STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

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In the matter of the application of WOLVERINE PIPE LINE COMPANY for authority under 1929 PA 16 to construct, operate and maintain a pipeline for the transportation of liquid petroleum products.	))))))	**Case No. U-13225**

PREFILED REBUTTAL TESTIMONY
OF
THOMAS J. WOODFORD
ON BEHALF OF WOLVERINE PIPE LINE COMPANY

Q_1 PLEASE STATE YOUR NAME, POSITION AND BUSINESS ADDRESS FOR THE RECORD.

A_1 My name is Thomas J. Woodford. I am an Associate professor and Head of the Department of Fire Protection and Safety Engineering Technology at Oklahoma State University. My business address is 303 Campus Fire Station, Stillwater, OK 74078-4082.

Q_2 PLEASE BRIEFLY DESCRIBE YOUR BACKGROUND AND WORK EXPERIENCE.

A_2 I received a bachelor's degree in Electrical Engineering from the University of Virginia in 1983, a Master of Science degree in Ocean Engineering from Massachusetts Institute of Technology/Woods Hole Oceanographic Institution in 1991, and a Master of Science in Fire Protection Engineering from the University of Maryland in 1996.

Before coming to Oklahoma State University, I spent two years with an independent fire testing laboratory in Washington State, where my responsibilities included work in Large Scale Fire Testing and Computer Fire Modeling. Prior to that, I spent 12 years in the U.S. Navy, specializing in Surface Ship Damage Control and Engineering.

I am an associate member of the Society of Fire Protection Engineers, International Association for Fire Safety Science, and I hold a membership in the National Fire Protection Association.

A copy of my curriculum vitae is attached as Exhibit A-____ (TJW-1).

Q_3 PLEASE EXPLAIN THE PURPOSE OF YOUR REBUTTAL TESTIMONY.

A_3 The purpose of my testimony is to respond to statements made by Greg Martin in his prefiled direct testimony in this matter.

Q4 WHAT IS YOUR OPINION REGARDING MR. MARTIN'S PRESENTATION AT PAGES 3 AND 4 OF HIS PREFILED DIRECT TESTIMONY?

A4 Mr. Martin raises five concerns at pages 3 and 4 of his prefiled direct testimony: (1) that a catastrophic failure of the proposed pipeline "could potentially result in a 'fountain of fire' with 'blowtorch' types of effects"; (2) that such failure "could create life-threatening risks to those situated in areas adjacent to the fire"; (3) mitigation of a fire; (4) the City of Lansing's lack of resources for putting out a fire and securing a leak; and (5) Wolverine's incident response time. In his prefiled rebuttal testimony in this case, Mr. Kevin Bowman effectively answers Mr. Martin's concerns about resources for putting out a fire and securing a leak, as well as incident response time, so I will not address those issues. Mr. Martin addresses the potential dangers of a flammable liquid fire in very general terms. I will provide more specific information to better describe the extent of such hazards.

As an initial matter, it is important to keep in mind Mr. Daniel Cooper's statements at page 15, lines 18-20 of his prefiled rebuttal testimony that the likelihood of a leak resulting in a fire for any one-mile segment of a hazardous liquid pipeline installed in or after 1970 is only once in 28,700 years. This is based on actual records kept by the United States Department of Transportation Office of Pipeline Safety.

Q_5 WHAT IS YOUR OPINION OF MR. MARTIN'S STATEMENT THAT A PIPELINE FAILURE "COULD POTENTIALLY RESULT IN A 'FOUNTAIN OF FIRE' WITH 'BLOWTORCH' TYPES OF EFFECTS"?

A_5 It is possible that damage to the top of the pipeline could result in flammable liquid being released upward, and that a nearby ignition source could start the liquid on fire. The magnitude of this fire would be a function of how long the pipeline remained pressurized after the damage occurred and the time between rupture and ignition. A large release would be short lived as the pipeline's SCADA system would detect the resulting drop in pressure, the pumps would be shut off, the automated valves would be closed, and the isolated pipeline segment would rapidly depressurize. A "blowtorch" effect requires pressure. Once the pumps stop, the valves close, and the pipeline depressurizes, there would be no pressure, no flow of product, and no additional fuel to feed the fire.

If a liquid release were too small to be detected by the SCADA system, such a release could continue until it was discovered, reported, and the safety shutdown system activated by pipeline dispatchers. If the leak ignited, the nature and magnitude of the fire would be a function of the release rate and location, and when ignition occurred.

Q_6 WHAT TYPES OF FIRE HAZARDS COULD OCCUR AS A RESULT OF A LEAK TOO SMALL TO BE DETECTED BY THE PIPELINE SCADA SYSTEM?

A_6 Wolverine has indicated that the largest leak rate that could go undetected by the SCADA system would be approximately 16 gallons per minute (gpm). This rate would result from a 0.16-inch hole in a pipeline operating at 900 pounds per square inch, gauge (psig). If this hole were in the side or bottom of the pipe, the product would be expected to flow into the ground until the soil was saturated. Then the product would bubble up to the surface as a liquid and flow into a drainage channel in the freeway right-of-way. If a leak occurred for 30 minutes prior to detection and valve shutdown, 1,056 gallons could be released by the time the pipeline depressurized. This is similar to a 2,500 gallon tank truck dumping just under half of its load into the drainage ditch. Assuming a 6-inch average pool depth of gasoline in a shallow "V" ditch, 1,000 gallons of fuel will create a pool of 267 square feet, or 18-feet in diameter. Once ignited, gasoline releases 204.4 kilowatts per square foot, totaling about 55 Megawatts, and would burn for about 36 minutes. The effects of this fire would be:

80-150' : minimum distance for unprotected personnel indefinite exposure to heat

25-40': wood may ignite after prolonged exposure with pilot

20-35': unprotected skin will blister in 5 seconds

10-20': fiberboard will ignite without pilot in 5 seconds

If a 16 gpm leak is directed upward and ignites immediately, a 32 Megawatt fire will be sustained for the duration of the leak. The diameter of the plume will have a significant effect on the exposure hazard due to radiant heat. A small diameter plume (3.3 feet) is the worst case, providing exposures in the range listed above. A larger diameter plume (16.4 feet) will cut those distances in half. Time between leak initiation and ignition is critical in determining if a fireball will occur. It can be expected that flame heights associated with the fires described above could be in excess of 50 feet.

Q_7 WHAT TYPES OF FIRE HAZARDS COULD OCCUR AS A RESULT OF A LARGE LEAK IN THE PIPELINE?

A_7 As an example, assume that a release of 25,000 gallons of gasoline occurred in a 15 minute period, and that most of the release flowed to the surface. Looking at pools of average depths of one, two and three feet, the worst case results in less than double the exposure ranges calculated above. Time to ignition will determine how far away the product can flow. After ignition, the fire will flash back to the area around the source and burn as a pool fire. As the physical dimensions of a pool fire increase, a larger portion of the energy released will be carried away with the smoke as convective energy. A small fire (3 feet diameter) has 40 percent of the energy carried off in the smoke, while a larger fire (33 feet diameter) has nearly 90 percent of the energy carried off in the smoke.

Q_8 WHAT IS YOUR RESPONSE TO MR. MARTIN'S CONCERN REGARDING MITIGATION OF A FIRE RESULTING FROM AND SECURING A PIPELINE LEAK?

A_8 In a leak situation where flammable liquids are flowing in surface drainage areas, emergency response efforts should focus on diking drainage ditches to contain the fuel, covering the exposed surface with Aqueous Film Forming Foam (AFFF) or equivalent, and being prepared to protect exposures (nearby buildings or other structures) in the event of ignition. If ignition does occur, exposure protection and diking will also be required. AFFF can be applied to extinguish the fire and prevent ignition.

For a spray fire, the best approach is to protect the exposures, secure the source of the fuel and cover any liquid that pools around the source with AFFF.

It is a simpler matter to fight a gasoline fire where the fuel has been absorbed into the ground. This provides a wicking action much like a kerosene lamp. The fire would be less intense and easier to extinguish than an open pool fire.

Q_9 DOES THIS COMPLETE YOUR TESTIMONY?

A_9 Yes, it does.

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Thomas J. Woodford
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Experience

Jan 1999 – Present. Oklahoma State University,

Associate Professor and Head, School of Fire Protection & Safety Engineering

Technology. Supervises 6 professors and 2 staff to provide an accredited program in Fire Protection and Safety Engineering Technology to approximately 230 students. Teach courses in the areas of fire dynamics, Life Safety Code ®, automatic fire sprinkler and detection systems. Appointed to the endowed Simplex Professor of Fire Protection

Feb 1997 – Dec 1998. Western Fire Center, Inc.

Project Coordinator/Safety Manager. Approves, plans, schedules and supervises all laboratory test procedures and projects. Develops and implements all non-standard fire test plans. Coordinates calibration of all laboratory instrumentation and conducts derivative calibrations of the hood system. Conducts CFAST, Branzfire computer modeling in support of testing and litigation. Lab conducts several standard test methods including UBC 15-2 (ASTM E108), UBC 23-6 Intermediate Range Calorimeter (ICAL), FM-4922, Lab also conducts non-standard large and full scale fire testing using an instrumented calorimeter hood rated for up to 20 MW. Proficient in PC hardware and software, and Labview.

Aug 1997 – Dec 1998. Member, Washington State Region 5 Life Safety Council.

Directly involved in formulation and enactment of programs for arson awareness and fire investigation in six counties in Southwest Washington state.

July 1995 - January 1997. University of Maryland at College Park.

Graduate Assistant in Charge of Laboratories, Department of Fire Protection Engineering. Set-up, calibrated, and developed Standard Operating Procedures for a Cone Calorimeter.

May 1983- April 1995. United States Navy.

Lieutenant Commander, Nuclear Propulsion Qualified, Surface Warfare Officer. Qualified to supervise the operation and maintenance of a Naval Nuclear Propulsion Plant. Duties included: Damage Control Assistant on a Nuclear Cruiser, Electrical Officer on a Nuclear Cruiser, Shift Engineer at a Land-based Naval Nuclear Propulsion Plant Prototype, Combat Systems Officer on a Frigate, Communications Officer on an Aircraft Carrier, First Lieutenant on an Aircraft Carrier, Assistant to the head of the Shipboard fire fighting school in Charleston SC, Assistant to the Commander Naval Base Norfolk for Oil Spill Facility Response Planning and Hazard Abatement.

Education

1996 M.S. Fire Protection Engineering, University of Maryland at College Park. Specialized in testing of materials, modeling and fire science. GPA: 4.0 out of 4.0.

1991 M.S. in Ocean Engineering, Massachusetts Institute of Technology in conjunction with Woods Hole Oceanographic Institution. Studied hydrodynamics and the design of underwater vehicles and structures. Designed and evaluated the propeller and prime mover for an autonomous underwater vehicle. Concentrated on weight and energy efficiency in order to maximize the vehicle's mission endurance. GPA: 4.8 out of 5.0.

1983 B.S. in Electrical Engineering, University of Virginia. Studied analog controls and instrumentation. Designed a constant temperature environmental chamber and investigated the effect of temperature on crystal oscillator frequency drift. Certified Virginia State Firefighter III. GPA: 3.73 out of 4.0.

Professional Organizations & Honors

1997 International Association of Fire Safety Scientists
1997 Institute of Electrical and Electronic Engineers (Lapsed)
1995 Department of Fire Protection Engineering Fellowship
1995 Society of Fire Protection Engineering
1995 National Fire Protection Association
1983 Tau Beta Pi, Engineering Honor Society
1983 Eta Kappa Nu, Electrical Engineering Honor Society