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## **Order of Appearances**

### **Government of Canada Panel 2**

Operations, Safety, Accident Prevention & Response,  
and Submarine Slope Failure and Tsunami Potential

Mr. George Armstrong	Dr. Andrée Blais-Stevens	Dr. Carl Brown
Mr. Kevin Carrigan	Dr. John Cassidy	Dr. Caroline Caza
Dr. Josef Cherniawsky	Mr. John Clarke	Mr. Kim Conway
Dr. Heather Dettman	Mr. Chris Doyle	Mr. Wayne Dutchak
Mr. Michael Dwyer	Mr. Michael Engelsjord	Mr. Charles Hansen
Mr. Grant Hogg	Dr. Bruce Hollebhone	Dr. Ali Khelifa
Mr. Erik Kidd	Dr. Gwyn Lintern	Ms. Laura Maclean
Mr. François Marier	Mr. Phil Murdock	Capt. Glenn Ormiston
Mr. Donald Roussel	Mr. Paul Topping	Mr. Rob Turner
Mr. Shane Walters		

Examination by Mr. Andrew Hudson for the Joint Review Panel 24165

Examination by Mr. Bernie Roth for Northern Gateway (continued) 24210

**Examination by Mr. Andrew Hudson for the Joint Review Panel** 24165

Because Mr. Thomas King is leaving mid-day, Mr. Roth and Mr. Andrew Hudson agreed to question him first. Mr. Hudson said that on April 23 & 24 Mr. King noted that the Centre for Offshore Oil and Gas Energy Research (COOGER) has initiated research on the behaviour, fate and transport of dilbit products in a marine environment. He asked if Mr. King or Dr. Hollebhone had any comment on the wave tank testing that was completed by Northern Gateway Pipelines (NGP). [[Exhibit B193-2](#)] 24165

**Testing shortcomings in NGP’s evidence on spilled dilbit in a marine environment**

Dr. Hollebhone said “It’s always useful to have more information ... but the questions and the conclusions that are raised in that report don’t fully address the gaps that we’ve identified in the evidence. In particular, that the test conditions that they set up and the way they conducted those experiments didn’t allow for examination ... of dispersion into the water column. There were a number of things that we’d raised in the evidence that we didn’t feel that that study fully answered.” Mr. King said, “The dispersion of the oil into the water column as well as the transport of oil in the water column and those are two things that we’re looking at quite extensively in our wave tank facility.” 24172

The COOGER facility is 2 feet wide, 7 ft high, & 100 ft long, capable of generating non-breaking or regular waves and breaking waves. They also have a flow-through system that’s capable of generating natural current effects. “We can study the fate of the oil from the water surface until it’s broken down by wave action, enters the water column, moves through the water column and then leaves the tank.” 24810

**IFOs and HFOs as a proxy for spilled dilbit**

Mr. Hudson said, “NGP has stated that dilbit is expected to behave [like] an intermediate fuel oil (IFO) or lighter heavy fuel oil (HFO) such as Bunker C. ... They do not ... sink based on weathering alone. ... Do you agree that IFOs and lighter HFOs provide a reasonable proxy or analog as to how dilbit spilled in marine waters might behave?” Dr. Hollebhone gave an informative and somewhat lengthy answer. 24185

“We ... have a lot more data both from laboratory and real world spills on HFOs and IFOs and a lot more experience. ... These probably form some of the best models we have currently for the behaviour of dilbit in the environment. ... However, ... the chemical composition of the dilbit is ... different enough from [IFOs & HFOs] that the evaporation rates could be different. ... Dissolution rates [and] emulsification behaviours could be different.” 24190

“Some of this is actually revealed in some of the Proponent’s testing. The IFOs and HFOs ... are actually quite difficult to emulsify and, yet, we found some of these products can emulsify in the SL Ross [[Exhibits B16-31](#)]. One of ... the main outcomes of the SL Ross meso-scale testing result was that this product [dilbit] could quite readily form what looked to me like a meso-stable emulsion.” 24193

### **Cannot understand dilbit behaviour from IFO or DFO**

“These are ... differences that I can look at in the data ... and say there’s enough here that makes me unsure that I can reliably use those models we have for an IFO or an HFO and then talk about understanding the fate and behaviour of dilbit in the environment in a confident way.” 24195.

Mr. King added that “We noticed as we’re going through using various spill cleaning agents, is that if you apply something like mineral fines to some of these more viscous oils, they tend to clump together with the mineral fines and sink to the bottom of the tank. ... In doing just one trial in the tank with the fresh state oil [dilbit] is that it floated no problem at all. It behaved very similar to a medium grade oil.” He also noted that by adding a dispersant, “[dilbit] looked like it dispersed fairly well but, after a period of time, there was some coalescence and ... it started to form almost like an emulsion and still floated on the surface.” 24199

### **Examination by Mr. Bernie Roth for Northern Gateway Pipelines (continued) 24210**

#### **Sulphur content of fuels & two-fuel systems**

Mr. Roth recapped yesterday’s discussion about the low sulphur marine fuel oil Canadian requirement for 2015 and the global requirement for 2020. Mr. Donald Roussel said that those regulations are concerned with fuel for the ship, not the cargo being transported. Mr. Paul Topping said these are air emissions regulations, “but the sulphur emissions are controlled through the sulphur content of the fuel.” 24211

Mr. Roth asked about vessels which “have two fuel systems and they essentially switch fuels once they get within the restricted zone.” Mr. Topping added that a decision will be made in 2018 as to whether there is a sufficient supply of low sulphur fuels, and the 2020 standard of .5% sulphur content may be pushed out to 2025. Also, “as a cost effective means to comply, [some vessels] could still use heavy fuel but use emission control technology.” He suggested that this might be more applicable to vessels operating within the .1% standard – cruise ships and other coastal and laker fleets – whereas the internationally-going fleet will use the lighter fuel meeting the .5% standard. 24219

#### **Current production, use and transport of heavy fuels**

Mr. Roth asked about the residual or waste products from oil refining, particularly those “bottoms” which are used as heavy fuel oils. Dr. Heather Dettman said they could be asphalt for roads and roofs. Mr. Roth said they could be used for electricity generation or heating. “It’s not as if this is likely to be a waste product, there’s going to have to be some market for it and we’re either going to have to find a way to get the sulphur out of it, either at the burner end of it -- like was being discussed by Mr. Topping -- or at the refinery, we’re going to have to find a way to get that sulphur out of the heavier residuals.” Dr. Dettman said, “In refineries, there’s no such thing as wastes.” 24247

Mr. Roth surveyed the present situation with heavy products from refineries. Dr. Dettman said that land-based heating plants must have SO<sub>x</sub> and NO scrubbers. Mr. Roth said we

also export them, which with Dr. Dettman concurred. “The largest or most significant spill of oil that affected the B.C. Coast was ... the Nestucca, ... a bunker fuel being transported by barge.” Mr. Roussel agreed. “The second largest spill was in Alaska, ... the loss of bunker of fuels from a cargo vessel called the Selandang.” Mr. Erik Kidd agreed. 24227

### **Orimulsion® in Canada**

Mr. Roth asked about Orimulsion® use in Canada, going back to the importation of Orimulsion from Venezuela, into Chaleur Bay in New Brunswick for power generation. Dr. Hollebhone agreed with Mr. Roth’s characterization of Orimulsion as bitumen mixed with 25% to 30% water, with a surfactant, ending up with a combustible emulsion. Later plans to increase the use of Orimulsion, and add a second plant in New Brunswick were cancelled. 24261

Mr. Roth said “The Orimulsion was going to be delivered at a multi-purposes pier ... that was also being proposed for [imports of] LNG.” “The marine transportation of Orimulsion, including the potential impacts from accidents and malfunctions, was part of an environmental assessment undertaken pursuant to CEAA by way of a comprehensive study report? And I provided you with extracts from the ... study report.” [AQ94-C, consisting of extracts from the [Irving Oil LNG Terminal project EIS](#)]<sup>1</sup> Dr. Hollebhone: “I have them in front of me.” 24284

### **CEAA’s report on Orimulsion**

Mr. Roth turned to Adobe 4/216<sup>2</sup> (hard copy page 167) and asked Dr. Hollebhone whether the physical properties of bitumen given there were the same as he used in his presentation. Dr. Hollebhone said “that looks approximately correct”. Mr. Roth noted the “extremely high viscosity of greater than 10,000.” Dr. Hollebhone said that “We couldn’t measure that. That’s the top end of our measurement range at the time so that bitumen could be quite a bit more viscous than that.” Mr. Roth also noted that the “pour point” of bitumen is given as 38 degrees Celsius. Dr. Hollebhone said that is “when held horizontally, the material will begin to exhibit flow.” 24297

Mr. Roth asked why no viscosity measurement was given for Orimulsion. Dr. Hollebhone explained that because Orimulsion is an emulsion or a heterogeneous mixture of oil and water – of oil droplets suspended in water – “it wasn’t possible to measure that.” Mr. Roth also noted that the pour point of Orimulsion goes down from 38° to between 3° and 0°. Dr. Hollebhone affirmed that the purpose of this is to thin the bitumen enough that it can be transported. 24315

Dr. Dettman confirmed Mr. Roth’s explanation that “to use [Orimulsion] in the heating process, you don’t remove the water. You just leave the water in and you have a much

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<sup>1</sup> This link is to the full EIS, a huge 48 mb file. It is not to Mr. Roth’s extract of the study report (AQ94-C) which he provided to the witnesses as a questioning aid, and which is not available online.

<sup>2</sup> This Adobe page reference is to the same page in two documents: Mr. Roth’s extract as given in the transcript, and the page in the full EIS.

higher flash point but you get the fire going with natural gas or something like that and the water just converts to steam as you consume the energy. 24335

### **Important information about surfactant and PAHs in Orimulsion**

Dr. Hollebone interjected: “I would also caution you a little bit. ... You’re leaving a component out ... that is ... relevant to the Orimulsion behaviour. ... A surfactant [was added] to stabilize that emulsion and [it was] the major factor in determining how this property behaved. In explaining why the surfactant is important, Dr. Hollebone spoke about polycyclic aromatic compounds (PAHs) and said these are the first thing that toxicologists want to know about to gain an understanding of these products. He said, however, that “They don’t feed into the physical fate and behaviour models very strongly.” You need to know this information for a number of reasons, including to “fingerprint” the oil to know better how to deal with it in the event of a spill. “This is one of the areas in our evidence where we’ve identified an issue.” His full explanation is in paragraphs 24342 – 24364.

Mr. Roth asked, “You requested this information from the Proponent?” Dr. Hollebone: “I have not seen it as of yet.” Mr. Roth put up Table 5-4 “Comparison of PAH and Alkylated PAH Composition of Representative Hydrocarbons to other Crude Oil Sources” [[Exhibit B80-2](#), Adobe 75], which was filed in July 2012. Mr. Roth said, “It provides you with all the information that you [sought] with respect to the Orimulsion.” “When Environment Canada filed its updated review information [[Exhibit E9-39-2](#)] in September of 2012, it didn’t take into account that it had this information?” Dr. Caroline Caza said that the report “was not an updated review of ... information ... filed by the Proponent.” 24363-24402

Dr. Hollebone said, “This isn’t all of it. This addresses I believe our recommendation 2-3 to look at the chemistry. But particularly on the fate side, there are many things that we’re still concerned haven’t been addressed.” Mr. Roth: “That [is] what we’ll continue to discuss for the remainder of the morning.” 24403

Mr. Roth returned to Adobe 5/217 and Table 2.24, “Summary of Physical Properties of Orimulsion”. The results shown are for three testing organizations: Battelle (a Seattle firm), Environment Canada, and PDVSABITOR (PDVSA is the Venezuelan state oil company, and Bitor was bringing the oil into Canada), and the text says that the tests were all performed in 1998. Mr. Roth asked if the three used the same sample or if different samples were used. Dr. Hollebone replied that he wasn’t involved in any of the tests, but that variability between operator, testing techniques, and the instability of Orimulsion can all be significant. 24406

Mr. Roth ascertained that the Orimulsion brought into Canada changed over the 18 years the product was imported, and that Dr. Hollebone had not done any of the tests and the last tests were done in 2000-2001. Dr. Dettman agreed that Orimulsion is a product that could have “significant variances in chemical and physical characteristics.” She and Mr. Roth discussed the variabilities and similarities between different bitumens, “heavy ends from a refinery” and “super heavy crudes.” Mr. Roth said that blending heavy crudes is “nothing new to Western Canada.” Dr. Dettman said that diluted bitumen has been

transported since the 1990s. Mr. Roth said that the Manitou Pipeline was constructed in the mid-1970s as “a double-blend diluent and blended crude line for Lloydminster heavys and then going up into the Cold Lake area in the later part of mid-80s to ‘90s.” Dr. Dettman said that was before her time. 24435

### **Information gap exists about many products, not just dilbit**

The discussion continues about blending oils. Dr. Dettman comments that the variety of base oils and blending substances creates potential risks, and “that’s why NEB’s there to make sure that, as they come up with these mixtures that they are safe, and, you know, that meet certain specifications for quality.” Mr. Roth replied that blending has “existed pre-oil sand development.” He emphasizes the variability of oils “when you get into all of the fields, conventional and unconventional, that producing in Western Canada.” Dr. Dettman said that crudemonitor.ca is there to provide information, “to help people understand” more about the variety of products. Mr. Roth said, “You need it regardless of what pipeline it’s carried -- the fact of the matter is, all these products are being carried now in extremely large quantities by pipeline, rail, truck, marine vessels. And regardless of this particular Project, the gap that you’ve identified exists for conventional products, unconventional products, right now. The gap isn’t something new from this Project.” 24483

Dr. Hollebhone agreed, but said “it is a problem ... -- particularly in the context of the marine assessment. ... So that’s the Recommendation 2-4 [[Exhibit E9-39-2](#), Adobe 6]. Mr. Roth: “But these products are being transported in the marine environment right now.” Dr. Hollebhone: “In terms of this Project, we were looking for this information to both assess the risk and to be sure that the ongoing recommendations for preparedness were following best practices.” 24549

### **Fate and behaviour of Orimulsion, & comparing knowledge gaps with dilbit**

Mr. Roth quoted from his AQ94-C, Adobe 10/222, a statement that he summarized as “Orimulsion submerges and becomes dispersed in the water column and there is no floating oil or oil slick.” Dr. Hollebhone said, “That is the result of this study ... done by Golder and not by Environment Canada.” 24555

After substantial discussion about Environment Canada and Orimulsion, Mr. Roth asked whether the gaps in knowledge and understanding of Orimulsion and preparedness for a spill, were similar to their situation with respect to oil sands products. “Did you have similar gaps or even greater gaps with respect to Orimulsion and meeting your mandate?” “[What is Environment Canada’s] capability to respond to a spill of Orimulsion relative to an oil sands product? [Does] Environment Canada feel that it’s less able to meet [its] mandate regarding a potential release of an oil sands product?” Ms. Laura Maclean said, “What we’ve said in the context of Northern Gateway is that, given the level of discourse and uncertainty that does exist around the product, its behaviour, its potential fate and effects is that we have recommended that a [multi-disciplinary, multi-party] scientific advisory committee be struck ... much like I’m imagining the Technical Review Committee did in this [Orimulsion] case.” 24627

Dr. Ali Khelifa said that in the technical review, [[Exhibit E9-39-2](#), Appendix 1, Adobe 11]. [it is] very clear the extra work that we recommended to the Proponent to conduct. In Appendix No. 1, we were very specific what we want. ... Even if we have ... very good knowledge in terms of fate and behaviour and we have a poor knowledge how the water ... moves, we can't do the modelling. The same thing for the wind." He said the Orimulsion "took place in the Bay of Fundy, ... one of the most studied water systems in the world. ... "Compared to the water system in Douglas Channel ... we can't compare them." 24651

Mr. Roth asked "Do you believe that Environment Canada is better positioned to meet its mandate with respect to Orimulsion spills on the West Coast than it is with respect to spills of oil sands products on the West Coast?" Mr. Grant Hogg said, "We're not the folks who actually conduct the science so we rely on our scientists from [other agencies.] 24656

### **Other agencies compromised by Environment Canada**

Mr. Roth turned his attention from Environment Canada to Transport Canada and the Coast Guard. He asked them if their reliance on Environment Canada "to provide these services" compromises their "ability to respond to a spill of Canadian oil sands products in West Coast waters ... relative to your ability to have responded to a spill of Orimulsion of the East Coast?" He asked as well about "the gaps you think have to be filled and when you'd like them filled." Mr. Phil Murdock said that "in our direct evidence ... the Canadian Coast Guard specifically noted that a research program focusing on enhancing knowledge of fate, effects, behaviour and impact of spills, response techniques and technology application with respect to the range of petroleum products, would be of significant benefit." Mr. Roussel of Transport Canada said that the products to be carried in NGP – dilbit, synbit, etc. – are "already carried in this country and we have certified organizations to respond to it." 24664

Mr. Roth stated that the general review statement on the Irving Oil LNG Terminal [[AQ94-D](#)], and "the advice provided to the Minister, was that a release, a significant release of either Orimulsion or LNG, would have significant adverse effects on the environment but those would be unlikely due to the low probability of a spill." Dr. Caza said, "We can't comment on the conclusions of that report." 24691

### **Two scenarios: a bunker fuel spill in the project area and out of Vancouver**

Mr. Roth asked about two scenarios "Environment Canada's preparedness and the preparedness of the Coast Guard and Transport Canada as well, to address a significant 30/40,000-barrel spill of bunker oil or intermediate fuel oil right now along the shipping lanes that will be used by this Project." 24705

He also wanted to know "the same information ... out of the Port of Vancouver. If we were to lose a significant quantity of dilbit or synthetic synbit right now out of the Port of Vancouver going along Vancouver Island, what is your ability to assess the fate and behaviour of those products, model exactly where they'll go and your knowledge of sensitivity mapping?" 24708

The discussion of these scenarios continues at 24718.

Specifically, Mr. Murdock noted that tankers transiting Canadian waters in excess of 150 tonnes and other vessels in excess of 400 gross tonnes “are required to have an arrangement with a response organization (RO). In the case of a vessel having an accident, that results in an oil spill, it would be expected that the ship Master and the ship owner would invoke that arrangement with the RO. In ... British Columbia, there is one recognized RO, the Western Canada Marine Response Corporation (WCRMC).” He also described how, as it becomes apparent that more equipment is necessary, WCRMC and the Coast Guard would “cascade in equipment” from elsewhere in BC, Canada, and then, North America from other agencies, such as the US Coast Guard. “That’s sort of the equipment piece and the personnel piece.” 24787

Mr. Roussel said, “You opened the door to a significant event, so we need to give you the -- how the whole of government respond to that. So that’s critical that we don’t leave open-ended thing that there is a non-capacity here of responding. And that’s not the message that we want to be transmit in the general public. There is a significant amount of capacity with the private enterprise and the whole of government approach to respond to oil pollutions.” 24806

### **Better spill response position with Northern Gateway than before it**

Mr. Roth asked, “If the Northern Gateway Project proceeds and delivers all of the information Environment Canada is looking for and substantially greater spill response capability, are we in a better position to have another cascading resource to respond to risks that presently exist?” Mr. Kidd put up 3.8.72, “Spill Response Capability” from Transport Canada’s observations on the General Oil Spill Response Plan [[Exhibit E9-6-15](#), Adobe 37], then answered Mr. Roth’s question: “I would say ‘yes’.” 24809

Mr. Roth put a similar question to Mr. Khelifa. Ms. Anderson expressed concern about the relevance of the question. “We’re not talking about the Bunker C oil in this case, we’re talking about the diluted bitumen project that Northern Gateway proposes to ship.” The Chairperson said they’d like to hear the answer, to which Mr. Khelifa replied that if NGP provided all the information that Environment Canada had asked for and if the systems as proposed are operational, then it would be of more general benefit. Dr. Caza also agreed with the general premise of Mr. Roth’s question. 24839

Mr. Roth asked how the government agencies would deal with the existing situation and increased activity – large volumes of oil sands product transported by rail and by marine - if NGP does not proceed. Dr. Caza said in reply that this is a review of a specific project, but some of what ensues in it, is relevant to the general work and broader agenda. 24854

### **Spills of oil sands product – Burnaby BC & Marshall MI**

In reply to Mr. Roth, Dr. Hollebhone said that the 2006 [correction: 2007]<sup>3</sup> Burrard Inlet spill and the 2010 Marshall spill are the only spills he is familiar with in which a

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<sup>3</sup> The Kinder Morgan Trans Mountain pipeline rupture in Burnaby, which spilled oil into Burrard Inlet, took place on July 24, 2007. Refer to [the Transportation Safety Board’s report](#). The transcript, and



significant volume of oil sands product has gone into a freshwater or a marine environment. 24862

Mr. Roth said, “By my rough calculations, since 1967, Canadian oil sands producers have produced approximately 10.5 billion barrels of oil sands products that have been safely transported across numerous major river systems in North America and we have a marine terminal in Vancouver that’s been shipping those products out for decades and is now doing so at a rate of 75 to 100,000 barrels a day.” The witnesses agree that “it’s a really big number.” 24874

Mr. Roth said, “In your evidence it suggests that you can find no example of a marine oil spill of an oil sands product.” [Exhibit E9-6-32, Adobe 19] Mr. Roth questioned whether the Burrard Inlet spill was a “marine spill” because, “a significant quantity of that spill was actually deposited into the marine environment through a storm sewer system.” Mr. Kidd said that the spill “is a marine spill by [Transport Canada’s] book ... as there was a vessel alongside at the terminal when it occurred. So indemnity was provided to the RO who responded.” Dr. Hollebhone said that “from [Environment Canada’s] perspective it was a spill from land through a discharge into the marine environment [and] it certainly involved marine clean-up issues.” 24881

Mr. Roth asked about samples received from the Burnaby spill by Environment Canada. “When you have reports of densities and information on Athabasca heavy synthetic, I take it that it’s as a result of that incident?” Dr. Hollebhone replied, “The sample that we have of Albion heavy synthetic came from that spill ... or it was provided by Kinder Morgan.” Mr. Roth asked some further questions of Dr. Hollebhone regarding weathering and testing. Dr. Hollebhone said, “When samples are collected for legal purposes [we] refrain from using them for research purposes.” 24922

Mr. Roth held a complex discussion mainly with Dr. Hollebhone about heavy oils, including crudes and diluted bitumens (dilbit, synbit, dilsynbit). He put up excerpts from three chapters of the book by Merv Fingas called “Oil Spill Science and Technology,” as aids to questioning (AQ94-E,F,G). He also drew on Environment Canada’s evidence .” [Exhibit E9-6-32] 24962-25008

### **What is known about oil product variability and what is not known about dilbit**

From an oil properties table in AQ94-E, page 65, Mr. Roth noted that “for light crudes we have high variances in density from .78 to .88; heavy crudes generally whether conventional or unconventional seem to have a range of density from .88 to 1; the intermediate fuels, you’re citing .94 to .99; Bunker C is even with a wider range of density of .96 all the way up to 1.04, and then the types of Orimulsion products -- I think crude oil emulsions, you have .95 to 1 over there. Is it fair to say that it’s not just oil sands products or products associated with this pipeline that have a wide range of physical characteristics, but it’s all oil products? Dr. Hollebhone replied, “I would agree with that statement, yes,” then explained that for all these products they have several

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Environment Canada’s evidence [Exhibit E9-6-32, Adobe 19], repeatedly note it as taking place in 2006, an error which does not appear to have been noted in any subsequent corrections.

hundred measurements, and 20 years worth of research. “During a spill, [we will] take a sample as fast as we can get it, run it, if that information is not known by the shipper and it often is not. ... That can be used to inform the response cycle.” 24974

Dr. Hollebhone said that they do not have a similar history of data for diluted bitumen products: just “five or six pieces of information that are in evidence. In particular, ... diluted bitumen has seasonal variation that we don’t entirely understand.” In this he is referring to mixes to adjust viscosity for cold weather. Dr. Dettman mentioned differences in behaviour between diluted heavy oils, the component parts of which are all refinery products, and dilbit, in which the unrefined bitumen has characteristics, including, for example, natural surfactants, that cause it to behave differently. She said, “It’s not like it’s going to be something radically different than everything else because in the end it’s all hydrocarbons ... [but] right now, we don’t know.” 24987

### **Incorrectly and persistently conflating crude oils with diluted bitumen**

Following this, Mr. Roth incorrectly applied the statement made by Dr. Hollebhone that it is “... highly unlikely that crude oils will sink.”, after reading material by Dr. Jeffrey Short from the excerpts from Chapter 3 of Merv Fingas’ book [AQ94-B], as to include diluted bitumen with other crude oils, specifically Bunker Cs. Dr. Hollebhone repeated that the material makes no comments about diluted bitumen. He said, “Diluted bitumen [has] a barbell chemical distribution; meaning it has a lot of light ends and a lot of heavy ends. But crude oil in particular tends to have a whole range, a broad range of composition. ... [There is a] missing middle part in the dilbit” and a different chemistry to it. 25009

Continuing to conflate other oils with dilbit, Mr. Roth said, “As far as a product that would have a similar characteristic to a diluted bitumen, IFO is of what we have representative or as close to a representative product as exists.” Dr. Hollebhone disagreed “that they would behave the same way in the environment. I think that would get you into trouble.” Dr. Dettman added technical detail to the discussion. 25047

### **Weathering –thickness, evaporation and wind**

This discussion should also be read in the transcript as it is quite technical and detailed. It begins at 25057.

Mr. Roth said that Dr. Fingas work suggests that thickness of an oil is “not that material” to evaporation rates and that he “disregards the thickness of the oil in calculating evaporation rates.” This is taken from Chapter 9, “Evaporation Rates”, in Dr. Fingas’ book [AQ94-F, page 215]. Dr. Khelifa said this is correct for water, but is not correct for oil for which only certain component chemicals can evaporate and they need to migrate to the surface, hence, “thickness matters.” Dr. Hollebhone explained that the migration factor is one consideration, and saturation at the vapour face is another which can suppress evaporation. “Water saturates the atmosphere very quickly.” 25057

Mr. Roth quoted “The rate of evaporation is very rapid immediately after a spill and then slows considerably. About 80 percent of the evaporation that does take place occurs in

the first two days after a spill.” This is from Chapter 8, “Introduction to Spill Modeling”, in Dr. Fingas’ book [AQ94-G, page 2]. 25118

Referring to a figure on the screen displaying the evaporation curves of various oils, Dr. Hollebhone said they don’t have information in Environment Canada for dilbit. “We don’t know if the curve is more like gasoline or more like the Bunker C example up on the screen. The Bunker C is the long tapered thing. ... You can see the gasoline changes relatively rapidly on that time scale and, in your evidence, the evidence for the condensate is that it behaves much more like gasoline than the Bunker C. ... That’s information I don’t have at this point.” Mr. Roth said, “That is information that we filed.” 25151

Mr. Roth put up Environment Canada’s evidence [E9-70-2, Adobe 8 & 9] and after a confusing discussion about what is actually represented on the chart on Adobe 9, Dr. Hollebhone and Mr. Roth agreed that “Your evaporation curves are actually consistent with Dr. Fingas; the vast majority of your evaporation will occur in the first two days.” 25159

#### **Are time and temperature the primary factors in evaporation?**

Mr. Roth said that Dr. Fingas “was telling us that wind can be disregarded, and he even suggests to the extent that you try and predict evaporation through wind modelling, prediction errors are as high as 400% over 200 hours.” Again from Dr. Fingas, Chapter 4, Mr. Roth quoted, ““The fact that oil evaporation is not strictly boundary layer regulated implies that simplistic evaporation equation will suffice to describe the process. The following factors do not require consideration; wind velocity, turbulence level, area, thickness, and scale size. The factors important to evaporation include time and temperature.” [AQ94-F, page 240] 25191

Dr. Khelifa said that most of the scientific community do not agree with this statement, particularly with respect to wind and the evaporation of oil. Mr. Roth said that Dr. Fingas’ conclusion argues that the opinion of Dr. Short, that “using a 2 centimetre thickness, 20 millimetres, in the wind tunnel modelling done, underestimated evaporation by 10 times,” has no basis. Mr. Roth also said that Dr. Fingas’ conclusion argues against Dr. Short’s criticism of the work of S.L Ross and Mr. Belore in the meso-scale modeling. Dr. Short “wanted the wind to blow much harder.” Dr. Fingas is saying that the thickness and wind “isn’t going to have the effect you’re suggesting.” 25196

Mr. Roth then summarized what he intended to question on at the next hearing day (Monday, 29Apr2013, Vol 173) and brought the day to a close.