Deep Geologic Repository Project

Joint Review Panel
Public Hearing

September 11th, 2014

Royal Canadian Legion
219 Lambton Street
Kincardine, Ontario

Joint Review Panel

Stella Swanson
James Archibald
Gunter Muecke

Co-Managers:

Kelly McGee
Debra Myles

Projet de stockage dans des couches géologiques profondes

Commission d'examen conjoint
Audience publique

Le 11 septembre 2014

Royal Canadian Legion
219, rue Lambton
Kincardine (Ontario)

Commission d'examen conjoint

Stella Swanson
James Archibald
Hunter Muecke

Cogestionnaires:

Kelly McGee
Debra Myles

TABLE OF CONTENTS

Kincardine, Ontario / Kincardine (Ontario)

--- Upon commencing on Thursday, September 11, 2014 at 9:00 a.m. / L'audience débute le Lundi 11 Septembre 2014 à 9 h 00

***OPENING REMARKS**

MME McGEE : Bonjour, Mesdames et Messieurs.

Good morning and welcome to the public hearing of the Deep Geologic Repository for Low and Intermediate Level Radioactive Waste Joint Review Panel.

Bienvenue à l'audience publique de la Commission d'examen conjoint pour le projet de stockage de déchets radioactifs à faible et moyenne activité dans les formations géologiques profondes.

My name is Kelly McGee, I am the Co-Manager for the Joint Review Panel and I would like to address certain matters relating to today's proceedings before we begin the scheduled presentations.

We have simultaneous translation. Des appareils de traduction sont disponibles à la

réception. La version française est au poste 2.

The translation devices are available at the reception desk and the English version is on Channel 1.

Please keep the pace of your speech relatively slow so that the translators can keep up.

A written transcript is being created for these proceedings and will reflect the official language used by each speaker. Transcripts will be posted on the Canadian Environmental Assessment Agency website for this project. To make the transcripts as meaningful as possible, we would ask everyone to identify themselves before speaking.

As a courtesy to others in the room, please silence your cell phones and other electronic devices.

These proceedings are being webcast live. The webcast can be accessed from the Canadian Nuclear Safety Commission Website at www.nuclearsafety.gc.ca.

A detailed agenda for all eight days of these proceedings was published on August 26th and is available on the website for

the project. Daily agendas are also being posted each day online and are available at the reception desk to reflect any necessary last-minute scheduling changes.

The hearing will begin each day at 9:00 a.m. and wrap up at approximately 5:00 p.m.

The Panel has asked a number of federal departments and provincial ministries to be available and we have representatives from the Ontario Ministry of Transportation here in the room today and we will have a number of other departments and ministries available by phone.

Emergency exits are located at the back of the room and to my left behind the screen and curtain. In the event of a fire alarm, you are asked to leave the building immediately.

Washrooms are located in the lobby of the main entrance and the wheelchair access and ramp is located in the back parking lot.

If you are scheduled to make a presentation at today's session, please check in with a member of the Panel Secretariat at the

back of the room. Each member of the Secretariat staff is wearing a name tag to help you identify them.

If you are a registered intervener and want to seek the leave of the Chair to propose a question for a presenter, you are also asked to speak with a member of the Secretariat staff. A proposed question must relate to one of today's presentations and access to the microphone may not be used to make a statement.

If you are not scheduled to make a presentation during these hearings, but would like to seek the leave of the Panel to make a brief oral statement, please speak with a member of the Secretariat staff and complete the application form. An opportunity to make a brief statement is subject to the availability of time at the end of the day and must be for the purpose of addressing one or more of the six permitted hearing subjects.

Opportunities for either a proposed question to a presenter or a brief statement at the end of today's session will be provided, time permitting.

In accordance with the Panel's Rules of Procedure, the resumption of this public hearing is solely for the purpose of addressing one or more of the identified six subjects. Again, neither presentations nor questions will be permitted if they do not follow these Rules of Procedure.

Anyone who wishes to take photos or videos during today's session should speak with the Joint Review Panel's Communications Advisor, Ms Lucille Jamault. Lucille is at the back of the room and is there to help you with any of your questions.

Thank you very much.

THE CHAIRPERSON: Good morning and welcome everyone to today's proceedings. First of all, let me, on behalf of the Joint Review Panel, welcome everyone here in person or joining us through the webcast.

My name is Stella Swanson, I am the Chair of the Joint Review Panel for the Deep Geologic Repository for Low and Intermediate Level Radioactive Waste Project.

I am going to introduce the other Members of the Joint Review Panel. On my right

is Dr. Gunter Muecke and on my left is Dr. Jamie Archibald.

We have already heard from Ms Kelly McGee, the Co-Manager of the Joint Review Panel, and we also have Mr. Pierre Daniel Bourgeau, counsel to the Panel, with us on the podium today.

As noted in the published agenda, the subject for today's session will be the risk analysis of alternative means.

Before we begin, I would like to explain the procedure for questions from participants or presenters. The Panel will ask its questions after each presenter unless otherwise stated, such as may be the case for government and OPG presentations.

As we did yesterday, the Panel will consider, time permitting, questions submitted by registered participants at the end of the day once the Panel has heard from all presenters.

Participants are reminded that questions must relate to today's presentations.

We will now proceed with presentations by The Ontario Power Generation and

the Canadian Nuclear Safety Commission pertaining to the subject of the relative risk analysis of alternative means. The Panel will hear both presentations before proceeding with its questions.

I would like now to call on the Ontario Power Generation Independent Expert Group to begin their presentation.

Ms Swami, the floor is yours.

***PRESENTATION BY / PRÉSENTATION PAR:**
ONTARIO POWER GENERATION

MS SWAMI: Good morning, Dr. Swanson and Members of the Panel. My name is Lori Swami, Senior Vice President of OPG's Decommissioning and Waste Management Organization. Today OPG's presentation will address EIS-12-513, Alternative Means Risk Analysis.

In this Information Request, the Joint Review Panel required OPG to have analysis undertaken by independent risk assessment experts. In order to meet this requirement, OPG hired an independent group chaired by Dr. William

Leiss. We provided them with the JRP direction and information necessary to respond to the IR.

To maintain independence, the IEG had complete control over the work. When completed, OPG received the report and submitted it to the Joint Review Panel.

Today's presentation is on the relative risk assessment of the four alternative means identified by the Panel. Tomorrow, the IEG will present on the risk perceptions of the four alternative means for managing the storage and disposal of low and intermediate level waste.

Dr. Leiss, as the head for the group, will now take over the presentation.

DR. LEISS: Thank you. I have all my colleagues with me here and we intend to make this presentation in four parts so that each of the panellists have a chance to speak.

On my left Greg Paoli, and further left Maurice Dusseault, and behind us Mr. Tom Isaacs. So I will call on my colleagues at the appropriate time to continue the presentation.

We will, in this presentation dealing with the relative risk assessment,

present an overview of the questions we were asked, of the method with which we chose to respond to the questions, and a brief description of the type of responses we provided.

We started with the concept of relative risk in order to define the parameters of our work in the sense that the charge, as we understood it from the Panel, explicitly required us to employ the concept of risk in comparing different options for the disposal of low and intermediate level nuclear waste.

Risk is defined as a concept that integrates two different aspects of a potentially dangerous or hazardous activity. These concepts are probability, often referred to more casually as a likelihood; and, second, consequences associated with different events. Both of these concepts are considered jointly when thinking about risk.

Characterizing options on the basis of risk is distinct from characterizing options on the basis of consequences alone. While it may be appropriate in some context to place greater or exclusive focus on consequences, we have been asked specifically to consider risk

in characterizing these options, which forces us to consider the relative likelihood of various types of consequences.

This is a key component to understanding how our results may vary from other characterizations of the disposal options which have been and will be presented at these hearings.

We will return to the specific components of relative risk when discussing the precise nature of our charge from the Joint Review Panel.

We will now proceed to the next slide. We have two slides on the four options that we considered and I would ask my colleague, Maurice Dusseault, to present those two slides and some additional comments.

MR. DUSSEAULT: Thank you very much, Dr. Leiss.

Madame la Présidente, ça me donne un grand plaisir d'être ici pour vous parler aujourd'hui. Je vais parler en anglais, mais si vous avez des questions en français, je peux aussi répondre.

I will speak in English. The

options that were presented for us to assess in a relative risk context were fourfold, two at the surface and two that we call DGRs, deep geological repositories.

Before we describe the new methodology that was developed by us to evaluate the relative risk of these four options, permit me to describe the nature of these four options.

The two surface options comprise options to place materials near or on the surface at the Western Waste Management Facility at the Bruce site. The status quo is what it says, the status quo, with the waste being repackaged on a fifty-year cycle and stored in structures similar to or perhaps slightly ameliorated compared to the structures that currently are used for this purpose.

The second surface option is the enhanced option, which would be a somewhat hardened surface option with perhaps more shallow burial, I'm speaking of a few metres, berms, more robust containment structures. For this option it is assumed that the waste containers are built and rebuilt every hundred years.

And for both of the surface

options we assume that storage will be required for a very long time. The term in perpetuity is perhaps a bit much, but for the foreseeable future and that means the foreseeable distant future.

The two deep geological repository --

DR. LEISS: Next slide, please.

MR. DUSSEAULT: Thank you.

The two deep geological repository options presented us with a little bit of a conundrum because one is an actual physical site that has been subjected to fairly rigorous site investigation and the other is a hypothetical site which forced us to make certain assumptions as to what a hypothetical site would be, what the constraints on a hypothetical site would be.

Nevertheless, the two options are a deep underground chamber in the un-deformed sedimentary strata beneath the Bruce nuclear power generation site close to us here at approximately 700 metres depth in the Cobourg formation, access through a shaft that would later be sealed with appropriate engineered

barriers.

With the granite site in an unspecified location, we assume that the shafting and the mining and the sealing would, for all intents and purposes, be identical to that of the Cobourg information site on the Bruce generation site, but it would be located in the Canadian Shield in an igneous rock mass of suitable quality and with geographical and hydrological features similar to that of the Bruce site so that a reasonable comparison of relative risk could be made.

Now, we have available to us, of course, commentary that will be tabled later on during these hearings and we felt that it was appropriate, now that these four options are defined, to address some of those comments in a general manner at the present time.

Specifically, we have some comments from CNRS that we took extremely seriously, of course, and examine them in detail.

Our first observation is that, in the comments, it becomes clear at the end of the comments, that the CNRS agree with our report and they said so explicitly.

With respect to the charge that certain phrases in our report are misleading, we reread our report carefully, all of us, and we have concluded that when taken in its entirety that our report is not misleading in terms of its comparison between a site that is well-defined at the Bruce generating site and a hypothetical site that exists in the Canadian Shield in Ontario with geographical and hydrological conditions similar to the Bruce site.

It is important to assess the report in its entirety and avoid taking things out of context, especially when we are discussing complex and interrelated issues involving comparisons with hypothetical cases.

Thank you, Madam Chairman.

Dr. Leiss...?

DR. LEISS: Thank you. Thank you, Maurice.

Next slide, Greg.

MR. PAOLI: Greg Paoli speaking now. So I am going to review the Joint Review Panel charge to the independent expert group as it pertains to understanding how we approach the relative risk assessment method.

So the Joint Review Panel provided a detailed charge to the independent expert group requesting a risk assessment with the following qualities: the characterization of risk among the options should be relative; the characterization should be qualitative, which we understood to intentionally exclude quantitative expressions of risk; and, the process and results should be transparent, defensible and repeatable.

And we'll return to the method and the means by which we have tried to achieve these objectives and charges.

As such, we defined the specific method to allow us to meet these requirements, the results of which are found in our two relative risk assessment reports.

So more specifically, in addition to these qualitative factors, the charge to the IEG was specific in requesting consideration of a variety of sources, pathways and receptors of harm. The specific category of socioeconomic impacts was explicitly excluded from our charge.

A key aspect of the charge as well was to limit the scope of our conclusions to judge relative risk among the options on each of

the individual criteria and not to provide a summary conclusion across these criteria, nor to provide an overall recommendation or characterization of the options.

We have explicitly avoided providing any kind of multi-criteria summary score or risk estimate in keeping with this aspect of the charge and respecting the distinct roles of the IEG and a Joint Review Panel in this matter.

Importantly, we have also not characterized any of the options as preferable to any other options, nor have we characterized any of the options as either safe or unsafe.

I will now describe the four steps. So in order to address the charge to the IEG by the Joint Review Panel and to meet the timelines provided, we developed an approach which consisted of four main steps.

Our first task was to review the Joint Review Panel charge questions in detail and to clarify our understanding of the four alternative means, that is, the four disposal options specified by the Joint Review Panel.

Next we organize the various

criteria requested by the JRP into a set of pathways of harm to ensure that we have captured all of the considerations requested. These pathways are described on the slide following this one.

We then prepared a relative and absolute qualitative risk assessment for each pathway of harm. We then prepared a set of observations to provide some context and analysis of our findings.

As previously stated, there was no step that included reaching a conclusion on which of the four disposal options might be deemed to be preferable, safe or acceptable.

In Step 2 of the approach just described, we assembled these considerations into 12 different criteria which we refer to as pathways of harm. In using the word "pathways", we mean causal pathways in the sense of potentially complex chains of cause and effect as opposed to specific physical pathways.

In using the word "transport", as you will see on items three and four above, we refer to the movement of radionuclides as opposed to accidents that may occur during

transportation.

Each of these pathways is described over two timeframes with three exceptions, being glaciation and loss of institutional control, which are only considered over the longer timeframe, and radiological exposure during transportation accidents, which is only considered in the earlier timeframe.

In characterizing risk for each of the first 11 pathways, there is an assumption that societal institutions are maintained intact. For the last pathway, in which we consider the long-term loss of institutional control of the waste sites, all of the other pathways of harm are reconsidered in that context with the consequences being effectively summed across these potential pathways under the loss of institutional control scenario.

The relative risk assessment exercise, as a result, was considered essentially twice over two timeframes.

The first timeframe reflects 100 years of operation of any of the storage options. The 100-year timeframe was selected to correspond to the point at which it is assumed that the deep

geological repositories are closed and sealed. It also reflects one lifecycle for the enhanced surface storage option and two lifecycles for the status quo surface storage options in terms of the replacement of buildings and waste containment materials.

The second timeframe captures the long-term and perpetual storage for each of the four options. In this long-term period, the DGR options are assumed to be closed and sealed, with no expectation for any human or mechanical access to the waste.

For the surface options, the facilities and containers are replaced and maintained according to their respective lifecycles as long as is necessary for each level of waste.

I will now describe some sample results. In the interest of time we present only a few sample results in order to provide the opportunity to explain the method and the results. We will characterize the full set of results for one of the 12 pathways of harm, specifically, worker health and safety.

We will also provide an example

of a summary view of the qualitative relative risk assessment across multiple pathways of harm as requested by the Joint Review Panel and the primary purposes of the second of our two relative risk assessment reports, that being the multi-pathway view.

We ask that you take note that there are no summary statements provided regarding the preferability, acceptability or safety of any of the disposal options. We did not include an overall judgment and have never attempted to form a consensus in favour of any of the options, contrary to some characterizations of our findings which may be found in recent media coverage.

Our process has been compared to that of multi-criteria decision analysis as well. In fact, while that's true to a large extent, in our method we have not completed the final step of a standard multi-criteria decision analysis approach, which is to weigh various criteria in order to render a preference ordering of the various options. That final step was not conducted.

For each pathway of harm in this

example of worker health and safety we delineated what mechanisms of harm or exposure were considered to fall within that category or pathway of harm. We also made note of exposure types that were excluded from that pathway, and the slide provides examples of that type of delineation for this particular pathway of harm.

In addition to various textual characterizations of likelihood, consequence and risk, such as the previous slide and the following tabular slide, the relative risk assessment process was facilitated through the use of a visualization technique. In this technique, the status quo option, here in the slide a circle with the letter “s” inside, “s” for status quo, is always at the centre of the diagram, and all references to probability or consequences are considered relative to this. As such, “much more likely” refers to an event that is considered much more likely when compared to the status quo option.

The display also represents logarithmic variability in both consequences and likelihood dimensions. This is intended to reflect the reality that the relative probability

between events can span many orders of magnitude or, to put it another way, they can represent differences by factors of thousands and millions in probability. This is the basis for including a logarithmic graph.

In addition to the main relative risk assessment exercise, we included a qualitative absolute risk assessment component in order to allow the likelihood and consequence dimensions across different pathways to be compared and qualitatively communicated.

I should also mention that the logarithmic variability applies to both the likelihood and consequence dimensions in that the significance of the consequences, if quantified, could also represent many orders of magnitude in their difference.

Once the expert group had reached consensus on the relative and absolute location of each option on the relative risk diagram, and the inset absolute risk diagram, the overall statement of the relative risk compared to the status quo was described in a tabular format. In the slide you'll see in the second row things like “equals risk”, “risk” with a single up

arrow, and so on. We provided indications of essentially equivalent risk for indications of elevated or decreased risk expressed with one or more up or down arrows.

In addition, the key assumptions that drove the assessment of relative likelihood and consequence were noted in this tabular format in the report.

This graphical result on the screen now represents the same pathway of harm but separately assessed under the assumption appropriate to the longer term timeframe. At the top of the slide you see the indication of the timeframe, greater than 100 years. This view illustrates one exception to the logarithmic nature of the graphical representations. In some cases, the assessment of probability was that something would simply not occur or for the assessment of consequences that it would be negligible for that receptor of interest.

As can be seen in the figure above, given that the DGR options are assumed to be closed and sealed, with no further access after 100 years, the likelihood and consequence components are denoted as, respectively, “does

not occur” and “negligible or no consequence”.

In the absolute diagram view, and that's the inset area at the top left in this view, the icon is placed on the axis to represent vanishingly small values or zero.

Once again, the tabular assessment was also provided for both timeframes with separate sets of assumptions and separate assessments of relative risk once again compared to the status quo option.

The graphics shown here serves as a reminder that our charge was to express the relative risk associated with each pathway of harm. This requires the separate and then joint consideration of both likelihood and consequences and their integration into a single qualitative expression of risk.

In addition, in a follow-up request we were asked by the Joint Review Panel to summarize all of our findings in a single view for each of the two timeframes considered. Our assessment resulted in considerable variability in the risk associated with the different options and for the different pathways. We reiterate the logarithmic nature of this diagram in which both

likelihoods and consequences vary substantially over many orders of magnitude. While we have not quantified the probabilities and consequences, it is important to understand that if they were quantified they would span several orders of magnitude. The range of risk is even more magnified in the longer term timeframe period shown next.

Due to the nature of the assumptions underlying our perpetual storage scenario, the likelihood of many naturally recurring, accidental, mechanical or structural failures becomes essentially certain or a probability approaching 100 percent since when considering a sufficient amount of time they become essentially inevitable. The key differentiation for many of these events lies in the level of consequences associated with these events. For surface mitigated events, like severe weather, glaciations, there is assumed to be either no consequence or minimal consequences for waste stored in the deep repositories. Some activities are assumed to cease entirely after 100 years, such as worker activity associated with the deep geological repositories and the

transportation of waste between storage sites.

DR. LEISS: The final set of slides will be presented by Mr. Isaacs.

MR. ISAACS: Thank you very much. It's a pleasure.

My job is to provide you with a summary of our activities to describe briefly the characterization of the methods that we used in this exercise to communicate our findings and hopefully to show you how we met the requirements and the charge from the Joint Review Panel.

We were given five criteria to use to guide our analysis and that made a marked distinction on how we decided to organize to carry out this charge.

The first of those was that this was to be a relative risk assessment and that was to be the primary output of the exercise, so we looked at each of the options compared to the status quo, as you've seen, for each of the 12 pathways of harm and for the two timeframes. That was the relative nature. It was a qualitative assessment, it was not a quantitative assessment, based on the charge that we received. It looked largely at the relative likelihood of

likelihood and consequences, reasoning that more, much more or much less were the kinds of distinctions that we would be able to make and therefore we used the log scale because, as Greg said, this spans many, many timeframes.

We tried to be quite transparent. In fact, we've received lots of comments, and you've received lots of comments, about this analysis, which kind of demonstrates that it was transparent enough that people could follow the analysis and the reasoning that we used. Others can legitimately and understandably come to different views on those rankings but, nonetheless, the fact that it was transparent allowed people to do that within that timeframe.

As you've seen from the presentation so far, we worked quite hard to describe option by option and pathway by pathway how we arrived at our conclusion for the scoring in that qualitative sense, and with respect to the likelihood and respect to the consequences.

The repeatable charge was a little more difficult because in a scientific fashion people expect to be able to conduct an experiment and if you keep the same set of

criteria you should be able to repeat the experiment. This is not an experiment in that classical scientific sense. What we did try to do was to put this together in a way that people could indeed repeat this by looking at our highly transparent process and defensible process in a way that they could see how we reached the results that we reached while also allowing people who might have different views on some of these criteria to use this formulation and come to their own set of judgments on it. We believe we met those five charges in that way.

The original charge asked us to look at community acceptance in the local and regional area. On February 18, 2014, we identified a list of documents we had received in this regard and statements of local support in the area here. We're also aware of countervailing statements by folks against the Bruce DGR and other options. We believe and arrived at the conclusion that we would not be able to conclude the relative community acceptance of these various options in any kind of defensible way. In particular, when one looks at a theoretical siting of a granite repository

versus an actual siting of a Bruce repository, when one looks at a surface facility versus a deep geological repository we felt it was beyond our capability and we wanted to make it clear that we couldn't do that.

With regard to our final results and observations, you've already heard that we did not express a preference among the four disposal options. That was what we were asked to do and that's what we did. It would take, indeed, some additional judgment and additional work on a multi-attribute utility analysis framework in order to do that, so we didn't. I think that reflects the criteria that we were assigned by the Joint Review Panel.

We deliberately avoided the concept of a summary measure of risk or summary conclusion on these options or on the alternate methods of disposal or on the overall safety of these options. This was clearly a relative analysis.

We understand and respect the fact that the level of consequences involved does involve some amount of social valuation. We could not avoid that. And it's also entirely

reasonable and not just based on expertise to understand that some might have entirely different perspectives on the consequences and the level of consequences that one might associate with these various pathways.

The most understandable and prominent one, of course, is the characterization of the consequences from the site being relatively close to Lake Huron.

Those are judgments that go beyond our technical evaluation. We provided a technical analysis of our views of the safety -- relative safety of the various options as they were portrayed to us. We did not include the social valuation that other people are free to choose.

The last comment I would make is that when we look at these four options, the greatest distinction appears when one looks at the very, very long time frame and the assumptions one makes about the ability or lack of ability to maintain institutional control for essentially geologic time periods.

In our evaluation, we, as most organizations who have wrestled with this around

the world, have concluded is you cannot count on institutional control into the indefinite future and, therefore, that definitely marks one views about vulnerability and risk to certain options if you believe that at some point in the long-distance future there is a loss of institutional control.

With that, I'll stop. Thank you very much.

DR. LEISS: Thank you. That concludes our presentation.

THE CHAIRPERSON: Thank you very much.

We will now proceed directly to the presentation by the Canadian Nuclear Safety Commission.

Dr. Thompson, would you please proceed?

***PRESENTATION BY / PRÉSENTATION PAR:**
CANADIAN NUCLEAR SAFETY COMMISSION

DR. THOMPSON: Merci. Bonjour, Madame la présidente, messieurs les commissaires.

Mon nom est Patsy Thompson. I'm

the Director-General of the Directorate of Environmental Protection and Assessment at the CNSC.

With me today are Ms Kiza Francis, the environmental assessment specialist on this project, Drs. Julie Brown and Son Nguyen, geoscientists -- geoscience specialists in the Environmental Risk Assessment Division, Ms K. Klassen, the Senior Project Officer from the Waste and Decommissioning Division.

CNSC staff have reviewed OPG's submission of the Independent Expert Group report on the relative analysis of alternative means. Today's presentation summarizes CNSC staff's review as presented in PMD 14-P1.2.

I would like to mention that the CNSC staff reviewed the report for the purposes both for which -- the purpose for which it was intended as an assessment of alternative means specifically for this environmental assessment and we also looked at it from the point of view of how the information could be perceived and understood by the public to judge the suitability of the geology for potential other sites. And that's, I think, the comment that -- the context

for the comments that we've provided.

And so I will ask Ms Kiza Francis to continue with our presentation.

MS FRANCIS: Good morning, Madam Chair, Members of the Joint Review Panel.

My name is Kiza Francis. I am environmental assessment specialist at the CNSC.

The purpose of this presentation is to provide CNSC staff's review and assessment of OPG's response to the information request as prepared by the Independent Expert Group. The presentation will also discuss whether any new information impacted our previous recommendations and conclusions in Panel Member Documents submitted by CNSC staff in 2013.

The information request required OPG to provide a renewed and updated analysis of the relative risks of siting alternatives under alternative means requirements of the EIS guidelines. The analysis was to be qualitative, transparent, defensible and repeatable.

Options to be analyzed included the "as is" facility at the Western Waste Management Facility, which is considered the status quo, an enhanced surface storage at the

Western Waste Management Facility, also referred to as hardened on-site storage, the current proposed DGR in the Cobourg formation at the Bruce Power site, which is the current proposed project, and a conceptual DGR in granitic bedrock of the Precambrian Canadian Shield.

Furthermore, information required for a qualitative analysis of a conceptual DGR in granite bedrock was to be based primarily upon the extensive data and analyses available within the environmental assessment performed by Atomic Energy of Canada Limited, or AECL, for the environmental assessment panel for nuclear fuel waste management and disposal concept, also known as the Seaborn Panel.

The relative risk analysis was required to focus on 12 pathways of harm as indicated by the Panel in the information request.

The information request required an assessment of community acceptance of the alternative in the local and regional study area as well as with outside the regional study area. The analysis was to be undertaken by independent risk assessment experts.

The Independent Expert Group sought clarification on the assessment of community acceptance. The response from the Joint Review Panel indicated that a comparison of risk perception and risk acceptability among the four options should be provided.

CNSC staff reviewed the responses provided by the IEG for this information request. CNSC staff used guidance documents from the International Atomic Energy Agency, including the safety case and safety assessment for the disposal of radioactive waste, which is Specific Safety Guide SSG23, published by the IAEA in 2012, as well as the CNSC regulatory guide G320 assessing the long-term safety of radioactive waste management published in December 2006.

CNSC staff also carry out independent research on the safety of geological disposal. In recent years, this research has focused on sedimentary rock building on previous research from the 1970s to the 1990s that focused on granite that could be proposed as a potential repository host rock type in the Canadian Shield.

Furthermore, CNSC staff's assessments benefited from knowledge and

experience gained from participation in the Seaborn Panel, which concluded in the late nineties.

Generally, CNSC staff had no major concerns with the baseline information provided in the report. The information was adequate to complete the alternative means assessment required by the IEG. However, there were some specific statements made by the IEG that CNSC staff must clarify for the record.

Staff's observations presented in the following slides aim to qualify or amend statements made by the IEG in their report, including the characteristics of granite when comparing a hypothetical site in the Canadian Shield to the Bruce DGR site, loss of institutional control and how it was used by the IEG in the assessment, the short-term risk of tritium exposure, which was not explored, and worker health and safety.

I will now pass the presentation over to Dr. Julie Brown.

DR. BROWN: Good morning. For the record, I am Julie Brown. I'm a geologist in the Environmental Risk Assessment Division.

So these examples are important to note because they reflect on the introductory information about the geology that provides the main barrier for any Deep Geological Repository. Some statements in the report that make comparisons between the proposed DGR site at the Bruce Nuclear facility to a hypothetical site in the Canadian Shield are misleading, such as the one given in the example on the slide.

All granite bodies in the Canadian Shield are known to be naturally fractured, and the details of the disposition extent, connectivity and aperture, opening size, of these fractures are uncertain, and no amount of investigation can reduce the uncertainty to zero. The same could be said for sedimentary rocks, yet there is no corresponding statement in the IEG's report.

Some of these statements imply that limestones are not naturally fractured, yet limestone is known to be highly fractured in Ontario and elsewhere. This points to the importance of detailed geological investigations and research to support the safety case for a proposed DGR in any geological formation.

OPG conducted detailed characterization of the site currently proposed for the low and intermediate level waste DGR.

The Lac du Bonnet Batholith in the Canadian Shield was characterized as a sparsely-fractured granite during previous investigations into siting a DGR conducted by Atomic Energy of Canada Limited a couple of decades ago with no significant groundwater flecks, similar to what the IEG cites on page 11 for limestone at the Bruce DGR repository horizon.

AECL's underground research laboratory, now closed, was excavated in the Lac du Bonnet granite batholith. Granite observed at the underground research laboratory between a depth of 185 metres to 443 metres was described as essentially unjointed.

This example isn't to be taken as a general characteristic of granite, but just that, at a specific location, the host rock must be carefully characterized.

The observation here is that out of context statements about rock types in general presented in an expert report may give misleading

information about the suitability requirements for this and other DGR projects that may be proposed in the future.

The IEG report assumes that active institutional control could be maintained indefinitely for both surface options. On its own, the loss of institutional control is not a pathway of harm even though it has a strong likelihood of occurring in the future.

It could, in turn, lead to three major pathways of harm: enhanced transport of radionuclides by water and by gas due to the deterioration of containment structures, and inadvertent human intrusion.

CNSC guide G320, on assessing the long-term safety of radioactive waste management, states that:

> "As a result of uncertainties associated with future human activities and the evolution and stability of societies, current international practice generally limits the reliance on institutional controls as a safety feature

> to a few hundred years. This is corroborated by IAEA guidance in SSG 23."

Contrary to international practice and CNSC requirements, when considering the normal evolution scenario for the two surface options, the IEG assumes that active institutional control could be maintained indefinitely. However, in an IEG report appendix, it is estimated that loss of stewardship, presumably meaning the loss of institutional control for surface options, would result in a dose of 1,000 millisieverts per year for someone growing crops on land.

So because of the high likelihood of loss of institutional controls for the two surface options, the risk assessment results for transport of radionuclides by water and by gas should, therefore, be portrayed as having a high consequence for time frames in excess of 100 years and not as having the medium low consequence, as estimated by the IEG.

Without active institutional control, surface options for the management of the OPG's low and intermediate level radioactive

waste are not safe after a few hundred years. Canadian and international consensus is that institutional control cannot be guaranteed after a few hundred years; consequently, those surface management options are not considered to be safe beyond that period of time and would, therefore, not be considered best practice by the CNSC.

I will now pass the presentation back to Ms Francis.

MS FRANCIS: Thank you.

For the record, my name is Kiza Francis.

Tritium gas is a potential exposure pathway over the short term and could have been considered by the IEG in its evaluation of risks, although it was not required in the information request.

There is minimal information on actual releases of tritium gas as opposed to tritiated water from wastes at the Western Waste Management Facility and at similar facilities around the world.

Risks from this data gap are, nevertheless, low due to the very low dose conversion coefficient for inhalation of tritium

gas, hence the exclusion of these considerations by the IEG does not affect the report's overall conclusions.

The IEG report contains some generalized comments regarding the relative risk assessment of worker health and safety in the short time period, indicating that the underground alternatives would be both more likely and more severe.

While the 2012 data from the U.S. Bureau of Labour indicates that underground mines have a higher work-related injury rate. When broken down further, some underground mines have a lower injury rate than does the general construction sector.

Further, the work-related injury rate associated with underground mining is generally associated with the actual mining activity, i.e. the moving of rock materials, which, for a DGR, would be a short period relative to the overall operational period, whereas the surface facility options, constructions of new buildings and demolition of old ones, will occur on an ongoing basis over the entire operational period.

CNSC staff conclude that the overall likelihood and severity should have been rated as similar for both aboveground and underground options.

This completes CNSC's presentation on the baseline information in the IEG report. The remaining few slides will focus on the overall CNSC staff assessment of this information request.

As indicated in PMD 14-P1.2, CNSC staff found that the assessment was carried out at a relatively high qualitative level. The risk assessment methodology used by the IEG was determined to be sound and in line with multi-criteria decision analysis, an approach that CNSC staff considers to be adequate and have accepted for options analysis in a number of other projects.

What is important to note, and I will reiterate this at the conclusion of the presentation, is that the concerns that CNSC staff have raised with respect to the response to this information request do not affect the current safety case that has been reviewed and accepted by CNSC staff for the proposed DGR

project.

I will now focus the presentation on the portion of the information request regarding the relative risk perception or risk analysis of the four prescribed alternatives.

In PMD 14-P1.2, CNSC staff noted that the response provided an accurate overview of the concerns and positions expressed by both the public and Aboriginal groups in the submissions to the Joint Review Panel both before and during the 2013 hearings.

However, CNSC staff note that the response does not take into account CNSC staff nor OPG responses and information provided during the lead-up to and at the 2013 hearings.

We understand that this information request is looking to describe how the community views the different options. However, the responses and information provided by the proponent and the regulator as well as other government organizations may have impacted community views.

Risk acceptability is highly dependent on community trust in the regulator and the proponent. It is CNSC staff's priority to

ensure the protection of health, safety and security of people and the environment.

Furthermore, a part of CNSC's mandate is to provide objective, scientific regulatory information.

Regardless of the alternative that is being assessed, it is also important to note that OPG is required to have a public information program. The Nuclear Energy Agency 2012 document titled "Geological Disposal of Radioactive Waste, National Commitment, Local and Regional Involvement" also outlines best practices.

In CNSC staff's opinion, the activities performed by both CNSC and OPG staff within the communities both prior to and since the licence application was submitted conform to the following practices: openness, clarity, accountability, independence and competence.

These characteristics contribute to trust in regulatory institutions.

At this time, CNSC staff must stick to topics and criteria found in our mandate. In the previous two slides, we have indicated how CNSC staff provide objective

scientific information to the public and Aboriginal groups.

As noted in a previous Record of Decision published by the Commission, social acceptability is not a criterion that appears in the *Nuclear Safety and Control Act*.

So this concludes the slides on this topic, as there's no criterion that exists in the safety-focused regulatory framework of the CNSC to provide further review.

To conclude the presentation, the final two slides will focus on whether the information provided in the response to the information request has impacted the previous recommendations provided by CNSC staff to the Joint Review Panel.

With respect to the conclusions and recommendations submitted in PMD 13-P1.3 regarding the review of the environmental impact statement, no new information has been submitted that would impact the conclusions for the review of alternative means under the *Canadian Environmental Assessment Act*. Furthermore, the long-term safety case assessment and conclusions remain the same.

Turning to the conclusions and recommendations presented in PMD 13-P1.2, the review of the licence application to prepare a site and construct, the information provided in response to this information request also does not change the conclusions presented in PMD 13-P1.2, and CNSC staff remain satisfied that OPG is qualified and will make adequate provisions to protect persons and the environment.

That concludes CNSC staff's presentation, and we are available to answer any questions the Panel might have.

THE CHAIRPERSON: Thank you very much.

The Panel will now take a 15-minute break. We will reconvene at 10:15 and begin with our questioning of both the presenters.

--- Upon recessing at 9:57 a.m. /
Suspension à 9 h 57
--- Upon resuming at 10:17 a.m. /
Reprise à 10 h 17

THE CHAIRPERSON: We will now

proceed with questions from the panel. And I would like to start with Dr. Muecke please.

MEMBER MUECKE: Thank you.

The Panel would appreciate some clarification both by CNSC and the Expert Group about how they perceived and dealt with the loss of institutional control.

The Expert Group states that loss of institutional control has a very high probability. And this is interpreted by CNSC -- and correct us if this is wrong -- as meaning that the Expert Group proposes or factors in institutional control into perpetuity.

Could maybe the Expert Group first clarify how they perceive and then maybe CNSC?

MR. PAOLI: Greg Paoli, responding on behalf of the IEG.

I think page 32 of our follow-up report has a graphic regarding the loss of institutional control in which we indicate that the likelihood of institutional control at some point in the timeframe past 100 years that the likelihood is very high. And that we also indicate that the consequences at the surface

would also be very high. So that is essentially our findings.

Something else you would like us to clarify?

MEMBER MUECKE: On the long-time period or the short-time period -- short-time period or on the long-time period?

MR. PAOLI: I am talking only of the long-term time period.

In the short-term time period, meaning the first 100 years, we don't consider the loss of institutional control at all. It is not a pathway considered in that timeframe.

MEMBER MUECKE: Could we have CNSC's perception, and why they disagree basically with the Expert Group on this?

DR. THOMPSON: Patsy Thompson, for the record.

We did not disagree with the Expert Group in terms of their assessment that reliance in the long-term for institutional control was not appropriate. As has just been mentioned, the Expert Group did consider that loss of institutional control over the long-term periods was high probability.

We also agree, based on international guidance and our own CNSC requirements that relying on active institutional controls for safety of facilities for disposal of waste is not appropriate.

The difference we have with the Expert Group is they did not look at the consequences of the loss of institutional control in the relative assessment that was presented.

So they identify loss of institutional control as being likely, but they did not look at the consequences in terms of the impact on, for example, release of radioactive material in its transport and water and gas.

And also, as we pointed, they do identify that doses to someone farming on the site could potentially be high. But we didn't think that this was reflected in the overall relative risk assessment.

MEMBER MUECKE: To what extent, and this is to OPG, in the assessments of consequences, a 300-year time period for institutional control has been assumed? How do the findings of the Expert Group affect that assumption?

DR. GIERSZEWSKI: Paul Gierszewski, for the record.

So in the analysis that we did for the DGR site, the post-closure safety assessment, we considered that institutional controls would be available for at least a 300-year period.

We would not rely on or it would not be available beyond that. And so we assumed human intrusion occurred at 300 years and we used that as a basis for estimating the consequences of the human intrusion scenario.

We also, in response to some of the information requested, looked at the case of human intrusion on an earlier timescale, up to 100 years. So we had evaluated those as scenarios in the context of the DGR project and came up with a magnitude of impacts that were within criteria.

THE CHAIRPERSON: Thank you, Dr. Muecke.

Perhaps, Dr. Archibald, did you have any follow-up on institutional control?

MEMBER ARCHIBALD: This is to OPG. In the matter of indefinite surface storage

versus permanent underground disposal presenters have made distinction quite often between storage with potential for a treatability versus disposal or abandonment.

Does OPG confirm that its concept of retrievability can be achieved for underground repository operations, but only up to commencement of decommissioning?

MS SWAMI: Laurie Swami, for the record.

The retrievability we have discussed in previous days of the hearing, that it was possible until decommissioning. We also noted at that time that as time went on it became more difficult to achieve simply because of the way the facility will be operated in future.

THE CHAIRPERSON: I would like to continue following up on the loss of institutional control, just because of the requirement that the Panel be crystal clear on how the IEG assessed this.

So to assist you, on page 48 I believe of your report where you have the loss of institutional control, both relative risk and, the inset, absolute risk diagram.

I think where we have the concern from CNSC is not that the absolute risk isn't distinguished here, because the consequences are definitely portrayed as higher on the surface.

But in the relative risk diagram, you don't see the enhanced surface storage distinguished from the surface storage. Because the status quo is always at the origin for the relative risk. But we were wondering why the other surface storage scenario was not distinguished in this diagram?

MR. PAOLI: So by convention in the way we visualized, if there was no essential distinction between two options at the surface or two options underground, we chose the same icon to represent both. So that is why the circle at the centre is marked neither S nor Enhanced.

In other words, we are saying once there is a loss of institutional control the distinction between the surface and the enhanced surface become essentially equivalent, that eventually over time they will become equivalent.

THE CHAIRPERSON: So just to be very clear, notwithstanding the fact that the enhanced surface storage would delay perhaps some

of the release to the surface environment over the longer term, they essentially become equivalent and, therefore, remain at the origin?

Is that correct?

MR. PAOLI: Exactly that, yes.

THE CHAIRPERSON: Okay, thank you very much.

MR. PAOLI: And just on that same page, if I can clarify something else which came up. If you look at the "includes" box on the top right of that, it indicates that all pathways of harm; natural, operational, accidental, and malevolent, that rely on continuous presence of institutional control are considered.

And that is why the consequences at the surface are so significantly different, because it is the sum of all of those pathways that rely on institutional control.

THE CHAIRPERSON: Thank you very much.

Dr. Muecke?

MEMBER MUECKE: This is to the Expert Group. In evaluating the granite option, you appear to restrict yourself in terms of the information that you used for the evaluation to a

granite site in the Canadian Shield in Ontario.

Could you explain to the Panel why you would not consider an extensive body of work that exists from the Seaborn Panel and the URL at the Whiteshell Research Laboratory?

MR. DUSSEAULT: Maurice Dusseault, for the record.

It is my understanding that the Whiteshell site, the Lac du Bonnet granite or Lac du Bonnet pluton site was specifically prohibited by law from becoming a repository site as a condition of the use of that site as an experimental facility.

That is my understanding, it may be an error, I apologize if I am in error.

That site, therefore, does not seem to be a representative site for us to take into account in an assessment of a hypothetical site.

It has been stated here earlier that the Lac du Bonnet granite was very very unfractured and very tight fractured. Nevertheless, at that site there were features, some people refer to them as faults, some people refer to them as fractured zones, that were

identified during the excavation and the creation of that test facility that were not identified from a surface evaluation, a priori using geophysical techniques and trial boring.

We decided that in the context of a hypothetical site in granite that the Ontario Canadian Shield contained all sufficient variations of potential sites as could be conceived, but we did not intend to exclude the possibility of a site that might be outside of the province.

However, our mandate came from OPG, so we tended to assume that that was an Ontario situation, not a Canada-wide situation. I hope we haven't erred in that assumption.

But you are quite correct, there is granite, there is sedimentary rock, there are many other geological sites across Canada. So we delimited in that sense.

For the record, I would also like to say that our assessment of this hypothetical site was that it was, from my notes here, the granite -- pardon me. We made the assumption that the future granite site would be substantially better with respect to the

existence of natural fractures than average in the Canadian Shield. So it would already have been a selected site of high quality.

But to assume an ideal site for a comparison is not justified in a relative risk assessment.

I hope that addresses the question. A little bit wordy response, but sorry.

MEMBER MUECKE: Yes. I guess the concern would be that by broadening the selection criteria in terms of geographically is the existence of datasets that would encompass a variety of crystal and rock settings.

And that would have allowed the analysis to consider both the worst case and the best case and to, you know, demonstrate that. And it should have demonstrated the range of possibilities instead of limiting it to Ontario.

THE CHAIRPERSON: Thank you, Dr. Muecke.

I would like a follow-up from Dr. Archibald.

Dr. Leiss, you had a follow-up?

MR. LEISS: I just wanted to add

that one of the -- we did discuss the variability in granite sites and we also were required to consider four options. And so if we had considered multiple granite sites, as would be the implications of your suggestion, we would have been really considering five, six, seven, eight options.

So there is a bit of a challenge, in that we had to choose one representative site to make it so that we were comparing four options.

THE CHAIRPERSON: Dr. Archibald, before you as your question, that leads me to a follow-up.

Notwithstanding those comments, the information requested from the Panel actually did explicitly site the dataset from AECL at Pinawa, and there was a reason for that. It was because there were data.

And then so you didn't have to rely so much on concept and you could have a little more of a comparison of data to data in terms of decades of characterization at Pinawa as well.

We certainly didn't want to imply

that we were searching for an ideal site, it is just data to data.

So we would appreciate any further clarification, and you will find that as we go with our questioning. But we are still searching for why the existence of an extensive dataset with its own pros and cons couldn't have been used by the IEG to compare with another very complete dataset with its pros and cons, comparing granite with sedimentary.

So if you would care to further comment on that, Dr. Dusseault, we would appreciate it.

MR. DUSSEAULT: Again, Madam Chair, given our judgment that finding an ideal site with community acceptance was an excessively optimistic view. We made it clear in our analysis that we chose a high-quality site, a site that had been so deemed by site investigation.

Site investigation in the Lac du Bonnet batholith and, for instance, in Chalk River and some site in Sweden and Finland, we are/I am aware of some of those results, although that is not my specific domain of research, and

we know of the variability.

For example, in the Scandinavian sites, given perhaps more intense fractures or more open fractures that they have identified during their site investigations, they chose to put into place more engineered barriers.

We assumed that to compare a Bruce site and a Shield site, that it was not in our remit to say, well, you could always make this site better with more barriers. We accept that, but we felt that that was fairly obvious.

So we had to, we thought or we felt that we had to choose a reasonable comparison, and our reasonable comparison is not an ideal site, but a much better than average site as selected by a proponent of a repository and one that has community acceptance.

And that is the justification for our choice of a type site for a comparison with a real site. It is hard to compare a hypothetical with a real, it really is. And you may continue to question our choice of the hypothetical, but we had to choose something that we felt was most appropriate.

THE CHAIRPERSON: Thank you.

Dr. Archibald?

MEMBER ARCHIBALD: Just to lead on slightly from Dr. Swanson's question. Another assumption that has been made in comparing the risk factors for the two DGR options was that with few exceptions geomechanical factors such as in-situ stress would be assumed to be uniformly characterized or uniform in both.

From detailed measurements at the Lac du Bonnet granite site, however, in Pinawa -- and again, this is based upon hard data over two decades -- very large variations in depth of high magnitude stresses were identified and this particular case would have jeopardized a site in this absolutely ideal situation in the batholith and based upon this variation in stability due to geomechanical risk or structural risk would have been inferred.

Would the IEG care to comment on this? I will also ask OPG and CNSC to comment on this, using hard data at an ideal site would have been unrealistic because it is also fraught with problems geomechanically?

Would this have compromised your assessment of the risk factors, the relative risk

factors between the two?

MR. DUSSEAULT: Maurice Dusseault again. I will pass it on to other people immediately, but there was also at the time discussion that the high horizontal stresses that existed in the Lac du Bonnet batholith would lead to a continued closure of the aperture of the fractures in place and, therefore, actually improve the safety factor. That was one view.

Another view was that the high horizontal stresses and the difference in the high horizontal stresses from zone to zone would lead to somewhat of a deterioration in the rock behaviour during the excavation and the placement of the waste during the active period in a hypothetical case that Lac du Bonnet might be used. So it is not clear to us.

Had the expert group been asked to compare the Bruce site to the Lac du Bonnet site, we would have proceeded on that basis without any doubt. We did not feel that we had been asked to do that. We continue to assume that we had a hypothetical site in the Canadian Shield and, given that there are no sites being assessed in Manitoba, that that site would not be

on the table. So we made our assumptions as to what our remit was, to some degree, and we feel it was the right assumption to make under the circumstances and with a limited timeframe and the limited resources. So that's the reason.

THE CHAIRPERSON: Dr. Dusseault, the Panel really requires even more clarification then in how the IEG came to the conclusion that the Panel had not explicitly required that the granite case was to be based on the extensive data from AECL because it's right in the Information Request.

MR. DUSSEAULT: I'm sorry, Madam Chair. I know that we discussed this in the first meetings. In the absence of detailed minutes, which we did not take as the experts were meeting without OPG personnel, I cannot tell you the exact reason that we chose an above average quality site that had been chosen, but a generic and hypothetical as opposed to the Lac du Bonnet, I'm sorry.

But I can say again that there is a wide degree of variability that is evidenced among sites that have been characterized very detailed, for instance, in Atikokan or in Chalk

River, in Stripa and other places and we are all, as geomechanical people, aware of this wide variety of fractures and orientations, apertures and stresses, which means that any site would have to be subjected to a very detailed and careful site investigation of a geological, geomechanical, environmental and fluid transport nature.

I suggest that perhaps focusing only on Lac du Bonnet might have prejudiced the results. That seems to me to come to mind.

I think we were a little bit concerned that it was not representative. The question of representativeness of a hypothetical site is a difficult thing to get our mind around, it's tough.

THE CHAIRPERSON: Thank you, Dr. Dusseault. Thank you for attempting to address that question, however, I think that provides the background for why you will now continue to hear questions from the Panel trying to evaluate how your relative risk assessment may actually have materially been changed had you actually used the data from the AECL two decades' worth of site characterization at Pinawa.

We're just setting that up as the context for further questions that we are now going to have for your group.

Dr. Archibald...?

MEMBER ARCHIBALD: Just to follow up on that, on slide No. 4 where you are discussing the components of the conceptual DGR and the granite formation, you identified that for the granite DGR and the Canadian Shield it should have similar geographical and hydrologic features to the status quo or, sorry, the current DGR at the Bruce site.

By "geographically similar", do you infer same location or same geologic or geomechanical features? This is not explicitly ascribed. What is meant by the term "geographical similarity"?

MR. DUSSEAULT: For the record, Maurice Dusseault is my name.

We specifically discussed, for example, topography. Very large differences in elevation give rise to large differences in hydraulic head, which is a fundamental and actual driving force for the transport of materials in fractured rock media or in porous media.

So we assumed that the geographical disposition of the hypothetical granite site did not have steep valleys or high hills that would give a geo-hydrological potential much, much larger than that which would exist from the elevation difference here in the Bruce Peninsula.

We assumed, therefore, a relatively flat terrain. We assumed no huge differences in rainfall, for example. Although one might argue that given that the Bruce site is a little bit closer to the track of severe storms such as tornadoes in the Midwest of the United States, a site in the Shield would have been a little bit further away. But since the site was not specified in the Shield, we felt that that would be geographically similar.

We, of course, recognize the geomechanics differences explicitly and we noted -- in our report we noted that given the very high quality of intact granite and the very high quality of the Cobourg formation, and given the stresses that could be expected at those depths, 700 m, that we did not feel that rock instability would be an issue of substance -- of

substantive difference between the two cases.

The rocks in both cases are extremely strong, the stresses may be different, but not so high as to give a large difference in the behaviour of the structures. That, in a sense, explains partly the hydrological part as well.

The second part has to do with the remit where we felt that it was appropriate to compare a site, and we use the term "near a large body of water", to some extent similar to a Great Lake. Of course, this could be another large lake in the Canadian Shield, such as that lake north of Lake Superior that has just escaped my mind. Nipigon, that's it. For example, you know, in relative proximity to Nipigon.

It's not appropriate, if you are doing a comparison of a real case and a hypothetical case, to hypothesize that the hypothetical case is in largely different circumstances, then the comparison becomes fraught and less valid, the relative risk evaluation. Remember that we always had to do a relative risk evaluation.

So if someone chooses to use our

tools, which we believe are relatively transparent, to hypothesize a granite site that is away from any big lakes and in much higher quality or much lower quality rock, they would come necessarily to somewhat different conclusions than we came.

THE CHAIRPERSON: Dr. Muecke...?

MEMBER MUECKE: In reading the instructions from the Panel, it specified different scenarios in the presence of a Great Lake, in the presence of wetlands, in the presence of a stream system. It specified them as three possibilities.

In terms of your evaluation, it seems to be that you took all three of these in combination as being your instruction.

DR. LEISS: Yes, exactly right, otherwise there would be more than four scenarios, or you would have to do the fourth case in terms of multiple scenarios considered independently.

So the question was to read it "and" or "or" and we read it as "and".

MEMBER MUECKE: Coming back to the granite scenario, would the risk profile of a

hypothetical granite DGR be changed significantly if the 675 m depth assumption would be removed?

The reason for asking that is, in case of the Bruce DGR, the depth is constrained by the sedimentary geology. In the case of granite DGR there would be no such restraint. Then the question becomes, why restrain the granite DGR to that same depth?

MR. DUSSEAULT: For the record, Maurice Dusseault. Again, it has to do with the scenarios. We could have postulated a deep DGR, for example 1,500 m, and a shallow DGR, for example 500 m in the Canadian Shield.

We felt that the remit we received from you was to compare a known Bruce DGR with a hypothetical granite DGR, but under similar circumstances.

Personally, as the rock mechanics person on the panel, I could speculate as to the impact of going much deeper. For example, it would probably mean that the fissures add depth. Those fissures that exist are more likely to be closed or of extremely small aperture and, therefore, providing less transmissive pathways for the interaction of any fluids or gases

generated with the biosphere.

On the other hand, we know that the stress state in the Canadian Shield, especially in some granite plutons, is such that even at 1,500 metres depth we have very high horizontal stresses and there is an increasing chance of the impairment of the integrity of the rock mass around the shaft, because when you excavate a shaft you take away all the rock and the radial stress becomes zero and the tangential stress is still very high and you have a whole bunch of microfissures that are generated.

This was investigated very carefully at Lac du Bonnet of course, but Lac du Bonnet was only 500 metres, 400 and something metres deep, so I assure you that the behaviour of rock is not linear enough that if you increase it to 1,500 metres you're going to have to look at that one really, really carefully because you've created a new pathway.

With all of these permutations and combinations associated with going to look at a shallow option versus a deep option in the Canadian Shield, this project would have, in my view, spun somewhat out of control in the sense

that we would have to evaluate a number of new dimensions for these options.

We chose again to assume that the hypothetical site was, for all intents and purposes, at a similar depth, in a high quality rock mass, not an ideal one but a reasonably high quality rock mass, and near a fairly large body of water, with some nearby wetlands and a nearby stream, and that was again trying to make, as much as we could, a reasonable analogue between a real site and a hypothetical site.

THE CHAIRPERSON: Dr. Archibald.

MEMBER ARCHIBALD: This is a question for OPG.

Would the OPG be able to confirm agreement with the IEG that the option for enhanced or hardened surface storage of materials must be assumed to be hypothetical and not based upon a facility analogue?

--- Pause

MS SWAMI: Laurie Swami, for the record.

I wonder if you could just repeat the question again for us.

MEMBER ARCHIBALD: Essentially,

do you stand in agreement with the IEG that the surface hardened storage option must be a hypothetical situation rather than a factual analogue?

MS SWAMI: Laurie Swami, for the record.

Thanks for the clarification. I probably would have answered the wrong question.

No, we're not aware of any examples of hardened storage internationally or here for low and intermediate level waste.

MEMBER ARCHIBALD: Okay. I would like some clarification also from the IEG. This is based upon page 38.

Thank you very much for your presentation today of the worker health and safety relative and absolute risk initiation. I'm very interested in that.

Also, on page 38 of your report you have the public health risk plot shown. In the less than 100-year timeframe the DGR granite option and the DGR option are both indicated to have apparent equivalent absolute risk whereas the relative risk of the granite DGR is shown to be higher than that on the DGR option. For

public health impact essentially due to dust and noise the granite DGR should have a lower impact seeing as this would be away from a major community area, built probably somewhere remote in the Canadian Shield.

My question is why would the shorter term relative risk for both options be not closer to equivalence than is indicated in your plot?

MR. PAOLI: Greg Paoli responding on behalf of the IEG.

There's a number of different types of consequences being merged together in that assessment of consequence, so dust and noise would be one of them.

I suspect that our judgment at the time was, in terms of putting the DGR granite repository at a slightly higher level of likelihood for consequences, primarily related to the additional transportation requirements and the public risks associated with transportation, which may have pushed it slightly to the more likely side.

Tom Isaacs would like to add a bit more, I think.

MR. ISAACS: Thank you. Tom Isaacs.

I actually don't have much more to add. I think that was the distinguishing feature in our mind for why we decided there was a slight increase in risk for a facility that was farther away.

MEMBER ARCHIBALD: The distinction would be the public risk for the public along the transport route versus the risk to the public living in the nearby community?

MR. ISAACS: Correct.

MEMBER ARCHIBALD: Okay. Thank you.

THE CHAIRPERSON: Dr. Muecke.

MEMBER MUECKE: In the IEG's considerations you state that the shaft seal is assumed to be similar in the case of granite and at the Bruce site. What led you to this conclusion, considering that in the case of the Bruce site the shaft will have transverse various formations with very different properties, in a granite body there would be much less variability? How was the similarity of -- can the similarity in shaft seal be assumed?

DR. DUSSEAULT: We assumed that the shaft seal would be purpose designed for the site. For example, if you have a granite site that is intensely fractioned for the upper 200 metres, 300 metres, which is very common because you have the stress relief cracks and the low-lying quasi-horizontal cracks that are associated with the erosion from a great depth, we assumed implicitly that that network of greater damage in the upper 200 metres or 300 metres of a batholith would be reasonably equivalent to the presence in the upper 300 metres or 400 metres, 200 or 300 metres of the Bruce site, to strata that are more permeable, more fractured and, shall we say, more challenging to seal than the deeper part of the repository, which in both cases is in very -- we assume in the case of granite very low fracture density and more sealed fractures and in the case of the Cobourg very low porosity apparently -- and we say apparently -- unfractured, although I don't think there is such a rock that exists that is absolutely unfractured. Even if there are fractures in this slightly porous rock, they appear to be very firmly closed. So we said,

technology being what it is in terms of putting in engineered barriers in shafts, we assumed the shaft would be appropriately designed for the conditions encountered at the site. Therefore, we have no basis upon which we discriminated between one or the other in terms of the engineered barriers. That was again our hypothesis to establish a comparative process.

It is always possible, Dr. Muecke, to postulate more engineered barriers in one scenario than another scenario, but then the comparison becomes flawed and it is not a comparison any more.

MEMBER MUECKE: Thank you.

THE CHAIRPERSON: Dr. Dusseault, if I may ask a supplementary on that as a biologist and not an engineer.

Assuming the same degree of rigour in the engineering design for the shaft seal, did the IEG consider, though, a difference in likelihood that shaft seal would fail given the two distinct geologic settings and the different challenges that may be associated with those two settings?

DR. DUSSEAULT: Maurice

Dusseault, for the record.

I'm going to answer only half of the question. Dr. Leiss will handle, I hope, the issue of biological processes, which were not part of the remit.

We assumed that the rock types and the ceiling technologies would achieve the same level of performance in both of the cases given the constraints that we had.

On the issue of biological processes, Dr. Leiss, would you like to comment on that?

DR. LEISS: I basically can't think of any reason why unspecified biological processes would affect this engineered barrier unless I had some -- because I don't really know what you might be referring to. Sorry.

THE CHAIRPERSON: Thank you, Dr. Leiss.

Dr. Muecke.

MEMBER MUECKE: Thank you for that clarification on the seal.

There is another assumption that the IEG made and that is that in the presence of approximately 200 metres of sedimentary rock in

the case of the Bruce DGR there was considerable groundwater flow that will not affect future pathways or the shaft seal in terms of relative risk. Could you expand upon that?

DR. DUSSEAULT: Yes. We assumed that the engineered barriers for the sealing of the shaft would be placed appropriately at depths below the rapid groundwater flow regime both in the granite case, when I spoke of the open fractures near the surface, the horizontal stress relief cracks that are inherent in any batholith as we know, the same thing there. We assumed that regime. We are not going to try to seal against all groundwater flow but that the seal would be effected in the hundreds of metres below that zone, so we have the bottom 400 metres in both cases.

Remember that we did assume identical depth for the hypothetical granite repositories, so that gave us, in both cases, 400 metres of very, very competent rock above the horizon that was to be excavated for the placement of the containers. We didn't discriminate any further between the two cases. We assumed again in both cases that an effective

engineered barrier would be in place of equal quality in both cases, pending of course a detailed site investigation. We assumed that, what we call, adaptive engineering is always part of every process of construction and management like this. You adapt your engineering solutions to the information that you find as you do the site investigation and as you proceed down the construction process.

There's always surprises. We believe that adaptive engineering can cope with those surprises for all reasonable cases that we considered both in the granite and the sedimentary rock. I think that we should, as an IEG we did, keep in mind that any kind of a repository construction process would be a highly adaptive process of engineering: you look, you see, you assess, you evaluate, you mitigate, repeat as necessary.

MEMBER MUECKE: For the last two points that I brought up, the basic assumption made by the IEG was that the upper 200 metres of the hypothetical granite would be highly fractured. The question arises of course then is that a generalization which -- is that a valid

generalization?

DR. DUSSEAULT: Maurice Dusseault, for the record.

We believe it to be.

THE CHAIRPERSON: Dr. Archibald.

MEMBER ARCHIBALD: I have a question for CNSC. This is based on page 10 of the written report.

Based upon the international and Canadian consensus, would CNSC have preferred to see the timeframe for short-term risk, as posed by the IEG, changed to less than 300 years or at least several hundred years rather than the 100-year term that was posed, and this being based upon timing, foresight, refurbishment for the surface operations?

--- Pause

DR. THOMPSON: Patsy Thompson, for the record.

In discussing with my colleagues the fact that the choice of 100 years makes for a more conservative safety case, it looks at loss of institutional control sooner and therefore would likely overestimate or overemphasize the long-term risk, we thought was a conservative

approach.

MEMBER ARCHIBALD: On slide 11 also you mention that tritium gas in water releases were not considered by the IEG for release from surface storage sites, they were not identified as pathways by the IEG, but you do state that passive tritiated water releases are high from the WWMF but it generates very low doses, and OPG plans to ventilate and monitor tritiated water in the air that will be able to mitigate risks of exposure.

So the ventilation and monitoring of tritiated water is stated to be mitigative procedures for lowering the risk of exposure. Could you explain how monitoring of surface tritiated water releases will mitigate risks?

DR. THOMPSON: Patsy Thompson, for the record.

The point we were trying to make is that the assessment of relative risk could have considered tritium exposures from the waste packages essentially, but in effect by monitoring and controlling exposures the relative risk, the end point, wouldn't have changed materially.

MEMBER ARCHIBALD: You also note

that the IEG injury rates are at a higher risk for underground workers versus surface -- which is a common feature in most modern societies, I totally agree with that -- but that the underground mining sequence will be only for a short interval of the 100-year period over which overall risk has been assessed for the short term. CNSC states that the likelihood for injury should be equal because of the short duration of mining. I guess that is one of your conclusions and that differs from that of the IEG.

In view of the fact, however, that the proposed repository will be developed as a low percent extraction, small excavation size, limited heading operation, and very similar in operational features to stone underground mines or quarries, this is not the large scale mining operation that we normally see in Canada or the United States, would you not view the injury rate potential as being lower or significantly lower than that of the general construction industry and well below that of very large scale metal mining operations from which the higher injury rate statistics that you have given in your slide have been derived? In this case, would the CNSC

view the injury likelihood rating for a repository as being less or much less than those of above-ground and general underground mining operations?

DR. THOMPSON: Patsy Thompson. If you'll give me a couple of minutes, Dr. Archibald, I'll speak with my colleague behind me.

MEMBER ARCHIBALD: Again, that's from slide 11, the data that you've put in.

--- Pause

DR. THOMPSON: Patsy Thompson, for the record. I will ask Ms Kay Klassen to respond to your questions in the context of the point we were trying to make on slide 11 -- slide 12, apparently.

--- Pause

MS KLASSEN: Kay Klassen, for the record.

When we looked at the mining and came to the conclusion that perhaps the risks were overstated given the nature of the activities and the duration that was taking place I was also aware that the kinds of buildings being constructed or demolished at western were

relatively simple. They're not tremendously high so the understanding of the construction might also have been somewhat conservatively stated so I felt it was probably more fair to say they were similar in the context of the risks to workers associated with the activities.

MEMBER ARCHIBALD: In fact, it's a more conservative case to estimate the higher injury rate risk statistics for mining.

As a follow-up question, would these rates have been Canadian rates or are these United States' rates?

MS KLASSEN: Kay Klassen, for the record.

These were U.S. rates. When I took a look at what was readily available through website access, I found that the Canadian readily accessible ones tended to lump mining sort of all in one. Often some of the rates were represented with oil and gas figures. On the American site it was possible -- they had presented the data, and quite detailed data, by different segments so that you could eliminate coal mining from the general mining risks, coal mining tending to be quite a hazardous form of industry, so that it

was clearer, the differences in the injury rate relative to the different kinds of mining activities, so coal having riskier -- underground having riskier and higher injury rates than some of the other underground activities.

MEMBER ARCHIBALD: In general, that's true. Definitely, we do know that coal is a riskier venture for underground operations but there are tremendously up-to-date statistics generated and because mining will be done in the province of Ontario or in Canada, where we have general statistic rates, it would be more appropriate to use them.

As has been identified for the WIPP case, as an analogue, there do exist very significant differences in oversight, worker management, and health and safety guidance in mining particularly, and published data may show significant differences that would affect the relative risk assessment.

In this particular case, as long as these are relative statistics and band as such, they would be appropriate but they may cause a skewing of the risk, especially noting that this will be a very high quality mining

venture and not under rate stress as we have in normal mining operations.

MS KLASSEN: Kay Klassen, for the record.

They were chosen as more representative of the general mining industry. Certainly CNSC oversight and uranium mining is lower in injury rate than general mining as well, so it does depend on the -- on the regulatory regime and attention paid to the activities.

MEMBER ARCHIBALD: I've been informed that the Ministry of Labour is available on the phone, and I would like to ask them to comment on the statements and questions just posed.

THE CHAIRPERSON: Do we have the Ministry of Labour representatives on the phone?

We will allow them some time to call in, and the secretary can let us know when we do have that connection. And then Dr. Archibald, perhaps you could repeat your full question for the benefit of the Ministry when they are on the phone.

Dr. Muecke.

MEMBER MUECKE: I have a couple

of non-geoscience queries. One really concerns the Panel as a whole.

You used consensus to produce the risk diagrams that you have produced, and you came to consensus where to place the factors that you were considering in each case.

Could you recall for the Panel in which cases it was most difficult to reach a consensus?

DR. DUSSEAULT: Maurice Dusseault, for the record.

We struggled with -- a lot with this idea of institutional control and the implications of what it would mean on it, but I don't think there was disagreement. There was -- it was a kind of a discussion as to what our basic assumptions were going to be in terms of institutional control loss after some time.

Another thing we sometimes struggled with, but again, it was -- we didn't argue about it. It's the idea that after, you know, the highly improbable, given geological time, becomes absolutely certain. In other words, there's going to be one big storm hit that area some time in the future.

In the next 100 years, it might be one chance in 100. For the 10,000 years, it's going to be one chance in five. For the next 100,000 years, it's going to be virtually certain.

So we had to come to grips with that.

So on many of our plots of absolute probability and consequences, you see the DGRs are way over on the right because it's absolutely certain that there's going to be, in the future, some level of storm, some level of tornado. But the consequences are zero.

So we actually did discuss these things quite heatedly but, you know, as colleagues saying, you know, is it right to give it as zero probability because of the DGR is 700 metres deep, is there some small chance, et cetera.

So yes, a consensual process, active discussion, you bet. And we're four different disciplines here, you know, so we did tend to defer to, you know, Tom when we were discussing issues of nuclear safety and to Greg in discussing issues of risk assessment and to

Dr. Leiss with his very broad knowledge of these issues. But I think we had enough of a collegiality and a broad technical basis to not really have any bumps in the road of any significance.

MEMBER MUECKE: It wasn't that I was implying that you had difficulty or that you didn't reach consensus. I was not questioning that.

It was in which cases, what are the most discussion, the difficulty in coming to a single point that you have to put on a graph?

MR. ISAACS: So Tom Isaacs.

So I thought we were surprisingly effective and efficient, maybe because of the time pressures, in reaching consensus on the scoring.

There were places where people had slightly differing points of view and we would discuss it and we would decide on this qualitative basis what we thought was the most appropriate single place to place it. In some cases, we might discuss whether there would be a distinction between the "as is" storage and the enhanced storage or whether they were together on

a particular criteria.

The thing that I think I recall having a lot of discussion about was how do we meet your charge to be repeatable. That was a very difficult thing for scientists to recognize that this was a qualitative judgment against a variety of options that had differing amounts of definitiveness to them and what did it mean to be repeatable when it was clear to us that, from a scientific point of view, reasonable people -- reasonably informed people could do the same kind of analysis and come to somewhat different conclusions. And we recognized that.

And so we worked hard to try and come up with our definition of repeatable, which essentially means it's trackable, that you can repeat the process and if you agree with our judgments, you come out with a clear agreement with our findings.

It doesn't mean you agree with our judgments, but you can do that. And we also worked hard for it to be transparent so that if you did have different judgments and different rationales for it, the process allowed you to put in your own as well.

I would say that was the area, for me, that was the one where we had the most discussion.

Thank you.

DR. LEISS: I would add, Dr. Muecke, that some of the pathways of harm, risk factors here ask you to speculate over very, very broad time frames, glaciation, lack of institutional control, even some of the others.

So there, you're -- you're at the extreme end of your capacity to make informed judgments in some things like that.

I expect in those cases that there would be variation.

I mean, if one -- and you're -- if you look at the basic diagram where you're asking yourselves to place -- even the act of placing on a logarithmic scale is, how shall I put it, challenging, so you rely a lot on the goodwill in a collaborative process.

And I think that just the challenge of making placements on a logarithmic scale would tend you to take the edges off judgments. Most -- it requires some capacity to compromise and so on, so what I can say is I

don't think there was significant difference among the 12 pathways of harm.

There was an attempt to arrive at a common view about the rough kind of area in which one is talking about on a log scale and avoiding any attempt to pretend that there's any precision involved in that.

So I think they're all similar in that respect in that the requirement for using the log scale puts you in a kind of decision framework where you know that you're working with very large parameters of error.

MEMBER MUECKE: Thank you for that.

THE CHAIRPERSON: Dr. Archibald.

Dr. Muecke, did you have any further questions?

MEMBER MUECKE: More geoscience? Okay.

And this is speculative, okay, so sorry to put you on the spot with this.

How or do you think that the recent incidents at the WIPP site would have influenced your decisions in evaluating risks, particularly for the DGRs?

MR. ISAACS: I actually did prepare that. Tom Isaacs.

So we're well aware of the incidents at the WIPP site, two of them in particular. There was a truck fire underground and then there was definitely some kind of an incident where there was release of radioactivity and some exposure at fairly low levels, from what I understand, to a number of workers. And that's still under investigation.

I think it would be premature to make any particular judgments about what caused it because I think it's going to be some time before they're entirely sure of what caused it.

These are regrettable incidents, for sure, and we may learn, over time, that they were avoidable. And I think they probably will find that they were avoidable.

In terms of its impact on our evaluation, we believed that there was probably a slightly enhanced risk of incidents underground as opposed to the surface. If I could refer back to Commissioner Archibald's comment, when you look at worker rates of risk, you have to look at two things, not just the rate of injury, but the

number of workers. And you have to multiply those two things. And I think that's why we came out with a slightly higher risk for that circumstance because we assumed if we were doing both surface and underground work there might be more workers on site and independent of the relatively small diversion in rates, we were going to be multiplying by a larger number.

I think the same thing holds true here, that we -- we are not surprised, if you will, that there were incidents underground. We're surprised by these particular incidents. They're not satisfactory to have occurred. But it is the nature of activity underground.

And so our findings that there would be some small degree of risk underground is confirmed, in a sense, if you will, by the fact that these regrettable things happened, so it wouldn't have changed our evaluation.

DR. LEISS: I would just add that in my work -- in my own work over many different risk issues I've been influenced by a number of particulars, one of them the famous book called "Normal Accidents" so that, in other words -- and I think a lot of my colleagues share that view,

that you expect it will happen and you build in provisions for that expectation, but the risk approach drives you, always, to the same place, to ask about likelihood and also consequences.

And so you look very carefully at the level of risk, you compare those risks to other situations.

And I think, in that sense, I, and I think my colleagues, do build that kind of expectation into the kind of judgments we make.

MEMBER MUECKE: Thank you.

Deviating from the theme again, there's a statement in your report indicating that, eventually, the radionuclides from the repository in the limestone in the proposed DGR would reach Lake Huron and that dilution would take care of any such incident.

Did you take into account the degree of mixing that -- in deep waters, bioaccumulation, the absorption onto sediments and so on in case of such an incident?

DR. LEISS: I'm going to ask Dr. Dusseault to discuss that, but are you sure that there's the expectation that it would, in fact, reach the lake? I did not think so, but ---

MEMBER MUECKE: Somebody would have to check that for me. I'm going by memory here.

DR. LEISS: I would be ---

DR. DUSSEAULT: We can leave the interpretation of our words somewhat to be parsed carefully, but we did not feel that we -- we stated there was an expectation that would occur.

In fact, in our document, we -- in developing our assessment in our -- using the relative risk tool that Greg has developed with us, we know -- we noted or we were well aware that OPG and NWMO, for that matter, do not -- do not use dilution as a barrier. That is explicitly not used.

There are natural barriers, there are engineered barriers, and dilution is not one of them.

But in discussion of the geoscience aspects of risk and relative risk, I felt, and it was my decision -- my co-members supported me. I felt that it was appropriate to point out that there were other physical processes that might attenuate risk even further to the levels of risk estimate that OPG, NWMO and

other agencies around the world have promulgated in the absence of one specific one. That was dilution.

Remember that our remit asked us to examine DGR near a Great Lake, both hypothetically and in reality. At least that was our interpretation of it.

So the issue is exposure to some radiological agent significantly above the level of background.

I remind you that water flowing into the Great Lakes does contain, in solution, small amounts of potassium-40, small amounts of uranium, small amounts of thorium, especially from black shales that are being eroded in the antrum. The antrum shale is a good example, and from the Canadian Shield sources coming in, too. And that gives a general background in the aqueous system of the Great Lakes.

So we said fairly clearly that it was extremely improbable that there would be the flight or -- or the escape of fluids from the deep repositories, but that in the eventuality that such a highly improbable event might happen, there was a further set of barriers.

We did, remember, discuss clearly the barriers that involved the low water solubility of the molecules that contained the radioactive species. In general, these are oxides and other molecules that are not soluble, so any effluent coming from a DGR would, first of all, be of relatively modest -- relatively low concentration because these are highly, generally speaking -- not always, but generally speaking, highly insoluble materials.

And I say not always because there are some chlorides and some others that might be more soluble.

Given the stipulated geographical disposition of the repository and given that the pathway, any pathway possible for escape would be passing in contact with large amounts of silicate minerals, as you get closer to the surface and as you get closer to bodies of water, more and more clay can be found, and this leads to a process that we call adsorption so that cations -- the radioactive cations, generally, are divalent or trivalent, and they tend to be adsorbed preferentially by these mineral surfaces and retarded, in fact, immobilized.

There's also the issue in porous media that these -- if the radioactive species are in cationic state they have a hydration sphere around them which causes them to be -- to have difficulty in passing through very small pores like the pores in the Cobourg formation.

So that's a further retardation having to do with kind of what we call a -- it's basically a retardation process because of the size of ions.

Okay. So we assumed or we postulated that there might be a flight or an escape of some small amount of fluid to the hydrosphere. At that point, and only at that point, did we invoke the possibility of dilution.

We already understand that it's undergone dispersion, diffusion, adsorption, retardation and that the rates of flow must be -- because of the low permeability of either repository, must be extremely low, so probability is very small.

But there's another safety barrier, if you wish, or a security barrier for the protection of the population, and that is that if a litre of water enters into a large body

of water and has, by advective mixing, generally speaking -- there's mixing going on all the time, there's water circulating. It's going to be diluted substantially. Exactly how much, I don't know.

But I did, maybe speciously, calculate the amount of water in the Great Lake, and it's -- I think it was 23 trillion cubic metres, give or take a litre or two.

And I thought that that was a fairly large number and we could rely on a very small amount of that for dilution, so that was the source of my statement.

It is a source -- the statement -- pardon me. The discussion was intended to indicate that, given the relative risks and given the barriers, both natural and engineered, that have been suggested for a repository, there exists additional security factors that protects the population in general from exposure to high levels or unacceptable levels of radioactive species.

A long-winded answer, I'm sorry, but --

DR. LEISS: Could I just

reiterate the short answer?

DR. DUSSEAULT: Short answer, yeah.

DR. LEISS: I don't think that we've said we expected this to occur. I honestly don't.

THE CHAIRPERSON: If I may interject, I found the quote, I think, where we -- and I think we -- thank you for your long-winded answer, Dr. Dusseault, because it put a relatively short quote on page 23 -- no, 21 of your report into greater context, and so the transcript will assist us as well.

But in there, the IEG states:

> "Furthermore, even if slow flow of water or gas containing radionuclides did reach the upper 200 metres of the strata at the Bruce DGR, groundwater flux, surface dilution with rainfall and stream flow and previously mentioned effects such as adsorption and dissolution of the gas into the shallow

flowing groundwater followed by geochemical immobilization or attenuation would take place."

And I think, in a nutshell, that's what you were just describing to us.

DR. DUSSEAULT: Well said.

--- Laughter / Rires

THE CHAIRPERSON: Dr. Muecke, did you have any further questions?

MEMBER MUECKE: Well, I'd just like to apologize if I phrased this wrong, a senior moment.

THE CHAIRPERSON: Dr. Muecke, did you have any further questions?

Dr. Archibald?

Okay. Now, it's my turn as the Chair. I get to wait and make notes and add on to the questions.

So I'm going to back up a little bit to where we were at the beginning -- toward the beginning of our questioning, which is back to the assumptions and the characterization of the conceptual granite site.

And this is actually directed to

the CNSC because the Panel have had a lot of explanation from the IEG regarding the basis for their case.

So to the CNSC, the Panel's question is, given the CNSC's comments regarding the IEG assumptions around the extent of fractures in granite rock and, in this case, particularly the upper 200 metres, does the CNSC still conclude and agree with the IEG that groundwater flow flux is the major factor affecting the comparative risk assessment and, therefore, would you still agree with the overall IEG conclusions?

I would give the representatives of Natural Resources Canada on the phone a heads up that I will also be asking you this question.

DR. THOMPSON: Patsy Thompson, for the record.

Dr. Son Nguyen will be respond to the questions.

DR. NGUYEN: In the IEG report there is a more detailed description of the alternative option No. 4 for the DGR in granite and in this I believe the basis of comparison is a hypothetical site which is based from the real

side but a hypothetical which was used in the third and fourth case study for the APM concept for spent fuel.

So the characteristics of this site, the topography and the hydrology were based on this site which was investigated from the surface. It is hypothetical, but it's realistic.

Now, the properties of the rock, especially the hydric properties, are based on a composite of properties from both the Whiteshell data and the Atikokan data as well. So the 200 metres indeed fractured, if I look at this composite picture of this hypothetical site.

And the answer is yes, we agree that for this site, based on experience gained from reviewing the APM for spent fuel, which we can extrapolate for low-intermediate level waste, the main pathway would still be groundwater transport and gas transport to the surface.

THE CHAIRPERSON: Thank you. May I now direct the same question to Natural Resources Canada. Are you on the phone?

MS CAVALLARO: Yes. This is Kate Cavallaro with Natural Resources Canada. You were cutting out a little bit when you were

asking your question and I was just wondering if I could get you to repeat the question?

THE CHAIRPERSON: Certainly. And also, may you please repeat your name, we didn't quite get that either.

MS CAVALLARO: Yes. This is Kate Cavallaro. Last name is C-A-V-A-L-L-A-R-O.

THE CHAIRPERSON: Thank you very much.

So, Ms Cavallaro, the Panel's question was, given the Canadian Nuclear Safety Commission comments regarding the IEG assumption about the extent of fractures in granitic rock, particularly the upper 200 m, does Natural Resources Canada conclude, as the IEG did, that groundwater flow flux is the major factor affecting the comparative risk assessment between the Bruce DGR and a granitic DGR?

MS CAVALLARO: First of all, I would like to point out that I am the Senior Environmental Assessment Officer with this file and not the expert with our Earth Sciences Sector, so I can give you a summary of what we included in our written submission to the Panel and then, if you require additional information,

I will have to get the expert onto the line.

THE CHAIRPERSON: Thank you. That would be helpful.

MS CAVALLARO: Okay. So first of all, Natural Resources Canada did review from a hydrogeological perspective the granite DGR option with respect to radionuclide mass transport flow path links and absorption and we did have some comments with respect to the statements made in the IEG report.

I think, first of all, what we would say is that fractures at any potential DGR site in the granite of the Canadian Shield are likely to be relatively numerous at the surface, but decrease in frequency with depth.

The vertical component of fractures is likely to be greater than the vertical component of any advective groundwater pathway at the Bruce site, therefore, advective flow path to the biosphere in the Canadian Shield site would probably be shorter.

It is also important to note that not all fractures in the granite are necessarily conductive. For example, some may contain clay fault gouge that decreases permeability and

provides significant absorptive capacity for radionuclides.

Second, the average diffusion porosity of the Cobourg formation is 1.3 percent and the average diffusion coefficient is 3.7 times 10 to the minus 13 m squared per second. In contrast, the effect of porosity in the granite from the URL is in the range of 0.2 percent while the effective diffusion coefficient is in the range of 2 times 10 to the minus 12 m squared per second.

Thus, the porosity of the Cobourg formation is higher than that of the potential typical host granite while its diffusion coefficient is lower.

The comments that I have just said, notwithstanding Natural Resources Canada would agree with IEG's overall assessment of the relative and absolute risk of the advective transport of radionuclides in groundwater and in gas.

THE CHAIRPERSON: Thank you, Ms Cavallaro. I think that is probably sufficient for now. If we have any follow-up questions as the questions proceed we will get

back to you, but thanks very much.

MS CAVALLARO: Thank you.

THE CHAIRPERSON: This question is to the IEG.

Notwithstanding whether the granite repository, the conceptual granite repository was modelled after the Pinawa example or not, is it the IEG's opinion that granite in general offers less absorption and less retardation of radionuclide transport?

MR. DUSSEAULT: Maurice Dusseault, for the record.

Yes.

THE CHAIRPERSON: Thank you for that succinct answer.

--- Laughter

MR. DUSSEAULT: It's a very rare one for me as well.

--- Laughter

THE CHAIRPERSON: The next question is again back to the IEG, and again this is perhaps a naïve question from a biologist.

Why would a granite fracture system be any more difficult to characterize than a sedimentary system?

MR. DUSSEAULT: Maurice Dusseault, for the record.

Sedimentary processes lay down similar strata over fairly large horizontal distances and in the case of a very definitely non-tectonically affected regime, such as the rock beneath our very feet, at least if you -- well, beneath our very feet for the last few hundred million years anyway, there is a lot of lateral continuity.

If you drill a hole, at one point you can assume that what you see in that hole has lateral predictability of quite a remarkable amount if it is in horizontally stratified sediments. So that does exist.

In granitic rocks it is less so, it is less so. For example, if you drill in a granitic pluton and say, "Well, I am going to extrapolate this two kilometres away," uh-huh, you are not going to do that, because they change -- the spatial variability of rocks in the Shield, even though they are competent and old, low permeability and all that kind of stuff, the spatial variability latterly is actually much, much larger than in the sedimentary basin.

Now, in the case of Ontario, where we are standing right now, the rocks have not been affected, to the best of the knowledge of the site investigation people that have done the drilling and done very detailed seismics and other work, has not been affected by faulting or significant displacement of the rock masses in any way, shape or form since the time of deposition and what we call induration or making a sediment into a good, strong, stiff rock. So that gives us more confidence in terms of our predictability in terms of the lateral predictability.

Even when it comes to the postulation of fractures, in a sedimentary rock mass like the Cobourg formation, if we do succeed in identifying fractures -- and we may as the time -- as the site investigation goes on, part of the adaptive engineering process, then we would probably even be able to say, "Well, look, we are seeing closed or very minute natural fractures at 5 m spacing". Now, that again can be projected out laterally quite a distance because essentially all the rocks have had the same geological history and stress history and

tectonic history.

You can't say that for fractures in a granitic rock mass, you are going to have to use many more boreholes to intersect a large number of fractures in a body that has lateral inhomogeneity and it's going to be far, far more difficult to characterize that fracture system to the degree that we can characterize the Cobourg formation in terms of lateral variability. So it's just inherently much more difficult.

Site investigation is absolutely, completely, totally necessary for any project of this kind, very detailed site investigation. It is likely to be much more challenging in a pluton.

THE CHAIRPERSON: Dr. Muecke...?

MEMBER MUECKE: Could we have CNSC's comments, I think they didn't come out very well during the presentation, about the lack of tectonic deformation in the stratigraphic sequence beneath the proposed DGR?

--- Pause

DR. THOMPSON: So Patsy Thompson, for the record.

Dr. Julie Brown will respond to

the question.

DR. BROWN: Julie Brown, for the record.

That statement was made in the IEG report on page 13 in the descriptive background information for the geology and they state that there are geological reasons for a lack of fractures such as the absence of any tectonic forces with reference to the rocks that have been characterized at the Bruce site.

But it just ignores existing information that OPG has actually previously presented on the existence of new tectonic faults in the broader geological region.

So particular examples would be on the Ottawa Bonnechere graben system and also there is the Clarendon-Linden fault which is an active fault in Northern New York State that extends into Ontario in the vicinity of Prince Edward County.

So that information has been presented by OPG in a Seismic Hazard Assessment Report and it describes further the new tectonic setting and the current contemporary stress field for the region.

Does that help? Does that answer your question?

MEMBER MUECKE: Yes, it does.

THE CHAIRPERSON: Would the IEG care to comment on whether or not what we have just heard would materially affect any of your conclusions?

MR. DUSSEAULT: Maurice Dusseault, for the record.

I would not. The distance of the Clarendon features and any tectonic events that have created significant displacement or alteration of the rock properties are sufficiently distant from the site or from a hypothetical granite site as well that we would not substantively change our conclusions on the basis of large region neo-tectonism.

THE CHAIRPERSON: The next question I have is around the general theme of climate change and I'm also going to be addressing this question to Environment Canada and the Ontario Ministry of Environment and Climate change.

On page 52 of the IEG report, the IEG states that:

> "The major consideration is that surface facilities will be more vulnerable to climate change and glaciation in the very long term."

The Panel's question is, what about the near to medium term, in less than 100 years? Could you remind us again about your deliberations regarding both the absolute risk and the comparative relative risk, especially among the two surface options regarding climate change and the potential for increased frequency, for example, of severe climate events?

MR. PAOLI: For the record, Greg Paoli.

I think when we referred on page 52 to climate change and adaptation we are primarily referring to extreme weather events. And although there are other climate change variables that we could consider, I think probably the part that would be least possible to predict with any confidence into the future, and the primary vulnerability is for structures which are intended to be strong, would be severe weather.

So I think that's the climate change angle and I don't think we differentiated between near and medium term in our deliberations, it was really a long-term consideration as we were thinking about climate change and severe weather. And I don't think it would change the determination that severe weather events at the surface would be inevitable under any climate change scenario.

THE CHAIRPERSON: Could you elaborate a little more about why you did not explicitly include this consideration in the less than 100 years, because we are trying to distinguish, if at all possible, between the status quo scenario and enhanced storage, and particularly if there is an increased frequency of severe weather event; i.e. tornadoes, which this local region has recently experienced, one would assume you could discriminate between those two options in the near term. This is referring to me -- and my experience is only as a layperson, but certainly coming from Calgary, we are very aware of the sudden one in 100 flood that took place kind of frequently in the last 20 years.

So we would simply like to know a little bit more why that distinguishing feature was not teased out a little bit more.

MR. PAOLI: Okay. Greg Paoli, for the record.

To the extent that climate change would be considered, and it was listed in the "Includes" category on page 45 of our report under "Severe Weather", we do indicate that the enhanced surface scenario has a reduced -- enhanced surface facility would have a reduced risk, primarily due to the lower consequences for any severe weather event and that would apply to -- that would be the case, and all we would be talking about under climate change is that those same extreme weather events might be more common, but that would not change the conclusion that the risk would be reduced in the enhanced surface storage scenario.

THE CHAIRPERSON: Thank you.

May I have now a comment from Environment Canada regarding the climate change implications for the comparative risks in the next 100 years?

MR. LEONARDELLI: It is Sandro

Leonardelli from Environment Canada. Can you hear me?

THE CHAIRPERSON: Yes, we can.

MR. LEONARDELLI: Great. So in terms of climate change, our original assessment for the project was in relation to the storm water management pond and the maximum flood hazard risk assessment, so we did make comments about that and various recommendations in regards to that in our original departmental submission from last year.

Now, I'm not sure if you are asking me for some information in relation to that or -- do you want me to revisit that at all?

THE CHAIRPERSON: Actually, Mr. Leonardelli, if you could then extend that, the recommendation of course is for the proposed DGR base case, but would your recommendations materially change in any way in the case, in particular, of enhanced surface storage and, if so, why?

MR. LEONARDELLI: Okay. So in terms of enhanced surface storage, so we would have the same considerations -- sorry, the same comments and recommendations that we made in

regards to the original base case DGR facility, the one that's proposed. Those would apply equally to the enhanced storage.

The aspects that we looked at were, you know, the sizing of the storm water management pond, so definitely whether it's an enhanced storage facility or the base case, our comments for the storm water management pond would apply just as equally and ditto for the -- and the same thing would be the case for the Maximum Flooding Hazard Assessment.

Now, just to remind people what that was about, the Maximum Flooding Hazard Assessment was to determine whether or not the underground workings might be susceptible to flooding from probable maximum precipitation events, and so there was some risk of that that was found and we had made a recommendation that the facility be redefined in accordance with the estimated flood level.

So what was being affected was the height of the shaft collar and that the flood modelling be redone based on the new design with a higher shaft collar and also factoring in the effects of climate change.

So if you are looking at a facility that -- a surface facility that is going to be there for let's say potentially 100 years, there is an expectation of incremental change to climate and that should be factored into the design of the surface facilities.

THE CHAIRPERSON: Thank you, Mr. Leonardelli.

I understand we now also have Ontario Ministry of Environment and Climate Change on the phone.

MR. CHAPPELL: Yes, you have Rick Chappell from the Ministry of Environment Climate Change.

THE CHAIRPERSON: Thank you. So, Mr. Chappell, can you also comment on this for the Panel's benefit?

MR. CHAPPELL: Yes. With regards to climate change, the types of provincial environmental approvals that the proponent would be required to obtain, we don't see those changing as a result of climate change.

Those approvals that are given are called environmental compliance approval and set out in those are terms and conditions under

which the proponent operates. Those are living documents, there is no specific end date to those documents. So based upon inspections that we may conduct with a proponent or changes to the environment, if those terms and conditions may have to change and that may be a result of a request that we make to the proponent for changes to that or it may be the proponent that is making changes to the facility that would come to us and apply for changes to that environmental compliance approval.

So that is a living, breathing document that actually can change based upon circumstances, and climate change might be one of those circumstances that may require the change of those terms and conditions as set out in the approvals.

THE CHAIRPERSON: Thank you, Mr. Chappell.

As a supplementary to you, do you have any recent examples of where an approval from your Ministry did require a change because of an increased frequency, for example, of storm events?

MR. CHAPPELL: Not to my

knowledge. Yes, the events of recently have not -- not specifically climate change am I aware of anything that has to change.

Obviously if you look at something, like for instance a sewage treatment plant that might have combined sewers, as the storm events increased you may have the potential for, you know, overflows. So that would be something that we would certainly address.

So I don't think there has been significant enough climate change at this point in time that we have seen that in our approvals.

THE CHAIRPERSON: Thank you, Mr. Chappell.

MR. CHAPPELL: You're welcome.

THE CHAIRPERSON: My next questions are around transportation and I note that the Ministry of Transportation has now come to the table.

Thank you very much. I have a question that I will first direct to the independent expert group and then to the Ministry.

Since the potential for radiological exposures from transportation and

handling were judged by the IEG to be quite low, does this reduce further the differences in relative risk between the two DGR options?

So what I'm questioning is actually discriminating between the two, given that in both cases, given your relative -- log relative scale, whether you could even distinguish between the two from a transportation point of view?

--- Pause

MR. REYNOLDS: It's Warren Reynolds with the Ministry of Transportation here. I'm with the Carrier Enforcement Program Office and I'm not quite sure how to even respond to that question. Maybe my colleagues in the back of the room could answer that, who are present at --

THE CHAIRPERSON: Yes, I will direct to the Ministry in a minute. We are waiting for the independent expert group.

MR. PAOLI: Okay. For the record, Greg Paoli.

We deal with transportation accidents in two different pathways; one is the consequences to workers -- well, actually three

different pathways I should say; impacts to workers, impacts to public, with a non-radiological component, just the sheer event of an accident on the roadway; and then we have a separate pathway for radiological exposure during transportation accidents.

Just to clarify, were you referring to any one of those three or all three in your question?

THE CHAIRPERSON: Let's go with all three.

MR. PAOLI: Okay. That might require me to flip a few pages.

We have already discussed the differences associated with the increased risk associated with worker exposure, associated with transportation accidents previously in this session and we do place some separation in radiological exposure during transportation accidents between the two granite sites, primarily associated with additional transportation miles. That does require an assumption of exactly where that facility is, which is inescapable, but we assume it to be hundreds --

MR. MORTON: Seven hundred kilometres I thought.

MR. PAOLI: Yes. We made an assumption and it's on page 44, requires additional transportation, 200 to 2,000 km, obviously that is a big range, from WWMF to a distant repository site, increasing frequency of traffic accidents.

We did place a relatively low consequence on those due to the nature of the secure transport, and so we essentially agree that we are dealing with relatively low risks in general in the transportation area. There is some separation, but they are on the left side of our absolute graph and, therefore, are in the ballpark of relatively small differences when comparing across all pathways.

Does that answer your question, Madam Chair?

THE CHAIRPERSON: Thank you.

I would like to now ask the Ministry of Transport to comment on this, especially vis-à-vis the relative risk of -- we have two variables here, number one, the distance travelled; and, number two, whether or not you

are in proximity to large populations.

I would ask you to also think about the information the Panel received in 2013 regarding the existing transportation of waste to the WWMF where the incident rate is virtually zero and that distance -- so that's actual data -- and whether or not that would affect the Ministry's evaluation of the importance of the variables, distance and population.

MR. FAVELL: Madam Chairperson, Members of the Panel, Martin Favell, for the record.

As you may know, we actually have three representatives here from the Ministry of Transportation, there is myself, beside me is Michael Morton from our Provincial Emergency Management Planning Office and on the line is Warren Reynolds from our Road User Safety Division. I believe Michael is going to try to speak to this question.

MR. MORTON: Thank you, Martin. Thank you, Madam Chair. For the record, my name is Michael Morton, I am Manager of the Emergency Management and Planning Office with the Ministry of Transportation.

Just to build a little bit on our presentation from October 10th, 2013, the location of an incident on Ontario's roads would be responded to in a very similar manner regardless of where it were to occur, and these accidents would be responded to in accordance with not just our Ministry Emergency Response Plan, but also the Provincial Emergency Response Plan, Part 7 of that plan which is maintained by the Office of the Fire Marshall and Emergency Management, outlines response protocols for all organizations in terms of a transportation accident.

So MTO's response, again, would be very similar. Our mandate is primarily to limit access to area of an accident while specialized response resources mitigate the incident and ultimately take measures to do any remediation and then we would open the transportation network. If necessary, we would do rerouting, we would liaise with our colleagues responsible for other modes of transportation like rail or marine.

But I think I would at this point really defer to other specialists to speak about

some of the specific consequences. For example, in our Provincial Plan, the Ministry of the Environment would look at the environmental impacts, our Ministry of Labour would look at the worker safety issues and our Office of the Fire Marshall Emergency Management really has that overarching responsibility for nuclear incidents, radiological incidents and could speak perhaps more to the response that first responders would do, if that is an area of interest to the Panel.

THE CHAIRPERSON: If I could follow up, Mr. Morton. The Panel would particularly be interested in, given the variable of distance, the availability of first responders in a timely manner if, for example, the proposed granite DGR was at the extreme range of the IEG's assumption, which is 2000 km, up somewhere in the middle of nowhere?

MR. MORTON: From the perspective of MTO, again our role is primarily to control access through rerouting traffic by assisting the OPP in closing routes, if necessary, and liaising with other modes of transportation if required, and we maintain that capability across the province, including in northern Ontario.

You know, regardless of what the hazard is, we regularly carry out rerouting and traffic control related to even weather events.

With regard to the specific assets to mitigate hazards, those really fall more under the purview of, again, Office of the Fire Marshall with respect to Fire Services and to some extent under the MOE and the MOL mandates.

MTO, again, is very much a supportive role and we are prepared to play that role wherever it may occur.

THE CHAIRPERSON: I therefore would direct a question to Mr. Chappell from the Ministry of Environment.

Mr. Chappell, in terms of availability of resources in remote areas to respond to a transportation incident, would you say that there is a material difference in availability and timeliness of response from the aspect of your Ministry's responsibilities and a remote site versus a site more similar to the proposed Bruce DGR?

MR. CHAPPELL: Rick Chappell, Ministry of Environment and Climate Change, for

the record.

We have our regional offices and district offices throughout the Province of Ontario. We would respond to environmental situations as opposed to anything from a transportation perspective. But in responding to environmental situations, we have staff that are available 24/7. We have an after-hours program that if a call does come in to the Spills Action Centre after hours, we have staff that can go out to specific sites.

Obviously from a more remote area, you know, the officer -- provincial officer goes to the office to gather the information and then goes to the site. So just from a distance perspective, obviously, it would take more time for the officer to get there. But, as I said, we are available 24/7 and do have officers that would be dispatched to sites, if appropriate.

THE CHAIRPERSON: Thank you, Mr. Chappell.

MR. CHAPPELL: You're welcome.

THE CHAIRPERSON: I understand also the Ministry of Labour, Mr. Doehler, is available on the phone. I have the same question

for you regarding resources and timeliness of response should a transportation incident occur in a remote location.

MR. DOEHLER: Lothar Doehler, for the record, Ministry of Labour.

Depending on the exact location of the incident, we have regional offices stationed throughout Ontario. In the northern region we have offices in North Bay, Sudbury, Thunder Bay.

We will be informed of any incident involving a worker through the Spills Action Centre after hours and we will endeavour to send an inspector as soon as possible to investigate.

I cannot give specific timelines in more detail.

THE CHAIRPERSON: Thank you, Mr. Doehler.

I am now going to shift focus a little bit back over to the CNSC. The CNSC specifically mentioned that the -- on your slide 12, if we could bring the slide 12 up, please?

The comment was that the worker

health and safety should have actually been regarded as more similar. Dr. Archibald has already gone into this in a little bit of detail with you, but the Panel just would appreciate absolute confirmation, and notwithstanding this comment, you really do feel that you would still agree with the overall IEG, both absolute and relative risk conclusions regarding worker health and safety?

DR. THOMPSON: Patty Thompson, for the record.

Yes, we would agree.

THE CHAIRPERSON: Thank you.

Again to the CNSC -- and we may get into this in quite a bit more detail tomorrow -- but you raised the issue of trust and the importance of -- in this, for the CNSC, trust and public engagement and public consultation.

Does the CNSC track the effectiveness of its public consultation programs? This comment was in response to the CNSC's remark that the IEG had not taken into account responses from OPG and CNSC to the Information Requests and also questions at last year's hearing that raised some of these issues

of concern.

DR. THOMPSON: Patty Thompson, for the record.

I will respond in a general sense and then perhaps, if you let me, I will check with my colleagues at lunchtime and may come back with more information, if we have some.

In terms of the variety of activities that the CNSC undertakes, it goes from putting material on our website to having public information sessions in various communities and there is a whole range in between, including Commission proceedings.

We do quite actively track the use of our website in terms of the number of people who come to consult on various documents, the time they spend, number of downloads and things like that.

We also track, for example, over the last year or so we have put out videos, for example, to explain radiation through our YouTube channel and we do track responses and how much these videos have been talked about by various groups.

So we do track effectiveness of

our engagement and outreach for certain activities.

We have gone in communities, for example, to talk about quite controversial projects and where we receive input essentially in terms of that people may not always agree with, you know, whatever the project is, but they appreciate the quality of the information provided by the CNSC.

So we do have that type of information, but that is not being tracked in a scientific manner, I would say.

THE CHAIRPERSON: Thank you, Dr. Thompson.

And as I alluded to, we will be getting into these broader issues in more detail tomorrow and the Panel would like to give CNSC a bit of a heads up about that. We know you don't have a presentation ready for tomorrow, but if we could ask that you be prepared for a somewhat more detailed response. Even if you don't track formally now, perhaps you can consult with your colleagues regarding whether you have any intention to do so and, if so, what types of tools you might be prepared to use.

I will also suggest to the IEG that that will be a topic for tomorrow.

DR. THOMPSON: Dr. Swanson, then perhaps rather than consulting with my colleagues during lunch and coming back after lunch, I will get the information for tomorrow.

THE CHAIRPERSON: That would be appropriate, thank you.

DR. THOMPSON: Thank you.

THE CHAIRPERSON: Dr. Muecke...? Dr. Archibald, did you have any further questions?

That means we're finished with the Panel questions for this morning. We will adjourn for lunch and reconvene at 2:00 p.m., when we will be hearing from Dr. Greer.

--- Upon recessing at 12:16 p.m. /
Suspension à 12 h 16
--- Upon commencing at 2:00 p.m./
Reprise at 14 h 00

MS McGEE: Good afternoon and welcome back.

I just wanted to make a brief

statement that in addition to registered participants, both today and many of the other days of this hearing, the Panel has asked certain government departments and ministries to be on standby for questions, as you would have probably noticed this morning.

Thank you.

THE CHAIRPERSON: Welcome back everyone.

The first presentation of the afternoon is by Dr. Sandy Greer, which is PMD 14-P1.18 and 18(a).

Dr. Greer, the floor is yours. You do have 30 minutes. The same rules as last time, the amber light comes on, you have five minutes.

***PRESENTATION BY / PRÉSENTATION PAR:**
SANDY GREER

DR. GREER: Thank you, Madam Chair. And I would like to thank the Panel for giving me this opportunity to speak again and participate at this public hearing.

The subject that I chose was the

methodology of OPG and to provide a critique. After submitting both parts of my presentation I was scheduled to speak today and, therefore, took responsibility to read the risk assessment on all of the alternative means as well, even though my entire presentation is really based on 510, the EIS-510 in terms of the methodology provided by the OPG.

So my presentation is going to address the absence of an ecological literacy approach to understanding the potential impacts of consequences from any releases of radionuclides into the environment at all levels.

So I now will proceed. And what I will do, because I made a very intensive presentation with the intention of providing good information to the Panel and to the wider public. And I, therefore, have made quite a long presentation just so it is on the public record.

So I am going to be speaking only to certain passages in each of my slides to try to fit everything into the half hour.

Thank you.

So first of all, I just want to introduce the concept of ecology, which is the

study of the earth household, regard to the relationships between all members of the earth household, including plants, animals and micro organisms and their natural environment, living and non-living.

In western culture these areas are referred to as the abiotic environment, which includes air, minerals, water and sunlight and the biotic environment, which are plants and animals and insects and all of the living organisms that reside on the earth in the air, water and on the ground.

And I want to point out that in looking at ecosystems we need to deal not only with ecology, but that awareness must be grounded in other fields of knowledge such as biology, geology, atmospheric chemistry, thermodynamics, and other branches of science.

Now, ecological ethics is the system of principles which indicate to humans how they ought to comport themselves in their interaction with a non-human world.

So here there are various ways that are really progressive in trying to go from a very linear to a more holistic understanding of

how we exist on the earth and can conduct ourselves in respect of the planetary life support system that humans enjoy.

And therefore, we can first of all look at the common English usage which suggests the empirical mathematical examination of physical reality to be no more than observation and statistical systematization of observed phenomena. It prides itself on objectivity. It seeks to be rigorously value-free.

However, then one can proceed to a deeper understanding of science and how we approach our reality on this earth through human ecology and ecological ethics in which we have to look at the deeper and broader enquiry into the value system of life and of human dwelling in the community of all beings.

These are no longer questions simply of the structure of life processes. Their purpose is not simply theoretical modelling, but a reliable guidance for our acting; how we ought to live it and in relationship to, as indigenous people would say, all our relations, that we are interrelated with everything alive on this planet

and we need to honour and respect and protect that.

So then in regard to ecosystem principles, the International Commission on Radiological Protection also has a perspective, and they refer to it as an ecosystem approach that is a more recent trend. And again, it is specifically for the protection of the environment.

This requires that one looks at the environment or a specific and identified part of it as a whole and considers all of the factors that might adversely affect it.

And therefore, I just wanted to point out too that in my reading of several publications by the ICRP I just got the sense that they are making very credible steps towards an understanding of an ecosystem approach.

But even their language sort of gives them away that they are still I think more engaged with the empirical mathematical approach rather than a more holistic ecological approach in its fullest sense.

But they are making great strides in the last decade or more in really identifying

the fact that we need to consider radioactive implications and potential consequences on all living organisms, not just humans.

Now, in regard to ecosystem principles again, Dr. Peter Duinker last year was invited by the Panel to be a presenter and to contribute his expertise. And one of the requests in the undertaking following his submission was to outline a holistic view of the ecosystem.

So here again he basically articulated what I quoted from another source. And I have quoted a few different sources to demonstrate that there is quite a wide awareness about ecosystem principles and ecology. Even if it is not necessary fully implemented at this historic moment, it is a journey that we are all on as human beings on this earth.

So I also have two other quotes here by Dr. Duinker. And the point I would like to emphasize is that at the bottom here he pointed out that what is critically important is the way an ecosystem analysis unfolds is always dependant on the objectives of the analyst. So he really stressed that last year.

And therefore, when an ecosystem approach is used for a project, the proponent may not invest as much energy into addressing the ecological relationships than if somebody were doing some type of other study for other purposes than an industrial project.

So my concern here, and I am going to be showing later the example of the Lake Fringe Watershed, is the ecosystem perspective in terms of watersheds, as an example, in relation to the specific DGR project.

And I would like to quote just the bottom paragraph that, "I Canada the Auditor General's fourth review of SEA, Strategic Environmental Assessment, practice in Canada reported the SEA directive has yet to be consistently applied across federal departments and agencies, and that SEA has not been undertaken for some proposals where significant environmental effects could result."

And that was part of a number of papers I read on impact assessment.

So in the different impact assessment perspectives of course Duinker and his working partner Greig, they recited a number of

times. But there are many other experts who have worked in the field and are working impact assessment and it is really a work in progress that is continually evolving and developing and improving on the various assessment procedures and what gets evaluated.

And so again, in the middle here, Greig and Duinker, they really emphasize the need to look at impact prediction, significance, determination, and an approach based upon systems analysis.

And the significance determination really is the core issue of my concern. Because, basically, the OPG's methodology concluded that there were no adverse effects of significance, which was the rationalization they gave for not doing certain kinds of investigations to date on potential impacts of possibly leaking radionuclides.

So when I read that, that is why I just wanted to find where else there might be that awareness, both within the nuclear industry internationally and independently from it.

So one of the issues is the huge uncertainties that are well-known, as that is one

of the reasons for the precautionary principle to be of such importance. Because one of the reasons for that is a scientific uncertainty.

So referring specifically to Canada, there is a whole history that I read about in a book called *Deliberative Democracy for the Future: The Case of Nuclear Waste Management in Canada*.

And again, similar to Greig and Duinker and people in the impact assessment field, the author Genevieve Fuji Johnson, she wrote about the whole history of how the partnerships and the responsibilities evolved in Canada in regard to the nuclear industry and in regard to the management of nuclear waste.

So she also points out that what the Seaborn Panel many years ago had recommended was actually not fully taken up by the federal government, who decided instead that the framework simultaneously gave the waste producers and owners the responsibility of establishing, organizing, managing, and funding radioactive waste facilities.

And established a policy role for the government and an operations financial role

for the nuclear energy industry, rather than the nuclear industry having more of an arms-length relationship, which is what the Seaborn Panel had recommended.

Now, in regard to her book, it is very informative and she also cites a researcher, Kristin Shrader-Frechette, who points to out that there are various types of uncertainties.

And here in regard to the modelling uncertainty, that is of key pertinence here because of the mathematical modelling that so extensively I believe has been used by the OPG and the CNSC in terms of arriving at some of their conclusions and suggestions.

And the modelling uncertainty refers to questions of validating and verifying models of complex systems that function over the very long period.

Given the timeframes at play and numerous areas of science, technology and environment, there is often no possible way of checking certain models against the reality they represent or of verifying hypotheses based on these models.

We cannot observe, for example,

the behaviour of a nuclear waste management system over its lifespan. So that is a pretty big area of uncertainty.

The other important point that is made in the book, among many, but here I wanted to identify the quantitative risk assessment as among the commonly employed policy decision-making models since the 1980s, and its process is embedded in risk, cost, benefit analysis.

And the basic presuppositions of QRA are that risk is defined as the probability of a harm multiplied by its magnitude. Probabilities are objective, determined empirically and expressed quantitatively. Harms can be identified, quantified, measured and weighed. And the acceptability of risks can be rationally calculated according to a maximizing standard.

Meanwhile, there are ecosystem concerns, and the ICRP is aware of them. And I wanted to give credit to the IRCP that for a number of years it is on a journey that continues in regard to recognition of protection of the environment.

And in this image I just wanted

to point out to everyone that they created and identified particular types of species which are shown in the image there in the centre at the bottom.

And what they have done is they are developing, and it is still in development, the referenced animals and plants in parallel with the criteria used for humans for a referenced man, and they show Leonard da Vinci's image of a human being to show the parallel here.

And that they are on this journey of investigation in terms of radiation doses, looking at exposure pathways and dosimetric models.

Now, I wasn't able to -- I just ran out of time to read more of the literature. But at this time they are focusing on the biotic species and they are not addressing pathways at this time.

But I happened to also look at conference presentations that occurred last year in the Middle East. And looking ahead, that what they want to do is also, in the future, develop and test under various scenarios the maximum concentrations of radionuclides in air, water and

soil.

So that is in their plan. So they are recognizing the limitation of awareness in regard to the actual effect on all species, all organisms, that we are still in really early days in really understanding the potential radionuclide impacts.

And the huge question for me is really, can we rely on the modelling and the technological tools that are really in the mainstream of practice today? And I would say we are not there yet. And so I do appreciate that the ICRP acknowledges that much more needs to be done to improve the understanding of potential impacts.

So they also point out that the tools -- well, they themselves say that the tools available today are still not developed enough to really address the complexity of an ecosystem approach to understanding potential consequences of radionuclide releases.

And I just wanted to here focus on the different pathways that the ICRP identifies in terms of different types of exposures, which include inhalation of re-

suspended contaminated particles or gaseous radionuclides, contamination of fur/feathers/kin and vegetation, ingestion of lower trophic level plants and animals, direct uptake from the water column, ingestion of contaminated water.

External exposure, the configuration of the source relative to the target clearly depends on the organisms' ecological characteristics and habitat.

A benthic dwelling fish will, for example, be exposed to radiation from radionuclides present in the water column and deposited sediments, whereas a pelagic fish may only be exposed to the former. And I put that in just as one little detail, one example about the complexity of even different types of fish, of how they will respond to radionuclides in different ways.

So this is data that has begun to be investigated and collected, and there is still so much more to do.

And they also are trying to improve on their modelling. And I didn't have time to -- I did bring, if you want to ask me a question afterwards about voxel phantoms in terms

of looking at doses in an improved way from even currently what is being used to do these measurements.

So now I want to look at the Lake Fringe Watershed because now, if you look at the picture on the left, if you look around the coast and the colour green, you can see that just around Kincardine, and unfortunately the nametag covers over this one watershed area, and I just want to point out that how few watersheds are on this eastern side of the lake. And so this watershed is really important because it is broken up and the wetlands have disappeared along a lot of the coast.

And so the protection of the Lake Fringe Watershed, which we see on the right, and that extends south of Bruce Power and the proposed site for the proposed DGR all the way up to Southampton.

So that whole area is an ecosystem, and it is a subwatershed area. And of course it is totally interconnected with the larger watershed region and other watersheds. So you can keep kind of expanding, expanding, expanding at different levels like how ecosystems

are interrelated to each other geographically.

But I just wanted here to point out that there are certain concerns here. You know, when I mentioned last year and other people have mentioned and, Bev Fernandez yesterday, was a reminder about the concern about the potential impact on the Great Lakes Basin.

But even if we just focused on watersheds instead of looking at just one tiny little, you know, site where the proposed DGR itself is proposed to be constructed, I mean to me that is not good enough, that there are still potential harms that can be caused environmentally, like even in the region of this area, along the coast for Bruce County and continuing.

So wetlands are under stress and under threat and there are various causes for that, including wetland draining or filling, contaminated runoff, artificial changes in water levels and the spread of exotic and invasive species.

Now in the next slide I want to emphasize that Baie du Doré in the Municipality of Kincardine is part of the coastal wetland

system and it is related to the DGR project, it is all interconnected.

And there are rare species in this area, there are species at risk, including turtles, and I haven't seen that mentioned specifically in the OPG documents.

I remember reading once in a technical report last year that they only found one turtle. So I got the impression the conclusion was that turtles aren't that important, because we only saw one. But I mean that is why it is important, because turtles are disappearing, they are species at risk. So we need to be concerned about all species, not just a few.

And also the Ministry of Natural Resources has declared this region, like the class 2 provincially significant wetland of which DGR is interconnected ecologically.

And another point is that benthic invertebrates are good indicators of water quality, responding quickly to environmental stressors such as pollutants. However, a very key benthic invertebrate includes the crayfish and the habitat for the crayfish is identified as

being disrupted by the proposed DGR.

Now, the OPG says it's only a 1 percent disruption for the crayfish, but how do we know that, based on what models, what kind of evidence? How can we really verify and say unequivocally that only 1 percent are being affected, especially when they are very important if they could be utilized to be indicators of possible future contaminants, and should they not be considered in creating the baseline now of how the water system is and so on prior to any potential future contaminants?

The other thing about more disruption to this area, then, I also got the sense in the OPG documents that because the area is already disrupted it isn't of consequence to do more disruption, I mean that was just what went into my body, that there wasn't really much concern, but more disruption also could cause more invasion by these invasive grasses, which are quite a major issue in Lake Huron and they're being acknowledged by the environmental organizations, so more disruption would cause these common reeds to perhaps invade this local area. What they do is release poisons into the

roots of native plants, so there's all these ripple effects.

Again, last year, not in my presentation last year but at the microphone one day, I mentioned this wonderful study done by the University of Michigan on Great Lakes' stressors. Just look at that red dot right at this area here. What that refers to is cumulative stress. The people doing the study told me that they did not include radionuclides in the study but they do include nuclear power plants.

The other cumulative stress factor is agricultural runoff. I feel it's very important that when cumulative effects are being evaluated that agricultural runoff needs to be included, absolutely, and not just the nuclear power plant.

In terms of significance determination for residual adverse effects, here is the methodology for anyone to read later who is not already familiar with the aspects that were asked by the JRP for the OPG to please give evidence for and use the precautionary principle. What really blew me away, which was why I did all this other research, because I could have done a

totally different presentation looking at every page and analyzing every page of the OPG document, but what really was upsetting was to read that both the EIS and the enclosed recent argument narratives reach the same conclusion, that the DGR project will not result in any significant adverse effects. I just question that collective conclusion for everything that I just don't think is good enough because we don't know enough yet. We don't have the tools to properly evaluate potential impacts on living organisms.

I'm just going to close off here. I say there is no justification provided by the methodology to give OPG a licence to proceed on the construction of a deep geological repository. The science is not available, as the ICRP honestly declares in its continued pursuit to improve methods. Even if ecosystem principles were applied, still very early in their maturation, can we really afford the hubris, as a human species, to proceed with burial of any level of radioactive waste with so much still unknown about the planetary life support system?

Thank you.

THE CHAIRPERSON: Thank you, Dr. Greer.

Panel members, did you have any questions?

MEMBER MUECKE: Ms Greer, you mentioned and elaborated upon uncertainties in the process, so I would like to ask both the IEG and OPG to perhaps clarify how uncertainties were handled.

First of all, for the IEG, could you elaborate how you have incorporated uncertainty in your risk analysis?

MR. PAOLI: Greg Paoli, responding on behalf of the IEG.

I guess the best way to summarize how we considered uncertainty is to be open about its existence and certainly admit to having a lot of it with respect to certain aspects of it but also reflecting to a certain extent that, in the context of a relative risk assessment where different options are being considered, we may have more uncertainty in the absolute level of risk but we may have more certainty in the relative risk between two different options. I just wanted to make that distinction clear. We

didn't formally score it or assess the uncertainty's relative magnitude but we did indicate on more than one occasion in our report that we're not able to provide precise estimates of risk, and certainly we weren't asked to do so quantitatively, but qualitatively, even with the qualitative characterization of risk as we tried to do visually and textually we still have to admit to a lot of uncertainty.

DR. DUSSEAULT: Maurice Dusseault, for the record.

The management of risk in large projects that are multidimensional, ranging from ecosystem impact to subsurface porosity and permeability to the atmospheric impacts, is always fraught with uncertainty, and more and more engineers and people that build these facilities for society use the term “adaptive engineering”. The whole philosophy of adaptive engineering is go carefully, keep your eyes open, do the science, take measurements, take steps to reduce uncertainty as much as you can, take steps to mitigate the impact of what you're doing, redesign, and so on, because we recognize that uncertainty exists at all levels and that

different levels of uncertainty are acceptable to different jurisdictions, different persons, different elements of society, so in trying to square that difficult circle, the process of adaptive engineering has become more and more formalized as a process of moving forward on, shall we say, multidimensional problems.

Thank you.

MR. ISAACS: It's Tom Isaacs.

I would just add that, in addition to what you just heard, we're dealing with risks that are usually at a very low level and discriminating amongst these very small differences of very small risks is quite difficult to do, so the fact that you're imprecise doesn't mean that somehow you're in a regime where there are significant risks. There could be, but it doesn't mean it is, and in this case I don't think it is.

The second point is the way in which engineering organizations deal with risk is fairly straightforward in lots of cases. The first one is you use conservatism, so when we design things in an era of residual risk we design to be conservative so that we are

confident that while we may not know what that very low barrier is we are clearly protecting against things that are much higher.

The second thing is people use what some people would refer to as defence in depth, which is that you use a series of multiple, redundant, diverse barriers between you and the environment, and the combination of that provides a degree of comfort and confidence that if one barrier of all of these conservative barriers were to turn out to be different than you thought it was you still have a number of other types of barriers that are not prone to common mode issues that will still provide the kind of protection that one needs.

Those are some of the sort of engineering principles that one would use in guiding a project like this.

Thank you.

MEMBER MUECKE: Thanks very much for the clarifications.

I would like to ask OPG next. Could you restate, for the panel and for the public, how conservative assumptions are used by OPG in its modelling of the safety case,

hopefully in words which everybody can comprehend?

MS SWAMI: Laurie Swami, for the record. I'll ask Dr. Gierszewski to respond to that and we'll work on making sure the words are --

MEMBER MUECKE: Could I add to that? Could you provide perhaps some relevant examples in terms of the safety case for the DGR?

DR. GIERSZEWSKI: Paul Gierszewski, for the record.

In developing the safety case we considered a number of approaches to deal with the uncertainties. In particular, if you think about the long term, which is really the unique aspect of this project, and the post-closure safety, you're invoking not only the concept of the multiple barriers, as has already been -- was recently alluded to in the selection of the design or the site.

In the analysis itself, the modelling, you're using conservative assumptions. You're testing your assumptions by analyzing different scenarios, things that could be likely, things that you might think are unlikely but you

analyze them to get a sense of the robustness of the system.

Again, to give specific examples, we looked at the case of somebody drilling a borehole directly into the repository 300 years from now and basically extracting material and bringing it to the surface, which goes entirely against the whole concept of a deep repository, which is to isolate it, but we looked at that as an example to see what the consequences would be.

Another example in the modelling approach is looking at conservative assumptions around what the receptor might be, so when you think about what are the potential impacts we assumed that somebody would be living on the repository site in the distant future or 300 years from now and farming and carrying out their activities in a way that maximized their exposure to any radiation that may have leaked. Therefore, we were using them as a proxy for the model and we were coming up with a conservative estimate of impacts.

I think those would be the key elements that we have considered in terms of developing the safety case.

MEMBER MUECKE: Thank you.

Ms Greer, what you just heard from the IEG and OPG, do you think it adequately addresses uncertainties?

DR. GREER: Dr. Sandy Greer, for the record.

No. I'm sorry, it does not. Last year in my presentation I pointed out a research I did in a book called “The Web of Life” in which physicist Fritjof Capra interviewed computer scientists who pointed out that human-constructed computer programming simply cannot mimic the natural world. I could elaborate on that if you like.

The nervous system of a living organism works very differently and this is why the ecosystem approach is so important to adapt, to understand and to learn about for people who are working in industrial projects. My main point here is the knowledge is not there yet. We still cannot rely on the types of mathematical modelling that so often is used as one of the major ways, aside from certain field studies and so on, laboratory studies, but the mathematical modelling is used quite extensively and is not

able to -- it's like mixing apples and oranges. It's just not the way that living organisms function. We're still all learning about how complex that is and that's where, to me, the primary huge uncertainty is at so many levels.

MEMBER MUECKE: Thank you.

THE CHAIRPERSON: Dr. Archibald, did you have any questions?

MEMBER ARCHIBALD: I have one question for OPG.

A question was posed by Dr. Greer on page 16 of her written presentation and slide 17 concerning a study conducted by the University of Michigan on environmental impacts on Lake Huron in the area of the proposed DGR where agricultural runoff into the lake is known to be a principal stressor. She stated that there exists many uncertainties in environmental assessments throughout her presentation, but in this one case a field data is available for the proposed site.

OPG, have you included agricultural runoff as a factor in your cumulative effects studies?

MS SWAMI: Laurie Swami, for the

record. I'll ask Ms Barker to reply to that.

MS BARKER: Diane Barker, for the record.

OPG's assessment of cumulative effects in considering the existing project --

THE CHAIRPERSON: Ms Barker, can you get a little closer to the microphone? Thank you.

MS BARKER: Sorry. Diane Barker, for the record.

OPG's assessment of cumulative effects, the existing projects that were reflected in that project, while we didn't specifically identify agricultural runoff as a contributor to the existing conditions it would have been included in the characterization of existing conditions. There were no specific, significant agriculture industries in the near vicinity that were included in the cumulative effects assessment and none that were identified as proposed to be implemented in the near vicinity of the project, but because we undertook water quality sampling in the vicinity of the project any effects of the agricultural runoff would be reflected in the characterization of the

existing environment and would be included in the cumulative effects assessment.

MEMBER ARCHIBALD: Thank you very much.

THE CHAIRPERSON: Ms Barker, I just want to ask for slightly more detailed information. The panel understands that your water quality baseline would inherently include current effects of the agricultural activities in the watershed that might be reflected in the water in your study areas. Are you confident that the water quality parameters that you included included those that are good indicators of agricultural impacts that your project might in turn add to, for example, specific nutrients?

MS BARKER: Diane Barker, for the record.

I would have to go back and check the list of contaminants that we did consider in -- that were sampled. I do believe, however, that the majority of the contaminants would be reflected.

THE CHAIRPERSON: Thank you. That would be sufficient.

I do have a question for the IEG

arising out of Dr. Greer's presentation.

On a number of occasions Dr. Greer referenced the use of the precautionary principle when faced with uncertainty. To what extent did the IEG apply the precautionary principle in its consideration of both likelihood and consequences?

MR. PAOLI: Greg Paoli, for the record.

The specific task of relative risk assessment makes the application of the precautionary principle more challenging than usual to apply because even the concept of being conservative is difficult to apply in a relative risk assessment context because you would have to choose to be equally conservative in all of your scenarios. While our instincts in this risk assessment field were to be conservative, and we certainly agree that the precautionary principle would be an appropriate way of thinking about some of these things, in a relative risk assessment context it wasn't really applicable in the usual way of being conservative.

THE CHAIRPERSON: Thank you. The panel understands, for example, that the

information provided by Dr. Dusseault this morning would be an illustrative example of that, where you actually incorporated some of the absorbed and attenuative principle processes rather than assuming they were absent in some of your relative risk comparisons. Would that be correct?

DR. DUSSEAULT: In a relative risk, yes, but in terms of applying a precautionary principle to the conclusions of the IEG report, I'm not sure that that was a remit. We did certainly apply an inherent precautionary principle to the availability of quantitative risk information so that when we evaluated the relative risk we, in a precautionary manner, bowed to the uncertainty in the various physical processes.

For example, I do not have data at hand that will tell you what percentage of radionuclides will be absorbed per metre, per litre per year, whatever the units are, so we don't have that quantitative information. We know what reasonable numbers might be given the surface area of these minerals, but these are somewhat speculative and are all fraught with

uncertainty themselves.

As part of the engineering approach to a complex system like this, a precautionary principle is inherent in our approach although not explicitly stated.

A precautionary principle means at least -- for example, I have served on some rather recent panels like the shale gas panel for the Council of Canadian Academies. The precautionary principle was discussed there and it was interpreted as meaning go slow, go carefully, listen to the science, collect the data, not stop everything until we satisfy all persons' comfort level with varying degrees of uncertainty.

DR. LEISS: My view of it is that precaution is often used a lot and used normally quite loosely and in that way doesn't really help you very much.

I think it has a very significant place, but normally that would be in a quantitative risk assessment where you have some numbers to work with. The easiest example is margin of safety. The question is: how much margin of safety? In part, it depends on the

specific threat, so in some cases you want more margin of safety. One of those considerations is how much uncertainty you have. That is a specific relationship there which ultimately can refer to certain measurable aspects of the risk you're facing, the amount of uncertainty, which again can be and ought to be quantified in a quantitative risk assessment, and the nature of the threat, some threats are worse than others, where you would want to be more precautionary, but in the quantitative risk assessment you get some magnitudes. In a health risk assessment you're trying to calculate a no effect level. You take the level where you can identify effect and add safety in terms of parts per minute and so on, add a safety factor of 1,000, and that's conventional in a health risk assessment.

I think it's most useful when you have some numbers, when you can quantify uncertainties and where you can specify specific margins. There you can argue about whether or not one is being sufficiently precautionary. Otherwise, it's just a more generic discussion that doesn't give you very much guidance.

THE CHAIRPERSON: Thank you very

much, Dr. Leiss.

I think that concludes the questions the panel has for Dr. Greer.

Dr. Greer, did you --

DR. GREER: Thank you. Dr. Sandy Greer, for the record.

I would like to just make one final quote from my presentation that I think is, if I may, just adding information. It is a statement by R.J. Pentreach, who is an emeritus member of the ICRP, and he has written that:

> "Significance determination has more than one process of criteria. It should be noted that regulatory requirements for protection of the environment have often been written in terms of 'no significant adverse effect' on the environment, but there are also other ways in which environmental protection has been addressed which may be usefully considered."

And given the conclusions by the

OPG that they did not determine significant impacts for anything, I mean, that is a huge concern, and on what basis?

So is it an issue of the limitation of the regulatory that need to be looked at and challenge?

Thank you.

THE CHAIRPERSON: Thank you, Dr. Greer.

While we're changing seats to the -- for the next presenter, the Panel would like to again give a little bit of a heads up about the proceedings for tomorrow.

We've -- the Panel has received a number of comments and pieces of information from various intervenors that speak to the ongoing concerns over modelling, the most recent speaker, Dr. Greer, being only the most recent speaker.

So the Panel would very much appreciate OPG, the IEG and CNSC to come prepared tomorrow to answer some questions from the Panel regarding the layperson's view of modelling in terms of mechanistic modelling that it purports to try to explain the detailed natural processes versus the type of modelling that is used for

planning or decision purposes which does not purport to be a detailed mechanistic model that models the real world accurately.

I think that is a theme we've been hearing a lot, and I think we are -- we would like to explore the distinctions in the various kinds of models because I think that is fundamental to some of the discussions we're going to continue to have.

Am I making myself clear with respect to the distinction I'm asking for?

Thank you.

Welcome, Mayor Kramer. Again, we will have 30 minutes for your presentation, and you may proceed.

***PRESENTATION BY / PRÉSENTATION PAR:**
MUNICIPALITY OF KINCARDINE, MAYOR LARRY KRAMER

MAYOR KRAMER: Thank you, Madam Chair. I hope to save you a few minutes this time around.

I know it's kind of unusual for the Mayor to welcome you on day three of your hearings, but welcome back to Kincardine to you,

the Panel, and all of the other participants in the process. We thank you for the depth that you're taking to examine this issue for us locally.

And I'd like to thank you for the opportunity to provide some supplementary comments from the perspective of the Municipality, with specific reference to the certain topics that are subject to this new round of hearings.

In terms of methodology to determine the conditions that would make a residual effect -- a residual adverse effect significant, the Municipality believes the methodology approaches is reasonable and that the outcomes are appropriate.

The anticipated effects are also consistent with the Municipality's own experience with large infrastructure projects that are regarding noise and dust. This is further supported by the outcomes of our own independent peer review that was undertaken by our consultants to review potential project impacts on our behalf, which concluded the methodology used was sound enough to permit an objective

review of issues, data and facts.

The consistency of the results of the two approaches to significant effects provides confidence that the DGR project will not result in significant adverse effects on the environment.

Our own peer review also reached the same conclusions of the socioeconomic effects presented and that they will not be significant.

Furthermore, when potential impacts such as noise and dust are considered, appropriate impact avoidance and mitigation will be undertaken.

Kincardine agrees that the follow-up monitoring actions in the DGR EA follow-up monitoring program are appropriate and adequate.

OPG further commits to follow municipal noise by-laws, for example, to avoid blasting on certain days and time if noise was found to be clearly audible.

Localized nuisance effects of noise and dust and the mitigation measures put in place to limit impacts are typical of those which have been effective in Kincardine with large

scale aggregate extractive operations, example pits and quarries. While effects will be short-lived, our experience indicates that commonly-used processes will be able to minimize impacts through mitigation as well as through tracking of any public complaints and addressing the concerns.

The additional commitment by OPG to place berms and vegetation along the perimeter of the DGR project site to control dust and noise are similarly effective measures we often ask of proponents seeking building and construction permits in the Municipality.

OPG also has a very effective environmental issues management program, and it is anticipated that should any environmental effects in the local community arise during construction, they would be identified and resolved through this management system.

The Municipality, from our experience, agrees with the detailed narrative applied to explain the significant determination and the significance of any changes, and are consistent with our own experiences.

Relative risk analysis of

alternative means.

The additional detail and information provided on the four alternative means analyzed are consistent with Kincardine's similar research and study and personal experience conducted over a decade ago. It was the Municipality of Kincardine that, in 2001, first approached OPG about the long-term management of low and intermediate level waste at the Western Waste Management site.

Memorandum of Understanding was signed between OPG and Kincardine in 2002 to jointly study options and alternative means for the long-term management of the waste.

A report was produced by Golder Associates in February 2004 titled "An Independent Assessment of Long-Term Management Options for Low and Intermediate Level Waste at OPG's Western Waste Management Facility".

The study, which has been previously considered by the Joint Review Panel during these hearings, examined the costs, impacts and benefits of constructing and operating long-term management concepts at WWMF, sustained surface storage, which was the status

quo, enhanced processing and storage, surface concrete vaults and deep rock as well as shallow vaults, actually.

Kincardine, in the assessment, chose not to review a hypothetical site elsewhere. Rather, we looked at options implementable at the Bruce. I'd just like to add some comments on this point.

Before making that, though, we also studied other communities in the world and we studied their siting experiences. One of the ones that we -- locally that we found particularly interesting to us was Port Hope, Ontario, who had been studying issues in their community for over 20 years.

And after 20 years and polling every municipality in Ontario, they only had one expression of interest, and that was from a nuclear host community, which is Chalk River.

Another one was -- that we studied quite closely was the U.S. co-op system to find sites for low and intermediate level waste where they could form co-ops between various states.

They were 25 years at the time of

our decision they had been doing that with no successful siting.

And also, the experience of the creation of the NWMO, a federally-incorporated entity with specific duty of finding a host site somewhere in Canada.

So those did not give us a lot of -- a lot of faith that other communities would step forward. And since 2001, when we began down this road, no Ontario community or community anywhere has expressed an interest in being the host for this obligation, so we believe that, as a community, that it's unlikely that others will step forward.

This reflected our belief that we have a responsibility -- this all grew into our belief that we have a responsibility that, as a community, we should work collaboratively with our local industry to arrive at a solution in our own home.

Information supplied in the EIS 12-513, relative risk analysis of alternative means, confirms the conclusions that Kincardine reached through our own study and continue to support today the Deep Geologic Repository deep

rock vault provides the best long-term safety for the waste.

Kincardine has also found that all options were technically feasible and may be safely constructed and operated at the Bruce site.

The Municipality's early work in combination with the studies and assessment performed by OPG and its most recent effort by the independent expert group clearly sets out why a Deep Geologic Repository is the best option for disposal of the waste.

The Municipality's own review conducted that while all options met the safety and economic requirements, study trips and research showed the deep rock vault option was the most appropriate for the Kincardine region and that this option would provide the highest margin of safety.

As stated at the 2013 hearing, we recognize that temporary storage forever was not acceptable. It was on this basis that Kincardine passed Resolution 2004-232 to endorse the option or the opinion of the nuclear waste steering committee and select the deep rock vault as the

preferred course of study.

Information presented by the Independent Expert Group showed that when you consider the four alternative means options, they are all equal. No one option provides for greater likelihood of public acceptance, and that acceptance by a host community is seen as the end point of a participatory process that balances both the benefits of the facility and the concerns.

This confirms the understanding of Kincardine respecting local acceptance of the Deep Geologic Repository.

We understand that people may be concerned, and so we made the best efforts we could to be informed prior to reaching a decision.

Our community and Council's experience with nuclear operations, coupled with personal travels to various international sites, also helped inform our decision to support the Deep Geologic Repository project.

As an existing nuclear community, we are aware of the potential risks that come with nuclear facilities, and this awareness

continues to make the community receptive to hosting waste management facilities. This is in large part due to the knowledge of operations by residents based on their direct and indirect involvement in the ongoing safe operation of nuclear facilities.

In our own community, we know the people who, day in and day out, ensure our safety. This understanding has also come through many years of hard work by the nuclear industry in our community to be open, honest and transparent and to effectively communicate what is going on at the facilities and what it means to the residents of Kincardine.

This is a community that knows and understands nuclear. The nuclear industry has been a part of our community for almost 50 years and will remain an important fixture for many decades to come.

It is this understanding of nuclear and those who are responsible for its safe management that is the foundation for the acceptance and trust that has been created which, in turn, is the basis for our continued support of the Deep Geologic Repository.

This understanding is continuously reinforced through our ability, on behalf of our residents, to participate in decisions and to continuously monitor progress in annual results of operations.

The two incidents at WIPP as described in the IR response are certainly of concern to Kincardine. I and many municipal and county Councillors have visited the facilities firsthand as an example of a similar operation planned for our own community.

Knowing the industry and how they value information and experience from other facilities, I am confident OPG will fully explore the events to capture any appropriate lessons that could be applied to the DGR project.

It would appear that many of the contributing factors are related to human factors and do not undermine the safety case of the repository currently or in its future end state.

Fire protection and mine rescue were of specific interest to Kincardine and reviewed as part of our peer review. OPG is committed to establishing a reciprocal mine rescue agreement and training program for mine

rescue workers.

The combined decades of experience in operating nuclear power plants and managing waste in our community gives us confidence in OPG's ability to bring the same careful, rigorous approach to the long-term management of waste in the DGR.

Thank you very much.

THE CHAIRPERSON: Thank you, Mayor Kramer.

Panel Members, did we have questions?

Dr. Muecke.

MEMBER MUECKE: Mayor Kramer, just for the record, are the views you just expressed fully supported by Council?

MAYOR KRAMER: Yes, they are.

MEMBER MUECKE: No dissenting voices?

MAYOR KRAMER: No.

MEMBER MUECKE: Thank you.

Since you're here today, I would like to pose one more question for the Panel which is not related, actually, to what your presentation was about. It has to do with the

expansion of the -- proposed expansion of the DGR.

The proposed expansion of the DGR to approximately double its size to accommodate decommissioning waste is anticipated in the hosting agreement, of course.

How does -- how did these surveys that were conducted to judge acceptance of the DGR by the community validate the acceptance of a substantially larger facility?

MAYOR KRAMER: Well, I believe that the thoughts on the future expansion are basically viewed in two different ways, one of which is what would happen to decommissioning or dismantling waste. I'm not sure of the industry term for it.

But down the road, we know that there will be a day when these facilities will be decommissioned and dismantled. I, myself, have visited a facility under that -- that was undergoing that in Spain called Vandellòs I. And a DGR was -- or a DGR. A repository or a storage or the end -- the end placement of waste generated from decommissioning was essential that the plants themselves can be safely dismantled at

some point in the future.

So we're quite aware of the issue and we feel that, at some day, it will be an issue here and that those wastes would probably be anticipated in the streams that you're talking about.

The other side of it is that it would also be, as the law stands right now -- we see no reason for it to change -- that it would be the subject of another hearing and that it would be a whole other generation of people that would be sitting there to examine it on its relative desirability.

And another point to it is that should this project go forward, which I believe that it should, that there will be an awful lot less theory and an awful lot more practical experience available to people that make that decision at that time.

One of the issues, I think, locally with all of this is that, as it stands right now, a DGR is somewhat theoretical in Canada where other places in the world like the U.S. and Sweden, Finland, France, they have them to see. But your average person hasn't seen once

or seen it in operation.

When we come to that state in the future here should this project go forward, it will be -- a breadth of experience will be available to make the decisions from and not theoretical, firsthand knowledge of operations and firsthand knowledge of results.

MEMBER MUECKE: Thank you.

THE CHAIRPERSON: Dr. Archibald.

MEMBER ARCHIBALD: Mayor Kramer, could you give us examples of avoidance procedures and mitigation measures that have been implemented by large-scale aggregate extraction operations in Kincardine of the same size and sale of the proposed DGR?

MAYOR KRAMER: We don't have them in Kincardine of the same size. We have some gravel pits and that, and they're -- they are -- you know, the Bruce is a very large component of our region. There aren't -- there isn't a second one of that significance.

And locally, it would be berms around gravel pits and quarries, those types of things.

You also see them sometimes with

major road construction that -- on the county, at that level, it's much greater. There are much larger extraction operations, much larger types of -- types of things and mitigations that are used, say, in the Wiarton area around the Wiarton stone and the quarrying operations there where, considering the depth and that, they have to take into account the groundwater, the groundwater intrusion.

They still go back to berms, dust control, things like -- that are used like controlling dust on the road, certain measures. Calcium chloride would be one that would be commonly used at the entrances to those types of quarry operations should they be on gravel or dirt roads.

MEMBER ARCHIBALD: This is the one stated principle, adverse impact, human impact, the noise and the dust, I guess, associated with it.

So Kincardine Council is fairly confident that the measures that have been taken in the nearby communities are adequate to mitigate or at least provide good avoidance procedures for some of the major problems that

could be anticipated for our proposed project.

MAYOR KRAMER: I believe so, yes. I believe I hit the button wrong.

THE CHAIRPERSON: Thank you very much, Mayor Kramer. That's the end of our questions.

We're going to proceed now directly to the first of two 10-minute oral presentations, and then we will be taking a 15-minute break.

So our first 10-minute oral presentation is from the Lake Huron Fishing Club, which is PM 14-P1.31. And our presenter is Mr. Michael Hann.

Welcome, Mr. Hann. The floor is yours.

***PRESENTATION BY / PRÉSENTATION PAR:**
LAKE HURON FISHING CLUB, MICHAEL HANN

MR. HANN: Thank you very much.

Good afternoon. My name is Michael Hann. I'm the Vice-President of the Lake Huron Fishing Club.

The Lake Huron Fishing Club is a

registered non-profit organization of 450 members, most of which come from the Saugeen Shores Kincardine District, but there are many of us from southern Ontario, me being one of them. The club is now in its 31st year.

I am here to present the club's position on the DGR regarding Item 1.4.4 of the Amended Public Hearing Procedures. Please allow me to record the club's preferences to the options listed there.

Our club's mandate is to guarantee angling opportunities for current and future generations. Using strictly unpaid volunteers, we rear brown trout, rainbow trout and Chinook salmon at our two hatcheries.

We raise 120,000 Chinook in our Port Elgin facility and we raise 120,000 rainbow trout and 60,000 brown trout in our Kincardine facility. Both hatcheries were built and are operated by our volunteer members.

We undertake stream enhancement, habitat restoration, tree planting as well as erecting livestock fencing as well as other conservation projects.

We have built, through our own

efforts, two public fish-cleaning stations, one in Kincardine and one in Port Elgin. Both stations, upon their completion, were donated back to their respective municipalities.

We mount a major two-week angling derby each summer, the largest on Lake Huron, called the Shantry Chinook Classic Derby.

We are always available for educational tours of our hatcheries, and we operate a classroom school hatchery program in 17 schools with the hopes of expanding that to 100 schools over the course of the next five or six years.

As you can see, the Lake Huron Fishing Club is deeply rooted in the community. Everything is accomplished with unpaid volunteers and the support of virtually every company and small business in the community.

Bruce Power, the Power Workers' Union and OPG are among those who support the club.

We have also partnered with Bruce Power on several conservation initiatives. That's a fairly new partnership, probably less than two years old, but a very successful one, at

that.

Most of our members are local, and whatever happens at the Bruce Nuclear site impacts them directly and personally. Many of our club members either work at the Bruce or are retired from the Bruce. They have personally driven by or worked in proximity to the material under discussion here.

Those of us who don't work at the plant are just as conscious of risks due to the proximity. Yes, the presence of radioactive waste is a concern, perhaps less so here than in other localities because our group is informed and knowledgeable about these hazards and know that these hazards are a matter of constant consideration. In our case, familiarity breeds respect.

Whatever one's thoughts or position on the DGR, the waste is a problem that won't go away. It must be dealt with.

These are our thoughts to the options listed in Section 1.4.4. I will deal as one with the first two options, the existing Western Waste Management Facility, or WWMF, and the enhanced surface storage at the WWMF.

Like other involved groups, we, too, are very, very concerned about the risks of contamination of the water and all the attendant consequences. It should be obvious that our group is passionate about the health of Lake Huron and its sport fishery as well.

Moreover, as most of the club members are local residents, they would be the first to suffer and would suffer the most in the event of any incident.

Even though I reside just outside of Kitchener-Waterloo, I do have a cottage less than a kilometre and a half from the outflow of Bruce A, so I am very concerned as well.

Now, these first two options would leave low and intermediate level waste aboveground -- or in aboveground storage buildings a few metres above the lake level. It is obvious to the club that surface storage is a far greater risk than sheltered storage 680 metres below the surface and, as well, 451 metres below the lake's deepest point. That would give us 1,480 feet of separation to the water.

To this year, 2014, all levels of government and the various parties of the site

have given us 46 years of incident-free storage through intelligence, diligence and expense. However, the amount of waste will continue to increase, and we understand that the typical half-life for some of these intermediate level materials is around 100,000 years.

So what will our situation be 1,000 years from now or 2,000 years from now, or beyond? So much will happen in the coming millennia. Will the materials still be sitting on the surface? Will it have slid into the lake and contaminated the lake? Will the site be barren and deserted?

What will our society be like? Will it be capable, either politically or economically, of managing this waste or any other hazardous site?

This is not fantasy. In less than 50 years, we have seen a major U.S. city slip back to nature, we have seen the emergency of Third World countries and we have seen the impoverishment of industrialized nations.

We accept and share the hesitation of downstream localities, but ask them to reconsider.

For certain, there are risks with our preference, but it is our read that the first two options pose more risk than underground storage. Containment inside a few metres of concrete on or near the surface at roughly the same distance from shore as the proposed DGR makes no sense to the club.

Greater dangers are immediately posed by nature and politics through this accessibility of the on-ground or aboveground storage.

The notion is advanced by some opposing that we wait until some method is developed to finally resolve this issue completely. It has taken us nearly 50 years to get to this point, and the hazard is still on-ground, aboveground, and there is nothing on the horizon, at least, that we can see that would indicate there's some scientific advancement that will make this go away.

If a better solution should arise, it's important to remember that if we're able to put the waste below the ground 600 metres, we can certainly bring it back to the surface.

That leaves me to cover the last two options, the proposed DGR at the Bruce site or a potential DGR north of us in the Canadian Shield.

From a risk point of view, we would accept that deep geologic disposal in rock formation, which have the same attributes as those characterized at the Bruce would be acceptable.

However, and I might be echoing Mayor Kramer a little bit here, to get to this point has taken 12 years. Our club supports a resolution for the public good as quickly as possible. Restarting the process and stepping back 12 years is not the way to proceed here.

Possible delay has, therefore, directed our support to the third option listed in Section 1.4.4 that the DGR be placed at the nuclear site -- Bruce Nuclear site.

It also makes sense to manage the waste and the DGR at the Bruce Nuclear site where much of the waste is already located along with experienced and a well-trained workforce.

We believe the proposed DGR at the Bruce Nuclear site is consistent with the

Lake Huron Fishing Club's mandate that I stated earlier, which is to guarantee angling opportunities for current and future generations. As the club's Vice-President, I am anxious to see this happen in my lifetime.

Thank you very much for your attention and this opportunity to express Lake Huron Fishing Club's position.

THE CHAIRPERSON: Thank you very much, Mr. Hann.

Panel Members, did you have questions?

Dr. Archibald.

MEMBER ARCHIBALD: Mr. Hann, in your statement and in your written submission you had made the statement, "The greater dangers are immediately posed by nature and politics through this surface accessibility."

Could you further explain what you feel to be political dangerous in this process?

MR. HANN: Well, the political dangers are the -- the ideological forces that are against the western beliefs, western society, terra being a big one, and just bipartisanship on

-- not coming to a resolve and just hoping that this temporary storage, you know, will -- is good enough.

MEMBER ARCHIBALD: Thank you very much.

THE CHAIRPERSON: Thank you very much, Mr. Hann.

We will now take a 15-minute break. We will reconvene at 25 minutes to 4:00.

--- Upon recessing at 3:20 p.m. /
Suspension à 15 h 20
--- Upon resuming at 3:37 p.m. /
Reprise à 13 h 37

THE CHAIRPERSON: Welcome back, everyone.

We are now going to proceed with our next 10-minute presentation which is from the Penetangore Regional Economic Development Corporation, which is PMD 14-P1.35.

Mr. Coristine, please proceed.

*__PRESENTATION BY / PRÉSENTATION PAR: PENETANGORE REGIONAL ECONOMIC DEVELOPMENT CORPORATION, RON CORISTINE__

MR. CORISTINE: Thank you. My name is Ron Coristine.

First of all, the Penetangore Regional Economic Development Corporation is an economic development agency, a not-for-profit organization incorporated in Ontario. We are governed by a Board of Directors and Board Members bring a wealth of business and community knowledge to the role and represent several key business sectors such as banking, real estate, manufacturing, energy and agriculture.

Our views about risk and the DGR. We are aware that there are four options for storage of low and intermediate level waste. First, the existing Western Waste Management Facility which was established as interim storage; second, the enhanced surface storage at the WWMF; third, the proposed DGR in the Cobourg formation; and fourth, the proposed DGR in granite bedrock.

Each of these has relative merits

and risks.

The existing waste management facility is an aboveground facility where waste is housed on the Bruce power site. The positive aspects of this option are that it is already in place and there are experienced people managing it.

The risks with this site are that it was not designed as a long-term solution, but as a temporary one. It does not allow for mitigation of risk if our society was to change in some way that institutions no longer had authority. In the face of climate change, there is the risk of a catastrophic event from extreme weather such as tornadoes. We are aware that tornadoes are increasing in magnitude and our occurring more frequently at our latitude.

In addition, given the long period of some radioactivity to decay, there could be issues with glaciation that would compromise or destroy any aboveground infrastructure. In our view, this is not a long-term solution.

The enhanced surface storage option at the WWMF also allows low and

intermediate nuclear waste to remain aboveground. The enhancements include compaction and more robust storage buildings. This will mitigate against the large land area that would otherwise be needed by current aboveground storage over time and provides protection from radiation. However, the risk from extreme weather, glaciation and social collapse remain. In our view, this is not a viable long-term solution.

The proposed DGR in granite bedrock appears to be a sound option. The Canadian Shield is stable and farther removed from urban and rural areas where people live. Experience around the world tells us that sedimentary or granite rock are appropriate for a DGR.

However, choosing the granite of the Canadian Shield would mean that all low and intermediate nuclear waste from all nuclear power plants in Ontario would have to be transported some distance along new routes and through different communities. This will require planning and greater transportation costs.

These factors are not insurmountable, but there is no efficiency in

this option. This option puts the waste out of sight and out of mind for most of us who live close to the 49th parallel, but adds time, cost and additional risk.

Finally, granite is susceptible to fracturing during the construction process which poses a challenge to ensuring a proper seal if such fracturing were to occur. These factors taken together indicate that this option is questionable.

The proposed DGR in the Cobourg formation makes sense and, in our view, offers the safest option. Low and intermediate level waste is already on site and simply has to be moved a relatively short distance to the proposed DGR. Transporting waste here from other parts of Ontario is already a reality and the safety record of that transportation is exemplary.

The community and those who work at Bruce Power are accustomed to the presence of low and intermediate level waste, we have been doing it safely for more than 40 years.

A recent fire event at the Waste Isolation Pilot Plant near Carlsbad, New Mexico raises questions about the efficacy of a DGR.

I read the U.S. Department of Energy Office of Environmental Management Accident Investigation Report on this incident to learn that the fire was due to human error in the form of inadequate fire protection, resources and training, a lack of rigour in ensuring safety for personnel and a perspective more aligned with mining than with nuclear management, to name a few of the direct and indirect causes.

Based on what I have witnessed living in this municipality, the safety culture within OPG would not stand for accumulation of 10 contributing causes as occurred in New Mexico.

A second incident at the New Mexico site involved the release of radioactivity into the air. This is cause for concern. The accident report for this radiological release event found, and I quote:

> "The cumulative effect of inadequacies in ventilation system design and operability compounded by degradation of key safety management programs and safety culture resulted in the release of

radioactive material from the underground to the environment, and the delayed/ineffective recognition and response to the release."

Here again, it is clear that the problem was not in the DGR itself, but resulted from human error and mismanagement.

There are many more reasons why the proposed DGR in the Cobourg formation is a sound choice. This is a community that has hosted the nuclear industry since 1968. That's 46 years.

We are comfortable with having a nuclear power plant in our backyard. Many employees at the plant are our friends and neighbours, they live in this community, raise families, shop, volunteer and contribute in so many ways to making this a great place to live.

The Kincardine community is well educated about the nuclear industry and associated risks thanks to the continuing work of OPG and the WWMF to ensure open and transparent communication.

Our experience with nuclear power, first when the plant was owned and operated by AECL and now by Bruce Power, is that the industry is well regulated and safety conscious. There was no question about the efficacy of operating a nuclear power plant here when it went from public to private operation.

We have the experienced workers to develop and operate a DGR here. Shifting the solution to a new location will add risk, but an equally experienced workforce may not be assembled or maintained in a remote location.

Based on our observations of the importance of safety to Bruce power, OPG and the nuclear industry, we feel that this culture of safety will be easily transferred to the new DGR.

The safety on site extends to the transportation of waste. Over the past decades there have been very few incidents and none of these have posed a risk to communities.

In 2010 there was a campaign to petition the provincial government to build a third nuclear reactor here, Bruce C. While the proposal did not go ahead, more than 10,000 people signed the petition. This demonstrates

the extent of support for and comfort with the nuclear industry here.

The entire nuclear industry, including the proposed DGR, is subject to regulation by the Canadian Nuclear Safety Commission.

Council members of the Municipality of Kincardine visited DGRs in Sweden and the United States to see first-hand what a repository looks like and how it is managed. After these visits Council did not waver in its support.

The information about the DGR over the past decade has been very forthcoming. The opportunities to ask questions and obtain more information have been constant. There is no question on my part that the process has been transparent and the information almost exhaustive.

Information about the safety and public protection afforded by the Cobourg DGR indicates it is isolated from drinking water and surface water. The rock formations have a history of stability over a period of 450 million years and provide a natural and effective

barrier.

Because we have no concerns about safety, we can speak about economic development factors associated with the DGR at the proposed site. It is expected to create 200 jobs during construction and 40 jobs during operation. This is a benefit to the community in many ways, more decent-paying jobs on which families can live, more economic activity as families purchase homes, groceries, goods and services, and so on.

We are comfortable knowing that the waste will be buried in a stable rock formation, removed from people and weather, managed by experienced workers and properly monitored.

In summary, we support the DGR being developed at the Cobourg site because it is the safe site and the most sensible of the four options. The industry is well regulated for safety and those working in it are safety conscious. The public and our local government are supportive of it. It will bring additional jobs and economic spinoffs to our community. And finally, it is part of who we are.

THE CHAIRPERSON: Thank you,

Mr. Coristine.

Panel Members, did we have any questions? Dr. Archibald...?

MEMBER ARCHIBALD: Mr. Coristine, I was interested in one of your statements concerning the granite DGR proposal or the aspect. You had mentioned that granite is subject to fracturing during the construction process, this essentially being a negative component of the process.

To OPG I would ask, would this be similar to what would be experienced for Bruce site development activity and, thus, no different? Would the rock not naturally be fractured in limestone and in granite? Would there be any significant difference?

MR. WILSON: Derek Wilson, for the record.

Using the controlled drill and blast techniques that we plan to use for the DGR project and looking at the experience that our international colleagues have had in DGR construction in crystalline sites, we would expect them to be fairly similar, yes.

MEMBER ARCHIBALD: And a question

to you, Mr. Coristine. I would just ask a confirmation, please. Does your Corporation hold the view that the technological design aspects of a storage facility, of whichever type that you are promoting, essentially DGRs, even the WIPP one, are capable of reducing the risk of contaminant release if they are well designed and that the primary risk is due largely to human error or inadequacy?

MR. CORISTINE: The short answer is yes.

MEMBER ARCHIBALD: That's all I need. Thank you.

MEMBER MUECKE: Dr. Archibald pre-empted me.

--- Laughter / Rires

THE CHAIRPERSON: Okay. Thank you, Mr. Coristine. I believe that ends the questions from the Panel on your presentation.

According to the Panel's public hearing procedures, people not previously registered might be granted an opportunity to make a brief oral statement at the end of the hearing day, time permitting. This opportunity is limited to individuals who did not previously

register to participate and did not file a written submission and/or the written submission did not meet our criteria.

In this case we have time today to hear from Senator Phil Pavlov of Michigan.

Welcome. Senator Pavlov, you will have 10 minutes to speak and at the end of the period we may have some questions for you. Please proceed.

***PRESENTATION BY / PRÉSENTATION PAR:**
MICHIGAN STATE SENATE SENATOR PHIL PAVLOV

SEN. PAVLOV: Madam Chairwoman and Members of the Panel, thank you for this opportunity to speak before the Canadian Nuclear Safety Commission Joint Review Panel regarding the deep geological repository project.

My name is Phil Pavlov and I am a State Senator from Michigan. I am here representing over 250,000 residents of Michigan's 25th Senate District, as well as the thousands of other Michigan residents who hold grave concerns about this proposal by Ontario Power Generation to permanently bury radioactive wastes within a

mile of Lake Huron.

The basis for these additional public hearings and the OPG application is restricted to six limited categories. My remarks focus on the issue of community acceptance within the category of relative risk analysis of alternative means of carrying out the project.

In a letter to OPG dated November 8, 2013, the Joint Review Panel requested a renewed and updated analysis of the relative risk of siting alternatives under the alternative means requirements of the EIS Guidelines.

This Information Request indicates that the relative risk analysis to the OPG safety case must include a review of community acceptance in the local and the regional study area, as well as outside of the regional study area.

As a publicly elected official in Michigan, I have pledged to uphold both our nation's and our state's Constitution. Article 4, section 51 and 52 of the Michigan Constitution charges me directly with protecting both public health and the national resources of our State.

I am bound by that pledge and

that is why I'm here today. The people of Michigan have entrusted me to represent their will and there is no doubt where their will rests on this issue.

Residents from my District and all across our state overwhelmingly oppose the proposed location of this facility. In fact, over 60 units of local government, 63 Michigan counties, cities and townships have passed resolutions officially opposing the plan.

The question I hear repeatedly from my fellow Americans is: "Why here? Why so close to such a precious natural resource?" I have yet to find any evidence of community acceptance for this proposal in the United States.

Interestingly, Canada has demonstrated a similar lack of community acceptance for these projects in the past. In fact, the Canadian government itself formally objected to the United States Department of Energy plans for permanent underground nuclear repository in 1986. At that time the United States Department of Energy was studying a number of locations for a DGR, including sites near the

Canadian border and within close proximity to the Canadian Watershed.

In a statement dated January 16, 1986, the Honourable Joe Clark, Canada's then Secretary of State for External Affairs, expressed opposition to any development that could present a trans-boundary threat to the welfare of Canadians or the integrity of the Canadian environment. Specifically, the Foreign Minister's statement opposed a potential site in Maine, the Bottle Lake Complex, located within 25 miles of the border and possibly at least partially in the St. Croix Watershed.

The statement also opposed the potential sites in Minnesota and Wisconsin because they were in drainage basins that eventually flow into Canada, including the Red River basin and the Great Lakes basin. I have copies of the statement available, if you would like one.

In response to Canada's opposition, the United States government reversed course and sought an alternative site. Canada has set the precedent and I am requesting you follow that precedent and find an alternative

location for this DGR.

Let me relate just one more example of Michigan's commitment to protecting the Great Lakes from any environmental risk of nuclear waste contamination and the absence of a community acceptance for this OPG proposal.

Michigan studied this issue in the 80s and found no suitable site within its border for a permanent disposal of low-level radioactive waste and, thus, imposed a ban on the importation of low-level radioactive waste.

Recent legislation passed with unanimous bipartisan support by the Michigan State Senate, would extend our current ban to include all sources of Class C, whether produced in the State or out-of-state, the most dangerous form of low-level radioactive waste.

Michigan residents are quite clear in their opposition to, their lack of community acceptance for any risk to one of our most precious natural resources, the Great Lakes.

We agree with the Canadian government of the 1980s that the permanent storage of nuclear waste has no place in the Great Lakes basin. This proposal to site a deep

geological repository within a mile of Lake Huron is contrary to sound public policy and it breaches the fiduciary responsibility we are all obliged to carry out as policymakers within the Great Lakes basin.

I thank you for hearing my comments. I urge you to make the right decision, which is to reject the OPG's application.

Thank you, Madam Chair.

--- Applause / Applaudissements

THE CHAIRPERSON: Thank you, Senator Pavlov.

Panel Members, did we have any questions?

We had one question, Senator Pavlov, and perhaps a follow-up. If you held public meetings regarding the issue of the proposed DGR in your District, did you invite OPG to present information at those public meetings?

SEN. PAVLOV: I did not, but they were publicly notified via the newspapers and everybody was welcome to come, but I didn't send a specific --

THE CHAIRPERSON: Thank you.

And just a part (b) to that

question. When you were holding your public meetings, did you ask for attendance by any of your State -- for example, Michigan Department of Environmental Quality representatives?

SEN. PAVLOV: Yes. We cast a pretty big net and we want to be able to have the most information available for the people that are going to take time out of their evening to come and listen.

THE CHAIRPERSON: Did the DEQ attend?

SEN. PAVLOV: No. The DEQ did come and testify in support of the four resolutions and the Senate Bill 948, they supported all four of those and the Director publicly stated his support.

THE CHAIRPERSON: Thank you, Senator.

SEN. PAVLOV: Thank you.

THE CHAIRPERSON: That will bring us to the time when we will invite questions from registered participants.

I will begin with Mr. Monem.

MR. MONEM: Thank you, Madam Chair. Alex Monem, for the record.

Madam Chair, I have a number of questions. I will endeavour to get through those quickly and, for that reason, I will leave all my questions respecting risk perception until tomorrow.

My questions will be directed primarily to the independent expert group. I don't know if I should ask those.

THE CHAIRPERSON: Yes. Perhaps if we can ask the IEG to once again move forward, that would be greatly appreciated. We will give you a couple of minutes to do that.

MR. MONEM: Madam Chair, my first question is actually directed to OPG, so I could begin.

THE CHAIRPERSON: Okay. So while we are shuffling chairs, please go ahead.

MR. MONEM: Thank you.

Ms Swami started in opening stating that OPG provided the independent expert group with information necessary to complete their work.

Could we just have it confirmed whether all of this information was information previously available and on the record?

THE CHAIRPERSON: OPG...?

--- Pause

MS SWAMI: Laurie Swami, for the record.

Yes, it was publicly available.

THE CHAIRPERSON: Thank you.

Mr. Monem...?

MR. MONEM: And in the record of these proceedings?

MS SWAMI: Laurie Swami, for the record.

For the material, most of the material was submitted as part of this proceeding, however, there was some material that was provided that is publicly available but was not submitted as part of this hearing.

We could be very specific about it, but I'm just going to get a list here.

THE CHAIRPERSON: While you are doing that, Mr. Monem, was there particular items in the IEG's information that you would request to be on the record of this Panel?

MR. MONEM: It would be primarily the information relating to the granitic DGR, as well as any information respecting the enhanced

surface options.

THE CHAIRPERSON: Ms Swami...?

MS SWAMI: Laurie Swami, for the record.

Yes, the information such as the Seaborn Panel Report obviously was not filed as part of our submissions for this work and other material that was provided. So we do have that information and, if that's helpful for submission, we can do that, but it is publicly available.

THE CHAIRPERSON: The Panel will determine whether it is required to have it as part of our record and we will get back to you, Mr. Monem, very shortly.

MR. MONEM: Thank you.

Madam Chair, my next question can be directed to the expert group.

Did the expert group form an opinion on whether the four options considered constituted a complete or representative set of reasonable alternatives for the long-term management of low and intermediate level wastes?

DR. LEISS: No, we were directed to the four options to be considered.

THE CHAIRPERSON: Mr. Monem, did that answer your question?

MR. MONEM: Did the Panel feel that its terms of reference would allow an exploration of alternatives other than the four?

THE CHAIRPERSON: Dr. Leiss...?

DR. LEISS: Did we feel that the terms would allow? No, I don't -- I think that's the same answer as the first question, we were directed to do that.

MR. MONEM: Thank you.

Given the opening comments made by the expert group that the differences in risk between the options were most pronounced over very long time periods, was it understood by the expert group that they were comparing storage options with disposal options and did they feel that this was an appropriate comparison?

DR. LEISS: I'm familiar with some of the commentaries in which storage and disposal is differentiated and in some cases some things which are called temporary, such as the existing facilities, seem to indicate very clearly a distinction between storage and disposal, but it's not a hard and fast

distinction.

In the case of DGR, not only this one but the existing material from MWMO on the high-level DGR, the plan for that repository indicates that over periods of time before final closure retrievability is possible and could be conceivably desirable, in which case that would convert it into, in effect, a storage facility rather than a disposal facility.

But I am assuming that it is very clear to everyone that once you decommission and seal a DGR, you have disposed.

THE CHAIRPERSON: Thank you, Dr. Leiss.

Mr. Monem...?

MR. MONEM: This follows on a question posed by Dr. Archibald. Does the IEG believes that the reference case it considered for enhanced surface storage was sufficiently developed to support a credible analysis of relative risk?

THE CHAIRPERSON: Dr. Leiss...?

DR. LEISS: Yes. It seemed to me that doubling the effective life of facilities is significant to differentiate clearly.

THE CHAIRPERSON: Mr. Monem...?

MR. MONEM: Would the expert group have considered, with a broader mandate, a deeper consideration of various enhanced surface storage options maybe that exist in other places in the world?

THE CHAIRPERSON: Dr. Leiss...?

DR. LEISS: Could you give me at least one example?

MR. MONEM: A number of other facilities in Europe segregate longer-lived intermediate level wastes and store only the short-lived intermediate level wastes and the low level wastes in enhanced surface storage and anticipate storing the longer lived ones eventually in a disposal facility.

Did you consider this category of solutions?

DR. LEISS: You will know that, in fact, we have referred to such facilities in our report, facilities in I believe France and Spain and with specific reference to that distinction in intermediate level waste between short-lived and long-lived.

So we did refer to that, but we

had no basis for assuming that such a division of intermediate level waste would take place in Canada.

MR. MONEM: Thank you.

Dr. Dusseault stated that if someone considered a granitic DGR far away from a large water body they would necessarily come to a different conclusion. I'm paraphrasing, I'm sorry.

Can we assume what was meant was that the conclusion you would arrive at would be a lower risk and risk perception of such a DGR relative to one that was located on a large water body?

THE CHAIRPERSON: Could you rephrase that question, please, Mr. Monem?

DR. LEISS: I'm confused about the question.

MR. MONEM: A comment was made, and I'm paraphrasing, that if someone considered a granitic DGR far away from a large water body they would necessarily come to a different conclusion, and this was in the context of relative risk.

The question is: Can we assume

that the conclusion would be a lower relative risk for such a DGR away from large water bodies?

DR. LEISS: I would like to actually state that I would prefer to have -- certainly that remark is not in our report. If the reference is to oral exchanges that will become part of the transcript in today's session, I would prefer to have an exact wording to make sure that we have an accurate reference to what Dr. Dusseault said.

THE CHAIRPERSON: Noted. So perhaps, Mr. Monem, this is something we could return to tomorrow, since the full IEG will be back to answer questions again tomorrow and by then we will have the exact wording.

I would also -- re: IEG that questions come through me and then I decide whether I will pass them on to you and sometimes I actually ask for clarification, I may paraphrase and I may pick which one of you I feel I would like to have the answer from.

DR. LEISS: Please do.

--- Laughter / Rires

THE CHAIRPERSON: So just so you know, that's the process that we are following

here.

Mr. Monem...?

MR. MONEM: I'm happy to proceed in the way you have suggested, Madam Chair, or I could phrase the question in a different way.

THE CHAIRPERSON: Let's try phrasing the question a little differently. I think I know where you're going, so instead of trying to paraphrase what the IEG said, maybe just state from the SON's point of view what your premise is and go from there.

MR. MONEM: In the expert judgment of the independent expert group, can they -- could they offer their opinion on what effect on the relative risk -- what the effect on the relative risk would be by locating a granitic DGR away from a large body of water like a Great Lake?

THE CHAIRPERSON: I think we now have a more generic and fairly clear question. So, Dr. Leiss, may I start with you and you can defer to your other colleagues as you see fit?

DR. LEISS: This would represent a scenario that we did not consider because, as explained earlier, we made a judgment about the

case that was referred to us that we thought made possible the four-way comparison and that some other judgment would provide a different comparison.

We did not interpret the directives given to us in such a way that would specifically direct us to consider such an alternative scenario; i.e., a granitic body at some considerable distance from a large body of water. Obviously we could have done so, but we did not do so and I would be loath to speculate on that off the top of my head, or to have any of us take up that very different scenario in this setting.

THE CHAIRPERSON: Dr. Leiss, would IEG be willing to consider this and return to the topic tomorrow, since it is a topic we have heard a couple of times, including from this Panel. It appears to arise from your understanding of our Information Request, but speaking on behalf of my colleagues up here, I think we would appreciate it very much if you would at least consider the question, and we understand that you would need time to confer among your colleagues, but get back to us

tomorrow.

DR. LEISS: Okay.

THE CHAIRPERSON: Thank you.

Mr. Monem...?

MR. MONEM: Thank you, Madam Chair.

This question could be directed to OPG.

Dr. Dusseault stated that the IEG relied on an assumption of adaptive engineering -- and again I apologize for the paraphrasing, but stating that there are always surprises and that he anticipates considerable or significant adaptive engineering might be required for development of any DGR and he stated you see problems, you assess, you mitigate, redesign and repeat.

My question is: Could OPG comment on whether this is a reasonable assumption and whether this is a part of OPG's project development philosophy?

THE CHAIRPERSON: OPG...?

--- Pause

MS SWAMI: Laurie Swami, for the record. Mr. Wilson will provide a little bit

more information here, but certainly from a design perspective we have a well-designed facility at this stage that we are in in this particular project and there are still aspects to go through that design process, but I will let Mr. Wilson speak more specifically to the comment.

MR. WILSON: Derek Wilson, for the record.

I think there are several aspects of the engineering and the design that go into a facility such as this, there is that which would be -- I wouldn't consider standard engineering, but there is surface construction which is predictable, we have -- we have done site investigations, we understand what's below us, we understand the areas that we are working in and we can have a high level of confidence that there is not a lot of uncertainty in some of the design aspects.

With respect to when we get to the underground design and into the shafts and into the lateral development, as we have discussed previously, we have verification programs planned that allow us to be able to

understand as we are going through the stratigraphy and as we are getting into the lateral development how the rock is performing, we have a good understanding of how it should perform.

We will talk about this under the GBP presentation, but an example would be the underground layout. As we've discussed, we don't know exactly what the in-situ stress will be underground, we have a range of possibilities, we have a good idea of what it will be, but we have also looked from a design perspective.

We have multiple designs pending the in-situ stress that we actually measure.

Similarly, in other areas such as ground support, we have multiple ground support designs based on the type of ground that we are going to encounter and this will come under the observational approach as we talk about that as well, I believe it's next Thursday.

So it's those types of examples where, yes, we go in, we have an expected result, we want to measure and verify that result.

We also have design considerations already considered for different

scenarios if we might encounter them and we would apply it at that time.

THE CHAIRPERSON: Thank you, Mr. Wilson.

Mr. Monem, was that sufficient?

MR. MONEM: It was, and perhaps I will ask a follow-up question during the geo-scientific verification plan presentation.

In this morning's presentation we heard again from Dr. Dusseault what sounded to be quite significant analysis and conclusions on the characteristics of granitic formations and their suitability to host DGRs.

Much of this felt like new information in these proceedings. Could we please be directed to where we can find the data and analysis which were the bases of the IEG's conclusions on this matter?

THE CHAIRPERSON: Dr. Leiss, I believe Mr. Monem might be referring to your more detailed information in support of the granitic option.

DR. LEISS: That was discussed earlier today?

THE CHAIRPERSON: Yes.

DR. LEISS: I will then ask Dr. Dusseault to reply.

DR. DUSSEAULT: I'm a little bit uncertain as to what the question means. It was not the intent to ask us to generate new information, we were using information that was provided for us and given to us in its entirety by OPG, including transcripts and including all the information that has been made accessible to people that follow this process.

So all of that was available to us and we generated -- or charts were generated for different pathways and with different commentaries for the different cases and I believe, Dr. Leiss, that that information is available in our report.

DR. LEISS: Let me just say, obviously the section in the report that deals with the comparison of the options is fairly extensive. I understood today's discussion to be amplification of the basic ideas that were in there, which are -- and references are indicated for that material. So I am, certainly for myself, not clear in my own mind what is supposed to be entirely new.

THE CHAIRPERSON: Mr. Monem, can you help the IEG understand what you might be referring to?

MR. MONEM: There was a relatively lengthy discussion of the general characteristics of granite formations and some of the characteristics of those formations that might have an impact on the suitability for DGR, either here or in the future.

Much of this may be based on what is in the record already, but we can't be certain, so perhaps this is a case where we could look at the transcripts and identify what may turn out to be new information and, if that's the case, I think it's important that the record be preserved in such a way that anything made and put into the record as information basis that we can all look at an test.

THE CHAIRPERSON: Mr. Monem, the Panel would be interested in your definition of "new information" as well. Obviously when, for example, the Panel asks questions, as we did this morning, asking the IEG to discuss for example criticisms from CNSC around the assumed fracturing in granite, the response back from Dr.

Dusseault is based on his experience and professional judgment, he didn't necessarily quote new information.

There is also a chapter in the report, or a section in the IEG report that explicitly outlines the IEG's understanding of the granitic concept.

So beyond those two examples I think that's what you -- I guess I would expect that if you feel that there is anything beyond those two examples you would bring it to our attention.

MR. MONEM: I will do so, and perhaps with the benefit of having others consider the information provided today in testimony so we can offer some assistance to the Panel.

--- Pause

MR. MONEM: It was indicated by the independent expert group today that its consideration of granitic repositories was in some way limited by -- or the sites for potential granitic repositories was somehow limited by the concept of community acceptance. Could we have that explained?

As well, a related comment was that no Manitoba site was currently being considered. Could we understand which siting process was being referred to in that comment?

THE CHAIRPERSON: Dr. Leiss...?

DR. LEISS: The first question related to the granitic option and community acceptance. Obviously, since there is no specific site there can't be a specific community, so I don't see any connection between those two things.

And of course, we did attempt to explain in our letter to you the exact basis of our reaction to that request about community acceptance, so I would really like to simply rest on that detailed written explanation that we gave.

THE CHAIRPERSON: Mr. Monem...?

MR. MONEM: Perhaps it was new today and not in the written submissions, but Dr. Dusseault stated that one of the reasons for not considering, for instance, the Lac du Bonnet site was the difficulty in finding a hypothetical site that would also have community acceptance.

So I would like to know if that

was in any way a constraining factor on the IEG's consideration of potential granitic sites and why they felt that.

THE CHAIRPERSON: Mr. Monem, I must confess now, I am losing -- maybe I am losing track of your logic as well. So your question is: Did the IEG's choice of their conceptual granite case for their analysis, was that influenced at all by community acceptance?

MR. MONEM: By the possibility of finding a site that also had community acceptance.

THE CHAIRPERSON: Okay.

MR. MONEM: That was the statement made this morning.

THE CHAIRPERSON: Okay.

Dr. Leiss...?

DR. LEISS: There is no reference to, I believe in our own discussion to the Manitoba site. I think Dr. Dusseault simply referred to it as a case in which the province had made its own choice about the possibility of locating an actual site as opposed to a research station in that province.

But that's the only connection

that makes sense to me. Since we have a hypothetical granitic site, it could not possibly in principle have anything to do with community acceptance, so I just am at a loss to know what really is being sought in the question.

THE CHAIRPERSON: Mr. Monem...?

MR. MONEM: I was perplexed by the statement this morning, that is why I am asking.

THE CHAIRPERSON: Perhaps, Dr. Leiss and Dr. Dusseault, you could confirm with us in the Panel that the origin of this concern may be because of the original information request stipulation that the granite option be based in large part upon the AECL database, which is from Manitoba.

And Dr. Dusseault was explaining why the IEG had decided against that, which is because the province had decided that they would not be an official site for a repository. And that in fact, as I recall, is in your report, in your preamble to your report.

Am I correct in surmising that that might be basis for this exchange?

Dr. Leiss?

DR. LEISS: Honestly, I don't believe so, but I may be just not as sharp as I once was.

THE CHAIRPERSON: Mr. Monem, does that sound logical?

MR. MONEM: I am happy to move on.

THE CHAIRPERSON: Okay.

MR. MONEM: I only have a few more questions, and thank you for your patience.

This morning the Expert Group explained its understanding of repeatability and that it required a new conception in this context than a standard, sort of the scientific methodology concept or repeatability.

But could I clarify that the Expert Group makes no claim to the reproducibility of their results of their analysis?

THE CHAIRPERSON: Dr. Leiss, I think Mr. Monem asking you to distinguish between repeatability and reproducibility.

DR. LEISS: As I would understand it, if it was used in the normal scientific terminology, which is based on

quantitative parameters, then repeatable and reproducible probably would be the same or at least very similar.

But in the context that we did it was qualitative parameters, as explained by us, and repeatability becomes specifically a reference to a process rather than results, and so in that case not strictly reproducible.

THE CHAIRPERSON: Thank you.

Mr. Monem?

MR. MONEM: And this means that a different group of experts could have placed icons in different positions following the same process, is that correct?

THE CHAIRPERSON: Dr. Leiss?

DR. LEISS: Yes.

MR. MONEM: How common is it to use a logarithmic scale for qualitative analyses rather than a quantitative analysis?

THE CHAIRPERSON: Dr. Leiss? Mr. Paoli?

MR. PAOLI: Thank you.

I think it is a little bit uncommon to -- very often in qualitative analysis people resort to verbal scales to describe the

variation and use words like remote possibility, very unlikely, to describe the same phenomenon that we are attempting to describe, which is a very wide range of probabilities in a very wide range of consequences.

We found and reported in our second report that we did not find that process reliable as a means of communicating. However, we did need to still communicate a considerable amount of variability.

So we did employ a logarithmic scale to identify that things which seemed to be only separated by a little bit may be separated by very large orders of magnitude, if they were measured. So that is the basis of our determination.

We haven't done any particular study of how commonly that particular method has been applied. But we found it not only appropriate, but necessary in this case to communicate the range.

THE CHAIRPERSON: Thank you.

Mr. Monem?

MR. MONEM: So we should understand the use of the logarithmic scale here

is not a way of implying a greater degree of precision, but sort of a shorthand for avoiding descriptive phrases like very very very unlikely. Is that right?

THE CHAIRPERSON: Mr. Paoli?

MR. PAOLI: I hadn't thought of about that as a particular way, but I think that would be a reasonable characterization of what we were trying to communicate.

MR. MONEM: Thank you. One last question which may require a longish answer.

I would like to follow-up with a more general question than the one posed earlier by Dr. Muecke.

The one thing that appears to be missing from the description of your work is a detailed description of the work that immediately preceded the placement of the icons. What I mean by this is how was your professional judgment exercised? What were the inputs? What were the analyses or the analysis process? How did that translate into a precise placement of the icons, and were adjustments made and on what basis?

Could we have a discussion of that process? And if it is described somewhere,

if you could direct me to that?

THE CHAIRPERSON: Dr. Leiss or Mr. Paoli?

MR. PAOLI: Right. There is a brief description of it in the report, but not an extensive description that I can point you to.

The process that we went through was to basically hold a series of workshops where we were essentially in a room together with another individual who was essentially helping to record what we were doing.

And we were literally discussing one pathway at a time, one timeframe at a time and going through the process of filling in exactly the exhibits that you see in the report, including the includes and excludes slides, the visualization diagrams, the crosshairs diagrams if you like.

And we would be staring at a screen all together and moving the icons around until we could agree that that was an appropriate representation. And then immediately recording what lead us to be in those locations in the tabular format as well as the characterization of risk in terms of how many arrows, you know,

significant increase in risk, three arrows, two arrows, one arrow, that sort of thing.

So we have had time before these workshops to try to come to our own understandings of things based on the materials presented, each of us able to do some research on our own.

But then we came together in a workshop format and walked through this process just as I stated.

And those exhibits that are in the report were essentially captured in that workshop format all at that same time. There were no real adjustments made after those workshops because that was our consensus at the time, and to change it we would have had to meet again to go through the same process again.

So I am happy to elaborate if more detail is required.

THE CHAIRPERSON: Mr. Monem?

MR. MONEM: Maybe in just one area. From the report it is quite clear what the includes and excludes were. But there is a step missing, which is once you have made those determinations on what basis did you give the

one, two or three arrow scale to the various risks?

Was there debate on that? Were any of those risks in any way quantified? If you could just let us into the workshop room a little bit on that point?

THE CHAIRPERSON: Mr. Paoli?

MR. PAOLI: So the characterization of the risk as having one, two or three up arrows or down arrows for that matter shares that same logarithmic nature; in that three arrows is not three times worse than two arrows, it could be 10 or 1,000 times worse.

So to answer the question, were any of the risks quantified either in likelihood or consequence, the answer is no. The likelihoods were basically understood by us as being on a continuum, that we were not able to judge with precision, but we understood that there was a very wide range of them. And we are only able to provide relative risks in the beginning or relative likelihoods.

On the consequence scale, again the consequences are rather different to different receptors and their different nature.

So even if they had been quantified I am not really sure we would have been in a position to put them on a single scale, even had they been quantified.

So we really were forced by the nature of the problem almost to give them a qualitative position on a scale relative to other pathways and relative other options. And we could not place them with precision for the combination of the evidence that we had available and the non-quantifiablity of some of the consequences.

THE CHAIRPERSON: Mr. Monem?

MR. MONEM: Very last question. Did the panel consider any other methodologies to enhance the objectivity of that critical moment; dividing the group in half, one group making a decision and then testing it with an independent marking by the second half of the group, having this reviewed by a third party? Were any other methodologies considered?

THE CHAIRPERSON: Dr. Leiss?

DR. LEISS: I think the short answer is no, there are constraints of time. With a group that small, dividing it would I

think hardly improve the quality of the decision making.

I can say, since I have had other experience in these matters, when you have a larger group you have, as in another work of my experience, you have the possibility of providing other techniques that enhance in some respects the outcome, for example, if you have as many as 10 or 12 one methodological routine tells you to drop the highest and the lowest score.

In this case you are actually scoring and so that -- you know, you remove outliers and so on -- but with a group of four you simply cannot do that.

THE CHAIRPERSON: Thank you.

Mr. Monem?

MR. MONEM: Thank you very much, Madam Chair.

THE CHAIRPERSON: We will now proceed with the rest of the questions. Mr. Mann?

MR. MANN: Thank you, Dr. Swanson.

Through you, I would like to ask the Energy Group a question, and I have a couple

of other questions as well.

Dr. Dusseault testified earlier about the lateral predictability about, for instance, the Cobourg rock formation in Bruce County. If you dig a hole in Kincardine, it should have the same qualities elsewhere in Bruce County, and the lateral predictability principle is what he uses.

My question is January 16, 2014, this year, NWMO concluded that Saugeen Shores and Arran-Elderslie, adjacent and in Bruce County, the geology in Saugeen Shores and Arran-Elderslie was unsafe for a DGR.

My question to Dr. Dusseault is doesn't that make the geology a few kilometres away in Kincardine unsafe for a DGR?

THE CHAIRPERSON: I will ask Dr. Dusseault to comment on I guess the general principle of the predictability horizontally regarding the extent of the Cobourg formation.

DR. LEISS: Excuse me, Madam Chair, could I ask if any part of the question has to do with something that someone else specifically said, could we have that on the record? In other words, a claim that OPG said

something was unsuitable. I am not aware of that information.

THE CHAIRPERSON: Yes, Mr. Mann, if you could be a little more specific with respect to what you were referring to around Saugeen Shores? Because the Independent Expert Group of course is not familiar with the other adaptive phase management process that you are referring to.

MR. MANN: That makes sense. Thank you, Dr. Swanson.

On January 16, 2014 Saugeen Shores was involved in a community liaison committee consultation group regarding the high-level spent fuel DGR, the APM DGR for high-level spent fuel.

At that time, on January 16, 2014 NWMO had concluded that Saugeen Shores and Arran-Elderslie no longer were going to be considered for the high-level spent fuel DGR because the geology of Saugeen Shores and Arran-Elderslie was unsafe for a DGR.

And basically, they said that there was about 500 metres of Cobourg rock in Kincardine and only about 400 in Saugeen Shores

and Arran-Elderslie, and that 100-metre difference apparently was the point where it was unsafe to consider DGR in Saugeen Shores and Arran-Elderslie.

So I am asking, would the principle, lateral predictability principle, doesn't that make the geology in Kincardine for a DGR also unsafe?

THE CHAIRPERSON: So before I direct the question to the IEG, I think for further clarification, CNSC, do you recall whether it was simply the geology or were there other considerations that took Saugeen Shores off the list from the APM process?

DR. THOMPSON: Patsy Thompson, for the record.

I will ask Dr. Julie Brown to provide some information. She has been involved in some of CNSC's working relations in this and also attending community information sessions.

DR. BROWN: Julie Brown, for the record.

I believe the reason they excluded that township is it is closer to the edge of the Michigan basin, so the Cobourg

formation is both narrower and at a shallower level. But it was also due to land use restrictions on the surface.

So it wasn't to do with the quality of the Cobourg, it was to do with the location of the town, close to the edge of the Michigan basin, and land use restrictions at the surface.

THE CHAIRPERSON: Thank you.

So, Mr. Mann, with that clarification, are you going to amend your question in any way?

MR. MANN: Well, Dr. Swanson, I have been asking OPG, CNSC and NWMO, I have communicated with them about that, that they disappeared from our town because they said that the geology was unsafe. They do not respond to any of my emails, none of them.

And so their silence, to me, has me absolutely knowing that they are admitting that it is the geology. And I know, they had a communiqué about it, that the geology was unsafe.

THE CHAIRPERSON: Okay, Mr. Mann, I will just simply redirect to Dr. Brown.

So could you elaborate on your

statement regarding being "on the edge of the Michigan basin" and that that means geologically speaking for the suitability of Saugeen Shores just for the Panel's benefit please?

DR. THOMPSON: Patsy Thompson, for the record.

Just to qualify, the document was an NWMO document, so Dr. Brown hasn't been involved in drafting the document and she certainly hasn't memorized it.

So the information she has provided is on the basis of her understanding and recollection of what is in the document and also participation in some of the community liaison group meetings to provide information on the CNSC's regulatory role.

With that, I will ask her if she can add anything else that would be useful for members of the public.

DR. BROWN: Julie Brown, for the record.

Just based on my recollection of reading the NWMO release, the reason that they excluded the community. So we are close to the edge of the Michigan basin at the site for

Bruce's proposed DGR.

So in the APM project my understanding and recollection of that document is just that as we go further away from the centre of the basin all of the sedimentary units become thinner, they also become closer to the surface, and so on that basis they are looking to characterize from what they can tell at the surface if there is a suitable site at a nominal level of about 500 metres. So that is, you know, what their characteristics are.

And one of the ones that they are using to try to and evaluate whether a certain community should proceed in that step-wise site selection process. And then I believe there was the additional constraint of different land use restrictions in that community. So with those two things together they didn't feel that they could find a suitable footprint for a repository to be hosted within the Cobourg formation.

THE CHAIRPERSON: Thank you, Dr. Brown.

Mr. Mann, was that clear enough in terms of their role of the geology in the decision for Saugeen Shores?

MR. MANN: Well, I am certain it had something to do with unsafe geology. It is in my record, Dr. Swanson. Tomorrow morning I will be able to -- or tomorrow when I am asking questions I will be able to refer you to the pages of my record with regard to NWMO's reason they gave Saugeen Shores why they left town.

THE CHAIRPERSON: Okay.

MR. MANN: But I wonder if that is -- I think Ms Brown said that it had something to do with unsafe geology as well.

So my question is, if it is unsafe in Saugeen Shores and Arran-Elderslie, doesn't that make it unsafe in Kincardine a few Kilometres away for a DGR?

THE CHAIRPERSON: If that has to do with the extent of that particular formation, I think I can ask Dr. Dusseault to comment on that.

DR. LEISS: Madam Chair, I hate to exercise my authority as chair of this small group, but I would much prefer to have a discussion based on what NWMO actually said rather than second-hand representations of it. And then see whether or not we can usefully

comment on that.

THE CHAIRPERSON: Very well, Dr. Leiss. This is another issue then that would wait until tomorrow.

And, Mr. Mann, you can provide us with the precise quote from your record.

MR. MANN: Thank you, Dr. Swanson.

My next question has to deal with WIPP and the conservative principle and the precautionary principle.

Since WIPP happened seven months ago and they still don't know why or how WIPP radiation leak happened and it is closed and sealed -- this is for the Expert Group -- would it be prudent and responsible to wait for a final investigation report as to why and how WIPP happened before proceeding with further proceedings with regard to this DGR?

THE CHAIRPERSON: Mr. Mann, that question is definitely not within the purview of the scope of work for the Independent Expert Group.

We did have considerable discussion about that yesterday, and your views

on that have been made very clear to the Panel and we have noted them.

Thank you.

MR. MANN: I wonder, Dr. Swanson, if OPG and Kincardine could tell us if a WIPP disaster leak should happen at the OPG DGR in Kincardine what contingency plan is in place for our community and our workers.

THE CHAIRPERSON: Mr. Mann, it's unfortunate that you did not ask that question yesterday during the WIPP -- the day before yesterday. The contingency planning for accidents and malfunctions is also part of the record in the EIS. I don't know that answering your question any further would add any information for the benefit of the panel at this time.

MR. MANN: I just have one more question for Mayor Kramer.

THE CHAIRPERSON: All right.

MR. MANN: Thank you, Doctor.

The OPG DGR will consist of 80 percent to 95 percent clothes and rags worn by the workers and used by the workers that don't need a DGR.

My question to Mayor Kramer is why did Kincardine council want to have a DGR for clothes and rags and at the same time prohibit a DGR for high level spent fuel that has been safely stored in Kincardine for over 40 years?

THE CHAIRPERSON: Mr. Mann, you did ask this question of Mayor Kramer last year. Mayor Kramer's answer is clear and on the record and in the transcripts from 2013, so I think we don't need any further information on that.

MR. MANN: Thank you, Doctor.

THE CHAIRPERSON: Ms Martin.

MS MARTIN: Joanne Martin, for the record.

My question is what is the weighted differential for the two DGRs for the greater distance compared to the greater population at risk for transport? If greater distance but little population scores a risk factor of 50, does shorter distance but through a much larger population at risk mean that scoring is like 200 or say 500, and where would that put those things on the continuum, or was it actually weighted like that?

THE CHAIRPERSON: Ms Martin, I

believe I asked a very similar question this morning regarding the two variables, population and distance. I believe the transcript contains a pretty clear answer from the IEG on that.

Was there anything about their answer that continues to puzzle you?

MS MARTIN: I think it was just the fact that -- maybe it's because I was looking for more quantitative rather than qualitative. Maybe that was my issue.

I have another question. If the DGR variables were geological, like Cobourg versus granite, and beside a significant source of drinking water or not, and transportation through a huge population at risk or a sparse population, why were the status quo and the enhanced surface storage variables not also compared as if they were situated not just at the WWMF but say 20 kilometres away from the source of water?

THE CHAIRPERSON: Ms Martin, that is part of the record. That is the information request from the panel. The information request clearly asked that the status quo be the existing WWMF.

For the location of the enhanced surface storage, I'll ask Dr. Leiss just to reiterate why they made the assumption that it would also be at the WWMF site.

MS MARTIN: Thank you.

DR. LEISS: I don't recall us having any parameters to decide that it would be anywhere except on the Bruce site.

THE CHAIRPERSON: Dr. Leiss, you're confirming that the expert group assumed from the start of your assignment that the panel had expected that the enhanced surface storage would also be at the WWMF?

DR. LEISS: Yes, I am. Otherwise, we would have had parameters such as distance and kilometres, or something like that, which we clearly did not have.

THE CHAIRPERSON: Ms Martin.

MS MARTIN: I guess it just surprises me because we did have distance when we talked about the granite versus the Cobourg, so it would have been nice to have had that variable, but we don't so that's what it is.

There was one other thing that was brought up, and I think it was Dr. Archibald

who said about the assessment of risk the aspect would have to do with how the project is to be tendered and constructed. It was mentioned this morning that the DGR project would be different from the other mining projects because it would not be subject to the kind of rate pressure in construction that might cause contractors to cut corners that would result in less safe construction conditions or less safe design implementation.

My question is will the DGR project be tendered on a public market to contractors familiar with this type of construction or will the province do this? This may have been answered before by OPG.

THE CHAIRPERSON: Yes, Ms Martin, I believe it was answered in some considerable detail. I would direct you to the transcripts from last fall, it's mentioned in numerous places, regarding OPG's contracting program. The panel asked numerous questions of OPG about that. I would direct you to the socioeconomic day as well as the final three days in October, particularly the last day.

MS MARTIN: Thank you very much.

THE CHAIRPERSON: Ms McClenaghan.

MS McCLENAGHAN: Thank you, Dr. Swanson.

The first question I have I think I know the answer to, but I want to make sure I'm thoroughly understanding it.

In terms of the comparative description of the two DGR sites that were compared by the IEG panel, who undertook and carried out the comparative description? Was that the IEG panel itself or was that provided to them by OPG?

THE CHAIRPERSON: Dr. Leiss, can you just give us a quick clarification?

DR. LEISS: Yes. If the reference is to the material that's in our report then it was written by us.

MS McCLENAGHAN: Thank you.

Then, similarly, my understanding is that it was the IEG not OPG who developed the assessment tools that were used in the report. Is that correct?

THE CHAIRPERSON: Dr. Leiss.

DR. LEISS: Which principles?

MS McCLENAGHAN: The assessment

tools, the methodology for comparison.

DR. LEISS: Yes, that is ours.

MS McCLENAGHAN: You said this morning that the IEG developed a new methodology to consider the four options. I'm wondering if you can outline specifically what aspects of your approach -- Madam Chair, if IEG could outline what aspects of their approach are new?

THE CHAIRPERSON: Dr. Leiss.

MR. PAOLI: Greg Paoli responding, for the record.

The novelty with what we did I think was partly in response to the charge that we were given, which was in some ways not the usual questions that a risk assessment group might be asked. The particular combination of qualifiers that the panel asked for, particularly that it be relative and qualitative, et cetera, caused us to try to produce -- the only really new part I would say is the visualization approach, which was partly intended to help ourselves get through the process in a relatively short time and partly to rapidly turn it into something we thought we could communicate well to people trying to understand our conclusions. I

don't think we should overstate the novelty of what we've done, but it was new in the sense that it was designed custom for this particular application.

MS McCLENAGHAN: All right. Thank you.

THE CHAIRPERSON: Thank you, Mr. Paoli.

Ms McClenaghan.

MS McCLENAGHAN: The next question I have, Madam Chair, is with respect to the assumption that, at least as I heard it, stated that both of the DGR options, once closed and sealed, would have no opportunity for intrusion in the long term. I'm wondering why that assumption was made.

THE CHAIRPERSON: Dr. Leiss.

DR. LEISS: That the DGR would have no opportunity for intrusion, was that --

THE CHAIRPERSON: Could you repeat the question, Ms McClenaghan?

MS McCLENAGHAN: There was a statement this morning that they assumed that both DGR options would be closed and sealed and there would be no opportunity for intrusion. I

didn't think that was consistent with the record and with the scenarios that had been examined to this point.

THE CHAIRPERSON: I think we have another one of those issues where we have to go back to the transcript and understand to what you may be referring.

MS McCLENAGHAN: Okay. That's fair, because I just don't want to leave it on the record as a statement like that if that's not what was actually intended and if it's not accurate.

THE CHAIRPERSON: Exactly. Yes. Would you mind if we defer that to tomorrow?

MS McCLENAGHAN: That's fine. Thank you.

There was also, in the worker health assessment, an assumption, as I heard it, that there would not be any pathways or consequences after the DGRs are closed. I'm just wanting to clarify, is that assuming that even if there were problems they're not the type of problems that would result in reopening or attempts to retrieve packages from the DGR?

THE CHAIRPERSON: Dr. Leiss.

DR. LEISS: We considered no scenario in which a DGR which had been decommissioned and sealed would be reopened.

MS McCLENAGHAN: Thank you.

I have a follow-up question, Madam Chair, with respect to Dr. Leiss' statement about the application of the precautionary principle.

He observed that the thinks its best applied to situations where there's quantitative data available. I wonder if he could comment on the suggestion that generally the principle represents the stance that the last information available and the more uncertainty there is, assuming serious consequences, the more necessary it is for decision makers to apply the precautionary principle.

THE CHAIRPERSON: Ms McClenaghan, the panel understood Dr. Leiss' comments to refer not to the type of statement you just made but to the application of the precautionary principle to the particular qualitative relative risk approach that the panel asked the IEG to follow, which are two very distinct points.

MS McCLENAGHAN: That's a valid

point, Madam Chair, and I can accept the first part of the answer given this morning that it would be difficult in that kind of relative risk scenario to apply, but then the commentary continued on at some length about the usual application in quantitative situations, which again I'm concerned about not having incorrect information on the transcript about the precautionary principle.

THE CHAIRPERSON: Okay. So we're back to the transcript again. I think in terms of fairness to the IEG a very accurate understanding would be required in order that Dr. Leiss can respond to that specific question.

Dr. Leiss, would you agree?

MR. LEISS: Yes, that would be preferable.

MS McCLENAGHAN: Yes. Thank you, Madam Chair.

The next question, Madam Chair, is perhaps for OPG. I'm wondering if OPG accepts and endorses the findings of the IEG report or if they take any position on it.

THE CHAIRPERSON: OPG.

MS SWAMI: Laurie Swami, for the

record.

The work that the IEG was asked to do was done independent from OPG as requested from the Joint Review Panel. Generally, we agree with the results of the work. However, as the IEG mentioned earlier, that is the charge of the Joint Review Panel for decision making.

THE CHAIRPERSON: Thank you.

MS McCLENAGHAN: My final question, Madam Chair, is with respect to the commentary made a few times today by the IEG panel members that they had resource constraints in terms of carrying out their work. I'm wondering what was the cause of those resource constraints and whether they were asked before they commenced the work to decide on the resources necessary to carry out the charge, as they call it, that they were provided.

THE CHAIRPERSON: Ms McClenaghan, I'm not sure I recall the IEG referring to resource constraints. I do recall them referring to time constraints.

MS McCLENAGHAN: Right; and they referred to resource constraints quite a few times.

THE CHAIRPERSON: Are you claiming there was also resource constraints mentioned?

MS McCLENAGHAN: Yes, I am.

THE CHAIRPERSON: Okay. We're back to situation A again in terms of checking the exact comments in the transcripts. I get the point of your question, but again, in fairness to the IEG, let's be clear.

MS McCLENAGHAN: Yes. Thank you. Those are my questions.

THE CHAIRPERSON: That completes the questions for today.

Just as a note, the secretariat receives the draft transcript between 4:00 and 5:00 in the morning. We can forward it after it after it is received, but we may still have to be trying to review and analyze the situation in real time tomorrow and there may still be some requirement for some holding over of some of the requests depending on how well we do with the review of the transcript.

Another clarification from the panel itself with respect to Ms Martin's question about why the IEG did not consider enhanced

storage away from the WWMF. I apologize. The panel itself should have remembered that it was our charge that the IEG consider enhanced storage at the WWMF.

Were there any other matters remaining for today? CNSC?

DR. THOMPSON: Patsy Thompson, for the record.

The only thing, Dr. Swanson, is at the end of the day yesterday you had asked that we come back to address the modelling and the plume that was shown by one of the interveners yesterday. I don't know if you feel it's appropriate now or it can be done later if you prefer.

THE CHAIRPERSON: Given that miraculously enough we're actually almost finishing on time, if you could quickly deal with that now that would be good.

DR. THOMPSON: Patsy Thompson, for the record.

The question as we understand it was to find the source of information and the explanations that went with the two figures that showed a plume extending for a fairly large area

as a result of the WIPP and the meaning of the plume and the colours and its significance in lay language.

What we did, we went back to find the source of the information. The model that is used is a model that has been developed by the agency that is quoted, the NOAA, so the National Oceanographic Atmospheric Administration. It is a commonly used model for certain circumstances. It is also freely accessible on the web with certain parameters that can be inputted by the user.

The source of the information we traced back to a blog called Bobby1. The information appears to be a representation of plutonium and units of mass per cubic metre. What we did, we looked at this information in relation to information that is officially published and available and looked at some dispersion modelling that had been done by official sources and compared it with the monitoring information that has been extensively done on the site.

The work that has been done since February looked at a number of air monitoring

stations that are close to the site and further away. They also had with the air monitoring stations soil monitoring stations that had been monitored for a long period of time, so they monitored air, soil and vegetation co-located. There's surface water and sediment samples that were also collected quite extensively.

The information as of I believe it's the 24th of July indicates that out of the monitoring stations there was some contamination identified early on in I believe four of the seven monitoring stations at very low concentrations of americium and plutonium and no contamination of soil, vegetation, water and sediment.

There was then a comparison of the dispersion modelling done with some of the air monitoring values and there was fairly good agreement very close to the source and then there was nothing detected further away, at the further monitoring stations. The model indicated that the concentrations would be also very low.

Our assessment is that the plume that's represented from the blog essentially overstates and gives the impression essentially

that part of the U.S. would be contaminated from this event when the actual modelling and validation with monitoring information shows that away from the site there's nothing that was detected at all and what was detected was for a very short period of time.

THE CHAIRPERSON: Thank you, Dr. Thompson.

With that I'd like to thank everyone who participated today either by being here in person or by watching the webcast.

We will resume tomorrow at 9:00 a.m.

Tomorrow's session is a continuation of the subject of risk analysis of alternative means.

Have a good evening.

--- Whereupon the hearing adjourned at 5:09 p.m., to resume on Friday, September 12, 2014 at 9:00 a.m. / L'audience est ajournée à 17 h 09 pour reprendre le vendredi 12 septembre 2014 à 9 h 00