TECHNOLOGICAL

H A Z A R D S

AIR TRANSPORTATION CRASHES

Definition of Hazard

This type of hazard is the failure of an aircraft to suspend itself in flight due to mechanical or human error resulting in a collision with the ground.

Though there are no airports located within Kent, we are surrounded on all sides by local and international airport facilities. Those in closest proximity are Sea-Tac International, Boeing Field (King County International), Renton Municipal, Auburn Municipal, Crest Air Park (south of Covington), and Cedar Grove Air Park (southeast of Renton).

Most commercial air traffic is concentrated at Sea-Tac International and Boeing Field. Renton Municipal and Auburn Municipal may be utilized as reliever airports by charter and commuter aircraft; however, their primary function is use by private and recreational aircraft. Crest and Cedar Grove Airparks are used specifically for small private and recreational aircraft.

Sea-Tac International Airport

History of Hazard

Fortunately the Kent area has not experienced an incident with high loss of life or the devastation possible from the crash of a commercial airliner. However, over the years small aircraft have come down in our area and serve as a reminder of the possibility.

Hazard Identification

Due to the devastating effect on life and property when an air carrier accident occurs, and the frequent news media accounts of what is termed the 'near miss', we are aware that virtually every community is vulnerable to air traffic accidents. The Greater Kent area is no exception.

Small aircraft traffic is nearly impossible to control or predict, as current regulations and safety equipment requirements are not as strict for small private planes as they are for commercial carriers. Therefore one cannot logically determine the probability or the possible location of a small aircraft accident. We do know, however, that several accidents occur each year in the area. We must, therefore, assume that the small aircraft disaster could conceivably happen anytime or anyplace.

Statistics are more readily available on major aircraft accidents, giving a more accurate picture of the potential for disaster and where it may strike. In recent years airport congestion and air traffic noise have increased. Consequently, commercial airline flight paths are alternated on a daily basis to decrease noise exposure to specific neighborhoods. While the exposure to aircraft noise is decreased by this method, the possible areas that could be affected by air transportation crashes have increased.

It is known that 16% of all major airline crashes are low impact crashes on the airport runway. 79% are high impact crashes with few or no survivors and are within one and one half miles of the airport. The remaining 5% of crashes occur enroute. In consideration of these facts and the proximity of the Sea-Tac International Airport to the Kent area, we must consider the fact that a major air transportation accident could happen in our area.

The area in which an aviation accident occurs will influence the effects of the disaster on the community. If an aircraft goes down in an industrial or residential area the number of fatalities may be much higher and the danger of fire is enhanced. If the accident occurs during peak traffic periods the responding forces may have problems reaching the area or transporting the injured out of the area. An accident in a large open area could also present a problem. With airplane wreckage scattered over a large area, crowd control could be difficult, especially if there is easy access to the area. Such a circumstance could easily overtax the responding police forces.

Auburn Airport

When a commercial airliner crashes the fire service will bear the burden of the immediate effects; however, while the effects are often intense they are usually of short duration. This type of disaster would place an unexpected burden on Kent, mutual aid and Zone 3 agencies and the entire County. This would be especially true if a large number of people on the ground were involved in the accident.

There are other emergency elements impacted by an aircraft accident. Area hospitals could be flooded with injured persons and blood banks could receive large orders for blood. Law enforcement agencies would be hard pressed to establish an effective crowd/traffic control; both Fire and Police would have to establish effective unified command operations; and a temporary morgue would be required affecting the public health component.

Vulnerability Analysis

The potential for disaster is great for both the commercial air carrier and the small private plane. Though we may think of an "air disaster" as being the major commercial aircraft crashing and killing over a hundred passengers, we must also consider the small private

plane that could crash into a large business, apartment buildings, shopping center or school housing several hundred people. All these scenarios paint a very grim picture. Such an occurrence would quickly exhaust emergency response capabilities and create panic within the community.

The most obvious hazard is of course the loss of many lives, both on board the plane and on the ground. Additionally, we must consider property damage from ground impact and the potential fire and explosion hazard associated with up to ten thousand gallons of jet fuel. Aircraft impact with a fixed facility warehousing hazardous substances should also be considered likely, given the prevalence of those types of facilities in the valley area.

The major traffic patterns and the areas adjacent to airports present the greatest potential locations an aircraft incident. Aircraft in a flight pattern merely passing over Kent present a small risk by itself. Weather related problems, equipment malfunctions and mid-air collision are the most likely ingredients for a large disaster; none of these has a high probability of occurring to commercial passenger aircraft. All three of these ingredients present problems for small private aircraft, especially with inexperienced pilots.

The largest number of aircraft accident occurs within a five-mile radius of the airport. Areas in the immediate vicinity and downwind of crash sites may also be vulnerable to the effects of toxic air pollution.

While the airline industry has an excellent safety record accidents continue to happen and they will continue into the future. Even though the chance of a major disaster resulting from an aircraft accident is relatively small, the potential impact of an occurrence forces emergency planners to be aware of the possibility.

Conclusions

Although a rare possibility, the catastrophic potential of a major aircraft crash in the Kent area cannot be ignored. Tremendous damage to property, utilities and transportation routes could result. Huge financial impact could occur, as well as the inevitable heavy loss of life.

CIVIL DISTURBANCE

Definition of Hazard

This type of hazard is a planned or random public uproar or disturbance of ordinary community life. This hazard occurs most often when participants in mass acts of civil disobedience become antagonistic toward authority, and authorities must struggle to wrest the initiative from an unruly crowd. In the extreme, civil disturbances include criminal acts of terrorism. Civil disturbances, in any form, are prejudicial to public law and order.

History of Hazard

Turbulent eras of our areas history, notably the civil rights campaigns of the 1960's and the Boeing layoffs of the 1970's, have produced civil disturbances that have affected the Kent area.

More recently in 1999, the Seattle Police Department experienced the WTO demonstrations which resulted in major rioting in downtown Seattle.

King County Regional Justice Center

The Kent Police Department was one of several agencies called to assist. Prisoners from the rioting were transported to the King County Regional Justice Center in downtown Kent. Intelligence revealed that demonstrators were threatening to riot and demand the release of prisoners. Fortunately, it did not happen.

Other times, high profile trials have been conducted at the Regional Justice Center and resulted in a much higher concern for security.

Recently, large crowds at dance clubs have caused problems. Fights have broken out in the parking lots; and the potential for a large disturbance is great. To date, some of these events have been controlled by calling more police officers from surrounding jurisdictions to help (mutual aid).

Since the war began in Iraq, anti-war demonstrations have become more popular. We have not had any directly in Kent, but the surrounding area has seen this activity.

Today, street racers pose a hazard. At times they gather in very large groups. Officers

work a special racer detail every weekend just to try to keep the situation under control. Street racing is very popular and the problems associated with street racing are increasing.

Hazard Identification

Those areas normally vulnerable to civil disturbances are often thought to be larger cities. However, the City of Kent is just as vulnerable. We are not immune from racial tensions, religious tensions, low-income housing areas, high unemployment, etc.

Vulnerability Analysis

The likelihood of civil disturbances increases daily given the fact that gang members formerly staking their territory in large cities in California have migrated north. Gang members do live in Kent. Others travel through or socialize in Kent. Other groups with extremist viewpoints are also of concern. Many of these groups have chosen to locate in our area.

Kent Cornucopia Days

Civil disturbance as a hazard could involve any large group of people assembled for any reason. Included are large assemblies of people such as at Canterbury Faire, Cornucopia Days, local or regional sporting events, or any other event bringing together large groups of people.

The presence of the King County Regional Justice Center renders Kent more susceptible to disorders resulting from a controversial arrests or verdicts.

Conclusions

In the event that a civil disturbance should occur, it would likely require crowd control measures by law enforcement agencies and the need for rescue and medical aid. Complications of this type of occurrence are injuries, property damage, traffic congestion, inaccessibility to the area involved and the possible need to impose a curfew or even evacuate area residents.

COMMUNICATION FAILURE

Definition of Hazard

Communication failure is defined as the severe interruption or loss of private and or public communications systems, including but not limited to transmission lines, broadcast, relay, switching and repeater stations as well as communications satellites, electrical generation capabilities, and associated hardware and software applications necessary to operate communications equipment.

These disruptions may result from equipment failure, human acts, (deliberate or accidental) or the results of natural or human made disasters.

History of Hazard

Communication failures in our area have been limited to small scale outages associated with natural events such as severe weather storms and mainly affecting landline and cellular telecommunication capabilities.

The Nisqually earthquake in 2001 caused a temporary disruption of the Regional 800MHz Radio system used primarily for public safety. Electronic mail failure has occurred more frequently and is usually a short term interruption causing assets or data to be lost or unusable for a period of time.

Hazard Identification

All areas of Kent are susceptible to communications failures. A communications failure would affect essential facilities and the day to day operations of local government as well as the business community.

Sites of concern would range from dispatch agencies, SCADA systems, satellite uplink and downlink sites, internet service provider sites, and the telecommunication industry switching sites.

Communications Tower

Vulnerability Analysis

Communication systems, like other utilities may suffer disruption from natural or manmade disasters. Seismic bracing should be reviewed on a regular basis to ensure system stability. Transmission stations, land lines, satellites, cellular and other facilities cannot be made completely secure and are therefore vulnerable to disruption.

Satellites are vital in the respect that they provide communication capabilities with the world outside of our local area. We depend on them daily for news, weather forecasts

and national defense. They are subject to the effects of natural disasters such as cosmic debris and mass coronal ejections (MCE). They are also subject to mechanical and electrical system failure like any other communication device.

Emergency response capabilities are dependent upon communication systems such as radio and telephone to direct and coordinate resources and to provide vital public information and warning during emergencies.

Conclusions

Interruptions in day to day communications would create problems for businesses, public agencies, citizens, and emergency services. The most common problems would range from minor inconveniences of our citizens to loss of production and revenues for businesses. Emergency services could face more serious consequences, as poor or nonexistent communications could escalate what would have been a minor emergency into a disaster situation.

ENERGY SHORTAGE/FAILURE

Definition of Hazard

An energy shortage/failure could involve various types of energy resources. Those shortages of primary concern would be petroleum, electricity and natural gas.

- Petroleum shortages could include a fast developing petroleum shortage caused by embargo, or war, and a slow, building problem caused by increasing prices or imbalance of supply[1]. These shortages could occur at any time, depending upon events in the politically unstable Middle East.
- Puget Sound Energy (PSE) supplies Kent with electricity. PSE is a private company whose services are regulated by the Washington Utilities and Transportation Commission. Six hydroelectric plants, four coal-fired plants and six oil and natural gas fired plants fuel PSE's electrical infrastructure. Nationally, 99% of all power lines are above ground. These above ground lines are susceptible to high winds and interference from trees and other vegetation.
- Most natural gas lines are owned by PSE and are located underground. Underground lines vary in sizes and pressures and are susceptible to age, ground movement, anomalies and flaws, and third party damage.

History of Hazard

The problems associated with petroleum shortages were vividly demonstrated in 1973 and 1974 during the Arab Oil Embargo, and again in 1979 during the Iran cutoff. Minor petroleum shortages developed during the 1989 Exxon Valdez grounding and during the Persian Gulf War in 1990-91. These events and others have caused the United States to utilize better conservation measures and increase domestic petroleum production, thereby reducing the need for imported petroleum products. Despite these efforts, the United States still remains dependent upon imports for about 35% of its petroleum needs.

Hydroelectric dams produce the majority of the electricity in Washington State. Low precipitation years have produced low river flow conditions which have resulted in insufficient amounts of water to operate hydroelectric plants.

The national energy system has three regions each region having a series of interconnected grids. The Western region has recently been exposed to scant sufficiency and power shortages, particularly in California. Some areas have experienced rolling blackouts dating back from 1996 to as recently as 2001. Rolling blackouts can occur due to line loading, when the transmission system is stressed because it is operating at or near full capacity. Rolling blackouts are also known as emergency load curtailments and involuntary conservation. The energy demands of the computer age represent an extra load on the nation's electricity system that wasn't there 10 years ago. For example, in 1995, there were just 20,000 servers in the world, today, there are 6 million.

[1] See Hazardous Liquid Pipeline HIVA

The Inaugural Day Storm of January 20, 1993, caused massive electrical power outages throughout the Puget Sound area. A total of 880,000 customers were without power from Olympia to Everett.

Wind and ice storms in December of 1996 and December of 2003 subjected thousands of area residents to the loss of power and in most cases the ability to heat their homes and businesses.

The Covington substation is one of many electrical distribution points near the greater Kent area.

Hazard Identification

All areas of Kent are susceptible to petroleum, electrical, and natural gas shortages.

Vulnerability Analysis

Electricity:
An electrical shortage is not a major concern for Kent due to Washington's proximity to substantial amounts of electricity transmitted from Canada to California. Although load-resource balance and the likelihood of rolling blackouts are minimal, regional supplies are tight.

The transmission system is over 40 years old, it experiences high utilization and requires more frequent maintenance. Interruptions in the transmission system due to interference would be of concern. This could be the result of a drought condition where increased loads cause electric lines to heat up; when lines get too hot they sag. Lines can sag into trees and other vegetation. Large wild land fires also cause carbon buildup on transmission lines and may weaken tower structures. causing them to collapse.

A major failure of electrical supply systems (blackout) would have a large scale impact on everyone affected. Major electrical failure would have a domino effect on nearly all supplies and services. Homes would have no electricity. Businesses would be unable to operate and would close their doors. Other utility systems would fail without power to run them. Disruption of emergency services would occur. There are few things which we depend in our day to day lives which would not be affected by electrical failure.

Natural Gas:
The vulnerabilities of the natural gas system are less than those of the electricity system mainly because the infrastructure is underground. The two most common causes of gas system failures are:

- Land movement -- mainly from earthquakes and landslides. This damage could include a catastrophic systems failure in which ground movement may sever pipe segments allowing gas to escape. Because gas is lighter than air, gas leaks in open areas are not as major a concern as leaks in an urban or confined setting.

- Integrity loss -- mechanical damage mainly through third party damage by excavators or utility owners/operators. Although RCW 19.122 requires the use of a "one call" system, this does not always occur. Third party damage can introduce dents with gauging leading to pipe failure or an outright rupture of the line. Internal anomalies can also lead to the loss of pipe integrity. Internal corrosion, the age of the pipe and general thinning, or other construction flaws can lead to pipe failure.

Conclusions

Major effects of energy shortages include inconvenience to consumers, reduced heating and lighting capability, reduced production in all sectors, potential failure of transportation, water and waste, communications, information and banking systems. Efforts made to create makeshift heating and lighting often lead to fires, explosions and asphyxiation. In addition, emergency response capabilities may be severely hampered.

Home owners and businesses need to educate themselves on all safety measures associated with energy outages and shortages. The safe use of emergency generators and how to shut off utilities are key first steps to safely mitigate an event.

FIXED NUCLEAR FACILITIES

Definition of Hazard

Fixed Nuclear Facilities (FNF) include a variety of complexes in which fissionable fuel is stored or used for such functions as electrical power generation or testing, and manufacturing fuels and materials.

History of Hazard

There have been no incidents affecting the local area in recent years from any of the FNF facilities.

Most are familiar with the explosion and fire at the Chernobyl facility in Russia, which caused heavy radioactive exposure to nearby communities and sent a cloud of radioactive fallout around the entire earth. The death toll from this incident will probably never be known due to the delayed effects of exposure to radiation. Smaller, but not less significant incidents include reported releases of radiation at Hanford in Eastern Washington, Three Mile Island in Pennsylvania and Crystal River in Florida.

Hazard identification:

Three facilities exist within our area of concern. Those are the training reactor at the University of Washington and the nuclear propulsion reactors at Bangor and Bremerton. Though none of these facilities are located within our jurisdiction, we must be aware that we are vulnerable to the radiation effects of an accident at any of these facilities.

Vulnerability Analysis

An incident can produce significant amounts of radioactive gases and or particles which can be released from the facility. Effects can range from a minor release to a radioactive release that would force the evacuation of the general population within a ten mile radius of the facility. Radioactivity from a release may enter the food chain through crops or dairy products out to a fifty mile radius of the facility. Meteorological conditions can have significant influence on the size of the contaminated area.

Widely publicized incidents of the exposure to radioactivity from nuclear facilities has alerted many to the potential dangers. Though all hazards of the fixed nuclear facility are not understood, it can be safely stated that a reduction of control over a nuclear facility is likely to be the leading factor in an incident.

Conclusions

The probability of a nuclear release is remote, yet is real and the results should be considered.

HAZARDOUS MATERIALS

Definition of Hazard

This type of hazard includes the production, use, storage, transportation and disposal of hazardous substance and wastes that place the public, property and environment at significant risk. Illegal drug labs and dumping present yet another concern. Recent history shows an increased threat from terrorists in connection with hazardous materials.

Hazardous substances are any materials that pose a threat to human health and/or the environment, and any substance designated by the Environmental Protection Agency (EPA) to be reported if a designated quantity of the substance is spilled into the waters of the United States or is otherwise released into the environment.

Hazardous wastes are by-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed, that possess at least one of five characteristics (flammable, explosive, corrosive, toxic, or radioactive), or that appear on the EPA lists.

A **hazardous chemical** is any hazardous material requiring an MSDS (Material Safety Data Sheet) under OSHA's Hazard Communication Standard. Such substances are capable of producing fires and explosions or adverse health effects such as cancer, burns, or dermatitis[1].

Hazardous materials are subject to regulation by a variety of local, state and federal agencies through an assortment of labor, building, environmental, and transportation laws, and their amount and location are also subject to City of Kent Zoning Code and State of Washington regulations.

History of Hazard

On December 4, 1984, a cloud of methyl isocyanate gas, an extremely toxic chemical, escaped from a Union Carbide chemical plant in Bhopal, India. More than 2,500 people lost their lives. Tens of thousands more were injured, some with permanent disabilities.

Through the years, concerns over incidents of hazardous materials releases have risen due to the frequency and potential damage these events can cause. This concern has led to the development and formation of teams specially trained and outfitted to handle these situations. Demand for use of mitigation teams and procedures have grown from a few handfuls of calls in the early 1980's to hundreds of calls today.

As a city in the state of Washington, Kent has the fifth largest quantity of hazardous material sites (188). During the period from 2001 to 2003 Kent has averaged **163** Hazardous Materials related calls per year ranging from flammable liquid spills/leaks to unknown chemicals, to a full Zone 3 HAZMAT team response.

[1] www.chemicalspill.org

Hazard Identification

The community experiences the regular use, shipment and storage of a host of hazardous materials and is a main traffic route for those materials enroute to other hazardous materials centers in the Puget Sound Region. Kent's exposure to hazardous materials includes transportation by rail, highway, pipeline, and its storage and use in industry throughout the City.

Transportation of hazardous materials over the highways poses the greatest potential threat to the community. It is dominated by flammable liquids such as gasoline and fuel oil which represent about 30% of the total. Other hazardous materials transported by truck include; sulfuric acid, anhydrous ammonia, caustic soda, liquefied petroleum gas (LPG), hydrochloric acid, nitrogen, nitric acid and sodium chlorate. These materials are heavily transported and move through Kent daily.

Kent Hazardous Material Team members

Interstate 5 carries the heaviest volume of hazardous materials in the state. State Routes 99, 516, and 167 are also major hazardous materials routes, all running directly through Kent. The shipments of hazardous materials by truck are conservatively estimated in excess of 60,000 bulk shipments annually and do not include materials transported between locations within the City.

Rail transportation of hazardous materials is also a factor to be considered. Rail transportation of hazardous materials along the corridor between Tacoma and Everett is the heaviest in the state. This corridor runs through the Kent valley. Regular shipments of chlorine, LPG, caustic soda, anhydrous ammonia, methanol, vinyl chloride, and motor fuel have origins or destinations along this corridor.

Storage and use of hazardous materials within Kent is currently so widespread that it is impossible to single out one particular area which has the greatest potential for an incident. Currently, there are more than 88 facilities in the city of Kent identified by the Community Right to Know Act that store 10,000 pounds or more of any one substance. There are also 54 facilities that have been identified as requiring emergency planning.

The area north of South 234th and west of Highway 167 houses the greatest volume and variety of hazardous materials. Other locations outside this area include those businesses located along Central Avenue and south of the central business district. Several facilities within Kent contain radioactive materials and the City is also host to several Federal Superfund sites.

Pipelines in the Kent area also pose a hazard, particularly in the event of accidental rupture from excavation or in the event of an earthquake. The Olympic Pipeline[2] runs north and south along the west side of the Union Pacific Railroad Tracks and carries gasoline, diesel, and jet fuel. Numerous other pipelines carrying natural gas are also present in Kent.

Vulnerability Analysis

The potential exposure to hazardous materials is the most complex and probable technological hazard in the City. Kent ranks among the top three focal points for hazardous materials in the Puget Sound Region. Kent houses many chemical producers and storage facilities and is also a major industrial consumer of hazardous materials.

Since the adoption of SARA (Superfund Amendment and Reauthorization Act) Title III / EPCRA (Emergency Planning and Community Right to Know Act), there have been 54 facilities identified within Kent which use and store "Extremely Hazardous Substances" in quantities large enough to require emergency planning for those individual facilities and surrounding area. With the ever growing industrial base in the community, this number is increasing on a regular basis. The chemicals included in the EPA list of "Extremely Hazardous Substances" are primarily chemicals which are extremely toxic, and when released are immediately dangerous to the life and health of humans and animals and cause serious damage to the environment.

An accident involving hazardous materials can happen anytime and any place. The danger to life and the environment is dependent on the product type and amount of material involved in the accident. A small amount of an extremely hazardous substance can be more dangerous than a large spill of a less hazardous substance. The release of hazardous materials into the air has the highest potential of being life threatening. This type of release can occur as the result of a tank rupture by an accident, pressure release or simply a leaking valve. Many life threatening chemicals routinely found in the area are in abundance and include chlorine, anhydrous ammonia, formaldehyde and cyanides. Many other hazardous chemicals stored locally can become airborne as the result of fire or reaction to other chemicals.

Flammable liquids such as gasoline and diesel represent the largest class of hazardous materials in Kent. They are probably the most likely substance to cause a chemical emergency in Kent.

[2] See Hazardous Liquid Pipeline HIVA

The average individual is not likely to consider the fuel they put in their car extremely dangerous. Considering the fact that the vapors from one gallon of gasoline provide the same damage potential as fourteen sticks of dynamite, imagine the damage and loss of life that would result from a tank truck that explodes in a traffic accident. Further imagine that the truck is located in a heavily populated area when the accident occurs. Another potential scenario is the train tank car rupture and explosion of liquefied petroleum gas. Many trains moving through Kent carry multiple tanks of this substance. An accident involving an explosion of this material could destroy a large area of the City.

The cleanup and recovery from a hazardous materials incident is very time consuming as well as costly. It is possible that a spill in Kent could enter storm drains and waterways before it could be contained. Ecological damage to the area aquifers and wildlife could be substantial. An incident could send dangerous chemicals into the Green River, downstream to the Duwamish River and into Puget Sound. Hazardous substances entering sanitary drains could create serious problems at Metro treatment facilities should they mix with incompatible material. Costs associated with a hazardous material spill cleanup can run several thousand dollars for a small spill, and into the hundreds of millions for an accident of disastrous proportion.

Thousands of possibilities exist for hazardous material emergencies. Everything from toxic gas releases which have the potential to kill thousands, to oil spills which can ruin environmentally sensitive areas for generations, can and do happen. Spills along roadways, parking lots and inside facilities occur almost daily to some degree. We must remember that each of us is vulnerable to the dangers of chemicals on the highway, in our work places, our schools, and our homes.

Conclusions

Any incident in which hazardous materials are involved has the potential for escalation from a minor incident into a full scale disaster. The hazardous properties of chemicals, fuels, radioactive substances and other potentially dangerous materials range from explosive to highly flammable to poisonous. They have the ability to contaminate the air, water and other areas of the environment, and are harmful to human, animal and plant life. The potential for loss of life, extensive property damage, and environmental contamination is always high when hazardous materials are involved in an accident or are improperly handled.

The presence of such a tremendous amount of hazardous materials poses a great threat to the entire community. The majority of area citizens are not aware of the potential danger to the community posed by the transportation and storage of hazardous materials.

HAZARDOUS LIQUID PIPELINE

Definition of Hazard

The Olympic Pipe Line Company consists of over 400 miles of pipelines extending from refineries in northwest Washington to Portland Oregon. These pipelines carry refined liquid petroleum products: **diesel, aviation fuel,** (basically a form of kerosene) and **gasoline.** Underground high pressure pipelines remove the equivalent of 1,800 tanker trucks from the regions roadways each day and carry 441,000 barrels or 18,700,000 gallons of fuel each day.

The pipeline in Kent was initially installed in 1965 and is a single 14" line that runs north to south in the Kent valley from milepost 114.5 to 120 approximately 5.5. miles long.

- The pipeline is located in the Puget Sound Energy right-of-way adjacent to the interurban trail on the west side of the Union Pacific Railroad track.

- The pipeline runs underneath the Green River and under several City roadways.

- The pipeline is buried between 30 and 48 inches in depth. It is also 8 feet deep and encased in steel pipe where it crosses roads and railroad tracks.

- The pipeline is constructed of carbon steel with walls .281 inches thick and caries a small electrical charge to reduce corrosion.

- 60% of the time the pipeline carries gasoline that travels at about 4 mph producing 5,900 gpm at pressures between **250 and 1440 psi**.

- One mile of 14" pipe in Kent holds **42,500** gallons of product. 5.5. miles of pipe in Kent holds **233,750** gallons. Total content of the 14" pipe from Renton to Tacoma is **850,000** gallons.

- Flow and pressure are controlled by computers in Olympic's Control Center in Renton. Shut down of the pipeline for maintenance or emergency is done by using valve blocks located throughout the system. Olympic uses three types of valve blocks:

    1. Clapper Valves only restrict backflow and work immediately without outside manipulation (located at pumping stations only).

    2. Hand-Operated Valves (HOV) are shut by Olympic personnel only, in the field. An HOV takes approximately 2 to 8 minutes to shut once the person arrives at the valve site (which can take anywhere from 5 to 60 minutes). The only valves in Kent are HOV's located on the north & south side of the Green River.

    3. Remote Operated Valves (ROV) are controlled by Olympic's Control Center in Renton. It takes approximately 45 to 90 seconds to completely close the valve using a computer-enhanced system.

History of Hazard

43 spills have been reported since 1965 totaling almost 821,000 gallons. Olympic Pipeline accounts for 65% of liquid fuel spills in Washington since 1985. In 1986 31,000 gallons of jet fuel leaked into the Des Moines Creek. In 1999 a rupture in Bellingham resulted in three fatalities, affected approximately 2 miles of streams and burned for several hours.

The estimate property damage in Washington State is $10,759,357 from pipeline accidents. Since the Bellingham explosion, Olympic Pipeline is under a corrective action order by the Office of Pipeline safety and operates at 80% of maximum operating pressure.

Kent has been fortunate, only a minor leak has occurred around the HOV on the south side of the Green River.

Hazard Identification

General Physical and chemical properties of petroleum products. Gasoline is highly flammable and is easily ignited when released into air. Diesel and jet fuel are combustible liquids and produce fewer vapors than gasoline.

Product	Flash Point (°F)	Flammable Range (%)	Auto-Ignition (Temp (°F)	Vapor Density (Air = 1)	Specific Gravity (H_2O = 1)
Gasoline	-45	1.4-7.6	220	4	0.7-0.8
Jet Fuel	100-140	0.7-5.0	410	6	0.81
Diesel	125-150	0.6-7.5	495	6	0.86

Petroleum product vapors are **heavier than air.** Vapors can spread along the ground and collect in low or confined areas, creating a vapor explosion hazard indoors, outdoors, or in sewers. All products have increased volatility and may form explosive mixtures with

air when released under pressure from the pipeline as an aerosol. Vapors may travel to source of ignition and flash back.

Petroleum products are **lighter than water,** (Thus will travel on the surface). Runoff to sewer or storm drain may create fire or explosive hazard.

Health hazards via inhalation or contact with material may irritate or burn skin and eyes. Fire may produce irritation and/or toxic gases. Vapors may cause dizziness or suffocation, Runoff may cause pollution.

Product	Benzene*	Narcotic & Asphyxia Hazard	Skin Irritant	Carbon Monoxide	PA's ** & Particulates
Gasoline	Yes	Yes	Moderate	Very Significant	Some
Jet Fuel	No	No	Mild	Significant	More
Diesel	No	No	Mild	Significant	MOST

*Benzene is a known carcinogen; ** Polynuclear Aromatics

The pipe is made by U.S. Steel via a High Frequency electric resistance welded (ERW) process. ▫The four cause categories of incidents in liquid pipelines are:

1. **Anomalies,** such as damage from construction equipment and corrosion, cause 62% of the incident on liquid pipelines. An anomaly is an imperfection in the pipe that if large enough could cause it to become a defect which is generally considered to reduce the failure pressure of the pipe to below the yield pressure of the pipe. The yield pressure is the design strength of the pipe which if exceeded will be on the verge of causing the pipe to permanently enlarge in diameter.
2. **Incorrect operation** causes 7% of the incidents on liquid pipelines.
3. **Malfunction of pressure control equipment** causes 5% of the incidents on Liquid pipelines.
4. **"Other" Causes such as gaskets, flanges, fittings, etc** cause 27% of the incidents on liquid pipelines.

FACTORS CONTIBUTING TO PIPELINE FAILURE

Movement. The Puget Sound region is seismically active, with hundreds of earthquakes occurring each year. The pipeline is located in the Kent valley which is made of soft soil or a sandy loam and is susceptible to soil liquefaction during an earthquake. This force is analogous to those that move an unsecured garden house causing lateral forces that strain the pipe. Some communities have reported that the actual pipeline location, when checked by probing, is well outside the supposed location or right-of-way (5-10 feet wide). This outside force can fatigue the pipe producing a partial collapse or buckling of the pipe.

▫Eiber, Bob "Overview of Integrity Assessment Methods for Pipelines", November 2003, prepared for Washington Cities and Counties Pipeline Safety Consortium

Mechanical Damage. Most commonly caused through third party damage by excavators or utility owners/operators. Although 19.122 RCW, Underground Utilities provides legislation requiring the use of "one call" system, this does not always occur. Third party damage can introduce dents with gauging leading to pipe failure. The pipeline runs parallel to the Union Pacific tracks also exposing it to mechanical damage should a derailment occur.

Internal corrosion. Corrosion leading to metal loss may cause general thinning of the pipe, pitting of the pipe, crevice corrosion in electric resistance and flash weld seams or stress corrosion cracking (SCC).

Cracks in the Seam weld that may be increasing in length and depth from the operational pressure cycles that were created from inclusion on the weld line, inadequate pressure during welding, and excessive trim of the excess metal extruded during electric resistance welding.

Gouges without a dent in the body of the pipe that may be due to construction damage. Also, cracks due to fatigue during shipment, stress corrosion cracks, or hydrogen cracks due to the environment that forms at the pipe surface. (Generally, these cracks are oriented along the length of the pipe or axially as this is the direction that is perpendicular to the maximum stress in a pipe or axially as this is the direction that is perpendicular to the maximum stress in a pipe which is due to pressure.)

System failure * such as;

- Safety critical devices such as shutdown switches, control valve interlocks and pressure relief valves.
- Management of change to pipeline modifications that can impact pipeline flow, surge pressures as well as the effectiveness of existing safety equipment.
- Improper tool selection or inadequate data review of inline inspections devices. The type of defect expected must be know or suspected so that the proper ILI tools can be selected toe the inspection. Several types of tools generally have to be run in order to inspect the pipe for all of the potential types of defects. Flaws may be missed due to the complex nature of the log interpretation.
- SCADA breakdown, programming errors entered into the main computer can transfer to the backup system if they are not independent of each other. For safety critical equipment, redundancy does not truly provide increased reliability if such systems can be easily linked to the same failure (mirroring).

* Kuprewicz, Richard B. "Preventing Pipeline Releases" July 22, 2003, prepared for the Washington City and County Pipeline Safety Consortium.

Vulnerability Analysis

The potential for damage to the liquid petroleum pipeline by a large earthquake, third party damage, internal failure, terrorist act, or other initiating event presents a risk of release incident. Only through continued training and preparation by response personnel, maintenance on and the practice with equipment, and safety-oriented integrity management principles can this risk be reduced. British Petroleum and their subsidiary, Olympic Pipeline, have responded with a significant improvement to the safety of their system.

A leak or rupture of the pipeline would expose vulnerabilities from:

1. **Fire or explosion;** could cause a conflagration to surrounding occupancies and put a tremendous strain on City resources. The Fire department would need all available firefighters to control the blaze; law enforcement to provide traffic and crowd control and possibly evacuations; Public Works in supplying infrastructure expertise, barricading and utility support. Other departments may receive emergency tasking as well to assist with longer term issues of support and recovery. Medical services, both public and private, may be overwhelmed if casualties are high. Movement of product through creeks, rivers and storm drains could cause downstream impacts and widespread fires.

2. **Ground Contamination**; can spread over the permeable ground surfaces, is a long-term problem. While a concern, there is little that can be done to stop or limit it unless there is a feature of the topography that lends itself to natural containment. This includes paved parking lots with curbs, streets, and natural depressions in the earth. Ground contamination could require a massive clean-up operation lasting several months.

3. **Waterway Contamination**; a rupture of the pipeline near the Green River that allows product to flow down the banks into the waterway is more likely than a rupture of the pipe under the river. Once in the river the steep banks should help contain the vapors that are carried along with the current and winds not allowing them to spread into adjacent businesses and residences. Mill Creek is a small, slow moving stream which starts on the East Hill of Kent. While slow moving, the stream, like the Green River, does create a path for flammable vapors to travel close to highly concentrated business facilities. In addition it lacks the rivers high banks to contain the runoff and vapors. The City has extensive storm drain systems. Many of the storm drains are interconnected and create an ideal path for flammable or combustible liquids as well as the resulting vapors. The spread of product can be undetectable from surface streets until there is either an explosion or a monitoring device is lowered into the storm system.

4. **Transportation;** the proximity of the pipeline to major rail, highway, and population centers would impact movement and commerce in the Kent valley and the region. Effects would be dependent on the type and amount of product (leak

or rupture), vapor, fire or both, time of day, weather conditions, and delay in detection or reporting.

5. **The Economy**; The possible economic impact should be of concern because business people and /or residents in the affected area may put pressure on the chief executive regarding access and contingency plans. The effect on business/industry, local commerce, and transportation woes would compound response and recovery issues. Area evacuations would cause a disruption by the large scale movement of people. Although the percentage of people seeking public shelter is typically only about 15-20% of the total evacuated population, shelters must be established. The proximity to senior housing, the Regional Justice Center (RJC), and the downtown corridor would create a heavy burden. This would cause additional problems for emergency officials. Difficulties range from telephone lines overwhelmed with petty complaints to more seriously disruptive activities. These issues arise most commonly with those people displaced into shelters and with the elderly, but they may occur to anyone at any time.

Conclusions

1. Since the June 10th pipeline spill and explosion in Bellingham some noted improvements have been made in pipeline safety. Some from an industry standpoint regarding corrective action items and integrity management. Some from the state regarding a joint agreement between the Office of Pipeline Safety (OPS) and the Washington Utilities & Transportation Commission certifying the state as an "agent" of OPS to administer the interstate program with no enforcement authority however.
2. The issue of Federal Pre-emption over interstate pipelines prevents local communities from having stronger safety requirement of their own which could be tailored to the area's unique environment. Issues of testing type and frequency, valve type placement, and improved leak detection remain vague or non existent within Federal Regulations.
3. There is no industry standard or even agreement as to an appropriate replacement schedule for old pipe. The industry belief is that with proper care and maintenance, a pipeline will last forever.
4. Since the placement of the pipeline, the Kent population has grown and considered a "high consequence area". Education of the risks, review of local ordinances, and the adoption of local land use measures should be considered.
5. Economic losses would be impressive resulting from a pipeline accident. Clean-up costs and environmental remediation coupled with the possible loss of critical utilities and transportation corridors would likely occur.

TRANSPORTATION

Definition of Hazard

Transportation, for the purpose of this analysis, will be defined as all forms of ground transportation which move people and materials through Kent.

History of Hazard

While no major transportation disasters have occurred in Kent, traffic accidents are a common occurrence. Development of the area has generally decreased the speed of impact of our accidents, but unfortunately has increased the frequency.

The City has also experienced train derailments that as of yet have caused only minor damage and no loss of life.

Hazard Identification

Increasing traffic congestion within the Kent area has given way to more and more transportation hazards over a wider area. Freeways filled to capacity have caused overflow on to alternative north south routes such as Pacific Highway, Military Road, Benson Road and the East and West Valley Highways. Development of the S. 196th, S. 277th and future S. 228th Street Corridors has helped to relieve some of the congestion on the east and west routes, such as James Street, Canyon Drive / Kent Kangley.

Traffic congestion is a major concern

The Regional Transit Authority and its implementation of commuter rail traffic will further congest busy rail lines as well as provide a new hazard to the area in the form of a new heavily populated transportation system that like any other is subject to failure.

Vulnerability Analysis

The highway system which runs through Kent is the most commonly used ground transportation system within the area. Though there is no accurate figure for the number of vehicles traveling through the area daily, it does not take an expert to recognize the traffic problems that currently exist.

Two state highways and one interstate highway run through Kent. Due to the limitation of access points to these highways, many feeder roadways are subject to interruption or gridlock during peak commuting hours. The vast amount of construction in the area has also led to frequent traffic disruptions as a result of detours and slow downs. On the East and West Hills of Kent, residential and commercial development has impacted the capabilities of the road network in those areas creating serious traffic problems during peak commuting hours. An item of major concern is the potential for complete gridlock in an emergency situation such as flood, earthquake, hazardous material or other emergency, requiring an evacuation of homes and businesses in a given area.

Bus traffic is steadily increasing bringing with it greater possibilities of multiple casualty incidents due to traffic accidents.

While intersections and major highways are particularly susceptible, major accidents can occur at any point along the roadway network. In addition to the obvious injuries and property damage incurred at a major traffic accident, there is great potential for hazardous materials to be involved in such an accident. The involvement of such materials creates additional hazards to both those at the scene and the entire community.

Emergency vehicles and crews are badly hampered by traffic congestion. These delays may add to the seriousness of injury and increase the potential for loss of life at accident scenes and other emergency responses. A slowdown in response to any type of an emergency due to traffic congestion is detrimental to life and property within the community.

Railroad transportation routes run parallel to industrial development. There are two rail systems within Kent, both running through the valley floor.

The addition last year of Sounder commuter trains running several scheduled trains through the Kent area on a daily basis has created further congestion issues during the heavy commute times. The hazard potential of railroad systems is much like that of highway transportation. Trains, like any other form of transportation, are vulnerable to accidents with other vehicles, derailments, terrorist activity, and potential complication involving rail accidents with the extremely large quantities of hazardous materials transported through Kent on a daily basis.

Railroad crossings with no over/underpasses in Kent create additional traffic congestion within the area. This additional traffic congestion may delay emergency response in other emergencies not related to the rail system, thus creating additional life and safety hazards to the residents of the community.

Conclusions

The transportation system running throughout greater Kent is heavily impacted and greatly increases our risk of major transportation emergencies.

URBAN FIRE

Definition of Hazard

Urban Fires in cities or towns involve buildings with potential for spread to adjoining structures. Although the statistics show a decline in fire casualty rates in recent years, the U.S. rate remains much higher than the yearly reported fire death and damage rates for Australia, Japan and most of the Western European countries.

The urban fire hazard in Kent involves areas where single family homes, multi-family occupancies and/or business facilities are clustered close together, increasing the possibility of rapid spread to another structure. Other areas are characterized by adjoining buildings. Adjoining buildings are found in the downtown region of the city or include other closely spaced wood frame structures. The cause of fires in urban areas usually includes one of the following:

- Criminal acts (arson, illegal explosive devices, acts of terrorism)
- Residential accidents (improper use of electrical appliances, faulty connections, grease fires, smoking, heating appliances or improper disposal of wood ashes).
- Industrial accidents (hazardous material incidents, explosions, transportation accidents)
- Acts of nature (lightening strikes, earthquake byproduct)

History of Hazard

On August 6, 1993, a series of fires began in the north Seattle area. Ultimately, 76 fires occurred, resulting in losses of over $22 million. On February 6, 1994, Paul Keller was arrested and charged with arson. He ultimately pled guilty to setting 32 of the fires.

Chem Central Fire in 1999 caused over $1 million (1999) dollars in damage

Major Kent urban fires:

- Adair's Restaurant, January 1983; a 2 alarm fire causing over $500,000 in damages.
- Department of Transportation, December 1991; a 4 alarm fire causing over $1,000,000 in damages.

- Village Green Apartments, June 1993; a 3 alarm fire including a regional strike team. The fire displaced over 100 residents and caused over $3,000,000 in damages.
- Chem Central, September 1999; a 2 alarm hazardous material fire causing over $1,000,000 in damages.
- Springwood Apartments, July 2003; a 2 alarm fire displacing dozens of families and causing over $1,300,000 in damages.

Fire in any area is a menace to both life and property. During the two year period from 2002 to 2003 there were more than 1,500 reported fire incidents[1] within the Greater Kent Area causing significant monetary loss of property.

Hazard Identification

Fire has many causes which can range from faulty wiring to improper storage and handling of flammables, illegal explosive devices, and arson. Fires range from small fires which can be easily managed to a conflagration. A conflagration is a fire that expands uncontrollably beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions and explosions are usually the contributing elements behind a conflagration.

Urban fires can overwhelm local resources

There are certain sectors of the city and populations which are more vulnerable to fire than others. Those areas which have a high population density present a high risk for fire simply due to increased exposure and probability. Those same areas can also pose the threat of high casualty rates for the same reasons. Other areas include large residential areas near heavily wooded wild land, posing a wild land/urban interface situation.

A large urban fire puts a tremendous strain on many of the operating departments of the community. The fire service needs all available firefighters to control the blaze and yet must continue to meet normal demands for service; law enforcement provides for evacuation activities, traffic and crowd control; public works is tasked with supplying barricades and a continuous supply of critical utilities necessary to manage the incident.

[1] Total 911 requests for service were 26,226 during the same timeframe.

Zone resources may be asked for assistance in one form or another, resulting in reduced response capabilities in the supporting jurisdictions. A large part of the city's business district may need to be shut down and major roadways blocked to facilitate the movement of emergency vehicles. Viewers, sightseers and news media personnel can add to the disruption as an indirect effect.

The mass movement of citizens through evacuation or disaster migration will affect emergency forces. If people are removed from a residential area, emergency shelters may be required. The evacuation may have a significant effect on other parts of the community depending on: the size of the fire zone, the materials burning, the population density, and the number of people needing to be housed.

Arson fires have been on the increase for the past several years. The arson fire presents a unique and significant risk to everyone in the community because there is no way of knowing where, when, and how an arsonist may strike.

Vulnerability Analysis

The housing of low income persons is often in older structures which do not conform to modern building and fire codes and do not contain fire detection devices. These structures are also prone to faulty electrical, heating and other utility systems due to age and lack of proper maintenance. Many of these older structures were constructed in very close proximity to one another, enabling fire to spread rapidly from one structure to another. Older apartment buildings and hotels also face increased risk of rapid fire spread due to inadequate firewall protection and the lack of fire detection and sprinkler systems.

Some of the newer residential structures and hotels, though still susceptible to high population risk, are not as vulnerable to fire as are older structures. These structures were designed and built to include fire resistive features which conform to modern fire and building codes. Fire detection and/or extinguishing systems were also installed in these buildings at the time of construction. Though a major fire could certainly occur in these structures, the likelihood of its spreading to adjoining structures or units before it can be brought under control is significantly reduced.

Commercial, industrial and multi-family fires present their own unique hazards. Some newer structures, like residential occupancies, are built with fire resistive construction and fire detection and/or sprinkler systems (in buildings over 10,000 sq. ft.) thereby reducing the risk of major fires. Older structures and single family dwellings however, share many of the same problems as older housing and are at greater risk of fire.

Many commercial and industrial occupancies within Kent store and use hazardous materials. Kent houses the second largest quantity of hazardous materials sites in all of King County. The storage and use of these materials not only increases the risk of fire, but also pose a significant threat to firefighters and the community if the material should become involved in a fire.

A sizable earthquake in Kent could damage any or all of the city's main water supplies, transmission lines, and/or feeder lines. Without adequate water reserves, automatic sprinkler protection would fail, and firefighters would be unable to attack a wide fire front. In such a setting, a small fire could easily spread beyond control.

Conclusions

The threat of a large scale urban fire is limited in Kent except for the introduction of an outside event such as an earthquake or hazardous materials incident. The number of commercial and industrial fires has been controlled in recent years due to the annual fire inspections performed by fire department personnel. These inspections not only identify potential problems, they also provide an opportunity for business owners and workers to be more aware of fire prevention through education provided at the time of inspection. Despite the best effort, however, some fires still occur.

The science and art-form of Arson Investigation has also been a significant factor in the reduction of urban fires. Investigators and fire crews are working together to convict and or deter more arsonists than ever before.

Despite the efforts of the fire service, aging buildings and acts intentionally or unintentionally made by people will contribute to incidents of burning buildings in the Kent area.

WATER SHORTAGE/SYSTEM FAILURE

Definition of Hazard

This type of hazard includes the reduction in performance or complete failure of part or all of the water supply system, due to equipment failure, human acts, (deliberate or accidental) and the results of natural or human made disasters.

History of Hazard

No catastrophic failures have been experienced however shortages have been and will continue to be of concern as a result of rapid growth in the area and drought.

Hazard Identification

All of the area is susceptible to water shortage or system failure regardless if served by private or public systems.

Vulnerability Analysis

The City of Kent owns and operates its own water supply system and provides water service for most of the Greater Kent Area. Any interruption or failure of this system would leave most of Kent's water needs unfilled.

Any utility system is subject to interruption or failure. The Kent water supply is no exception. While precautions to safeguard the system exist, such as tie lines to other water districts and the wide distribution of Kent owned wells, water system failure may still occur for a number of reasons including the lack of on-site generators for emergency power. Anticipated causes of water system hazards are earthquake, severe weather, power failure, or system failure. The system is also subject to shutdown due to environmental contamination from accidental or intentional causes.

Numerous problems may occur as the result of water shortages or failures. In addition to the obvious inconvenience of being without water for daily needs, it would be impossible to fight any fires that may occur. Sewer systems would fail. The lack of necessary water supplies would create a serious public health concern, and unemployment would occur at those businesses requiring water to run day to day operations. Agricultural businesses would fail without water, causing an interruption in the local food chain.

Conclusions

Water shortages and system failures and the chain of associated events would most certainly create a grim scenario for the area.