Enbridge Northern Gateway Project
JRP Hearing Notes

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Contents

Order of Appearances

Northern Gateway Panel 3

Kitimat River Valley

Mr. Drummond Cavers	Mr. Ray Doering	Mr. Jeffrey Green
Dr. Matthew Horn	Dr. Malcolm Stephenson	Dr. Elliott Taylor
Mr. Paul Anderson	Mr. Owen McHugh	Mr. Jim Mihell
Mr. Dennis Yee		

Examination by Dr. Josette Wier (continued) 20924

The Human Health Risk Assessment

Noting Mr. Green's previous comments that human health risk assessment (HHRA) is a requirement of the CEAA, Dr. Wier asked why an HHRA was not conducted for marine spills. Mr. Green answered that the Act requires an assessment of the effects of routine operations as well as accidents and malfunctions, and cumulative effects of routine activities, in general. He explained that routine effects are "very likely" whereas accidents are unlikely to occur. Dr. Wier noted that the HHRA looked at effects of spills, not routine effects, and Mr. Green agreed, stating that there were two assessments done: one for marine, and one for the pipeline. 20925

Dr. Wier asked about the references cited in the Ecological HHRA, noting a lack of literature on the effect of hydrocarbons on human health, and suggesting that it is "not very sound robust science". The Chairperson indicated that her argument could be presented at a later opportunity. 20933

Dr. Wier and Mr. Yee continued on the sources used for the discussion of human health effects. Mr. Yee agreed that NGP did not rely on literature of other HHRAs from oil spills, stating that doing so was too difficult because such studies are uncontrolled studies and that it is "very difficult to tease out causal effects". 20973-20987

Dr. Wier highlighted Dr. Owens' statement from Volume 145, line 17098, "*condensate spills have… very strong safety issues associated with them. There is a propensity for fires and explosion, and so the health of responders and the public is of prime concern*". She asked if such risks had been analyzed in the HHRA. Mr. McHugh answered that worker safety was assessed but that "it is a different type of risk assessment, much more immediate." Discussion continued. 21007-21022

Weathering and toxicity of hydrocarbons

Dr. Wier highlighted a statement from Exhibit B80-2, page 77: indicating an analysis had revealed that, "*the toxic effects of the hydrocarbon will be reduced over time as the weathering process proceeds*." She then compared that statement, with one from Exhibit B132-2, page 13, which indicates that sensitivity increases with increasing molecular size. She asked if weathering thus results in increasing molecular size. 21023-21043

Dr. Stephenson explained the processes involved in weathering of hydrocarbons, which can involve evaporation, microbial breakdown and dissolution, meaning that weathering will decrease the mass of hydrocarbons, but that the residuals will be the heavier components of the hydrocarbons. He stated that this means that weathered oil will have a smaller mass, and will be less toxic as a result. 21044

Dr. Wier clarified that the evidence seemed to suggest that weathering would result in increased toxicity because weathering results in increased molecular size, and increased

molecular size creates increased toxicity. Dr. Stephenson provided a detailed response, using the figure on Adobe 81 of Exhibit B80-2. Discussion continued. 21060

Dr. Wier asked questions about the assumption that hydrocarbons deposited in sediment would not become re-suspended, noting a separate US EPA document indicating that submerged oil will remobilize in the water column downstream. Dr. Stephenson described the assumptions made in the modelling that was done on the subject. He indicated that submerged oils could be re-suspended downstream. See transcript for more details. 21088-21123

Looking at Exhibit B80-3, page 207, Dr. Wier continued questioned how the weathering process of hydrocarbons could result in decreased toxicity levels. Discussion continued and Mr. Yee explained that high-molecular weight compounds tend to be absorbed into organics, and are thus not usually released back into the environment for further exposure. See transcript for greater detail on the subject. 21125

Questions on modelling the effects of hydrocarbons

Dr. Wier moved to questions on modelling acute and chronic effects of hydrocarbons, from various exhibits. Dr. Stephenson and Dr. Horn provided details on the modelling methods and results. Please see the transcript for details. 21175-21270

Pulling up Exhibit B80-3, pages 123-124, Dr. Wier noted a statement, "*for the purpose of modelling human health risk*…" She asked how the locations of interactions between humans and oil spills were determined. Dr. Stephenson indicated that he had previously addressed the way in which assessment locations were distributed. Mr. Lee added that fishing spots were considered in the model, noting, "it is an ultra-conservative approach in terms of determining what the maximum exposures for an individual will be." 21271-21284

Dr. Wier asked how far downstream the model allows a human to interact with an oil spill. Mr. Yee indicated that distances up to 66 kilometers downstream had been looked at in the model. 21285

Looking at Exhibit B80-12, page 5, Dr. Wier noted that an assumption in the model was that soil and air temperatures were moderate. She asked if acute effects from peak summer temperatures had been considered. Dr. Stephenson answered that NGP didn't anticipate any acute effects on humans after the first few hours of a spill, and that exposures during the acute phase would be occupational. 21296

Looking at Exhibit B80-2, page 89, Dr. Wier noted that the sediment model did not directly include the effects of winter. She asked questions about consideration of temperature variations. Dr. Stephenson described the difficulty of modelling seasonal effects, and explained that in the case in question, the model was run for 52 weeks, acknowledging that "it would take a bit longer… for the real world, in effect, to catch up to the model" as the weathering process could cause slowdown. 21307-21322

Dr. Wier continued with questions of details in NGP's modelling, this time asking about Exhibit B80-3, page 121. She noted the statement, "*The risk characterization is based on an evaluation of the potential…*" and questioned why recipients of concern were not identified in the risk characterization, noting the list of receptors on page 123, and highlighting the absence of concerns such as people with pre-existing conditions, people on chemotherapy, and the very young and very old. Mr. Yee answered that Health Canada (HC) defines the receptor categories. 21324

Dr. Wier followed up, asking if in Mr. Yee's professional opinion, recipients of concern should not be included because of HC's model. Mr. Green answered that HC's guidelines are quite general as are the types of contaminant risk assessments typically done on human health. He stated that he wasn't aware of any other project undertaking the types of HHRA that NGP had, which he suggested is "far above the typical standard for Canada." Mr. Yee added further points. 21340-21349

Toxicological effects on women and developmental effects

Dr. Wier asked why pregnant women are ignored in the HHRA. Mr. Yee answered that women in general are considered in the risk assessment, as guided by HC. Discussion continued on the issue of weight assigned to women in the assessment, which the witnesses again answered were HC guidelines. 21351

Dr. Wier asked about the implications for women in the assessment, given their smaller weights and the resulting possibility of greater toxicological effects. Mr. Green described the various reasons that the model is very conservative. Mr. Yee added comments about NGP's confidence in the model and its results. He pointed out that the results show "significant and adverse effects", which won't change whether women, or other factors, are considered. 21378-21397

Dr. Wier continued with questions related to evaluations of risks to a female receptor, such as developmental toxins. Similar discussion continued, with Mr. Yee pointing out that none of the chemicals evaluated have toxicological effects unique to women. He stated that although developmental effects may be attributed to some of the chemicals, they would be built into the toxic reference value. He explained that the toxicological endpoints used are "probably…much more prevalent and much more sensitive" than developmental effects. 21398-21410

Dr. Wier asked about the hazard quotients (HR) used in the assessment, and how they compare to that which was recommended by HC. Discussion followed, consistent with that above. 21426

Dr. Wier compared the statement, "*it is likely that no adverse effect will exist*", from Exhibit B80-3, page 122, to a sentence from page 137, "*However, exceedances above the exposure limit do not… mean that adverse health risks occur*", asking if an element of uncertainty is introduced from these statements. Mr. Yee answered "no" and again explained his confidence in the conservatism of the assessment. Discussion continued around what Dr. Wier called the insufficiency of the methodology used. 21468-21508

Further questions were asked about the HR values used in the assessment, at length. For example, Dr. Wier asked if the proponent was prepared to critically assess HQ values of 1 or lower. Dr. Stephenson answered that the scenarios evaluated in the risk assessment are sufficient for the relevant management purposes. 21530

Dr. Wier asked if HC was consulted on the considerations of multiple exposures to carcinogenic compounds from a spill. Mr. Yee answered that it was not, and that NGP had "sufficient information in the tox reference values that preclude us needing to require any consultation with HC." 21554

Looking at the information on exposure pathways in Exhibit B80-3, page 127, Dr. Wier asked why inhalation of contaminated air or vapours from contaminated soil and water is not included. Dr. Stephenson answered that the HHRA looked at chronic exposures, and that volatiles persist for a few days only. He pointed out that an acute assessment was done for vapours and was presented in the same document. 21566

Dr. Wier asked why exposure to the foetus for pregnant women was not considered as an exposure pathway. Dr. Stephenson again answered that reproductive health effects were included in the toxicological reference values (TRVs). 21577

Human consumption of fish exposed to oil

Dr. Wier asked about the considerations given for the range of species consumed by Aboriginal people, as mentioned on page 127. She asked how "*generic fish*" would apply to eulachon, which are composed on 25 percent fat as compared to 12-15 percent in salmon. 21592

Dr. Stephenson explained that eulachon only spawn and hatch in rivers, but spend the majority of their lives in in the ocean, meaning that the fat they store when caught in rivers has come from outside of the area of oil spill effects. As a result he stated, "we wouldn't expect to see any significant contamination of eulachon in the very short period of time that they would be in freshwater." 21601- 21603

Dr. Wier asked about the tainting of eulachon by the pulp mill in Kitimat and asked if it offers a similar example where the fish spend a short time in contaminated waters, but are significantly impacted. Dr. Stephenson answered that water-soluble compounds from pulp mill effluent are different from hydrocarbon compounds. 21604

Dr. Wier continued with questions related to details of the models and methodology used in the HHRA. Discussion again turned to the comparison of eulachon to other "*generic fish*" assessed in the model. 21617

Dr. Wier asked about commercially grown food along riverways such as the Bulkley, noting an NGP statement, "*no home gardens would be expect[ed] to be in the vicinity of the spill location that would require irrigation with surface water*". Mr. Anderson noted that any operations impacted by a spill would be compensated. 21649-21653

More on HHRA calculations, methodology and definitions

Dr. Wier asked questions about tables 9-2, 9-3 and 9-4 from Exhibit B80-3, pages 130-136. For example, Mr. Yee described the averaging times for carcinogens and non-carcinogens, as set out by HC. Dr. Wier continued to seek clarification on details from the tables and the criteria from HC. Please see transcript and exhibit for details. 21666-21735

Describing consequences, risks and health effects

Dr. Wier noted that many of NGP's panels had indicated many times that "risks are the product of consequences and their probabilities of occurring." She asked where the health effects consequences are in the environmental HHRA. Mr. Yee answered that the entire document "speaks to the actual human health risks associated to exposures to chemicals." Dr. Wier stated the importance of describing consequences associated with risks, and assigning probabilities. She again asked where descriptions of risks could be found in the report. 21737-21740

Dr. Stephenson described the scope of probability, and again answered that the EHHRA speaks to the consequences. Dr. Wier again indicated that she was seeking mention of consequences, noting that the only place they are is under the "toxicological basis" table, which she said is "very, very, very vague". She pointed out, "the public would want to know what can happen to me if I am exposed to an oil spill." 21743-21747
Mr. Green pointed to Exhibit B80-3, page 152, where he explained "there's a discussion of exposures related to different types of spills…and then a summary of human health effects. Dr. Wier answered that she could not see the section describing health effects." 21749-21760

Mr. Yee answered, "The purpose of this risk assessment is not to essentially provide a literature survey of health effects associated with exposure to chemicals", indicating the assessment looks "at the consequences of a full-bore rupture and the exposure to the chemicals thereof." He added that HC asks the Proponent to speak about risk, not to predict health effects. 21761-21767

Discussion on the subject continued. Dr. Wier persisted with questions about the lack of descriptions of health consequences. Dr. Stephenson likened the assessment to the health effects of tobacco smoking, stating, "we still don't have that certainty for individuals regarding their decisions of when to smoke and how much to smoke… that does not translate into an ability to predict a specific health outcome." 21768-21781

Alternative sources for TRV data

Dr. Wier asked for the references for the TRVs in Table 9-5, page 137-8, Exhibit B80-3. Mr. Yee confirmed that HC doesn't provide short-term or acute reference values, and that the given TRVs "were sourced from other regulatory agencies such as the Agency of Toxic Substances and Diseases Registry." He provided other sources. 21782-21791

Turning to page 139, Dr. Wier noted HC's recommendations for alternative TRV sources. She asked why NGP didn't use most of the recommendations. Mr. Yee indicated that not all recommended organizations had TRVs for the chemicals in question. 21793

Dr. Wier asked why HC doesn't endorse the alternate TRV sources. Mr. Yee explained that HC's guidelines allow for the Proponent to use "even more credible reference values", which he pointed out in some cases may be more stringent than HC. Discussion on the subject continued. 21804

Dr. Wier continued with questions around the Health Canada Guidance, comparing figures given in the guidelines to those in the HHRA. Mr. Yee stated that HC changed some the guidance values after NGP had done its assessment, explaining why the HHRA didn't reflect the new values. Dr. Wier continued with detailed questions related to the values used. The witnesses continued to describe the conservative approach of their calculations. 21823

Dr. Wier asked why description of non-carcinogenic chronic effects of inhalation is not given in table 9-6, page 141. Dr. Stephenson again indicated that the report describes adverse health effects but doesn't attempt to predict "the specific nature of those effects." 21863-21872

More on developmental effects

Dr. Wier asked if the assessment considered TRVs based on developmental effects. Mr. Yee again explained, "the TRVs are based on the most sensitive end points", stating that developmental toxins are a less sensitive endpoint than others, so using it was not necessary. Dr. Wier asked if that meant that benzene doesn't have any developmental effects and Mr. Yee explained that TRVs are based on "a comprehensive review of all toxicological literature", reiterating that the most sensitive effect is the driving force for the TRV values. Discussion continued. 21888-21904

Looking at page 150 of Exhibit B80-3, Dr. Wier highlighted a sentence, "… *no long-term health effects would be anticipated*." She questioned why "would" is used instead of "are". Mr. Yee explained that the language is consistent with an assessment of a hypothetical scenario. Dr. Wier asked if the witnesses' level of confidence could be placed on the word "would" instead. Mr. Green answered that the words could not be substituted, adding similar comments about the hypothetical nature of the assessment. 21905-21913

Dr. Wier asked if the previously discussed statement applies to pregnant women, pointing to external literature that raises the issue of short exposure presenting risks to foetuses. Mr. Yee provided a detailed explanation, beginning by stating, "the dose makes the poison". He explained that the document Dr. Wier was referring to included persistent pollutants that are not found in the hydrocarbons in question, and that the relevant chemicals included are not developmental toxins. 21914

Discussion continued and Mr. Yee explained that NGP's assessment addresses effects of consumption of food and water, dermal contact, and other non-inhalation exposure pathways. Mr. Yee also explained that the external study derived its TRV values from studying effects to rats, and described ways in which it wasn't applicable to the to the assessment in question. Discussion continued. 21927

The dose is the poison

Dr. Wier again noted Dr. Maki's quote from Volume 143, "*the dose is the poison*." She asked for agreement with the statement. Mr. Yee answered that the principle is general and has guided toxicology for 400 years. Dr. Wier asked how the statement relates with the idea that developmental toxicant exposures at a low dose and short duration may present risks to foetuses. Mr. Yee opined that the principle is still applicable, stating, "there's always a dose lower in which it will not cause an effect." 21936-21942

Discussion continued around whether or not short-term, small doses cause health effects, with Mr. Yee indicating, "You can be exposed to chemicals and be essentially safe. If that wasn't the case, we might be having a lot more health issues than observed." 21943-21944

Looking at page 150 of Exhibit B80-3, Dr. Wier noted a section where "respiratory effects" was missing from a list of acute effects. Mr. Yee agreed. 21960

Cumulative effects

Dr. Wier asked if consideration should be given to cumulative effects from both acute and chronic exposures, questioning if acute could worsen chronic exposure. Mr. Yee answered that an acute exposure wouldn't necessarily exacerbate chronic exposure. Dr. Wier asked for some evidence on the matter and Mr. Green explained the course of action following a spill, which would involve closures of areas around the spill site and banning of certain food and water, so as to protect humans from exposure, as indicated in Exhibit B3-42, page 62. 21980

Duration of acute risks following a spill

Dr. Wier highlighted a statement from page 182 of Exhibit B80-3, "*the high acute risks occur for only a few hours for each spill location*." She brought up a separate document noting the evacuation zone for the Kalamazoo oil spill, which indicates elevated benzene levels three days following the spill. She asked how NGP could justify its statement, given such evidence. 22020-22028

Discussion continued and Mr. Yee stated that NGP's models were for local rivers, indicating that NGP couldn't comment on the case of the Kalamazoo spill because the models wouldn't be relevant to that river. He confirmed that the assessment predicts high acute risks in the modelled areas within the given timeframes of "only a few hours". Discussion continued. 22030-22056

Dr. Wier asked about endocrine disruption effects from polycyclic aromatic hydrocarbons (PAHs). Mr. Yee responded that HC and the World Health Organization have not directly linked PAHs to be endocrine disruptors. Discussion continued on the reliance on HC and whether the Department is generally behind on such research. 22060

Uncertainties of the SIMAP model

Dr. Wier highlighted statements regarding the marine and freshwater environment SIMAP models, from Page 198 of the Exhibit. She noted that the spill models "are based on decades of experience". Given this, she asked why there are so many sources of

uncertainties, such as: the unknown effects of thousands of chemicals in oil products, and a lack of validation of the physical and chemical processes of oil in the environment. She asked why NGP was offering to conduct further research on the uncertainties. Mr. McHugh spoke about the recommendation to better understand fate of dilbit, especially with respect to interactions with sediment. 22075

Drag-reducing agent

Dr. Wier asked for details related to the drag-reducing agent, as introduced in Exhibit B184-2. Mr. Doering described the agent, EXTREME Power 1000. He explained that NGP is considering injecting two barrels of the product, per day, into the pipeline. It is mixed with the oil to reduce friction within the pipeline and improve flow characteristics. 22121

Dr. Horn explained that the main toxicological ingredient in EXTREME is ethylene glycol, or antifreeze, and indicated that the effects of the product in a spill would be negligible given the small concentration of it in the oil. Mr. Yee stated that the chemical degrades in the environment, so it will not be persistent and will have limited effects. 22131

Dr. Wier asked some general questions about the HHRA model. Mr. Yee again stated his confidence in the model and the conservative assessments. He confirmed, "there could be some adverse and significant health effects in the event of a full-bore rupture under the spill scenarios… without mitigation." 22146-22152

Mr. Yee's CV

Dr. Wier asked why Mr. Yee didn't offer an erratum to his CV because of an inaccuracy contained in it, when she first noted the problem in a previous hearing. Mr. Yee answered that he made a verbal correction to the error when he realized there was an error. Dr. Wier asked if Mr. Yee was prepared to make an erratum on his expert evidence as well as his CV. Discussion continued. 22154

Examination by Mr. Andrew Hudson for the Joint Review Panel 22184

Mr. Hudson asked for details of ultimate and serviceability limit states for the locations such as the Chist Creek crossing, as indicated in the Kitimat Valley design, construction and operations study report in Exhibit B83-8, Section 5.6. Mr. Doering answered that the panel didn't have enough information to provide details on the limit states, and offered to provide it through an undertaking. Mr. Hudson added requests for information on how NGP will determine primary and secondary loads, and environmental conditions to be used. He also asked for how NGP will determine strain capacities of the pipeline for the given locations. 22186

Mr. Hudson asked about Direct Pipe techniques and how they differ from other techniques such as micro tunnelling. Mr. Cavers explained details of Direct Pipe, a subset of micro-tunnelling techniques. Mr. Hudson asked if it had been used in similar pipelines. Mr. Cavers answered that Enbridge has used it before. 22210

Drag-reducing agent

Mr. Hudson asked about the functions of the drag-reducing agent that NGP proposes to use in the pipeline. Mr. Doering explained that the product reduces friction within fluid at along the pipe sidewalls, but that it doesn't necessarily reduce turbulence within the fluid. 22218

Mr. Hudson asked about the product's impact on internal corrosion susceptibility. Mr. Mihell that the agent does not cause such effects, as confirmed by NGP's investigations. He answered that Enbridge has used the agent extensively. 22220

Potential route revision

Mr. Hudson asked about a proposed route revision in the Burns Lake area, as indicated in Exhibit B183-46. Mr. Doering and Mr. Cavers spoke about tentative solutions for the location, which hasn't yet been finalized. Mr. Hudson asked if environmental or socioeconomic effects had been assessed for the alternative route and Mr. Cavers answered that neither had yet been conducted. Mr. Anderson answered that the final decision to deviate from the proposed route had not yet been made, and deferred to Witness Panel 6 for that decision. 22232

Mr. Hudson noted that the alternate route falls outside of the project effects assessment area and asked about implications for the *CEA Act* Assessment. Mr. Anderson indicated that a decision would hopefully be made soon, and that NGP may have to look at the consequences of a subsequent filing for the *CEAA*. 22245

Impacts of climate change on geohazards

Noting a section on climate information for the Kitimat Valley Design report, Exhibit B83-8, page 20, Mr. Hudson asked about the impact of climate change on the frequency and severity of geohazards in the Kitimat Valley and on the pipeline. Mr. Cavers indicated that climate change would magnify the already existing geohazards. He spoke about expected increases in precipitation resulting in more frequent and larger debris flows, as well as deeper scour events. He also mentioned more extensive lateral erosion. 22251

Mr. Cavers continued, describing the conservative design techniques used to mitigate the effects of increased scour, avulsion or other events. He spoke about learnings from the past 50 years of pipeline operations and the improved pipeline designs. Discussion moved to geohazard modeling and Mr. Cavers' explanation of the need to "have a look at the detailed routing to be alert for things like avalanches, heavier snow packs, wet snow sliding, blocking a stream, triggering an avulsion…" 22258-22266

Discussion continued on expected deep-seated slide events. Mr. Cavers spoke about the history of such events in the area and the design components of pipeline in consideration of deep-seated slide. 22267

Mr. Hudson asked what flood return periods were being used, "1 in 100, 1 in 200 years?" Mr. Cavers stated that there isn't a huge difference between the two, indicating "it probably will be the 1 in 200", adding further rationale on the subject. 22274-22279

Mr. Hudson asked how confident NGP is, "that all geohazards will be identified and avoided or mitigated so they don't pose an appreciable risk to the pipeline?" Mr. Cavers answered, "we think we have a very good starting point here…[which] will be refined in the next…few years as we go into detailed design, get more LiDAR, get more investigations." Mr. Cavers spoke about the possibility of an advisory group to gather further input from experts. 22280-22287

Further discussion ensued on details of the potential geohazard working group. 22288

Impacts on drinking water quality

Mr. Hudson noted that Health Canada had submitted a comment for consideration to the JRP, that NGP "*Did not assess the effects of the proposed project on drinking water and recreational water quality on human health*". Mr. Hudson replied that the panel was aware of the letter and that consideration of water quality issues hadn't been included in the risk assessment because the planned mitigation measures would ensure closures for any effected sources of drinking water. He also explained that the marine terminal operations didn't consider drinking water because the water is salty. 22290-22295

Examination by Member Kenneth Bateman of the JRP 22301

The witnesses' concerns of uncertainty

Member Bateman asked the witnesses for their views on the greatest uncertainty or vulnerability in the Kitimat River drainage area in terms of emergency response preparedness. Mr. McHugh spoke about variability in meteorological conditions playing a role in responding to an incident. He also mentioned areas that are "fairly devoid of human activity", potentially making detection and reporting an issue. Dr. Taylor agreed with Mr. McHugh's uncertainties and spoke about his confidence in the development of the framework to address such issues. 22302

Mr. Green pointed out that although NGP is responsible for funding and initiating the monitoring program, there is uncertainty about which agency is responsible for making decisions and following up after a spill in terms of monitoring, food and water safety, reporting, and other processes. 22316

Mr. Cavers spoke about the need for more weather and climate data for the area, which is valuable for operational planning, construction, and design. Dr. Taylor spoke about the importance of pre-SCAT work- such as delineating segments along watercourses, identifying bank and flow characteristics- for emergency response preparedness. 22321

Examination by Sheila Leggett, Chairperson of the JRP 22328

Spill response exercise and training

The Chairperson asked Dr. Taylor about about optimal spill response exercises, given his experience and expertise. Dr. Taylor talked about the importance of integrated exercises, noting that the onus is on industry to bring various parties together. He stated that training

and exercise is what defines a response's success, and provided details on various exercise elements. He also highlighted the importance of bringing together these elements during the development phase of the project, as well as continual improvement to plans through practice.

Discussion between The Chairperson and Dr. Taylor continued, with Dr. Taylor providing further advice for emergency preparedness exercises and systems and exercises. See transcript for specific details. 22349

More on acute and chronic health effects

The Chairperson followed up on earlier comments from Mr. Yee. The witness confirmed that he had stated that an acute effect wouldn't necessarily exacerbate a chronic effect. She asked if in some cases, acute effects would exacerbate chronic effects. Mr. Yee responded that there are some instances, and gave an example with exposure to hydrogen sulfide causing permanent damage and giving way to chronic health effects. 22370

The Chairperson asked if Mr. Yee was testifying that such an effect would not happen as indicated in the health study for the given project. Mr. Yee answered that aside from temporary effects, he doesn't expect the exacerbation of chronic effects resulting from exposure to the chemicals discussed for the Project. 22374

The Chairperson asked Dr. Stephenson for his perspective on the subject, in relation to ecological effects. Dr. Stephenson provided details about harm to aquatic species. The Chairperson reiterated her question about acute effects leading to chronic effects and Dr. Stephenson spoke about the reversibility of effects when fish are exposed to hydrocarbons below chronic levels. 22376