BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

In the Matter of: Application No. 2013-01	CASE NO. 15-001
TESORO SAVAGE, LLC	**PRE-FILED TESTIMONY OF LARRY R. GUTHRIE**
VANCOUVER ENERGY DISTRIBUTION TERMINAL	OFFERED BY THE PORT OF VANCOUVER USA

I, LARRY R. GUTHRIE, certify and declare as follows:

1. I am employed by TÜV Rheinland Mobility Rail Sciences Division ("TÜV") as the General Director, Operations Analysis. I was originally hired by the Port of Vancouver USA (the "Port") in 2013, well before any litigation related to the Vancouver Energy project. I was hired to conduct modeling and provide advice to the Port regarding rail safety. Since then, I have been hired by the Port to provide expert testimony in the above-captioned case in the areas of rail engineering, operations, and safety, as it relates to the railroad tracks that would be used by the oil unit trains that are contemplated for the project described in the Draft Environmental Impact Statement ("DEIS") that is the subject of this adjudication. This declaration is based upon my own personal knowledge, and I am competent to testify to the matters contained herein.

2. I joined TÜV in 2011 after retiring with more than 41 years of service with Norfolk Southern Corporation (and its predecessor company, Norfolk & Western Railway). My staff and I are responsible for providing analytical, certification, and planning services to the domestic and international rail industry utilizing computer simulation, physical auditing, testing, and applied engineering methods to assess factors impacting safe and efficient train

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operations, capacity planning, process improvement, and accident/derailment investigations. My background and experience is further detailed in ¶¶7–16 below.

ASSIGNMENT

3. I was originally hired on this project in December 2013. I was hired without regard to anything having to do with litigation or this adjudication. Instead, the Port wanted an additional level of scrutiny for the safety of its rail operations. Importantly, the Port wanted me to look at key areas, such as areas of rail curvature, since such areas can have a higher level of risk associated with them. As a result, my original assignment was to evaluate the derailment risk of the Port's track as it enters the Port (where it connects to the main line) and continuing up to the trench that was being designed at the time (the "Connection Track"). This analysis looked at three types of commodities that were potentially going to come through the Port: grain, potash, and oil. I was instructed to model each cargo on the proposed Connection Track and then provide the Port with recommendations for enhancing the safety of these tracks.[1]

4. In February 2014, my scope of work expanded to include an evaluation of the derailment risk potential for the entire Port rail system for the three potential commodities (grain, potash, and oil). I did conduct this modeling and analysis, and made recommendations to the Port for the entirety of the Port's rail facility. However, the Port's plans changed after I conducted that analysis. Notably, the potash and grain commodities were no longer in play. In addition, with regard to the oil trains, the track layout and geometry had been altered. As a result (and in preparation for this adjudication), in December 2015, the Port asked me to look specifically at the final route for the proposed oil trains, beginning where the trains would enter the Port from the Burlington Northern Santa Fe ("BNSF") main line, continuing through the Port, around the loop at T-5, and back out of

[1] My February 19, 2014, report related to the Connection Track (that resulted from this assignment) is attached as **Ex1008**.

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the Port onto the BNSF main line (the "T-5 Loop Track").[2] This analysis was conducted specifically for the facts and circumstances related to this adjudication, and my analysis was based on the train configuration contained in the DEIS.[3] Once again, the Port asked me to use my analysis to make recommendations that would enhance the safety of the T-5 Loop Track.

SUMMARY OF OPINION

5. My opinion, which is detailed in this declaration, is summarized as follows: The Port has taken a better than average rail system and made it even better and safer by adopting the recommendations I have made for enhancing the safety of the Port tracks that the oil trains will traverse. The Port's rail infrastructure is well above the norm for industry track. The in-train forces and vehicle dynamics in the T-5 Loop Track that the oil trains will be using present a very low risk of derailment. This is even more true, given the implementation of the recommendations I have made to the Port.

6. The Connection Track and the T-5 Loop Track structure meets or exceeds main line class 3 track, resulting in a track that far exceeds normal industry track (industry track is generally constructed and maintained to a class 1 standard, which is 2 classes below the Port's rail infrastructure). In addition, the Port has committed to maintaining the track to a standard higher than class 1, which will reduce the risk of track anomalies over time. Two

[2] My May 11, 2016, report related to the T-5 Loop Track (that resulted from this assignment) is attached as **Ex1010**.

[3] After TÜV completed the modeling based on the train configuration contained in the DEIS (120 cars with 5 locomotives—3 on the head end and 2 on the rear end), I was provided with portions of the comment letter submitted by Vancouver Energy on or about January 22, 2016. Pursuant to that letter, Vancouver Energy slightly changed the train configuration (with a maximum length of 120 cars and 3 locomotives—2 on the head end and 1 on the rear end—instead of the 5 locomotives from the DEIS). TÜV re-ran key models with the new 3-locomotive configuration. This modeling confirmed my belief that the DEIS configuration (that TÜV used) is more conservative than the new configuration. The reduction in the number of locomotives had no negative impact on the results of my analysis. The minor change in the train configuration did not adversely affect the results of TÜV's modeling or my opinions and recommendations. *See* **Ex1010**, p. 10.

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of the key items the Port is committed to in order to enhance safety are: (a) inclusion of guard rail between the main line and the trench, which will significantly reduce the opportunity for a rail car turnover or rollover in areas where the general population is likely to be impacted (such as the Esther St. and Grant St. overpasses); and (b) lubrication in the higher degree curves (normally not required) which will encourage proper rail car steering and reduce the potential for wheel climb and rail wear.

QUALIFICATIONS

7. *Résumé*: My résumé is attached hereto as **Ex1005**.

8. *Degrees and Certifications*: I received my AAS in Electrical/ Electronic Engineering from Virginia Western College and a BS in Management from Southern Polytechnic State University. I have certifications in Project Management, Six Sigma, Supply Chain Management, Lean, Locomotive Engineer, and Designated Instructor of Locomotive Engineers.

9. *Real World Experience*: I have hands-on, real world experience that is applicable to this adjudication. I first worked directly on trains in 1978, when I was certified as a locomotive engineer. I actually operated trains for several months before moving on to becoming a supervisor of locomotive engineers for 11 years. I also have extensive experience modeling rail yards. I have modeled approximately 30 yards, which includes nearly every major yard for Norfolk Southern (Norfolk Southern is the fourth largest railroad in the U.S.).[4] In all of the dozens of yards I have modeled, the modeling we conducted was, indeed, accurate and predictive.

10. *Forty-One Years at Norfolk Southern Railroad*: I spent 41 years of my professional life with Norfolk Southern and its predecessor railroads. I started out as an electrician in the mechanical shops, performing locomotive repair and maintenance. After

[4] For comparison, BNSF (one of the largest railroads in the U.S.) has 32,500 miles of track, and Norfolk Southern has 21,500 miles of track.

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that, I moved through the company, being promoted to various supervisory positions including:

(a) Systems Engineer, Mechanical, where I was responsible for industrial engineering projects, designing shop facility lay-outs, conducting cost-benefit analyses, and (importantly) conducting train simulations.

(b) Road Foreman, Shenendoah Division, where I supervised division-wide train operations, investigating accidents/derailments (including modeling), acting as a hearings officer, and recommending discipline for safety rule violations.

(c) Regional Road Foreman, where I supervised 3 divisions and 20 District Road Foremen on the Eastern Region of the Norfolk and Western Railway (a predecessor company to Norfolk Southern) for performance, safety, and operating rule compliance.

(d) General Road Foreman, where I supervised 4 divisions on the Northern Region of Norfolk Southern. I also authorized and revised safety procedures and operating rules and developed a system-wide training programs in compliance with US Department of Transportation's Federal Railroad Administration ("FRA") standards, 49 CFR §240 (requiring all locomotive engineers to be certified).

(e) Senior Industrial Engineer, where I managed Norfolk Southern/ Conrail's "ABC Network" project team, which developed a new information management system in order to integrate Norfolk Southern and Conrail. As project leader, I was responsible for the design and modeling of vehicle [Ford] distribution centers and Norfolk Southern Mixing Centers (train yards), including recommendations for track lay-out, train schedules, train make-up, and crew size for Norfolk

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Southern Mixing Centers in Chicago; Kansas City; Fostoria, Ohio; and Shelbyville, Kentucky.

(f) <u>Manager of Industrial Engineering, Planning and Technology Department</u>, where I supervised 7 engineers and logistics specialists and provided internal and external consulting services to all departments at Norfolk Southern, including Operations, Marketing, and Strategic Planning. I also analyzed all capital improvement projects ($5-$100 million projects) for feasibility, providing recommendations to the Senior VPs in charge. This included the 2 biggest projects in Norfolk Southern history (the $150 million Heartland and the $250 million Crescent Corridor Projects). I simulated future train operations for Strategic Planning using Berkley Simulations RTC software to determine the best and safest equipment and infrastructure combinations. I simulated train operations using Train Performance Simulator, Train Operation Simulator, and Train Operation and Energy Simulator to determine stopping distances, signal locations, train handling procedures, train make-up, and accident and derailment causes. I modeled approximately 30 proposed and existing yards and intermodal facilities to handle current and future traffic requirements. I recommended yard lay-outs, schedules, and operational improvements.

11. *<u>TÜV Rheinland Mobility Rail Sciences</u>*: In 2010, I retired from Norfolk Southern. In July 2010, I was hired as a consultant for Rail Sciences, a predecessor to TÜV Rheinland Mobility Rail Sciences. In that position, I provided U.S. Department of Transportation's Federal Railroad Administration ("FRA") §213 training and testing for Designated Supervisors of Locomotive Engineers. I also provided hands-on instruction and

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administered qualification exams.

12. In 2011, Rail Sciences merged with TÜV Rheinland, Inc., creating TÜV Rheinland Mobility Rail Sciences. I was named General Director. This is the position I currently hold. TÜV provides consulting services to the rail industry, including derailment incident analysis as well as forward-looking planning and prevention work. As the General Director, I coordinate day-to-day operations of 4 engineers. My staff provides analytical, certification, and planning services to the international rail industry. We utilize rail simulations/modeling to assess factors impacting safe and efficient train operations, capacity planning, derailments, and accident investigations. We evaluate designs, recommend solutions, and draft reports for clients. We conduct these types of analyses for main line, shortline, and regional railroads, as well as for industry track.

13. In my position at TÜV, I have been involved with approximately 35 derailment analyses. I have worked for entities such as the Transportation Safety Board of Canada, General Electric, Union Pacific, Burlington Northern, and many other railroads. My role is to analyze derailment cause by reviewing pertinent facts, data, and computer simulations/modeling. In conducting this analysis, I also assist clients with understanding how to prevent derailments from occurring in the future.

14. While much of my work is devoted to analyzing derailments after they occur, I have also been involved in a number of projects that are very similar to the work I have done for the Port (forward-looking and preventative work). In total, I have worked on approximately a dozen projects that are similar to my work here. While many of those projects are confidential and I cannot disclose details, the following are some of the projects that I can disclose:

(a) HDR Millennium Bulk Terminal – 12/2011

(b) HMM Neptune Terminals Unloading Facility – 4/2012

(c) HDR Simulation Assessment of Designed Track Loops – 11/2012

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(d) BNSF Four Rivers Terminal Vehicle Dynamics Study – 6/2013

(e) BNSF Sibley Power Plant Track Expansion Study – 5/2014

(f) HDR Port Van (BC) Metro Track assessment – 10/2014

(g) Parsons Vancouver (BC) Wharves Loop Track Operations Analysis – 9/2015

15. *Positive Train Control Initiative*: I am also a participant in the U.S. Department of Transportation's Positive Train Control initiative ("PTC"). The PTC initiative is aimed at getting all railroads fail-safe. PTC is a train control technology that will provide a national rail system capable of reliably preventing derailments and collisions by automatically stopping trains before certain types of accidents can occur. The goal of the PTC initiative is to develop specifications and standards that will facilitate implementation of this technology for rail safety on a nationwide basis. I have been involved in the drafting of PTC safety plans as well as validation and verification of the technology and the system. I am one of the authors of the specifications and documentation related to the safety aspects of the system as it is being designed and implemented.

16. *Authored Articles*: I have authored two articles that are relevant to the testimony that I give herein. They are:

(a) MASS TRANSIT, PREVENTING RAILROAD ACCIDENTS, Larry Guthrie and Sebastian Oertel, Mass Transit Magazine, December 19, 2014. Mass Transit Magazine is a leading industry publication.[5]

(b) HAVE ACCIDENTS SENT CRUDE-BY-RAIL (CBR) TO INTENSIVE CARE?, Larry Guthrie, Warren Egan, and Sebastian Oertel, TÜV Rheinland Whitepaper, February 2014.[6]

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[5] This article can be accessed online at: http://www.masstransitmag.com/article/12019066/preventing-railroad-accidents.

[6] This article can be accessed online at: http://education.tuv.com/mobility/crude-by-rail.

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INFORMATION RELIED UPON FOR ANALYSIS

17. *Port's Design and Port Consultation/Visits*: I have reviewed various iterations of track designs from HDR, including the final track design for the T-5 Loop Track. I have also reviewed the train specifications provided by HDR (and found in the DEIS), along with the slightly altered train specifications that are in Vancouver Energy's DEIS comment letter (January 22, 2016). I have had numerous meetings and conversations with the Port's rail team about the Port rail configuration, rail planning and maintenance, and other matters related to my work. I have also visited the Port on at least three separate occasions to meet with various HDR and Port personnel and to inspect relevant portions of the Port's rail.

18. *Modeling*: I relied on simulations/modeling conducted by my staff at TÜV. The modeling we conducted included:

(a) Train Operations Simulator Modeling Software ("TOS"), which models the longitudinal forces (coupler/drawbar) in the entire train; and

(b) VAMPIRE Modeling Software ("VAMPIRE"), which is step two of the modeling. VAMPIRE takes the longitudinal coupler forces that are calculated in TOS to focus the in-train forces to the wheel-track level to see if the modeled train exceeds acceptable lateral to vertical ratios ("L/V ratios").

19. For the modeling work described above, I relied upon the work of Jack Chislet, PE (who conducted the TOS simulations) and Corey Hogan (who conducted the VAMPIRE modeling). Together, Mr. Chislet and Mr. Hogan have 33 years of experience in the industry and conducting this type of modeling. Both Mr. Chislet and Mr. Hogan are absolutely qualified and experienced to run the modeling. I have full confidence in their work, I find their work trustworthy, and I have relied on their work in most all of my projects for TÜV. Both Mr. Chislet and Mr. Hogan used the same methodology on this project as

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they have done for every other project they have worked on with me. Mr. Chislet's and Mr. Hogan's résumés are attached here to as **Ex1006** and **Ex1007**, respectively.

20. *__FRA §213 & AAR Chapter 11 Standards__*: A critical element of my analysis involves reliance on industry standards. One set of standards I rely on is the FRA §213 standards (49 CFR §213, subparts A–F). Based upon my training and experience, these standards are relied on in the industry as the standard for track safety for various classes of tracks. Another set of standards I rely on is the Association of American Railroads' ("AAR") Manual of Standards and Recommended Practices (M-1001), Chapter 11. AAR Chapter 11 contains the equipment design standards that—based upon my training and experience—set the design standards for the railroad industry. These standards are used by all railroads and related agencies. I utilized the FRA standards, the AAR Chapter 11 standards, my own expertise and knowledge in the areas of modeling and engineering (in train operations, track design engineering, and car design engineering), and my years of accident investigation and prevention work to conduct the analyses requested by the Port.

21. *__Current State of the Industry__*: I am constantly reading up on the current status of the railroad industry in order to keep abreast of recent developments. On a daily basis, I review Progressive Railroading, Railway Age, Railway Gazette, and other online publications to see what is happening in the industry. I get notices from the AAR when manuals are being revised and when the FRA makes rulings.

PURPOSE OF MODELING

22. Modeling is intended to represent operations in the most realistic way possible to determine certain parameters or achieve certain objectives. Modeling helps quantify whether wheel-rail forces exceed generally acceptable thresholds. If they do, then we can conclude that the circumstances in that particular model present a higher risk of derailment.

23. *__TOS Modeling__*: TOS models longitudinal coupler forces (static and dynamic). These longitudinal forces run through the length of train—front to rear and vice versa. This

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force translates into forces where the train wheel meets the rail. Essentially, the TOS modeling looks at the impact of the train car couplers skewing one way or the other. TOS quantifies the coupler longitudinal force (every second) throughout the operation of the train. The modeling considers train handling and track geometry. TOS is a validated model, which means that the software was written and then tested on trains to compare to the model.[7]

24. *VAMPIRE Modeling*: VAMPIRE is a dynamic modeling tool where we break down the modeled vehicle's individual component forces on each individual car. We input results from TOS into this model, along with other forces (vertical force due to car weight, for example), to calculate L/V ratios. L/V ratios are important to know because if the ratio gets too high it will create excessive lateral forces between the wheel and rail, and the train wheel will ride up over the rail. L/V ratios vary based on the weight of cars, speed, curvature, and track cross-level. VAMPIRE gives us the most accurate L/V ratio and the most conservative results (with proper input parameters). VAMPIRE is the state of the art for train modeling and is generally accepted in the industry as being the best model for determining these sorts of forces. VAMPIRE is the most accurate model because it requires a high level of detail to be inputted, which allows for very accurate calculations of force levels at any key point on the rail car. In VAMPIRE, every part of the relevant car and track geometry is modeled to the most minute detail.

25. The modeling in this case was not only done with design parameters, but also with real world track surface variations. This makes the modeling more realistic and accurate.

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[7] When the model was written in the late 1970s, the model was compared to the actual train testing and then calibrated until it matched reality. After extensive real world testing, the model was validated in the early 1980s. Since that time—and over a period of many decades—the industry has further validated the model by using the model and comparing results to real world circumstances.

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NATURE OF TÜV ANALYSIS

26. *Longitudinal Forces*: The main focus of our analysis looks at the forces created when accelerating, slowing, and stopping trains, since this creates dynamic forces in the trains. Train acceleration and deceleration create slack action between the train cars (which is totally normal). Acceleration and deceleration also create draft (or tension) and buff (or compression) forces. These are called longitudinal forces. Draft forces occur when the cars are pulling away from each other or accelerating and buff forces occur when cars are compressing or braking. When the longitudinal forces are changing from draft to buff or vice versa, then they are dynamic in nature. If those forces are not managed properly (by stretching or bunching the train slowly), then the couplers can break (when in draft) or cause wheel lift or rail shift in curvatures (when in buff). As a result, the goal of the locomotive engineer is to manage forces gradually over a period of time to minimize slack action (going from bunched to stretched or vice versa). Our TOS analysis computes those forces every second.

27. *L/V Ratio*: Those longitudinal forces impact coupler angularity and have a significant effect on the wheel/rail interface. This effect is measured as the lateral to vertical ratio (the L/V ratio). This ratio is the key number to analyze in determining derailment risk. The vertical force is the weight of the car on each wheel, pushing downward. The lateral force can be thought of as the horizontal force of the wheel pushing outward against the rail (in a curve). When the lateral force exceeds the vertical force, the wheel of the train will climb over or shift the rail and will likely cause a derailment.

28. *Braking Scenarios*: We look at braking (especially in a curve) because it impacts the four indicators that we model for: (a) individual wheel L/V ratio (a wheel climb indicator); (b) vertical wheel load percentage (a wheel lift indicator); (c) axle sum L/V ratio (a wheel climb indicator); and (d) truck-side L/V ratio (a rail shift/rollover indicator—loaded vehicles only). When any of these four indicators exceed industry standards (AAR Ch. 11),

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the conditions create derailment risk. Because braking is a key component of train operations that can affect these indicators, we look at both full service braking and emergency braking. Full service braking is the highest braking effort using train air brakes under normal operations. Emergency braking is the maximum amount of available braking for air brakes under any circumstance.

29. *Industry Standards*: The modeling results in assigning numerical values to the four indicators discussed above (individual wheel L/V ratio, vertical wheel load percentage, axle sum L/V ratio, and truck-side L/V ratio). These numbers are compared to industry standards to be sure that all results are within the industry standard requirements. Based upon my training and experience, the industry design standards are specified in the AAR Chapter 11 (as discussed in ¶20, above). The relevant industry standards for the indicators measured by our modeling are:

(a) Individual Wheel L/V Ratio: This is an indicator of potential for wheel climb (where the train wheel will climb up the track). The AAR Chapter 11 standard maximum allowable L/V ratio is 1.00.[8]

(b) Vertical Wheel Load Percentage: This is also referred to in the industry as "% wheel unloading" and is an indicator of potential for wheel lift. The AAR Chapter 11 standard minimum allowable percent wheel unloading is 10.0%. When that number gets below 10%, then the wheel can hop up over the track. This happens most often when the car is very light and/or when cars rock and roll on the rail.

(c) Axle Sum L/V Ratio: Again, this is an indicator of potential for wheel climb. This indicator measures all the wheels on a single axle (instead

[8] It should be noted that the industry's generally accepted maximum allowable L/V ratio for tracks that have been in service for some time is .82 (which takes into account wear factors that occur in track and trains over time). By exceeding this standard, the Port is ensured of an even higher level of safety.

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of an individual wheel). The AAR Chapter 11 standard maximum allowable axle sum L/V ratio is 1.5.

(d) Truck-Side L/V Ratio: This indicator measures all the wheels on one side of truck and is an indicator of the potential to shift the rail laterally (or roll the rail). The AAR Chapter 11 standard maximum allowable truck side L/V ratio is .60. If this number exceeds .60, there is a possibility of the rail rolling over due to lateral forces. This analysis is most appropriate for a loaded car.

FEBRUARY 19, 2014, REPORT
(Main Line Connection Track)

30. In my first report, I was asked to evaluate the derailment risk for the Port's connection line coming from the BNSF main line at MP 10.69 into the Port of Vancouver and through the trench. At that time, the Port asked me to look at three types of unit trains that could potentially operate at the Port: (1) grain unit trains with 110 cars and 3 locomotives; (2) oil unit trains with 120 cars and 5 locomotives; and (3) potash unit trains with 170 cars and 4 locomotives. This report is attached hereto as **Ex1008** ("TRAIN OPERATIONS STUDY PORT OF VANCOUVER CONNECTION TRACK," February 19, 2014).

31. It was important to model these three types of unit trains separately because each train utilizes different car types with different design specifications. These different equipment types and weights of rail cars—along with the different loads—create different lateral, vertical, and dynamic forces.

32. *Distributive Power*: We used TOS and VAMPIRE to model the three different train scenarios at 10 mph through the Port's facility. In each scenario, the unit trains use distributive power—with locomotives in both the front and rear of the train. This spreads out the forces in the train and makes for a very safe operation, especially when coupled with the benefits of unit trains (discussed in ¶33, below). Having locomotives on

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both the front and back of the train makes braking safer. This distributive power allows the engineer to handle longer and heavier trains in mountainous terrain. All locomotives (front and rear) are controlled by the head locomotive, which distributes the forces in the train to reduce the forces on the couplers and cars.

33. *Unit Trains*: For each of the three cargos, the trains are also unit trains. A unit train is when the train is made up of homogenous individual cars, all carrying the same commodity. Unit trains have a safety benefit. Because all of the cars are of similar type, they start to behave more as one solid mass than if the train were made up of different car types. This allows for the train to be more predictable as far as train handling is concerned. Accelerating and decelerating is a lot more predictable. The cars at the rear will have the same braking characteristics as those in the middle and the same as those in the front. With unit trains, it is highly unlikely that a train would experience unpredictable slack action that could cause derailment.

34. *Results of Modeling*: We ran both the TOS and VAMPIRE modeling on the Connection Track for the three different unit trains that the Port was considering (grain, oil, and potash). All modeling was conducted across the (then) proposed Connection Track using a 10 mph speed limit and nominal train handling. In addition, cross-level dips were introduced into the modeling at key locations (such as in areas of track curvature). These dips are imperfections where one rail is lower than the other. Cross-level dips are normal rail anomalies that occur over time from normal operations and use.[9] The modeling is then re-run with the cross-level dips in place to ensure that we have modeled any normal track variations that could potentially occur. Some of the key findings are:

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[9] Cross-level dips are normal occurrences that happen despite the best efforts of the rail owner to install and maintain rail free from dips. However, dips can be minimized by using continuously welded, high gauge rail (as I recommended in this report). In addition, routine maintenance (such as I recommend in this report) will eliminate any risk associated with dips that normally occur.

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(a) Draft and Buff Forces: The draft and buff forces were measured for each of the three train types. We modeled each train type using nominal operations, full service braking, and emergency braking scenarios. In all of those scenarios, we did not find any unusual forces. All forces were within industry standards. Even under the worst case scenario (emergency braking) on the Connection Track, there is a very low risk of derailment (in both draft and buff).

(b) Individual Wheel L/V Ratio: The AAR Chapter 11 standard for this metric is a maximum of 1.00. In all of our modeling, all of the ratios were well below the AAR industry design standards. *See* **Ex1008**, pp. 30, 33. These results support my finding that there is a very low probability of wheel climb on the Connection Track.

(c) Vertical Wheel Load Percentage: The AAR Chapter 11 standard for this metric is a minimum of 10.0%. In all of our modeling, all of the percentages were well above the AAR industry design standards. *See* **Ex1008**, pp. 31, 34. These results support my finding that there is a very low probability that the wheel will derail on the Connection Track.

(d) Axle Sum L/V Ratio: The AAR Chapter 11 standard for this metric is a maximum of 1.5. In all of our modeling, all of the ratios were well below the AAR industry design standards. *See* **Ex1008**, pp. 32, 35. These results support my finding that there is a very low probability that all the wheels on a single axle will climb the rail on the Connection Track.

(e) Truck-Side L/V Ratio: The AAR Chapter 11 standard for this metric is a maximum of .60. In all of our modeling, all of the ratios were

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well below the AAR industry design standards. *See* **Ex1008**, p. 36. These results support my finding that there is a very low probability that all the wheels on one side of the truck will shift the rail laterally (or roll the rail).

35. All in all, the modeling indicates a very low risk for derailment for the Connection Track.

36. <u>*Recommendations*</u>: As part of my assignment, the Port requested that I make recommendations for measures the Port could implement to enhance the already-safe (as demonstrated above) Connection Track. While this track already had a very low risk of derailment, I did make the following recommendations to the Port, in order to even further increase the level of safety:

(a) *Construct the track structure with new concrete or wooden ties, premium fasteners, and continuously welded rail (136-141 pounds)*. This recommendation provides for a less dynamically varying track structure (for example, it will reduce the occurrence and severity of cross-level dips).

(b) *Perform rail neutral temperature measurements during track construction to properly set track neutral temperature. Periodically monitor track neutral temperature following construction*. This recommendation ensures that the rail does not expand (hot weather) or separate (cold weather) after installation.

(c) *Maintain track to a minimum Class 2 standard to reduce levels of allowable track deviation and the associated risks of local track perturbations over time*. This recommendation provides for the connection track to be designed and maintained as a Class 2 track, but

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the Port enjoys an extra safety factor because it will only be running at Class 1 speeds (10 mph).

(d) *Install a high guard rail (on the running rail) opposite the frog on #15 turnout, MP 10.69, and double guard rail on the connection track between #15 turnout and the BNSF overhead bridge, to lessen the potential of significant derailment and damage*.[10] This recommendation ensures a smooth and safe transition from the main line onto the Port's rail. The guard rail also ensures that in the unlikely event of a derailment on the Connection Track (especially in key residential areas, such as the Esther St. and Grant St. overpasses), any derailment should not be catastrophic, because the cars would be restrained from leaving the railroad road-bed.

(e) *Maintain gage face lubrication in curves to encourage proper railcar steering, lessen curve binding, the potential for rail climb, and rail wear*. This recommendation provides an extra level of safety to guard against derailment by allowing cars to traverse the tracks more smoothly.

(f) *Periodically measure track geometry and perform vehicle dynamics simulations to ensure safety against derailment as the track changes over time*. This recommendation allows the Port to ensure that track continues to function as designed well into the future by conducting proper inspection and maintenance.

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[10] In my report, this recommendation contained a typo, stating that the Port should install "high guard rail frog" instead of a "high guard rail opposite the frog." The intent of the report then (and now) was to recommend a high guard rail on the running rail opposite the frog at this location.

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(g) *BNSF remotely operate and monitor the connection track turnouts between the BNSF main line and the Port yard tracks to ensure a clear route for trains entering or exiting the Port*. This recommendation ensures that there are no train-to-train collisions.

37. The extensive modeling conducted shows the Connection Track is well within industry standards, even without implementing any of the additional safety measures recommended above. However, the Port asked for recommendations that would go above and beyond industry standards and further enhance safety for the Connection Track. By implementing my recommendations, the Port's Connection Track has the lowest risk of derailment as I have ever designed or analyzed on an industry track.

MARCH 25, 2014, PRESENTATION TO COMMISSION
(Main Line Connection Track)

38. On March 25, 2014, my then-supervisor, Sebastian Oertel, presented some of my findings to the Port Commissioners at their regularly-scheduled meeting. Portions of my report were presented there, along with some additional slides explaining what TÜV does and how we were involved in this project. This presentation is attached hereto as **Ex1009** ("PORT OF VANCOUVER SCHEDULE I RAIL ENGINEERING, OPERATIONS, AND SAFETY REVIEW," March 25, 2014).

MAY 11, 2016, REPORT
(T-5 Loop Track)

39. In preparation for this adjudication, I was asked to focus my analysis on just the oil trains that are contemplated as part of this project (as opposed to the oil, grain, and potash trains that I analyzed in the above-described report and in my follow-up report in August of 2014).[11] By the time I started this more focused effort, the Port had determined

[11] As discussed in ¶4 above, the Port expanded my scope of work beyond just the Connection Track in February 2014. That work resulted in an August 2014 report on the entire Port rail facility. The primary difference between the August 2014 report and my May 11, 2016, report is that the latter report focuses only on the oil trains as configured in the DEIS. The new report is intended to help the Council focus on the issues that are

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that it would not be using its facilities for grain or potash (as previously modeled), and the final track design for the unit oil trains had been altered. Therefore, my final report of May 11, 2016, specifically analyzes the final route for the proposed oil trains, beginning at the BNSF main line where the trains would enter the Port, continuing through the Port, around the loop at T-5, and back out of the Port onto the BNSF main line (the "T-5 Loop Track"). This analysis was conducted specifically for the facts and circumstances related to this adjudication, and my analysis was based on the train configuration contained in the DEIS.[12] Once again, the Port asked me to use my analysis to make recommendations that would enhance the safety of the T-5 Loop Track. This report is attached hereto as **Ex1010** ("PORT OF VANCOUVER T-5 LOOP TRACK ASSESSMENT," May 11, 2016).

40. The same modeling used for analysis of the Connection Track was used for this analysis. We conducted both the TOS and VAMPIRE modeling, and looked at the same indicators for potential wheel lift, etc. Like the modeling for the Connection Track, the T-5 Loop Track modeling used trains with distributive power (locomotives at both the head end and rear end) and unit trains (homogenous individual cars, all carrying the same commodity).

41. _Results of Modeling_: All modeling was conducted across the T-5 Loop Track using a 10 mph speed limit and nominal train handling. We modeled a 120-car unit train with 5 locomotives (3 at the head end and 2 at the rear end).[13] This modeling was conducted

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relevant to the adjudication, thereby stripping out all of the grain and potash data from the August 2014 report. In addition, I would point out to the Council that my recommendations in the August 2014 report covered the entirety of the Port (including a small loop track west of the T-5 loop that was being considered at the time). That loop (which never did come to fruition and is not now a part of the Port's plans) had curves in the rail line that exceeded 12 degrees. Because of that, I had recommended a higher level of maintenance—recommending maintaining to a Class 3 level—instead of the Class 2 level that I ended up recommending for the T-5 Loop Track. The maximum curve on the T-5 Loop Track is only 8.5 degrees and, therefore, the higher Class 3 level of maintenance is not recommended.

[12] *See* fn3 for information on minor changes made to the train configuration by Vancouver Energy after the DEIS was issued. These changes had no negative impact on the results of the modeling or on my analysis.

[13] *See* fn3.

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for full service braking and emergency braking, and for the 8.5 and 7.5 degree curves in the T-5 loop. We also introduced cross-level dips into the modeling at key locations, just like we did in the Connection Track modeling. Some of the key findings are:

(a) Draft and Buff Forces: The draft and buff forces were measured for the entire length of the loop that an oil train would travel, beginning at the BNSF main line switch, continuing around the loop at T-5, and then exiting the Port back through the BNSF main line switch. All draft and buff forces were well within industry standards.

(b) Individual Wheel L/V Ratio: In all of our modeling, all of the ratios were well below the AAR industry design standards. In fact, the maximum recorded in our modeling was .70 (compare to AAR Chapter 11 maximum of 1.00). *See* **Ex1010**, pp. 29–36. These results support my finding that there is a very low probability of wheel climb on the T-5 Loop Track.

(c) Vertical Wheel Load Percentage: In all of our modeling, all of the percentages were well above the AAR industry design standards. In fact, the minimum recorded in our modeling was 81% (compare to AAR Chapter 11 minimum of 10.0%). *See* **Ex1010**, pp. 29–36. These results support my finding that there is a very low probability that the wheel will derail on the T-5 Loop Track.

(d) Axle Sum L/V Ratio: In all of our modeling, all of the ratios were well below the AAR industry design standards. In fact, the maximum recorded in our modeling was .80 (compare to AAR Chapter 11 maximum of 1.5). *See* **Ex1010**, pp. 29–36. These results support my finding that there is a very low probability that all the wheels on a single axle will climb the rail on the T-5 Loop Track.

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(e) Truck-side L/V ratio: In all of our modeling, all of the ratios were well below the AAR industry design standards. In fact, the maximum recorded in our modeling was .38 (compare to AAR Chapter 11 maximum of .60). *See* **Ex1010**, pp. 29-36. These results support my finding that there is a very low probability that all the wheels on one side of the truck will shift the rail laterally (or roll the rail).

42. All in all, the modeling indicates a very low risk for derailment for the T-5 Loop Track.

43. *Recommendations*: As part of my assignment for the T-5 Loop Track, the Port requested that I make recommendations for measures the Port could implement to enhance the already-safe (as demonstrated above) track, if/when this project is approved by EFSEC and the governor. While this track already has a very low risk of derailment, I did make some recommendations to the Port, in order to even further increase the level of safety. Those recommendations, which are very similar to the recommendations I made in my February 19, 2014 report, are as follows:

(a) Construct new track structure with new concrete or wooden ties, premium fasteners, and continuously welded rail (136-141 pounds) to maintain a robust and less dynamically varying track structure.

(b) Perform rail neutral temperature measurements during track construction to properly set track neutral temperature.

(c) Maintain track to a minimum Class 2 standard to reduce levels of allowable track deviation and the associated risks of local track perturbations over time.

(d) Maintain gage face lubrication in the 8.50 and 7.50 degree curves to encourage proper railcar steering, lessen curve binding, the potential for rail climb, and rail wear.

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(e) Periodically measure track geometry to minimize derailment potential as the track changes over time, particularly in the high degree curves, spirals, and switches.

(f) Perform vehicle dynamics simulations if track horizontal/vertical geometry, train make-up, or method of operation change significantly.

44. The extensive modeling conducted on the T-5 Loop Track shows the track is well within industry standards, even without implementing any of the additional safety measures recommended above. However, the Port again asked for recommendations that would go above and beyond industry standards and further enhance safety for the T-5 Loop Track. By implementing my recommendations, the Port's T-5 Loop Track will have the lowest risk of derailment as I have ever designed or analyzed on an industry track.

AS-BUILT INSPECTION

45. *Connection Track*: The Connection Track (from the BNSF main line through the trench) is now completely constructed. On March 29, 2016, I visited the Port personally to inspect the completed improvements and to confirm that the Port had complied with my recommendations contained in ¶36, above. I did, indeed, confirm that the Port had implemented all of my recommendations for the Connections Track. Specifically, the Port has constructed the track with new concrete or wooden ties, premium fasteners, and 136 pound continuously welded rail. *See* ¶36(a). I also confirmed with Port personnel that rail neutral temperature measurements were taken during track construction. *See* ¶36(b). The Port also installed double guard rail between the #15 turnout—where the Port track connects to the BNSF main line—and the BNSF overhead bridge. *See* ¶36(d). The high guard rail (on the running rail) opposite the frog that I recommended for the #15 turnout was already in place. *See* ¶36(d). The Port has installed an automatic lubricator that will automatically lubricate the curves in the Connection Track. *See* ¶36(e).

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46. In addition, I have spoken to Port staff about their maintenance schedules and procedures, and I have determined that the Port's standard maintenance protocols will ensure that: (i) track neutral temperatures will be periodically monitored (¶36(b)); (ii) the Connection Track will be maintained to a minimum Class 2 standard (¶36(c)); and (iii) track geometry will be periodically measured so that vehicle dynamic simulations can be performed if the track changes significantly over time (¶36(f)).[14]

47. *T-5 Loop Track*: The T-5 loop is not yet complete. I understand that those improvements will be made if/when the Vancouver Energy project is approved by EFSEC and the governor. However, in speaking with Port personnel, I have been assured and do believe that the Port intends to implement the recommendations I have made for the T-5 Loop Track, contained in ¶43 herein. If/when the T-5 Loop Track is ever used for the modeled unit oil trains, the additional measures taken by the Port will result in a very low risk of derailment. Essentially, the Port has committed to taking track that is already designed way beyond what is required by industry standards and has added unit trains (which are safer) at 10 mph (which is safer) with additional enhancements (which is safer).

I DECLARE UNDER PENALTY OF PERJURY UNDER THE LAWS OF THE STATE OF WASHINGTON THE FOREGOING IS TRUE AND CORRECT.

Dated this 13th day of May, 2016, at Tucker, Georgia.

L.R. Guthrie

Larry R. Guthrie

[14] It should be noted that my final recommendation—for BNSF to remotely operate and monitor the connection track turnouts between the BNSF main line and the Port's yard tracks—was already being done.

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