BEFORE THE STATE OF NORTH DAKOTA
PUBLIC SERVICE COMMMISSION

IN THE MATTER OF DAKOTA ACCESS, LLC CONSOLIDATED APPLICATION FOR AN AMENDED CERTIFICATE OF CORRIDOR COMPATIBILITY AND AMENDED ROUTE PERMIT; DAKOTA ACCESS PIPELINE PUMP STATION - EMMONS COUNTY SITING APPLICATION

CASE. NO. PU-19-204 | OAH FILE. NO. 20190280

PRE-FILED TESTIMONY OF DONALD HOLMSTROM
ON BEHALF OF INTERVENOR STANDING ROCK SIOUX TRIBE

November 1, 2019

EXHIBIT
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I. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, business address, and position.

A. My name is Donald Holmstrom. I am an attorney, investigator, and process safety practitioner with many decades of experience with the oil industry and U.S. government. I currently serve as a consultant to the Standing Rock Sioux Tribe (the "Tribe") and as a member of the technical team advising the Tribe on technical matters relating to the risks imposed by the Dakota Access Pipeline ("DAPL"). My business address is 6200 Gale Drive, Boulder, CO 80303.

Q. Please summarize your work experience and qualifications.

A. For nearly a decade, I directed the Western Regional Office of the U.S. Chemical Safety and Hazard Investigation Board, a nonregulatory scientific agency modeled after the National Transportation Safety Board. As director, I managed and/or led many of the largest and most significant chemical incident investigations in recent U.S. history, including the 2005 BP Texas City explosion, the 2010 Tesoro Anacortes oil refinery fire, the 2010 Deepwater Horizon offshore fire and explosion, and the 2012 Chevron Richmond, CA oil refinery fire. During my tenure, approximately two thirds of the Board's investigative staff worked for the Western Regional Office under my direction.

Prior to that time, I worked in the oil industry, conducting incident investigations, and implementing process safety protective measures for nearly two decades, including investigating pipeline incidents. I have technical certifications and/or technical training related to fire and explosion investigation, hazardous materials, mechanical integrity, root cause determination, chemical testing, and emergency response. I have authored or co-authored numerous articles on incident investigation and process safety in publications such as Chemical Engineering Progress, Loss Prevention Bulletin, Process Safety Progress, and the NFPA Journal. More details on my experience and expertise is included in my c.v. which is attached to this document.

Q. On whose behalf are you testifying in this proceeding?

A. I am testifying on behalf of the Standing Rock Sioux Tribe. The Tribe has retained me to assist them in this matter and I am being compensated for my time at a rate of $100 per hour.

Q. What is the purpose of your testimony?

A. Dakota Access, LLC ("Applicant") has filed an Application for an Amended Certificate of Corridor Compatibility and Amended Route Permit in which Applicant proposes to nearly double the potential throughput of DAPL from 570,000 to 1,100,000 barrels per day (the "DAPL Capacity Expansion").[1] I was asked to assess the potential consequences of the DAPL Capacity Expansion in light of Applicant's existing oil spill response planning efforts, risk management

[1] While Applicant's application states that the current capacity of the pipeline is 600,000 bpd, other records indicate a capacity of 570,000 bpd. *See, e.g.*, In the matter of the application of Dakota Access, LLC for an amendment to certificate and permit in accordance with the Dakota Access Pipeline Optimization in Emmons County, North Dakota, Case No. PU-14-842, "Application of Dakota Access, LLC for Waiver or Reduction of Procedures and Time Schedules," p. 3.

approach for High Consequence Areas (HCAs) and the safety record of Applicant and its corporate parents. I was asked to analyze whether and how the DAPL Capacity Expansion may worsen the consequences of a potential discharge from DAPL and its potential adverse effects on the environment and on the welfare of the citizens of North Dakota. In particular, I was asked to analyze whether the DAPL Capacity Expansion increases the risks associated with a discharge into Lake Oahe and the resulting impacts to human, animal, and Tribal welfare, rights, and interests.

Q. Did you prepare or direct the preparation of this testimony?

A. Yes.

II. SUMMARY OF TESTIMONY

Q. Please summarize your testimony.

A. The DAPL Capacity Expansion poses significant risks in light of Applicant's existing oil spill response planning efforts, risk management approach and the safety record of Applicant and its corporate parents. I have two primary concerns. First, over the last 13 years, Applicant's corporate parent Energy Transfer ("ET") has the worst hazardous liquid safety record in the industry. Its poor safety record indicates that oil spills from DAPL are a significant risk.

Second, by doubling the amount of oil that is transported through the pipeline, the DAPL Capacity Expansion will greatly increase the Worst Case Discharge

(WCD) volume amount if and when such spills occur. Applicant's oil spill planning efforts to date do not meet industry or regulatory standards and are untethered from reality. Applicant relies on a WCD analysis that significantly underestimates the true worst-case scenario, and Applicant has failed to develop a valid spill model based upon an accurate WCD that can tell Applicant (or anyone else) what will happen to the oil once it is spilled.

Finally, Applicant's pipeline risk management approach is seriously dated and ineffective. It does not incorporate the latest approaches from pipeline industry best practices that have been developed specifically to address concerns related to the number and magnitude of pipeline releases over the last few years. In fact, modern pipeline safety standards would have Applicant rigorously examine the safety implications of a change such as doubling the throughput for a crude oil pipeline utilizing a Management of Change safety system approach. The same standards would base risk management focus on an operator's own safety record to drive continuous improvement rather than declaring low risk by pointing to generic industry statistics as Applicant has done. But examining the current record, we know these more rigorous industry approaches have not been employed.

By doubling the amount of oil transported through the pipeline, the DAPL Capacity Expansion will significantly increase the risk associated with any spill and compound the deficiencies in Applicant's existing spill prevention and oil-spill response planning efforts.

Q. What specific areas are you concerned about?

A. I am concerned that Applicant has failed to develop an oil-spill response plan that adequately reflects and mitigates the risks associated with operating DAPL at double the throughput. Applicant's existing oil-spill response efforts seriously underestimate oil spill impacts, and Applicant has failed to develop a valid WCD sufficient to permit sound oil-spill response planning efforts. In particular, Applicant has failed to develop a valid WCD for a discharge in Lake Oahe that is sufficient to permit sound oil-spill response planning efforts and to minimize DAPL's adverse effects on that critical resource.

A valid WCD is the starting point for the development of an oil spill response plan. One needs to be prepared for the biggest spill that is realistic at a given site. Without that estimate, any response plan is an empty exercise. How many booms are needed? How many people will need to respond and in what time frame? What kind of equipment needs to be staged and available? The answer to all of these questions depends to a large degree on the WCD.

The development of a WCD is a simple and straightforward process that is done all the time for pipelines and similar facilities. In fact, it is governed by regulation, at 40 C.F.R. § 194.105 and follows a formulaic calculation: worst-case detection time plus time to shut down the pipeline, multiplied by the maximum flow rate, plus “drain down” volumes (i.e. how much oil would be in the pipeline segment between values that can still be released once valves are shut off). Applicant, however, has failed to perform this critical but simple exercise.

Q. What are your specific concerns related to Applicant’s existing WCD?

A. First, the WCD analysis appears to underestimate both the risk as well as the amount of a potential spill. It is worse than a “best case” scenario in that it leaves required calculations out and then assumes all systems will function precisely as intended—i.e., the incident is discovered as quickly as physically possible, the correct decision and response is immediately initiated, and all equipment such as controls, sensors, pumps and valves function as intended. In the real world, however, this is not how major events happen. Major spill incidents typically occur with multiple system causes, when people, or equipment, or systems do not function exactly as they are expected to. People make mistakes. Equipment malfunctions. Systems are deficient. Modern major accident prevention focuses on rigorous analysis of all potential hazards (what could go wrong) and implements continuous improvement to a variety of complex, interrelated safety systems such as operational controls, human factors, integrity management, incident investigation, safety culture, risk management, and safety assurance. Effective risk analysis must consider all these important elements to achieve incident prevention.

Applicant's WCD ignores these realities. Applicant assumes that any spill will be detected immediately and shut down in a mere 9 minutes. Applicant omits entirely the time it takes detect the spill or the time it takes to shut the emergency isolation vales (referred to as Emergency Flow Restriction Devices (EFRDs)).

The assumptions baked into Applicant's WCD are not realistic and do not comply with the minimum regulatory requirements. Detection time is a critical factor in worst case discharge. In some cases, it takes hours or even days to detect the leak before shutdown is initiated. For example, in the 2016 Permian Express II pipeline crude oil spill of 361,000 gallons, it took ET 12 days to detect the spill and shut down the pipeline. The spill from the central Texas pipeline, which had only been operational for one year, led to a reported $4 million in property damage. Yet, in the case of DAPL, Applicant lacking any evidence such as performance metrics assumes that it will instantaneously detect any spill.

Applicant is now proposing to double DAPL's capacity – and to double the amount of oil that will be discharged if and when a spill occurs – despite the unrealistic WCD on which its oil-spill response planning efforts are based. Allowing Applicant to double DAPL's throughput despite Applicant's failure to provide any proof of performance would impose serious risks on the environment and on the welfare of the citizens of North Dakota.

Q. Besides Applicant's failure to include detection time in its WCD, do you have other concerns regarding Applicant's WCD?

A. Yes. In addition to Applicant's unrealistic assumption that it will instantaneously detect any spills, Applicant's WCD underestimates the true worst-case scenario for other reasons:

- The PHMSA WCD regulation requires the worst case analysis to be applied to each element of the calculation. Applicant's "best case" approach is not compliant with this explicit instruction.
- The WCD does not appear to include any consideration of "historic" discharges and there are many examples from ET's numerous other spills and leaks.
- Applicant's calculation does not include the time it takes to shut down the EFRDs after the pumps are ramped down but while oil is still flowing past the valves and out the point of pipeline failure.
- The WCD does not account for potential delays and complications due to adverse weather conditions. This includes the lack of backup power to close the Lake Oahe EFRDs in the advent of a power failure. DAPL has backup power to the communication system but not electrical power to the valve actuator. DAPL's EFRDs are capable of manual closure, however, travel to the remote, unstaffed location of the EFRDs particularly in winter conditions should be measured in hours and included in the WCD.
- The WCD does not incorporate other factors called for by industry best-practices, such as including the time to interpret or verify data, check for

false alarms, or the human factors of decision-making under the stress of a possible emergency shutdown. Pipeline Industry safety standards require evaluation and decision-making by a pipeline controller where leak detection systems such as a Computational Pipeline Monitoring (CPM) systems are in an alarm state indicating a possible commodity release. DAPL's leak detection system does not automatically shut down the pipeline – this requires human decision-making and action. API RP 1130 Computational Pipeline Monitoring for Liquids (2007) for example, requires such an evaluation. RP 1130 (2007) has been incorporated into DOT regulations by reference. This factor must be included in WCD shutdown time. However, DAPL's WCD calculation includes no time for detection generally and none for issues related to spill identification and shutdown decision-making.

- Software-based leak detection systems are notoriously unreliable. A 2012 PHMSA study examined the agency's spill database and found that CPM systems detected hazardous liquid leaks in the pipeline rights-of-way (ROW) only 20% of the time. Similar leak detection performance can be seen by a review of Energy Transfer's pipelines in the PHMSA database from 2010-18. Like the PHMSA study, more Energy Transfer spills in the right-of-way (ROW) were identified by random members of the public than SCADA or CPM systems. To address this serious industry performance issue, API issued Recommended Practice 1175, Pipeline Leak Detection Program Management (2015) requiring in its RP that pipeline operators evaluate their own performance by establishing leak detection metrics for continuous improvement. There is no record that Applicant has identified its leak detection record as a problem or evaluated its past data and established metrics to improve performance under this important standard.

The North Dakota Public Service Commission (NDPSC) should review the 2016 DAPL source documents that relate to its spill model calculation and compare this for themselves to the PHMSA formula. NDPSC should request and examine metrics related to DAPL pipeline emergency shutdown response time including leak detection – both CPM system and human performance. The NDPSC should also request any performance testing of the DAPL CPM leak detection system as provided in API RP 1130, including actual and simulated crude oil removal.

Q. What is a spill model?

A. A spill model is an analytical tool that tells you what will happen to the oil and its impacts once it is spilled. A valid spill model is essential to assessing the risks associated with pipeline discharge.

Q. Has Applicant developed a valid spill model?

A. No. To the best of my knowledge all DAPL spill models were based on the assumption of a WCD that has been significantly underestimated. The technical spill model is only as valid as the assumption of the WCD. In the case of the latest 2018 spill model it stated that the model incorporated the deficient WCD produced by Applicant. The fact that Applicant grossly understates the WCD in the information supplied to the spill model developer invalidates the model as to emergency response planning and spill impacts.

Q. Why is Applicant's failure to develop a valid spill model concerning?

A. Applicant's failure to develop an accurate spill model means that critical information is missing from oil-spill response planning efforts. These serious deficiencies include important information concerning the magnitude of hazards faced by emergency responders, the geography of areas impacted by a spill, and number and type of equipment needed by emergency responders. Applicant's failure to develop a valid spill model and response plan concerning Lake Oahe – a High Consequence Area (HCA) – is particularly concerning to me, especially because Applicant's corporate parent, Energy Transfer, has the worst safety spill record in the industry.

Q. What are your general concerns regarding the safety record of Applicant's corporate parent, Energy Transfer?

A. In evaluating Applicant's oil-spill response planning efforts and their WCD calculations in particular, it is important to take the incident history and safety record of Applicant's corporate parent, Energy Transfer, into account. Since spills are the result of company management system deficiencies including often issues of leadership, governance and effective oversight over safety and environmental protection, it is important to examine the record of the company as a whole. The eight hazardous liquid pipelines entities in the PHMSA database listed on the Energy Transfer website and that are wholly owned subsidiaries or with an ET controlling interest include DAPL-ETCO Operations Management, Energy Transfer Company, Sunoco Pipeline L.P., West Texas Gulf Pipeline Co., Mid-Valley Pipeline Co., Permian Express Partners LLC, Harbor Pipeline Co., and Inland Corporation.

The Energy Transfer hazardous liquid pipelines including DAPL have the poorest pipeline spill record in the industry. Their poor safety record indicates that there is a higher risk that a DAPL spill will occur, and that, when it happens, the consequences will be severe. However, this elevated DAPL risk has not been effectively evaluated by Energy Transfer nor is there any evidence the company has taken appropriate corrective action for performance improvement.

Q. What are your specific concerns regarding the safety record of Energy Transfer?

A. The history of Energy Transfer pipelines is replete with spill incidents – and not just in the distant past. In recent months and years, Energy Transfer and its pipelines have caused a number of high-profile release incidents that have resulted in government enforcement actions, shutdowns and remedial actions.

As of December 3, 2018, the Dakota Access Pipeline itself had experienced 12 spills of over 6,100 gallons of Bakken crude oil in less than two years of operation. In fact, from 2006 to 2018 across all ET hazardous liquid pipeline entities in the PHMSA database that are wholly owned subsidiaries of ET or in which ET has a controlling interest, hazardous liquid incidents numbered 458 with $109,737,246 in property damage from 2,557,716 gallons (60,898 bbls) of hazardous liquid spilled. For the 13-year period, ET entities experienced 45% more hazardous liquid spills than the pipeline company with the next largest number of incidents. Just in the 2017-2018 operating period of DAPL, Energy Transfer company-wide hazardous liquid spills have resulted in $20,540,487 in property damage, indicating significant harm from the company's most recent hazardous liquid pipeline operations. For the 13-year period, ET experienced three spills a month - by far the highest spill incident rate in the industry for that period.

In recent years, Energy Transfer's poor safety record has prompted unprecedented regulatory enforcement actions. In 2017-2018, Sunoco was forced to suspend pipeline operations because of environmental contamination on four separate occasions across three states.

In Pennsylvania, the Department of Environmental Protection (DEP) Secretary noted "a permit suspension is one of the most significant penalties DEP can levy," HDD drilling operations were reported shutdown by FERC on the Rover Pipeline in Ohio related to the release of nearly 150,000 gallons of drilling fluid. A spill of 2,000,000 gallons of drilling fluid reportedly occurred at the same site in

April 2017. The Mariner 2 East pipeline was shutdown January 3, 2018 by the Pennsylvania DEP for leaks and spills that were described as "egregious and willful violations" of law. And West Virginia's DEP reportedly ordered the halt to Sunoco's Rover Pipeline Construction in July 2017 due to environmental violations.

Before being allowed to double the throughput of DAPL, Applicant should adduce some evidence demonstrating that it is taking appropriate corrective actions to improve on ET's poor safety record. Yet applicant has failed to do so. Applicant's spill model, response plan, and general approach to risk management along DAPL, and particularly the DAPL crossing at Lake Oahe, fail to meet regulatory and industry standards. It is concerning that Applicant would seek to double DAPL's capacity despite these failings.

Q. Why are Applicant's spill model and response plan for Lake Oahe concerning?

A. In addition to dramatically underestimating the WCD, the latest DAPL spill model indicates that a Bakken crude oil spill will only remain on the surface of Lake Oahe for a few hours and then be primarily immersed in the water column. The remediation of crude oil spills immersed in the water column is very difficult. The DAPL Geographic Response Plan (GRP) for Lake Oahe, however, focuses on a cleanup that assumes the oil will persist on the lake's surface. In other words, Applicant has developed a spill model that underestimates the magnitude of a

WCD into Lake Oahe and acknowledges that a spill would only remain on the surface of Lake Oahe for a few hours before becoming immersed in the water column, yet Applicant has developed a response plan for Lake Oahe that focuses on surface – not water column – cleanup efforts. Applicant's Lake Oahe response plan is fundamentally at odds with its spill model, deficient as it is. Doubling DAPL's throughput would compound the gravity of these safety deficiencies.

Regulators, first-responders, impacted parties such as the Tribe, and Applicant itself need to see a spill model that reflects realistic risks and can guide effective response efforts based upon an accurate WCD and what would be the increased spill impacts from a doubling of DAPL flow. Without a valid spill model that answers the following questions, it is impossible to plan effective response efforts. Applicant should also provide the corresponding documentation to the NDPSC.

- Has Applicant updated their WCD calculation compliant with PHMSA and industry standards for the proposed doubling of the DAPL flow?
- Has Applicant revised the spill model to include the updated compliant and more accurate WCD?
- Has Applicant updated their Geographic Response Plan to be consistent with the 2018 spill model conclusions and revised WCD for the doubling of the DAPL flow?

- What is Applicant's plan for a clean-up of Bakken crude that is immersed in the water column of Lake Oahe?
- Has Applicant researched and incorporated into the GRP recent research on technologies for the cleanup of crude oil spills immersed in the water column?
- Does a release under the lakebed of Oahe present a more difficult problem with cleanup and the threat of a persistent source of contamination 90-feet below the lakebed, to groundwater, and the Missouri River system? Is there a plan for that remediation?
- How does the model impact the operation of the Lake Oahe dam and the Master Manual?

This information is critical because it tells responders what will happen in the event of a spill so they can respond appropriately—i.e., where to focus their initial efforts, where to place booms, and what specific sensitive ecosystems and cultural resources may be in the most harms' way.

Q. What are your concerns regarding Applicant's Risk Management Approach for Lake Oahe?

A. The DAPL Lake Oahe crossing is considered under PHMSA regulations to be a High Consequence Area (HCA). As an area where a spill can have significant environmental and human health consequences, Lake Oahe requires increased measures for protection. These include effective risk reduction, an integrity management plan that is pipeline segment specific and the application of up-to-date pipeline safety standards. Applicant's risk management approach for Lake Oahe has failed in all these areas. Risk management in part looks at what can happen and what can be the consequences. The significant underestimation of potential consequences – the WCD – is a serious risk management deficiency. Lacking effective risk management, doubling the capacity of DAPL is an even more serious threat to the people and environment of Lake Oahe.

Applicant committed itself in the Dakota Access Environmental Assessment to "construct and maintain the pipeline to meet or exceed industry and governmental requirements and standards." However, Applicant has failed to implement for DAPL key recently issued American Petroleum Institute (API) pipeline standards that have been implemented specifically to prevent the number of spills companies like Energy Transfer have been experiencing.

For example, API RP 1173 Pipeline Safety Management Systems (2015) is seen as the best practice approach to risk management and spill prevention. RP 1173 is a risk analysis methodology that focuses on actual performance using a Plan-Do-Check-Act approach to achieve continuous assessment and improvement. For effective pipeline risk management RP 1173 would have Energy Transfer assess and continuously improve its own spill performance. ET, however, assessing the risk for DAPL cites generic PHMSA statistics rather than examining the real risk of its own poor safety record. ET is not utilizing the RP

1173 modern management system approaches for spill prevention that include requiring risk reduction, implementing corrective action and using metrics to drive incidents to zero. API RP 1175 addressing leak detection systems would require using metrics to improve detection improvement but has not been adopted by Applicant for Lake Oahe. With a spill and leak detection record of serious concern, Applicant's failure to adopt standards that aim to improve that performance - particularly where doubling the impact is being considered - is deeply concerning.

Additionally, there is no record of Applicant applying a needed Management of Change review to assess the safety implications of doubling the DAPL throughput. This analysis is required for such a change under API RP 1173 and API RP 1160 Managing System Integrity for Hazardous Liquid Pipelines (2019). RP 1160 states that an increase in throughput should also trigger an evaluation of its impact on the Integrity Management Plan. It notes that such changes can impact the safety of the pipeline's maintenance, operations, monitoring, integrity management including the magnitude and velocity of pressure surges, corrosion susceptibility, and leak detection. I encourage the NDPSC to request and thoroughly evaluate these important reviews required by modern pipeline safety standards.

Finally, and perhaps most concerning is that there is no record of Applicant implementing an up-to-date Integrity Management Plan (IMP) as required by

PHMSA. An effective IMP is a vital risk management element. Under PHMSA regulations an IMP must be pipeline segment specific - in other words here specific to DAPL. An IMP was requested from Applicant in the Corps' Environmental Assessment. In a Court ordered independent assessment, the DAPL IMP was not found. There was a generic IMP document, but it lacked any DAPL specific content as required by the regulation for HCAs. IMPs are a key requirement developed by PHMSA to prevent hazardous liquid releases in HCAs. A lack of a compliant plan is a serious issue and doubling the flow of DAPL by a company that would operate a pipeline at any time without such a plan is a danger to the public and the environment. The NDPSC should request from Applicant evidence they are implementing the key API best practices referenced, the detailed DAPL pipeline segment specific IMP, and any MOCs for the DAPL throughput increase including specific safety changes made as a result of the MOC hazard evaluation.

Q. What do you recommend the Commission order?

A. I recommend that the Commission deny Applicant's application to expand the capacity of its pipeline. Applicant has failed to apply recognized industry safety good practice to the design, construction, and operation of its pipeline such that, even absent capacity expansion, DAPL's operation would pose unacceptable risks to human, animal, and Tribal welfare, rights, and interests. Permitting Applicant to double the amount of Bakken crude it transports through DAPL despite Applicant's failure to develop valid risk assessments and spill response plans would exponentially increase these risks.

Applicant's Energy Transfer family of pipelines have the worst safety spill record in the industry. Regulatory authorities in three states in recent years have been forced to suspend the operations of Energy Transfer's Sunoco because of its poor safety performance. Given their poor safety record and Applicant's insufficient risk assessment and response planning efforts, moving in the opposite direction and permitting Applicant to double the throughput of DAPL by granting the instant application would create unacceptable risks to the Standing Rock Sioux Tribe as well as the citizens of North Dakota.

In addition, the Commission should order Applicant to produce to the Commission and to SRST as Intervenors to allow for independent verification and assessment the important documents and data described in my testimony, including:

1. An up-to date and DAPL-specific Integrity Management Plan (IMP) that complies with PHMSA regulations and industry standards.
2. Proof that the DAPL Capacity Expansion adheres to all applicable API best practices, including RP 1173 (Pipeline Safety Management Systems), RP 1175 (Leak Detection Program Management), RP 1160 (Managing System Integrity for Hazardous Liquid Pipelines), and RP 1130 (Computational Pipeline Monitoring for Liquids).

3. An updated WCD for the DAPL Capacity Expansion that properly incorporates all factors required by PHMSA regulations.
4. A revised spill model based on the updated WCD and corresponding changes to the DAPL Facility Response Plan and Lake Oahe Geographic Response Plan.

Q. Does this conclude your testimony?

A. It does.

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Key Qualifications

Over 35 years of experience conducting chemical incident investigations for the oil industry and US government. Seventeen years of experience managing and leading chemical incident investigation and recommendations activities at the US Chemical Safety Board (CSB), a non-regulatory, scientific agency modeled after the National Transportation Safety Board (NTSB). Nineteen years of industry experience in oil industry operations, process safety systems and extensive involvement with incident investigation in process plants, pipelines and exploration and production. Recognized leadership in process safety problem solving. Broad knowledge of safety practices, standards and regulations. Demonstrated ability as a writer and public speaker.

Work Experience

US Chemical Safety and Hazard Investigation Board (1999-2016, retired 11-1-16)

Director, Western Regional Office (WRO) (2008-2016)

- Managed and/or led over 70 major accident investigations - many of the largest and most significant chemical incident investigations in recent US history including the 2005 BP Texas City explosion, the 2010 Tesoro Anacortes oil refinery fire, the 2010 Deepwater Horizon offshore fire and explosion and the 2012 Chevron Richmond, CA oil refinery fire.
- Developed and successfully advocated the implementation of important technical, safety standard and regulatory recommendations that were addressed to parties such as the National Fire Protection Association (NFPA), the American Petroleum Institute (API), National Association of Corrosion Engineers (NACE), the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA).
- Responsibilities included managing multi-disciplinary teams of chemical and mechanical engineers, chemists, human factors specialists, and lawyers – approximately two thirds of the agency investigators reported to the WRO.

Total Petroleum Inc./Ultramar Diamond Shamrock/Asamera Oil (1981-1999)

Operations and Process Safety (1981-1999)

- Participated in and led numerous chemical accident investigations. Implemented the first root cause analysis and process hazard analysis activities at Total Petroleum Inc. in response to serious process safety issues. These activities led to establishing new procedures for incident investigation, the elimination of unsafe refinery equipment, process winterization, decommissioning process equipment, establishment of more rigorous mechanical integrity protocols, asbestos handling protocols for insulation removal, and safe lighting of fired heaters.

Additional Experience

- Numerous technical certifications and/or training related to fire and explosion investigation, hazardous materials, mechanical integrity, root cause determination, human factors analysis, chemical testing, and emergency response.
- Speaker on CSB investigation reports and recommendations to such organizations as API, the American Industrial Hygienist Association (AIHA), the Center for Chemical Process Safety (CCPS), the Department of Energy (DOE), the Pipeline and Hazardous Materials Safety Administration (PHMSA), the International Association of Drilling Contractors (IADC), Exxon Mobil, Covestro, and the Society of Petroleum Engineers (SPE).
- Author or co-author of numerous articles on incident investigation and process safety in publications such as Chemical Engineering Progress, Loss Prevention Bulletin, Process Safety Progress, Journal of Hazardous Materials and the NFPA Journal.
- Served on the 2014 Technical Panel for the project "Separation Distances in NFPA Codes and Standards" undertaken by The Fire Protection Research Foundation, an affiliate of NFPA.
- Served as a member of the 2019 National Academy of Science Gulf Research Program's Safer Offshore Energy Systems Grants Review

Education

University of Colorado School of Law, Juris Doctor, 1978

Stanford University, Bachelor of Arts (Human Biology and English), 1974

Interests

River running, hunting and fishing in the Rocky Mountains