BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

In the Matter of: Application No. 2013-01 TESORO SAVAGE, LLC VANCOUVER ENERGY DISTRIBUTION TERMINAL	CASE NO. 15-001 **PREFILED TESTIMONY OF MICHAEL S. HILDEBRAND, FILED BY THE CITY OF VANCOUVER**

Q: Please state your name, place of employment and title, and address.

A: Michael S. Hildebrand, CSP, CHMM, CFPS
Hildebrand and Noll Associates, Inc.

Q: What does Hildebrand and Noll Associates, Inc. do?

A: Hildebrand and Noll Associates, Inc. is a Florida based, 100 percent Veteran owned S-corporation. The company was founded in 1989 by Michael S. Hildebrand and Gregory G. Noll. Our consulting firm specializes in hazardous materials emergency planning and response.

Q: What types of businesses have you worked with?

A: My business partner Gregory Noll and I have designed, planned, and managed over 700 hazardous materials emergency planning and response, safety, and security projects in the United States, Canada, South America, Europe, Central Asia, the Middle East, Australia, and the Caribbean. I specialize in hazardous materials emergency response and planning

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in three primary markets: industry; U.S. military; and public safety. Some examples of our experience in industry include:

- We have served as consultants at 30 refineries, 27 chemical plants, and 13 gas plants where we have conducted operational readiness reviews of emergency response programs, developed facility Emergency Response Plans, and trained Incident Management Teams.
- We have conducted 55 comprehensive emergency preparedness program audits and assessments of petroleum refineries, petrochemical plants, pipelines, bulk storage tank farms, and hazardous waste facilities.

As senior partner with Hildebrand and Noll Associates, Inc. I have served as a Subject Matter Expert or witness on many legal cases involving industrial emergency response and fatal accidents. A few examples include:

- Torrance, California. *Gower, et al v. Mobil Oil Corporation.* Provided technical support concerning complaint against the Mobil Torrance Refinery concerning risks to the community from operating a Hydrofluoric Acid Alkylation Unit. (Latham and Watkins) 1990.

- San Francisco, California. *United States v. Chevron.* Conducted investigation and provided deposition concerning the use of specialized protective clothing in refineries. (Chevron Office of General Counsel) 1990.

- Baltimore, Maryland. *Atlantic Mill and Lumber v. Autoline Lubricants, Inc.* Provided technical support concerning complaint against Autoline Lubricants regarding ultra hazardous operations. (Stein, Mitchell and Mezines) 1991.

- Kansas City, Missouri. *Heim/Herken, et al v. Simco Petroleum Co., et al.* Conducted investigation and provided deposition concerning oil field production tank standards. (Payne and Jones) 1991.

- Orange County, California. *Mullenax v. Mobil Oil Corporation.* Provided technical assistance concerning a bulk storage tank explosion resulting in injury. (Cummins and White) 1991.

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- Los Angeles, California. *Lekberg and Mostoufi v. Mobil Oil Corporation*. Conducted investigation and provided deposition concerning a storage tank explosion. (Cummins and White) 1991.

- Columbus, Ohio. *United States v. Gem Industrial, et al.* Provided technical assistance concerning the use of protective clothing in refineries. (Bricker and Ecker) 1992.

- Denver, Colorado. *Diamond Shamrock Refining & Marketing v. AMR Combs-Denver, Inc*. Conducted investigation of safe operating practices used at Denver Stapleton International Airport's bulk storage tank facility prior to the 11/25/90 tank farm fire. This fire burned for 55 hours and damaged seven storage tanks consuming more than 1.6 million gallons of jet fuel for a loss of $32 million. (White and Steele) 1993.

- Wichita, Kansas. *Township of Buena Vista, Michigan v. C. Reiss Coal Co. and Saginaw Asphalt & Paving Co.* Conducted investigation and provided technical advice concerning how a coal fire was managed by the fire department at the Reiss Coal Company. (Koch Industries Office of General Counsel) 1994.

- Boston, Massachusetts. Provided technical advice in support of *Stanley J. Johnson, et al. v. Exxon Corporation* regarding an underground tank explosion. (Nutter, McClennen & Fish) 1996.

- Bakersfield, California. Conducted investigation of oil tank explosion at the World Oil refinery and served as consulting expert in *Greater Bakersfield Separation of Grade District v. World Oil, et. al.* (Latham & Watkins) 1997.

- Lansing, Michigan. Served as consulting expert and provided testimony for the State of Michigan MIOSHA Appeals Division concerning underground tank explosion and fatality involving Midland Environmental Services 1997.

- Tulsa, Oklahoma. Provided technical consulting in defense of the National Propane Gas Association in *Nehring, et al. v. Thermogas, et al.* involving a propane tank explosion at Albert City, Iowa (Conner & Winters) 1999.

- Chatham, New Jersey. Provided technical advice in support of *Gonzalez/Lopez/Rivera v. Genie Co., et al f.* Case involved a fire resulting in employee burns from using acetone inside an ocean yacht under construction (McCusker, Anselmi, Carvelli & Walsh) 2000.

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- Mobile, Alabama. Served as a consulting expert concerning *Plaintiffs v. Celanese Chemicals, et. al.* Case involved a fatality of an industrial emergency responder. (Frazer, Greene, Upchurch & Baker, LLC) 2003.

- Milwaukee, Wisconsin. Provided technical support concerning a warehouse fire involving a fire at a large warehouse and propane storage facility in Dania, Florida. *Travelers Property Casualty Company of America a/s/o Uniweld Products v Chilton Manufacturing Corporation* – Case No. 04-60013 - United States District Court. (Folley & Lardner, LLP) 2004.

- Calgary, Alberta, Canada. Served as consulting expert on *Shell Canada, Ltd v. Superior Propane Plus, Inc.* concerning March 18, 2002 propane truck fire at Albian Sands. 2006.

- San Jose, California. Served as technical consultant in support of *McCormack v. PG&E, et. al.* This case involved an accidental electrocution of a Santa Clara County Fire Captain at a multiple alarm residential occupancy fire. (Shea & Shea) 2007.

Q: Can you review your professional experience prior to forming Hildebrand and Noll Associates, Inc. as it relates to hazardous materials emergency planning and response?

A: I served as the Director of Safety and Fire Protection for the American Petroleum Institute (API) from March 1980 – May 1989 (9 years 3 months) in Washington, D.C. I managed the safety and fire protection program for the American Petroleum Institute's member companies. Areas of responsibility included legislative and regulatory affairs, fire protection engineering standards, and recommended practices for safety and fire protection of refineries and bulk storage terminals.

I was employed as a Fire Safety Research Analyst for the International Association of Fire Chiefs from May 1979 – March 1980 (11 months) in Washington, D.C. At the IAFC I managed a Federal Emergency Management Agency contract in fire service disaster planning and wrote the *Disaster Planning Guidelines for Fire Chiefs*.

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I served as a Hazardous Materials Safety Technician with the U.S. National Transportation Safety Board from January 1978 – May 1979 (1 year 5 months) in Washington, D.C. At NTSB I supported senior investigators with analysis of accident data, conducted telephone interviews with accident victims, and prepared technical reports for NTSB's Hazardous Materials and Railroad Divisions.

I served as an active duty firefighter with the United States Air Force from September 1972 –1976 (4 years) with service at Mountain Home Air Force Base and at Sembach Air Base in Germany. While with the Air Force I served as a firefighter, rescue technician and medic, rescue crew chief, and fire department communications supervisor. I was a member of the USAF Prime Beef Disaster Mobility Team. I received the Good Conduct Medal and an Honorable Discharge.

Q: Can you review your education as it relates to emergency preparedness and management?

A: I attended the following colleges and attained the following degrees:

- University of Maryland at College Park (1976 – 1979) and obtained a Bachelor's Degree in Science. My major was Fire Safety Analysis and Investigation.
- Montgomery College, Rockville, Maryland (1976 – 1977) where I obtained an Associate in Arts Degree in Fire Science.

Q: Have you earned any professional certifications?

A: Yes, I am certified by the following organizations:

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- Certified Safety Professional - Board of Certified Safety Professionals, License 13750. Starting in 1995.
- Certified Fire Protection Specialist (CFPS), Fire Protection Specialist Certification Board, License 772. Starting January 1995.
- Certified Hazardous Materials Manager (Masters Level), Institute of Hazardous Materials Management, License 6915. Starting January 1996.
- Certified Hazardous Materials Incident Commander, National Board on Fire Service Professional Qualifications, Certificate 29185. Starting January 1995.
- Merchant Marine Officer - Master of Inland Steam or Motor Vessels (50 Gross Tons), with Commercial Assistance Towing. U.S. Coast Guard, License 906817 (License in Continuity) Active license 1995 – 2010.

Q: Have you written or instructed on the topic of hazardous materials emergency planning and response?

A: Yes, I have authored or co-authored the following publications:

- Gasoline Tank Truck Emergencies: Responding to MC-306/DOT-406 Cargo Tank Trucks Transporting Gasoline/Ethanol Blends and Fuel Oils, 4th edition (2016) Jones and Bartlett Learning.
- Guide for Communicating Emergency Response Information for Natural Gas and Hazardous Liquid Pipelines, HMCP Report 14, by Jennings, Charles, Groner, Norman, Hildebrand, Michael, Noll, Gregory, and Zimmerman, Rae, Transportation Research Board, The National Academy of Sciences, Washington, D.C. The HMCRP Report 14: Guide for Communicating Emergency Response Information for Natural

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Gas and Hazardous Liquids Pipelines is designed for use as a pre-incident planning tool for both pipeline operators and public safety agencies, such as fire departments, law enforcement, and emergency management agencies. It is intended to provide information to assist all parties in identifying information needs and the means for communicating this information.

- Hazardous Materials: Managing the Incident, 4th edition (2014) Jones and Bartlett Learning. This textbook is now in its 28th year of continuous publication. The textbook is designed to train emergency responders how to safely respond and manage emergencies involving hazardous materials. It meets the requirements of the National Fire Protection Association Standard NFPA 472, "Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents" for Incident Commanders and Hazardous Materials Technicians. (622 pages).
- Pipeline Emergencies, 2nd edition (2011), National Association of State Fire Marshals. This textbook provides emergency responders with information on how liquid and gas pipelines systems operate and how to safely respond to pipeline emergencies. It includes many scenarios that can be used for training. (204 pages).
- NFPA Fire Protection Handbook, 20th Edition Chapter 13-6, "Public Fire Protection and Hazardous Materials Management," National Fire Protection Association (2007). This chapter describes the various hazardous materials regulations and standards that relate to emergency planning and response to hazardous materials emergencies. It contains useful information for fire marshals and inspectors as well as responders.

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- Propane Emergencies, 3rd edition (2007) Propane Education and Research Council (PERC) This textbook provides information on how to safely respond to propane emergencies. It explains the chemistry of propane, the various types of storage tanks and transportation vehicles, and a variety of tactical scenarios. (302 pages).

Q: What organizations are you a member of related to hazardous materials emergency planning and response?

A: I belong to and have volunteered for the following organizations:

- National Fire Protection Association (NFPA), NFPA 472 – Committee on Professional Competencies of Emergency Responders to Hazardous Materials and Weapons of Mass Destruction Incidents. (Alternate Member since 1997).
- Yvorra Leadership Development Foundation (YLD). YLD is 501C (3) non-profit organization. I am the President and member of the Board of Directors. (Founded 1988). YLD promotes leadership development within the U.S. emergency services. For more information go to www.yld.org.
- 10 Year member of the Prince Georges County (Maryland) Hazardous Materials Response Team. Served as HazMat Team Shift Commander for 5 years. Served from December 1980 – December 1990.
- Firefighter, Montgomery County (Maryland) Fire Department. Served as volunteer firefighter with the Silver Spring, Maryland Station-19 (1976-1977).

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- Volunteer Firefighter, Hagerstown Fire Department, Engine Company-2. Served from March 1970 to September 1972.

Q: Can you please give an overview of the oil terminal proposal as it relates to the opinions you have in this proceeding?

A: I understand that Tesoro Savage Petroleum Terminal LLC proposes to construct and operate a new crude oil terminal in the Port of Vancouver, Washington. The terminal will receive an average of 360,000 barrels of Bakken crude oil and diluted bitumen per day by way of the BNSF railroad. The crude oil will be moved by High Hazard Flammable Trains (HHFTs).[1] The crude oil will be unloaded from the HHFTs, stored on-site, and loaded onto marine vessels at the terminal. Marine vessels would deliver crude oil to refineries primarily located on the U.S. West Coast. Vancouver is Washington's fourth largest city with a population of approximately 170,000 people. The BNSF's mainline railroad tracks which will transport HHFT trains will travel through an urban environment consisting of residential and commercial areas as well as the city's downtown.

The DEIS for the project indicated that the Applicant would "require all tank cars used to transport crude oil to the proposed Facility to meet or exceed DOT-117 (or newer) specifications." [2] However, the applicant commented that this is not the case. According to the applicant it will "follow the requirements of the new US DOT / PHMSA Tank Car

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[1] The U.S. Department of Transportation – Pipeline and Hazardous Materials Safety Administration (DOT / PHMSA) defines High Hazard Flammable Trains (HHFT) as trains that have a continuous block of twenty (20) or more tank cars loaded with a flammable liquid (i.e., unit train), or thirty-five (35) or more cars loaded with a flammable liquid dispersed through a train (i.e., manifest train with other cargo-type cars interspersed).
[2] DEIS at 4-116.

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rule Final Rule on Enhanced Tank Car Standards" due to concerns that using only the DOT 117 cars would put it at a "commercial disadvantage."[3] The Enhanced Tank Car Standards" allow for the use of DOT-111 and DOT CPC-1232 cars in crude oil service according to the following schedule: non-jacketed DOT-111 cars until May 1, 2017; jacketed DOT-111 cars until March 1, 2018; non-jacketed CPC-1232 cars until April 1, 2020; and jacketed CPC 1232 cars until May 1, 2025.

Q: What can you tell us about the performance of tank cars used to transport crude oil by rail?

A: At the present time, crude oil and ethanol are transported in DOT-111 or CPC-1232 tank cars.[4] On May 8, 2015, PHMSA issued a final rule, Hazardous Materials Enhanced Tank Car Standards and Operation Controls for HHFTs, which established standards for the construction of new tank cars built to transport crude oil and ethanol in HHFTs.

The following facts can be noted with respect to the behavior of the railroad tank cars in a HHFT derailment scenario:

- Legacy DOT-111 and non-jacketed CPC-1232 (i.e., Interim DOT-111) tank cars have not performed well in high-energy derailment scenarios.[5] Jacketed CPC-1232 tank cars have performed slightly better than non-jacketed tank cars. See Exhibit-A for examples of rail car breaches and damage.

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[3] See Comments submitted by Vancouver Energy at page 2-20.

[4] CPC stands for Casualty Prevention Circular, which was issued by the Association of American Railroads. The CPC-1232 is a DOT-111 tank car that has enhanced features, including head shields constructed of ½ inch thick steel to protect the bottom half of tank heads during derailments and some are equipped with insulation and jackets.

[5] In the 24 HHFT derailments occurring between 2015 and 2006 there were a total of 442 tank cars derailed. Of these, 314 tank cars breached (71%).

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- Observations from actual derailment performance show that the number of tank cars that breach or fail is dependent on the type of tank car involved (e.g., DOT-111, CPC-1232 jacketed vs. non-jacketed tank car) and the configuration of the derailment (i.e., in-line vs. accordion style). Tank cars that pile up generally sustain greater numbers of car-to-car impacts that result in breaches, or will be susceptible to cascading thermal failures from exposure to pool fires. Tank cars that roll over in-line are less susceptible to a container breach, but may leak from damaged valves and fittings.
- During a dynamic derailment, tank cars are stressed mechanically and may breach due to punctures from couplers or other objects such as broken rails or as a result of damaged fittings. Tank cars damaged by mechanical stress often ignite and burn. Other causes of tank car failure may include: (a) thermal stress from an external fire impinging on the tank car shell; (b) the heat-induced weakening and thinning of the tank car shell metal; and (c) internal tank car pressure. The hazards posed by the release of flammable liquids include flash fires, pool fires, and dynamic energy release from container failure; i.e., fireballs with associated shock wave and possible separation of the tank shell.

A review of research literature by the Sandia National Laboratory for U.S. DOT/PHMSA showed that a 100 ton release of a flammable liquid (approximately equivalent to a 30,000 gallon tank car) with a density similar to kerosene or gas oil would produce a fireball diameter of approximately 200 meters (656 feet) and a duration of about 10 – 20 seconds. Note: "Gas Oil" is fuel distilled from petroleum.

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Observations that can be made with respect to the behavior of the railroad tank cars in a HHFT scenario include:

- Derailments resulting in a liquid pool fire scenario can lead to the failure of valve gaskets, which leads to additional tank car leaks and associated issues during derailment clean-up and recovery operations.
- Heat induced tears have been observed on tank cars containing both crude oil and ethanol. While the majority of heat induced tears have occurred during the initial 4-6 hours of an incident, tank car failures can occur at any time. Heat induced tearing has occurred within 20 minutes of the derailment and as long as 8+ hours following the initial derailment. This is significant from an emergency response context because tank car breaches due to heat induced tears can rapidly release flammable liquid and immediately increase the magnitude of the fire, which can further impinge on un-breached cars. If firefighters are engaged in rescue, evacuation, or firefighting when a heat induced tearing occurs their lives would be at risk.

Experience has demonstrated that HHFT incidents are large, complex and lengthy response scenarios that will generate numerous response issues beyond those normally seen by most local-level response agencies. In addition to the hazardous materials issues associated with the response problem, there will be a number of other secondary response issues that will require attention by the Incident Commander. These will include evacuation, foam and water supply logistics, situational awareness, information

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management, public affairs, and infrastructure protection. Managing an HHFT derailment and fire in an urban environment may also require an Incident Management Team supporting a Unified Command structure; e.g., National Incident Management System Type-III Team.

Q: How are HHFT fires different than the type of fires an agency such as the Vancouver Fire Department would typically respond to?

A: Based on our experience as hazardous materials emergency planning and response specialists, and from studying the experience from actual HHFT train derailments and fires, there are a number of observations that can be made that would directly relate to what the City of Vancouver would face in dealing with an HHFT derailment with fire.

Most fire service emergencies are "high intensity, short duration events" that are terminated in a matter of hours. In contrast, HHFT train derailment spills and fires are long duration, major environmental incidents that will extend over several days. With few exceptions HHFT incidents cannot be safely managed by a single agency or organization. These are "All Hands" incidents that require a coordinated fire department, law enforcement, and Emergency Management Agency response that is supported by mutual aid organizations, State and Federal technical support, Oil Spill Removal Organizations (OSRO's), and emergency response specialists from the railroad that are organized in a Unified Command format to bring the incident to closure.

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An HHFT train derailment scenario may likely be the largest flammable liquid incident encountered by most emergency response agencies in their history. Challenges will include the location and access to the incident, the overall size and scope of the problem, the rapid growth of the fire, spill control, and the level of resources available in the first one hour of the incident. The large quantities of foam concentrate required for fire control present most fire departments with significant challenges that include: (a) Having the right type of foam concentrate and in sufficient quantities; (b) A foam logistics plan to move foam caches to the scene of the incident; (c) Ability to access the burning tank cars; and (d) Adequate and sustainable water supply and the proper foam eductors and application devices. Initiating large flow foam operations at HHFT scenarios will be a significant operational challenge for most public fire departments.

In comments to the DEIS submitted by the Applicant, it is stated, "As generally discussed in the DEIS, if a potentially fiery crude by rail incident is not within the capabilities of certain responders to actively combat, then those first responders are unlikely to be prepared to actively combat a similar rail incident involving any flammable liquid or gas."[6] I believe this statement tries to simplify what is, in reality, a range of factors that are inputs into the incident commander's risk-based decision making response process. I would agree that there is a high probability of failure to successfully combat a HHFT fire. Responding to a HHFT derailment and fire will be different than responding to derailments and fires of tank cars containing Hazard Class 2.1 Flammable Gases

[6] Vancouver Energy comment letter, dated January 22, 2016 at Attachment 4-6, page 9.

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regardless of the relative volatility of the Class 3 liquid.[7] Class 3 flammable liquids account for the highest number of hazardous materials incidents in both transportation and fixed facilities. However, the challenge in the HHFT scenario is the overall size and scope of the response problem as compared to the level of available resources. A 100 car general freight train consists of a variety of rail cars like flat and box cars carrying a mixture of commodities as well flammable gas and liquid cars. In contrast, an HHFT train made up of a block of 20 to 100 flammable liquid cars in a row will present a different, and potentially more hazardous, dynamic than a general freight train.

Q: Can you describe the behavior and phases of an HHFT fire?

A: The behavior of HHFT derailments resulting in tank car breaches and fire goes through three distinct phases as illustrated in the graphic shown on page-17. These include:

The **first phase** is the initial derailment and fire. This is usually the first hour of the incident. If the derailed tank cars are initially breached through mechanical stress or valve failure and an ignition occurs, the breached cars burn and the fire will impinge adjacent exposures. These exposures may include adjoining tank cars that are initially intact, but are now stressed by fire. This behavior can result in additional tank car failures and an increase in the size of the fire. In this phase of the incident there may be a window of opportunity for the fire department to intervene and use an offensive strategy to attempt to attack and extinguish the fire. An adequate supply of water and foam concentrate must be available to execute an offensive strategy. Based upon our analysis of 24 HHFT incidents, there is a very limited window of opportunity in the early stages of an incident

[7] 49 CFR 173.115 – Class 2, Division 2 (Flammable Gas).

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for implementing offensive fire control strategies. There is a higher probability that response options will be limited to defensive strategies (e.g., exposure protection and spill control) to minimize the spread of the problem or non-intervention strategies. e.g., take no action and allow the fire to burn until equilibrium is achieved. It is important to note that to date, no HHFT fires have been controlled or extinguished using an offensive strategy in this phase of the incident.

The **second phase** is the incident growth (2 to 8 hours into the incident). In this phase of the incident, the fire grows larger and becomes very hot and intense. Incident growth will generally follow a process of: (a) thermal stress from the initial fire upon exposed tank cars; (b) activation of tank car pressure relief devices; (c) continued thermal stress on adjoining tank cars from a combination of both pool fires and pressure-fed fires from activated Pressure Relief Devices; (d) increasing probability of container failures through heat induced tears; and (e) subsequent fire and radiant heat exposures on surrounding exposures when rapid release events occur. During this phase of the incident, the size of the fire and the potential for container failures and associated fireballs make approach to the derailment difficult and unsafe for any offensive operations. Running or unconfined spill fires and releases may occur. Spills may flow into storm drains and other aboveground and underground structures creating secondary spills and fires. In addition, the use of large water streams for cooling may also spread the fire to non-involved areas. The window of opportunity for extinguishment closes and the fire department has to switch to either a defensive or non-intervention strategy. The curve on the graphic shown

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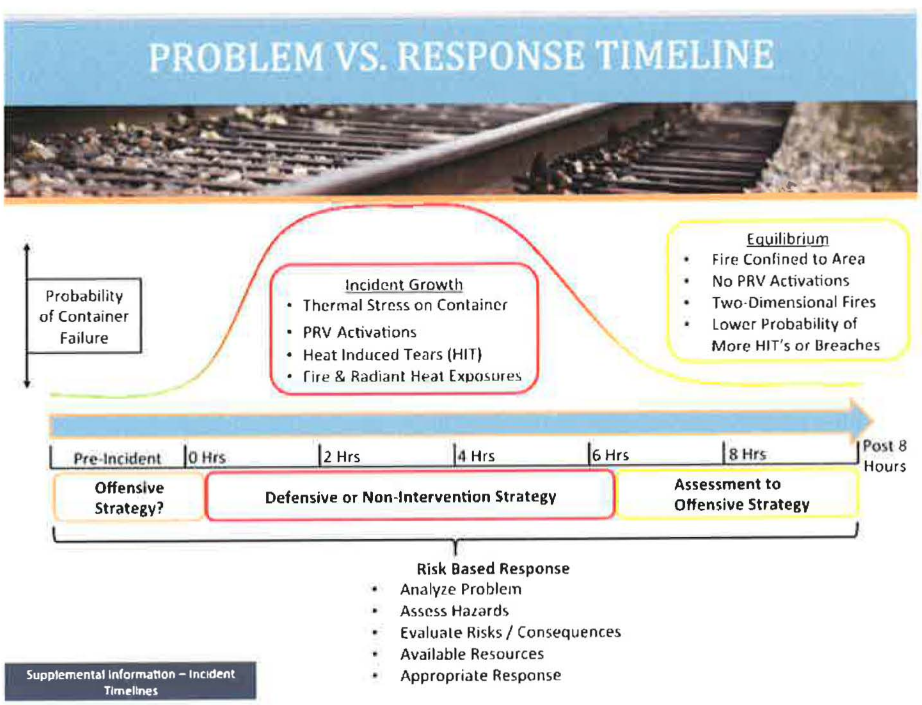
on page-17 represents the probability of additional container failures, which leads to a cascading and growth response scenario.

The **third phase** is what a number of emergency responders would call "Equilibrium." Fires will continue to burn off the available flammable liquid fuel until such time that the fire is no longer growing in size. An analysis of historical incidents shows that equilibrium at a major HHFT incident may not occur for approximately 8-12 hours into the incident timeline. The fire reaches a state when there is a lower probability of additional heat induced tears or tank car breaches. Equilibrium benchmarks would include the fire being confined to a specific area and no longer increasing in size or scope, no Pressure Relief Device activations, and the fire dynamic primarily being two-dimensional.

The graph below illustrates these phases of the incident:



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Q: Could you describe what you would consider to be a couple of plausible worst-case scenarios of HHFT derailments and fires in Vancouver?

A: Yes. First, let me review my work leading up to the preparation of these scenarios.

I and experts from Hall and Associates, LLC examined twenty-four train accidents between 2006 and 2015 that resulted in the derailment of tank cars transporting crude oil or ethanol in the DOT-111 and CPC-1232 tank cars. The focus of the analysis was on types of cars involved, number of cars derailed, train speed, number of cars breached, and the amount of product released. The primary sources for data used in this review were from reports and documents on file at the following organizations: the National Transportation Safety Board (NTSB), the Federal Railroad Administration (FRA), the Pipeline and Hazardous Materials Safety Administration (PHMSA) and the Transportation Safety Board of Canada (TSB of C).

On October 6 and 7, 2015 I along with Robert Chipkevich, who is a railroad safety Subject Matter Expert from Hall and Associates, LLC, conducted site inspections of property along the BNSF rail line, overpasses, grade crossings, adjacent exposures and storm drainage within the city limits of Vancouver. I participated in interviews with city planners and engineers to determine future urban development along the BNSF rail line through the city center. I also conducted interviews with police, fire, and emergency management senior leadership to determine current emergency response capabilities, including, communications, command and control, fire suppression, and evacuation.

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The first scenario would evolve as follows:

At 3:35 pm on a weekday, seven rail cars from a 100-car tank train carrying Bakken Crude Oil derail at a track speed of 10 mph. The derailment occurs at the new overpass near Esther and Phil Arnold approximately 400 feet from City Hall. Three of the seven derailed cars fall off the overpass onto Phil Arnold Avenue.[8] Each of the three tank cars carrying 30,000 gallons of crude oil is breached due to mechanical damage.

- One tank car is punctured and loses 30,000 gallons of cargo onto the roadway which flows into storm drainage under the overpass.
- A second tank car is breached and loses half of its cargo - 15,000 gallons.
- Valves on a third tank car are damaged and 3,000 gallons of cargo are released.

The low flash point crude oil accumulating in depth under the overpass ignites from an unknown ignition source. The intense burning liquid causes severe spalling to the concrete bridge supports. Burning crude oil enters the storm drainage system which flows into the Columbia River creating an oil spill. Depending on the available oxygen in the storm water system, the fire may pop up at some or all of the storm drains along the drainage route to the river causing secondary fires involving debris and automobiles parked along the curb. If the oil entering the river is still on fire, a second fire front could develop igniting brush and setting structures on fire along the shoreline.

The remaining four of the seven derailed tank cars come to rest on the overpass and adjacent hillsides. Due to the final resting position of these tank cars, orientation, and

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[8] The area just south of this location between the BNSF rail line and the Columbia River is planned for waterfront development. This 186-acre site will include commercial retail, office space, and 1,125 residential dwellings. There will be a significant addition to the population density.

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proximity to a large pool fire involving up to 48,000 gallons of crude oil, the tank cars are exposed to intense fire and heat from the pool fire under the overpass.

Within two hours of the initial ignition of the pool fire, additional tank cars are breached due to thermal induced damage to the tank sidewalls and an additional 60,000 gallons of crude oil is involved in the fire.

In this scenario 108,000 gallons of crude oil are released and involved in fire, the equivalent of 12 large highway cargo tank trucks. The fire would grow rapidly in the first hour and emergency response would shift from an offensive strategy to a defensive or non-intervention strategy. The fire would may reach equilibrium for six to eight hours and might not be approachable by firefighters for approximately 8 to 12 hours.

The second scenario would evolve as follows:

At 2:45 pm on a sunny summer weekend, 27 cars of a 100-car Bakken Crude Oil tank train traveling 33 mph derails east of Interstate-5 along the SR-14 EB near Marine Park and the Marine Park Wastewater treatment plant along 45th Street. The wind is blowing 10 knots from the southeast. Seven tank cars are immediately breached due to mechanical punctures or damage to valves releasing 102,000 gallons of crude oil and resulting in large pool fires which flow downhill into Marine Park, threatening the waste water treatment plant.

The length of the train blocks the only exit from Marine Park trapping people in the park between the railroad track along SR-14 EB and the Columbia River. The SE wind

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spreads the fire to brush, which extends to the wooden residential buildings uphill from the railroad track near Shorewood. Residents in homes near Kaiser, Victory, and Assembly Roads are unable to evacuate.

Within 4-hours, an additional 13 tank cars are breached due to thermal damage from the fire and release an additional 275,000 gallons of crude oil.

In this scenario, 377,000 gallons of crude oil is released with much of it involved in fire, the equivalent of 42 highway cargo tank trucks. The fire would grow rapidly in the first hour and emergency response would shift from an offensive strategy to a defensive or non-intervention strategy. The fire would not reach equilibrium for six to eight hours and might not be approachable for firefighters.

Q: What concerns do you have, if any regarding Vancouver Fire Department's (VFD) ability to respond to the two HHFT derailment scenarios you have described?

A: The biggest challenge for the VFD in dealing with a HHFT derailment incident with breached tank cars and fire involved would be the ability to rapidly deploy fire suppression resources and intervene with an offensive strategy, and confine, contain, and extinguish the fire within the first hour. As noted earlier, no HHFT derailment with fire has been successfully extinguished in Phase-1 of the incident.

In addition to the challenge of sufficient personnel required to deploy large diameter hose lines and master streams, large quantities of foam concentrate would be required early in the incident. In order for a flammable liquids fire to be extinguished, you need the right amount of foam concentrate, at the right application rate, for the right length of time or

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the fire will not go out. There is a total of 18,365 gallons of foam concentrate available in the Vancouver metro area.[9] While this is an impressive inventory, the quantity of foam concentrate available does not necessarily translate to an immediate successful deployment and operability at the fire scene. The foam concentrate needs to be transported to the scene and turned into foam solution using fire pumps, hose lines, foam eductors, and application devices. There are significant logistical factors involved in a large scale foam operation. For example, in the Vancouver Metro Area there are 18,365 gallons of foam concentrate available in the foam cache. Of that total, only 1,600 gallons or 8.7% of the foam cache is immediately mobile and could likely arrive quickly at the fire scene; i.e., 20-30 minutes. This time factor would also apply to a response to the proposed terminal. Further, of the 6,365 gallons (34.6%) of the foam cache readily available and owned by fire departments, 4,765 gallons are stored on pallets or POD's. Transporting a POD requires a flatbed type chain truck to trans-load the POD to the vehicle so it can be driven to the scene. 12,000 gallons of the 18,354 gallons of the foam concentrate available is stored in fixed storage tanks on site at Boeing and would require transfer to totes or tanker trucks to be useful.

Q: What concerns do you have, if any regarding Vancouver Fire Department's (VFD) ability to respond to a fire at the proposed terminal?

A: In my opinion, the Vancouver Fire Department would be able to manage most High Probability/Low consequence incidents at the terminal like a large office building or warehouse fire with available manpower. On the other hand, responding to Low

[9] DEIS Page-5.4, Appendix-A to the Appendix-B *Fire Protection Assessment Report* – Chapter-5 – *VFD Foam Resources*. Table 5.3 shows the location and amount of foam concentrate available in the Portland/Vancouver Metro area.

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Probability/High Risk incidents like a crude oil bulk storage tank or process and loading area fires would present some strategic challenges.

A typical fire service response to a major hydrocarbon industrial facility like a refinery, tank farm, or marine terminal in a city the size of Vancouver would typically include: 4-Engine Companies, 2-Ladder Companies, 1-Hazardous Materials Unit, and 1-Command Officer. The table below shows the most likely 1st due through 5th due fire stations to the proposed Tesoro terminal, the type of fire apparatus, staffing level, and estimated response times.

Fire Station	Fire Apparatus	Staffing	Response Time
Station-1	Engine-1, Truck-1, Batt-1	8	8-Minutes
Station-2	Engine-2	3	9-Minutes
Station-3	Engine-3	3	14-Minutes
Station-4	Engine-4	3	18-Minutes
Station-5	Truck-5	4	15-Minutes
Station-10	HazMat Unit and Foam Unit	3	23-Minutes

This response would require 24 firefighters or 60% of the on duty complement of 40 VFD firefighters. The VFD runs about 70 emergency calls per day. This would leave 16 firefighters to cover the rest of the city and staff the other uncommitted stations. Mutual aid and a backfill would be required to support a sustained incident at the terminal.

Q: What are your concerns as they relate to evacuation?

A: The DOT Emergency Response Guide provides emergency responders with general evacuation guidance.[10] Evacuation Guide #128 provides guidance for petroleum crude oils and recommends an initial evacuation of at least 300 meters (1,000 feet) for large

[10] U.S. Department of Transportation PHMSA, Transport Canada, and Secretariat of Transport and Communications, 2016 Emergency Response Guidebook: A Guidebook for FirstResponders During the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident.

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spills with no fire. For fires, involving rail cars the Guide recommends an initial isolation and potential evacuation of 800 meters or ½-mile in all directions.[11] Using the DOT guidance, most Incident Commanders would initially defer to the Guide 128 recommendations and implement an evacuation of ½-mile radius around the incident until additional risk-based information becomes available. Therefore, using the Emergency Response Guidebook guidance the initial evacuation zone would be one-mile from one side to the other.

According to information provided to me by the Clark Regional Emergency Services (CRESA) during our October 2016 interview, the BNSF mainline as it transects Vancouver is located along the north shore of the Columbia River. State Highway 14 also parallels the north shore of the river to the north of the railroad tracks. This area is 4.78 square miles in size and has a population of 3,261 people. It is steeply sloped and there are only five streets (Columbia Shores, Shorewood, Lieser, Ellsworth and 164th Avenue) that allow vehicles or people to evacuate the area between the river and Highway 14. A map of this area is attached as Exhibit B. These streets are not designed or built to serve as evacuation routes. In the event of a derailment, an evacuation of this area would be extremely difficult. Additionally, a derailed train that is 1.5 miles long would block several at-grade crossings and the only means of egress for residents living south of the railroad tracks.[12]

[11] This is only guidance. The incident commander may request a larger or smaller evacuation zone based on size up and incident potential.

[12] CRESA has identified 25 Critical Care facilities for senior citizens within 2.75 miles of BNSF rail line, with about 18 of these facilities within 1-1/2 miles of the track.

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The difficulties of evacuation are exacerbated by the inability of the notification system to give differing evacuation instructions to different recipients using the existing Emergency Communications Notification System (ECNS).[13] Clark County does not currently have an enhanced ECNS which would allow focused notification of thousands of people with customized messages based on their location e.g., shelter-in-place, evacuation instructions, or areas to avoid. The current ECNS relies on the Incident Commander to determine how large of an evacuation area is required. This initial assessment will be based upon a combination of the initial size-up reflecting actual incident conditions and the recommendations of the Emergency Response Guidebook. Once the fire department Incident Commander makes a decision, the ECNS is activated and begins to alert telephone numbers inside the identified evacuation area. One restriction of the current ECNS is that it dials only home telephone numbers and not cell phones unless they are registered.

As noted above, many areas along the rail line have limited access for evacuation; a derailed train would isolate people between the Columbia River and the rail tracks. A 1.5-mile train in downtown Vancouver would block 2/3rds of the road exits.[14]

Q: What are your concerns as they relate to sheltering of evacuees?

A: Under the current City of Vancouver Comprehensive Emergency Management Plan, the Vancouver Police Department (VPD) would be responsible for coordinating the evacuation of the population from a hazard area and for safe return when the hazard has

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[13] The ECNS is paid for using Homeland Security money through Clark County's budget.

[14] Page 2-2 of Tesoro's comments to the DEIS states that unit trains would be composed of 100 to 118 sole-purpose oil tank cars with two buffer cars and three locomotives. The DEIS Page 3.14-14 states that oil trains are assumed to be 7,800 feet long (1.477 miles).

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passed. This plan addresses evacuation emergency activities for the authorization, direction, routing, and relocation of people from their homes, schools, and places of business. In reviewing a one half-mile evacuation radius, depending on the location in the City, the estimated number of citizens requiring evacuation and relocation to a shelter is 7,000 to 13,000. According to the Washington State Patrol, based on a slow moderate event, approximately 45-60 officers per 10,000 residents are needed for traffic control. Based upon the University of California Crowd Control matrix, VPD would need approximately 7 sergeants and 38 officers for an estimated 13,000 citizens needing evacuation and approximately 4 sergeants and 26 officers for an estimated 7,000 citizens needing evacuation. VPD does not have the resources to meet demands of an evacuation of this nature.

Assuming that a timely and effective evacuation notification could be made to citizens at risk, and the required law enforcement personnel could be marshaled to direct the evacuation, the remaining problem would be locating shelters for evacuees.[15] Once a citizen is evacuated to a shelter their minimum stay time is 48 hours due to the transportation and processing time and availability of vehicles.

Q: Did you review the DEIS regarding fire suppression equipment at the oil terminal?

A: Yes. I did review the DEIS Fire Protection Assessment Report and the Fire Protection System Report.[16] One observation that I noted regarding fire protection systems for the proposed terminal design plan is that there are no provisions in the plan for a back-up power supply for the facility and no provisions for back-up fire pumps.

[15] According to CRESA officials, there are approximately 1,100 hotel rooms in Clark County.

[16] DEIS *Appendix-B Fire Protection Assessment Report – Appendix-A Fire Protection System Report.*

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As noted in the DEIS report, there will only be one dedicated diesel fire pump in each area. Having one auxiliary fire pump without any type of back-up capability in each area is risky. Diesel fire pumps can be problematic if they are not inspected, maintained, and started on a regular basis. Oil and gas processing facilities typically have redundant fire pumps within the facility that are supplied by alternative energy sources. For example, an area in the facility would include two fire pumps; one diesel and one electric. This approach decreases the potential for a major fire loss due to a single pump failure. It also provides better capability to manage a large fire where both fire extinguishment and exposure protection water is required.

Q: What is a gap analysis as it relates to emergency response?

A: A gap analysis involves comparison of actual capabilities of the emergency response program with potential or desired performance to address the hazards and risks present.

Q: Did you review the Draft Environmental Impact Statement for this project?

A: Yes.

Q: Did the DEIS include a gap analysis of VFD's ability to respond to HHFT fires or fires at the oil terminal.

A: No.

Q: Do you have an opinion on what additional resources VFD would need if the proposed oil terminal project is to be constructed?

A: Based on my interviews with Fire Chief Joe Molina, Deputy Fire Chief Doug Kollermer, Division Chief Steve Eldred, and Battalion Fire Chief Ken Griffee, as well as reviewing

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the potential hazards and risks, I believe that the Vancouver Fire Department would need the following improvements to close gaps in order to maintain the operational readiness to respond to a fire at the proposed oil terminal: (a) More personnel on shift to increase staffing; (b) Training in industrial and storage tank firefighting; (c) Backfill (overtime) funding to cover the cost of attending training; (d) development of a Foam Logistics Plan; (e) Improved mobility, transportation, and deployment for the existing foam concentrate stockpile (e.g., foam tank trucks); and (f) Sustained funding for training, backfill, and equipment maintenance.

I declare under penalty of perjury of the laws of the State of Washington that the foregoing is true and correct to the best of my knowledge.

DATED this 7th day of May, 2016 at Port Republic, Maryland.

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