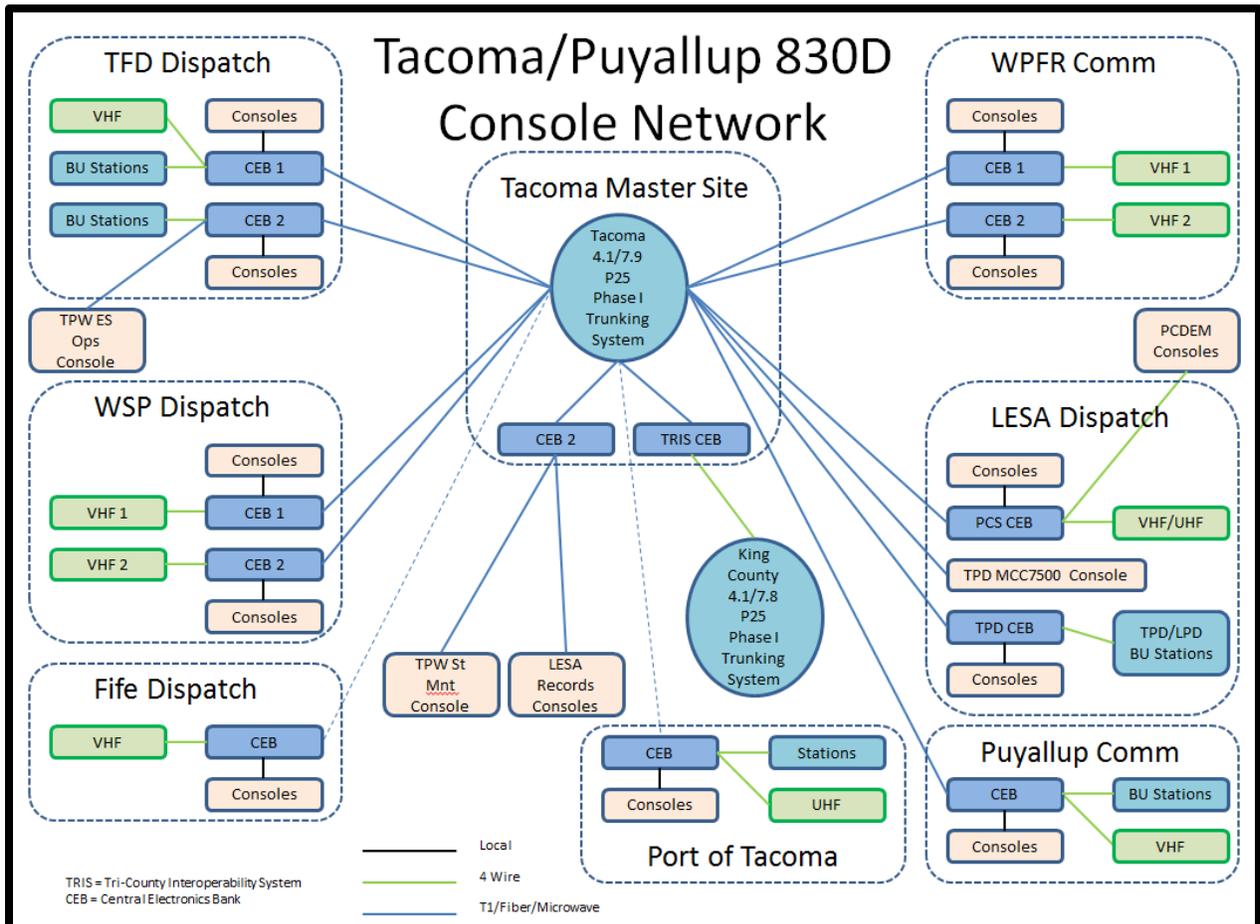
| <b>Has your communications center been designed to be blast resistant?</b> |                         |                       |
|----------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                      | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                        | 12.5%                   | 1                     |
| No                                                                         | 37.5%                   | 3                     |
| Unknown                                                                    | 50.0%                   | 4                     |

**Question 61.**

| <b>Is there a method in place to restrict vehicles from approaching within 82 feet of the building?</b> |                         |                       |
|---------------------------------------------------------------------------------------------------------|-------------------------|-----------------------|
| <b>Answer Options</b>                                                                                   | <b>Response Percent</b> | <b>Response Count</b> |
| Yes                                                                                                     | 0.0%                    | 0                     |
| No                                                                                                      | 85.7%                   | 6                     |
| Unknown                                                                                                 | 14.3%                   | 1                     |

Appendix B

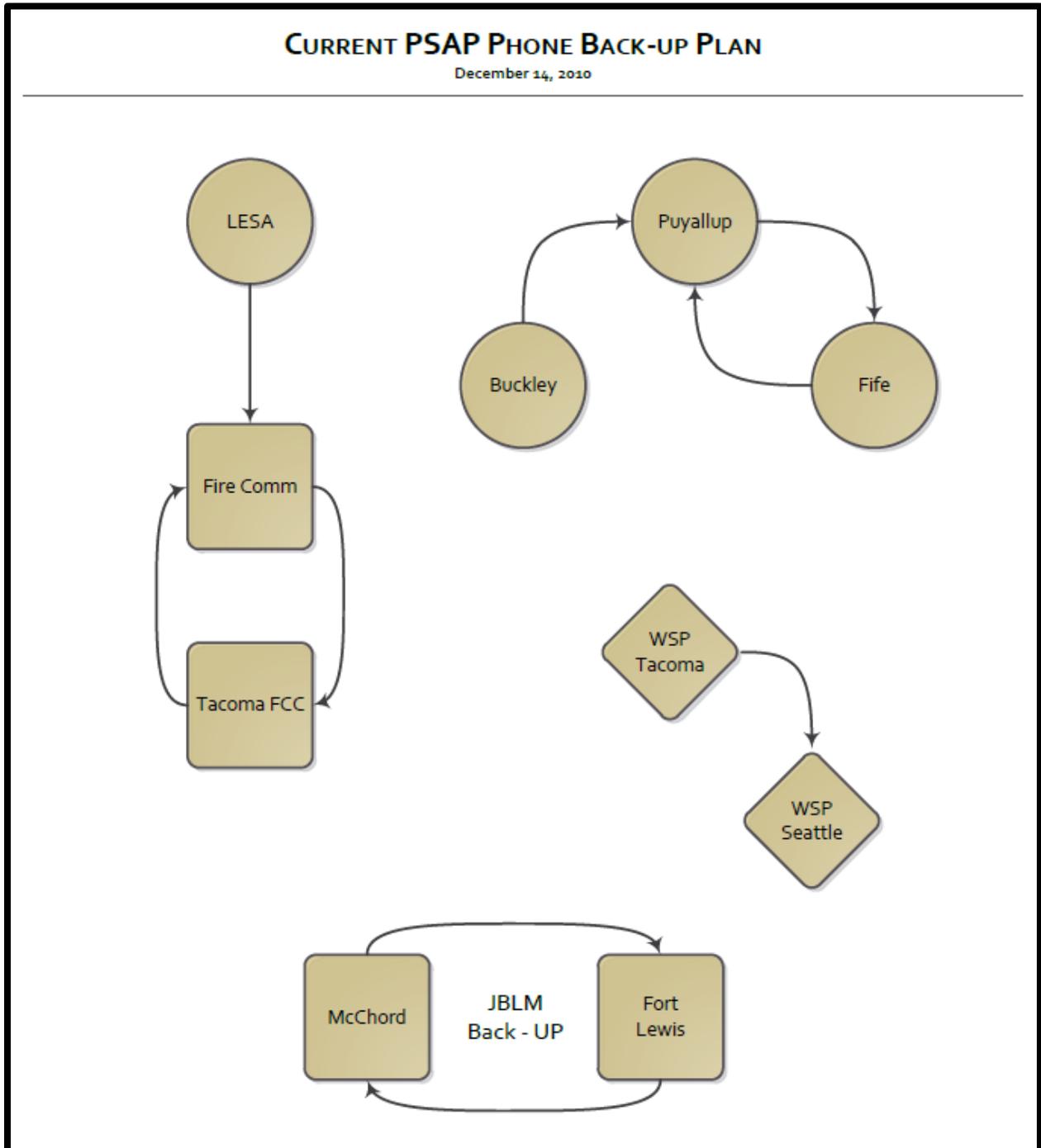
Gold Elite Console Network



(Totten, 2011)

Appendix C

Pierce County PSAP Managers' Phone System Backup Plan



(Dobbs, 2010)