Deep Geologic Repository Project

Projet de stockage dans des couches géologiques profondes

Joint Review Panel
Public Hearing

Commission d'examen conjoint
Audience publique

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Kincardine, Ontario

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Kincardine, Ontario / Kincardine (Ontario)

--- Upon commencing on Thursday, September 18, 2014 at 9:00 a.m. / L'audience débute le jeudi 18 septembre 2014 à 9 h 00

OPENING REMARKS

MS MYLES: Good morning. Could everyone take their seats so we can start, please.

Good morning everyone and welcome to the last scheduled day of the Joint Review Panel Public Hearing for the Deep Geologic Repository for Low and Intermediate Level Radioactive Waste Project.

My name is Debra Myles and I am the Panel Co-Manager.

We have simultaneous translation, the English is on Channel 1 and the French is on Channel 2. Headsets are available at the back of the room.

Please keep the pace of your speech relatively slow for the translators.

A written transcript is being created for the proceedings and will reflect the

official language used by each speaker. Transcripts will be posted on the Canadian Environmental Assessment Registry website for the project. To make the transcripts as meaningful as possible, please identify yourself before speaking.

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

The hearing is being webcast live. The webcast and the archived webcasts can be accessed from the home page of the Canadian Nuclear Safety Commission at www.nuclearsafety.gc.ca.

A schedule for the additional hearing days was posted on the Registry on August 26th, 2014. Daily agendas that reflect the changes made since the 26th are prepared and posted on the Registry each day.

Emergency exits are located at the back of the room and to my left behind the screen and curtain. Washrooms are in the lobby of the main entrance and the wheelchair access and ramp is located in the back parking lot. In the event of a fire alarm, please leave the

building immediately.

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

If you are a registered participant and want to seek leave of the Chair to propose a question on a presentation, you are also asked to speak with a member of the Secretariat.

If you are not scheduled to make a presentation during the hearings, but would like to seek leave of the Panel to make a brief oral statement, please speak to a member of the Secretariat and complete a request form.

The opportunity to make a brief oral statement is subject to the availability of time and must be for the purpose of addressing one or more of the six subjects that are the focus of these additional hearing days.

Opportunities for either a proposed question to a presenter or a brief statement at the end of today's session may be provided, time permitting, on a first-come first-served basis.

In accordance with the Panel's

hearing procedures, the resumption of the public hearing is solely for the purpose of addressing the six subjects of the Information Requests issued by the Panel since November, 2013. Neither presentations nor questions will be permitted if they do not follow the hearing procedures.

Anyone who wishes to take photos or videos today should speak with the Panel's Communications Advisor, Lucille Jamault.

Thank you very much.

THE CHAIRPERSON: Good morning.

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 Debra Myles, the Co-Manager of the Joint Review Panel

and we also have Denis Saumure, 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 updates to the geo-scientific verification plan.

I would like to note that we will have certain government departments on standby on the phone in the event that the Panel has any questions for them.

I remind everyone that dials into the hearing to send an e-mail to the Secretariat when they join and also when they leave the call. This is the only way the Secretariat can confirm who is standing by.

Before we proceed with this morning's presentations we will address some outstanding responses to questions from the Panel.

I understand we do have the experts for the Saugeen Ojibway Nations, Mr. Monem?

MR. MONEM: Alex Monem, for the record.

Thank you, Madam Chair. I sincerely hope we have the experts for SON on the

line. I believe Mr. John Greeves and Mr. Daniel Mussatti are on the line.

MR. GREEVES: Yes, John Greeves is here.

THE CHAIRPERSON: Hello.

Mr. Mussatti, are you on the line?

MR. MUSSATTI: Yes, I am.

THE CHAIRPERSON: Good. Thank you.

MR. MUSSATTI: And Robert Jackson is on the line also for SON.

THE CHAIRPERSON: Would you please repeat that name?

MR. MUSSATTI: Dr. Robert Jackson.

THE CHAIRPERSON: Thank you.

So we will return to the question posed by the Panel regarding the SON's review of the methodology for documenting the deliberations of the Independent Expert Group.

So please proceed with your response.

MR. GREEVES: This is -- Alex, do you want me to respond at this point?

THE CHAIRPERSON: Excuse me, you are very unclear. Perhaps just use your handset and take it off speakerphone. There is a very bad echo.

MR. GREEVES: Okay. Hang on. Is this better? Is this better? Can you hear me?

THE CHAIRPERSON: Yes, we can.

MR. GREEVES: Hello?

THE CHAIRPERSON: We can hear you now.

MR. GREEVES: Can you hear me?

THE CHAIRPERSON: Yes. Please proceed.

MR. GREEVES: Can you hear me now?

THE CHAIRPERSON: Yes we can, thank you. Please proceed.

MR. GREEVES: Okay. All right.

For the record, my name is John Greeves and I have read the transcript. I think I understand the nature of the question.

I am an advisor to the Saugeen Ojibway Nation and in advising them I identified what I thought were significant weaknesses of the Independent Expert Group process and those that

run to the question you raised was about the transparency, defensibility and repeatability of the study that they did.

I would observe that the logarithmic graphical representation method that the IEG used for comparison of alternative sites and risks is an uncommon approach. I can't find where this has been applied anywhere else.

I believe Dr. Paoli acknowledged that it was an uncommon approach. I can't find any references in the report to methodology, data or analysis that explain the use of the logarithmic scales to support positioning of icons.

I understand the question is, well what could they have done, and I have provided four references to Alex Monem, he can provide for the reference. The literature is rich with ways to do subjective assessment. You can find U.S. Nuclear Regulatory Commission documents, the American Society of Civil Engineers produces documents along these lines and Sandia National Laboratories, to name a few.

These types of approaches, which I have worked on quite a bit over the last 10

years, normally involve a disciplined expert judgment process and a series of steps and the key is to involve a trained expert elicitator and I have had two experiences doing this in the last six or seven years.

And to me this process needs to be documented, you need to select an expert elicitator who puts some objectivity into the process and there needs to be a statement of what the issues are and how you qualify to be an expert in that process, then select experts that meet this qualification.

Once that group is formed, there is a step in terms of training, the expert elicitator would train the group on how the subjective opinions would be documented. This helps remove any biases or false assumptions like siting a deep geologic repository near a fresh body of water. That would be teased out by the expert elicitator at the beginning.

Then there would be presentation of issues to the experts and they would analyze those issues and discuss them, and then there would be an additional session where their judgments would be documented and portrayed to an

expert elicitator and then the expert elicitator would document all of those proceedings and include those in a summary report.

The advantage of these approaches, which have been done elsewhere, is that it is a much more scrutable process; it would enhance the quality of the judgments expressed by the experts, it would be easily evaluated elsewhere by people like us who were remote to the process, and it would end up with a scrutable process with any biases -- frankly, we all have some biases, those would be removed through an expert elicitation process and it would make the process much more scrutable.

So in a short fashion I have tried to answer I think what your question was that you raised yesterday, Madam Chairman.

THE CHAIRPERSON: Thank you, Mr. Greeves.

It's unfortunate we were not able to engage in a bit more of a dialogue with you yesterday, but I think at this point what the Panel simply wants to do is confirm the salient points that you have just made for us.

So would you confirm that the

most salient points in your description of the processes you have been part of is that it involves a disciplined expert judgment process with expert trained facilitation and accompanying quite thorough documentation.

Is that a fair summary of what you have just explained to us?

MR. GREEVES: In a few sentences you have absolutely captured it. I have done this two times recently and I think the experts in the group are very familiar with this process. I have worked with at least one of them for decades on these types of issues.

THE CHAIRPERSON: Thank you, Mr. Greeves.

We understand in terms of the second issue from yesterday that OPG has sent in the latest NPRI report for the Western Waste Management Facility and that will be posted on the registry.

Thank you to OPG.

We will now proceed with presentations by Ontario Power Generation and the Canadian Nuclear Safety Commission pertaining to the subject of updates to the Geo-Scientific

Verification Plan.

The Panel will hear both presentations before proceeding with its questions. We will wait to hear from Natural Resources Canada until after the Panel has asked its questions of OPG and CNSC because Natural Resources Canada's presentation covers a more broad range of topics.

I would now like to call on Ontario Power Generation to begin their presentation, which is PMD 14-P1.1F.

Ms Swami, the floor is yours.

PRESENTATION BY / PRÉSENTATION PAR:
ONTARIO POWER GENERATION

MS SWAMI: Laurie Swami, for the record.

Good morning, Dr. Swanson and Members of the Panel. This morning Mr. Mark Jensen will provide the presentation on the Geo-Scientific Verification Plan. Mr. Jensen is the Director of the DGR Geo-Science and Research Program at the Nuclear Waste Management Organization.

Mr. Jensen...?

MR. JENSEN: Thank you, and good morning.

For the record, my name is Mark Jensen. I am joined this morning by Dr. Joe Carvalho, Principal from Golder Associates who was involved in the development of the geotechnical component of the revised Geo-Scientific Verification Plan.

The purpose of the presentation this morning is to describe a revised Geo-Scientific Verification Plan that addresses Information Request EIS 12-511. In particular, it describes material changes to the Geo-Scientific Verification Plan that involved the addition of planned geotechnical activities related to safe construction practice and engineering design verification.

The main elements of the presentation include, the nature of the Information Request EIS 12-511; the Geo-Scientific Verification Plan approach; enhanced geotechnical verification activities; the subsurface excavation design and construction approach, including trigger values; and a

summary.

Following the October, 2013 presentation of the Geo-Scientific Verification Plan at the Joint Review Panel hearing and discussion of additional geotechnical information to support DGR construction and design verification activities, Information Request EIS 12-511 was received.

The Information Request asked OPG to provide an updated Geo-Scientific Verification Plan that included more details concerning specific methods, timing and sequencing of the sampling, as well as how OPG will develop triggers for changes to engineering design and benchmarks for verification of the safety case.

The revised 2014 Geo-Scientific Verification Plan now incorporates both geo-science safety case and geotechnical construction activities.

The original geo-science related activities remain materially unchanged. The increased scope in the Geo-Scientific Verification Plan describes best international rock engineering practice as relevant to safe construction practice and design verification during construction.

The geotechnical monitoring and investigations proposed significantly extend activities associated with geomechanics, in particular excavated rock mass response during construction. Proposed rock mass response monitoring activities will be conducted real-time in both the ventilation and main shafts during construction.

Recent geotechnical trigger values have been established to gauge whether the rock mass response observed during construction is within expected ranges and engineering design tolerances. These geotechnical trigger values were included in the OPG response to Information Request EIS 12-511.

As was demonstrated and found best practice in the surface-based investigations, detailed test plans will be developed prior to initiation of any activities. This approach assures, first, that the methods and techniques applied are consistent with best demonstrated experience at the time of construction; second, that the test plans are available in a timely manner to provide technical specification of services and monitoring

instrumentation for implementation; third, that relevant geotechnical trigger values for excavation safety and design verification are established; and, fourth, that there is compliance with the DGR Project Quality Plan.

The planning and timing of all activities is directly linked to specific information requirements whether they be real-time assessment of excavation safety or geotechnical design verification or the verification of site-specific characteristics to verify the DGR safety case in support of a future operating licence application. In other words, the timing and scheduling of activities is established to coincide with the need for the information.

It is important to recognize that the Geo-Scientific Verification Plan may evolve as the final engineering design is developed to ensure consistency with improved Canadian or international underground construction experience and to respond to future regulatory comments and/or guidance.

In a sense, the plan is a living document, the revision of which would be subject

to regulatory oversight.

Slide 5 and the accompanying table provide an overview of the revised Geo-Scientific Verification Plan. The parameters and site attributes that the Geo-Scientific Verification Plan is designed to address are listed on the left-hand side of the table. The centre and right-hand columns denote activities for the geo-science or safety case, and the new geotechnical or construction components of the plan within the shafts and lateral development.

The original safety case related activities were broad in scope and specifically proposed to support verification of the DGR safety case. These activities focused, for example, on the verification of parameters most influencing DGR safety, assessment -- safety assessment, obtaining site-specific geo-science evidence to test and re-assess the understanding of GS for stability and confirming geomechanical conditions governing the assessment of long-term DGR opening stability.

The safety case related activities are shown by the open green diamonds and the blue triangles in the centre column.

Within the revised 2014 Geo-Scientific Verification Plan, the planned geotechnical related activities associated with construction are now described. This is shown in the right-hand construction column of the table with the small blue circles representing new activities and the large circles increased activity over the original plan.

These activities specifically address the requirement to confirm rock mass properties and response during construction. The increased scope within the Geo-Scientific Verification Plan includes, in-situ stress measurements using the United States Bureau of Mines over-coring technique within the vertical and lateral development; an under-excavation test which has been repositioned to the DGR geo-science room within the Cobourg formation to obtain improved estimates of in-situ stress, orientation and magnitude; geo-technical instrumentation, installation -- there is extensive installation of multi-point borehole extensometers and stress cell arrays to monitor rock mass displacement and opening stability --; parameter upscaling tests, the use of excavation

response, and large diameter samples to verify expected rock mass properties; pillar stability integrity, including the instrumentation of emplacement room pillars to monitor and demonstrate pillar structural integrity and groundwater inflow as relevant to safe construction practice.

It should be noted that where properties and attributes are of interest to both geo-science and geotechnical work programs, the proposed methods and techniques for characterization are now described in the geotechnical section of the Geo-Scientific Verification Plan.

The location of planned geotechnical or construction-related activities within the main and ventilation shafts are shown in slide 6. Geologic mapping will be performed to gather information with regard to lithology and geologic structure. The mapping would include both LIDAR and photogrammetric imagery of the excavated walls. Geomechanical properties, in particular upscaling and isotropy, will be assessed through the observation of rock mass displacements and stress change within the

extensometer instrumental rays at seven locations, as shown in the figure.

Groundwater ingress in the upper 200 metres of the excavated shaft will be monitored to assess grout curtain effectiveness and to ensure manageable construction conditions are achieved, inflow rates of less than three litres per second.

Groundwater inflow is not anticipated below 200 metres with the exception of the confined saline aquifers at the top of the Salina A1 member and the Guelph formation, each horizon approximate four metres thick.

Finally, in-situ stress measurements will be obtained in vertical boreholes extended beyond the working phase in the main shaft using the over-coring technique, the selection and justification of which is described in the Geoscientific Verification Plan.

Slide 7 illustrates the location of the new geotechnical or construction-related activities within the lateral repository development. All excavated openings will be geologically mapped which will include the collection of LIDAR and photogrammetric imagery.

The LIDAR profiling will be kept capable of detecting rock mass displacements of millimetre scale through the comparison of subsequent surveys using benchmark monuments.

Geomechanical properties will be confirmed through characterization of rock mass response such that upscaled values are obtained for confirmation of design properties. In addition, laboratory strength testing will be performed on large diameter samples to characterize anisotropy.

Excavation response will be monitored through the installation of multipoint boreholes extensometers and stress cell arrays within the ground and the floor of each emplacement room.

Although hydrogeologic conditions make it extremely unlikely, evidence of groundwater seepage will be recorded during mapping and, if possible, samples gathered for analysis.

Studies to monitor pillar response to excavation will be performed at three locations, as shown in the figure. The intent is to confirm pillar integrity given they have been

purposefully designed to be unconditionally stable.

Finally, in-situ stress measurements will be made within the Sherman Fall formation on the down ramps to the shaft bottoms by USBM over-coring, in addition to the performance of a large scale under-excavation test, now repositioned from the base of the main shaft to the geoscience room.

The observation method is a practical and internationally-accepted approach for subsurface rock engineering design and construction. The approach is designed to reduce the risk of engineering decisions given possible uncertainties in subsurface conditions. This approach, as described within Eurocode 7, has been applied by other international radioactive waste management organizations.

Application requires consideration and adaptation of an engineered design to site-specific geotechnical conditions. Implementation of the observation method within the DGR project requires that acceptable limits of rock mass behaviour for site-specific engineering designs be established.

A plan for monitoring is devised to yield reliable information on parameters able to reveal whether behaviour lies within accepted design limits.

The monitoring plan requires response time sufficiently rapid to allow for analysis and confirmation of acceptable design conditions during the construction cycle. To achieve this trigger values are developed to allow an objective reassessment of rock mass response parameters most influencing excavated opening safety and shaft lateral engineering design.

This approach allows for design verification during construction with the possibility for design revision or adaptation in the event that conservatively estimated rock mass response assumed in the design is observed to be materially different than expected.

The purpose of trigger values is to provide an indication of a deviation in expected rock mass response from that considered in the DGR design basis. The trigger values are purposefully selected and set for rock mass parameters and conditions that govern opening

stability and safety and information needs required to verify the DGR engineered design.

As described in Table 4 of information -- sorry -- of the response to Information Request EIS 12-511, an example of a geotechnical trigger value during shaft excavation would be that rock mass deformation measurements should not exceed 5 percent of predicted before casting of the concrete liner.

Another is in-situ stress in the lateral development such that the maximum principle stress not exceed 35 megapascals in and orientation be within 30 degrees of expected.

This is in contrast to the geoscience or safety case program in which assessment of collected data is -- sorry -- in which assessment of collected data requires it to be considered as a whole or system. This said, if a fault with 0.5 metres displacement in high groundwater inflows were unexpectedly intersected at the repository horizon, this would represent a reportable event to the CNSC and would require reassessment of the safety case.

As noted, the geotechnical trigger values are established on a conservative

design basis. For example, the rock mass strength is lower than actually expected and, thus, are unlikely to be exceeded.

It is important to recognize that each trigger parameter represents only one indication of rock mass behaviour. Proper interpretation and assessment of geotechnical trigger value trending and possible exceedance requires a holistic approach in which coincidence between multiple parameters in evidence are considered to assess impact on shaft or repository design and, if required, any mitigating activities.

As discussed, trigger values may require further refinement at the final stage of DGR design, in part, to ensure consistency with contractor equipment and construction methods. This would be documented within the detailed test plans that would be subject to regulatory oversight.

In summary, the Geoscientific Verification Plan has been revised to include planned geotechnical activities associated with the assessment and monitoring of excavated opening stability, construction safety and design

verification.

The geoscience or safety case component of the Geoscientific Verification Plan originally presented remains materially unchanged. The plan represents a framework for subsurface geoscience and geotechnical activities to be conducted during DGR construction. The timing and scheduling of activities coincides with requirements for the data need, whether this be real-time monitoring to assess opening stability and design verification or confirmation of site attributes underpinning the DGR safety case.

As has been practiced in the past, detailed test plans will be developed for individual activities prior to their initiation. Such test plans will establish and document trigger values to be observed during excavation monitoring and design verification.

Information and data gathered during geoscientific verification activities will be included in a future safety assessment to reveal impacts, if any, on DGR performance. This information would be included in an operating licence application.

The Geoscientific Verification Plan is subject to change in terms of addressing the final detailed repository design and/or regulatory comments and guidance. Any modification or revision of the plan would occur within regulatory oversight.

This completes the presentation of the Geoscientific Verification Plan. We would be glad to answer any questions. Thank you.

THE CHAIRPERSON: Thank you, Mr. Jensen.

We'll proceed directly with the CNSC's presentation.

But before we do, apparently NRCan has contacted us to note that their presentation actually addresses only the Geoscientific Verification Plan as was originally requested by the Panel for today. So a quick change back to plan A which is we will hear from Natural Resources Canada immediately after CNSC and then we will go to the Panel's questions.

With that, I'll ask Dr. Thompson to proceed.

PRESENTATION BY / PRÉSENTATION PAR
CANADIAN NUCLEAR SAFETY COMMISSION

Dr THOMPSON : Merci, Madame la Présidente. Bonjour, et bonjour, Membres de la Commission. Mon nom est Patsy Thompson. Je suis la directrice générale de la Direction de l'évaluation et de la protection environnementale et radiologique à la Commission canadienne de sûreté nucléaire.

With me today are Ms Kay Klassen, Senior Project Officer for Licensing the Waste Facilities; Dr. Son Nguyen, Geoscience Technical Specialist and Ms Kiza Francis, the Environmental Assessment Specialist on this project.

CNSC staff have reviewed OPG's submission of the updated Geoscientific Verification Plan. This was requested in Information Request EIS 12-511. Staff's sufficiency review of this information request can be found on the registry as entry 1867.

Today's presentation summarizes CNSC's staff review as presented in PMD 14-P1.2.

This presentation covers the following points:

- The purpose of the Geoscientific Verification Plan, or GVP;

- The main points of Information Request EIS 12-511;

- The main point of OPG's response to that information request;

- CNSC staff assessment methodology;

- The results of CNSC staff's review with respect to the following GVP activities proposed by OPG: Geological characterization, geomechanics and excavation damage, shaft seal performance; other studies in support of the safety case and trigger criteria.

The presentation will also cover the handling of the uncertainties associated with the safety case, CNSC staff's conclusions and CNSC's compliance monitoring program to ensure that the GVP would provide the necessary data and information to verify that the DGR system falls within the safety envelope for both pre and post-closure safety which forms the licensing basis.

To start the presentation it is useful to review the purpose of OPG's GVP in order to understand its important role in the

licensing process.

OPG has completed a Geoscientific Site Characterization Plan initiated in 2006 to obtain site data on relevant aspects of geology, hydrogeology, geochemistry, geomechanics and seismicity.

Eight boreholes were drilled at the site to characterize the subsurface conditions. The Geoscientific Site Characterization Plan provided reasonable evidence that the rock formations being proposed to host and enclose the DGR would provide multiple barriers to safely contain and isolate the low and intermediate level radioactive waste. However, subsurface characterization was performed from the ground surface and has not been done underground. There remains some uncertainties in relation to the subsurface site conditions and data obtained.

In order to reduce the uncertainties, OPG has developed in accordance with CNSC requirements a Geoscientific Verification Plan to gather additional information to confirm that the subsurface conditions fall within the safety envelope

defined in the safety case.

In addition, the activities of the GVP also aim to collect geoscientific data to optimize the DGR design and reduce construction and operational risks.

The information from the GVP would also be used to update the safety case in support of future licence applications should the project proceed.

OPG submitted a GVP in 2011 in support of the environmental assessment and licence application to prepare a site and construct the proposed DGR. Information Request 12 -- EIS 12-511 required that the GVP be updated in order to include more details on specific methods, locations, timing and sequencing of sampling and triggers for changes to the design of the proposed DGR and benchmarks for verification of the safety case.

OPG's response to Information Request EIS 12-511 contains a GVP that has been updated with respect to the one submitted in 2011. The following main points are provided in the response:

A more detailed description of

the various verification activities and definition of trigger criteria as requested in the information request.

The updated Geoscientific Verification Plan divides the proposed activities into two categories. One, those activities that support the geotechnical design and reduce construction and operational risk and, secondly, those activities that support the long-term safety case.

The response and updated Geoscientific Verification Plan address CNSC staff's Recommendation number 20 which was found in PMD 13-P1.3 and the Revised Recommendation 19 which was provided to the Panel as Undertaking No. 15.

Recommendation number 20 requested that OPG review and, if necessary, revise the long term geomechanical models and the safety assessment at the end of the shaft construction before lateral development is started.

Revised Recommendation 19 related to the need for OPG to develop and conduct a research and development program on the longevity

of shaft seals. The program should include demonstrations that the long-term seal performance and their interaction with the host and cap rock formations as well as other formations that influence the long-term safety case.

I will now pass the presentation to Dr. Nguyen.

Dr NGUYEN : Merci, Madame Thompson.

Bonjour, Madame la Présidente et Messieurs les Commissaires. Mon nom est Son Nguyen.

CNSC staff reviewed OPG's response to EIS 12-511 by verifying whether the response is in line with the guidance and requirements set out in IAEA and CNSC safety standards SSR-5, SSG-23 and G-320; respectively.

Staff also used technical knowledge and experience to evaluate the rationale and methodologies proposed for geoscientific monitoring activities.

This knowledge and experience were gained through staff involvement in projects that have been carried out at underground

research laboratories, or URLs, around the world by conducting independent research and by keeping up to date with technical information through international and Canadian conferences and workshops.

CNSC staff also sought clarification on particular aspects of the updated GVP in a teleconference with OPG. The outcomes of that meeting are documented in staff's Sufficiency Review found on the registry at number 1867.

The geoscientific verification activities proposed by OPG are summarized on this slide. They would be initiated during sinking of the shaft at different elevations to characterize a range of rock types. During lateral development the verification activities would focus on the host Cobourg formation.

All of the planned activities would provide data to verify the long-term safety case. The activities shown in the box at the left in addition to allowing the long-term safety case to be verified will also provide the data to optimize the DGR design and to ensure safety during construction and operation. The data from

the verification activities shown in the left box would be compared to the triggered criteria defined in OPG's response.

In the following slides CNSC staff will summarize OPG's verification activities in more detail and provide CNSC staff's assessment of each of those activities.

Geological characterization activities will provide information for both pre and post-closure safety. During construction of the shaft and lateral developments, OPG proposes to perform geological mapping by direct visual inspection and by analysis of high resolution digital images and LIDAR images. A seismic reflection survey will be carried out along all emplacement rooms to characterize the configuration of the surface of the pre-Cambrian basement below the DGR and to identify any structural discontinuities that may be present.

CNSC staff conclude that the proposed activities will provide a permanent record of rock structure and quality for future safety case updates and also allow for the optimization of the ground support.

CNSC staff recommended and OPG

have agreed to consider the use of geophysical methods to verify the presence or absence of major fracturing outside of the DGR footprint. This is reported in staff's Sufficiency Review.

In-situ stress and upscaling tests will provide information for both pre and post-closure safety. During construction OPG proposes to perform lab compression tests on large 160 mm diameter samples of the Salina A1, Queenston, Georgian Bay and Cobourg formations. The results will be compared to similar tests that were already performed on 76 mm diameter samples in order to assess the effect of scale on mechanical properties.

OPG also proposes to measure in-situ stress in the Salina A1, Queenston, Georgian Bay, Cobourg and Sherman Fall formations using the USBM method from the U.S. Bureau of Mines.

CNSC staff recommended that OPG assess anisotropic and creep properties of the same rock formations where in-situ stress will be measured. OPG agreed to carry out this recommendation in the teleconference as reported in staff's Sufficiency Review.

It should also be noted that in

the updated GVP OPG proposed to perform periodic laser profiling in rooms and tunnels. This will provide additional information on any time-dependent movement.

Additional geomechanical tests performed underground will further confirm the geomechanical properties and in-situ stresses. These tests will be reviewed in the following three slides.

Excavation response test will provide information for pre and post-closure safety. During construction and operation the rock mass response to the excavation of the shafts and lateral openings will be monitored. A LIDAR survey is planned to provide a detailed profile of excavation openings to monitor rock response and provide data for numerical modelling.

As an example, the illustration on the slide shows the proposed instrumentation to measure stress and displacement around the shafts at the dolostone/limestone horizons. The monitoring results would be used to calibrate geomechanical models in order to verify the geomechanical properties determined in the lab

for both small and large samples.

Monitoring results would also be used to verify the in-situ stress magnitude and orientations measured using the USBM methods previously discussed. Similar types of monitoring are proposed for rooms and access tunnels.

CNSC staff conclude that the proposed plan is adequate to provide confirmation of design of excavation and shaft liner, optimization of ground support, verification of geomechanical properties and in-situ stress and calibration of the geomechanical model.

Under-excavation tests will provide information for both pre and post-closure safety. In this test the rock mass response during excavation of a room will be monitored. It is likely that the geoscience room will be used for the test. Instrumentation will be pre-installed in boreholes excavated from the adjacent main level sump.

This instrumentation would allow the measurement of the change in deformation and stress in the rock mass during the excavation of the geoscience room.

The data recorded during the excavation of the geoscience room could be back calculated using a geomechanical model in order to verify the geomechanical properties and in situ stress determined previously from lab tests and USBM measurements.

During the teleconference reported in CNSC staff's deficiency review, staff recommended that pour pressure be monitored in order to verify the effects of pour fluid on mechanical behaviour and also to verify the hydraulic response of the host rock.

OPG has concurred with this recommendation.

Pillar response tests will provide information for both pre and post-closure safety. These tests are proposed for three pillars, two located in Panel No. 1 and one in Panel No. 2.

Instrumentation would be installed from a fully-excavated room in order to measure the change, deformation and the micro seismic events during the excavation of an adjacent room.

An inspection borehole would also

be excavated to obtain cores for lab strength testing and to allow for the visual observation of damage with a tele viewer.

CNSC staff are satisfied that the proposed pillar response tests at three locations will provide both a large scale verification of pillar integrity and a confirmation of geomechanical properties and in situ stress.

Excavation Damage Zones, or EDZ, are important factors that influence the post-closure safety case. The EDZ will be characterized at eight levels along the main shaft, in the Salina F, Salina C, Salina A2, Salina A1, Cabot Head, Queenston, Georgian Bay and Blue Mountain and Cobourg formations and also during the lateral development in the Cobourg formation.

The EDZ characterization will be initiated during construction and will be extended to the operation and decommissioning phases.

A series of radial boreholes will be established as illustrated, and will be geologically characterized prior to testing and instrumentation using a tele viewer. Ultrasonic

velocity locking techniques will be used in the geophysical boreholes.

Permeability and fluid pressure will be measured, and cores will be retrieved from other boreholes.

The data from the three different sets of boreholes will be correlated in order to characterize the extent and hydromechanical characteristics of the EDZ and its evolution.

CNSC staff conclude that the proposed activities will, number one, provide data on the extent of the EDZ, the mechanical hydraulic characteristics of the EDZ and its evolution. Number two, provide for the calibration of geomechanical and hydraulic models. And lastly, verify assumptions of the safety case.

The long-term performance of seal materials is another important component of the post-closure safety case. In situ borehole testing of proposed DGR seals will be conducted with a geoscience room in the Cobourg formation.

The purpose of this study is to support the DGR safety case.

The tests might be similar to the

ones performed at the Mont Terri Underground Research Laboratory, or URL, in Switzerland as Illustrated on the slide.

Saturation, hydraulic conductivity and long-term chemical compatibility with the saline pour fluid will be monitored. The interface between the materials and between materials and host rock would also be examined.

Similar types of studies are currently being performed at different URLs around the world. CNSC staff are currently involved in those studies through international collaborations.

CNSC staff will use that experience in order to review the detailed design of the seal performance study to be developed by OPG should the project be approved.

These studies would be initiated during construction and would be extended to the operation phase of the DGR and beyond, if necessary. It is likely that more than one vertical borehole test would be installed in order to allow sampling at various times.

Similar types of demonstrations are also proposed for the Queenston and Georgian

Bay formation by installing horizontal boreholes from the shaft or vertical boreholes in large blocks or vertical boreholes at other surface sites.

CNSC staff are satisfied that the proposed studies will provide additional confidence in the longevity of shaft seals. These studies also fulfil CNSC staff revised recommendation number 19 in Undertaking 15 which was submitted during the hearings in the fall of 2013.

As part of the GVP, OPG proposed to conduct during construction and operation additional studies in support of the post-closure safety case.

The first study relates to fracture infill materials, minerals. Fracture infill minerals would be collected in the Cobourg, Sherman Falls and Kirkfield formations in order to verify the geochemical characteristics and ages of mineral infill.

Geochemical information on mineral infill is required to confirm the pour water profiles that support the conclusion in OPG's EIS that, at the depth of the proposed

repository, the surrounding rock formations have remained isolated for geologically long times of the orders of millions of years.

The age of minerals that fill fractures would provide important information on timing of any fluid flow that could impact the integrity of the repository.

In the second study, long-term in situ diffusion tests would be conducted in the Cobourg formation to verify estimated rock matrix diffusion coefficients.

A third study looks at multi-phase flow processes. Water and gas injection testing in 20 metre-long boreholes is planned for the Cobourg formation to verify multi-phase flow and transport properties and mechanisms.

A fourth study would be undertaken to characterize microbial activity in the Cobourg formation and its influence on DGR performance and to evaluate the occurrence and post-closure effects that micro-organisms would have on geochemistry and gas generation within the DGR.

In the fifth study, seepage water will be collected, where possible, from the

Cobourg, Sherman Falls and Kirkfield formations to provide information on the groundwater geochemistry.

CNSC staff are satisfied that the above studies would provide multiple lines of evidence in support of the ability of the geosphere to provide long-term containment and isolation of the wastes.

Preliminary trigger criteria for design updates for pre-closure safety and benchmarks for the post-closure safety case are defined as well as the ensuing cause of actions should those be exceeded.

Trigger criteria and contingency measures should those criteria be exceeded are given in detail in OPG response to Information Request EIS 12-511.

It should be noted that the purpose of those criteria and contingency measures is to ensure pre-closure safety.

As an example, there are uncertainties related to the magnitude and orientation of the in situ stress since those parameters are difficult to measure from the surface. In order to handle the above

uncertainties, OPG has provided a design based on two conservative assumptions.

Number one, the long-term strength of the host rock is equal to the crack initiation stress, which is approximately equal to 40 percent of the lab peak strength.

Number two, the maximum horizontal stress is assumed to be equal to two times the overburden stress. This value corresponds to upper bound values based on regional data.

In addition, OPG assumed that the maximum horizontal stress acts in all directions around the lateral openings.

In addition to the above conservative assumptions, for increased confidence in the stability of the underground openings, OPG has proposed trigger criteria for the magnitude and orientation of the in situ stress. Should the magnitude of the measured maximum horizontal stress exceed 35 mega Pascal, which is equal to the above upper bound value of the maximum horizontal stress or the direction of the stress deviates from plus or minus 40 degrees from the estimated northeast direction. The

orientation rooms and the measures for ground control would be modified if necessary after a re-evaluation of the room's stability.

From CNSC's staff experience, similar adaptive management methods have been used with success at underground uranium mining facilities in Saskatchewan under much more challenging conditions than the ones expected at the proposed DGR.

If safety is not maintained, CNSC staff can issue an Order to stop unsafe activities. The Order would then be reviewed by the Commission.

Benchmarks for long-term post-closure safety are more difficult to define using quantitative criteria. Post-closure safety relies on multiple barriers and characteristics, and it is difficult to define criteria for each individual component of the system.

However, for the proposed DGR, important characteristics could be identified as follows.

The low permeability of the host and cap rocks that would ensure that diffusion would dominate transport of contaminants, which

will be at very slow rates.

Number two, the absence of major fractures that ensure there will be no preferential transport pathways.

Number three, the absence of economically viable resources that would minimize the likelihood of future inadvertent human instructions.

If the GVP shows deviations from one of the above characteristics, this deviation would be reported to the Commission in an initial event report.

CNSC staff would review that assessment. If staff finds that, number one, long-term safety could not be ensure even with mitigative measures or, number two, a major change in the design of the DGR is needed, staff will bring the matter to the Commission with a recommendation to either abort the project in the first situation or amend the licence in the second.

As a result of staff evaluation, CNSC staff are satisfied with the identification and definition of the trigger criteria and benchmarks and ensuing courses of action.

As previously discussed, an important objective of a GVP is to reduce uncertainties associated with the post-closure safety case, and it is useful to review the way uncertainties are handled by OPG.

Uncertainties related to the natural and engineered barriers always exist due to the long timeframe, the complexity of the processes and the variability in characteristics of the DGR system.

Uncertainties do not necessarily mean that a project should be aborted unless those uncertainties compromise the licensing basis or safety of the project.

A DGR project usually proceeds by stages: construction, operation, decommissioning and post-closure. In Canada, the regulatory licensing process coincides with the stages of DGR development and involves a full review in the public process.

To justify the decision to proceed with the next stage of development, international and Canadian guidance requires the proponent to submit a post-closure safety case that first identifies the uncertainties and,

second, show that they do not influence safety.

OPG has applied for a site preparation and construction licence that would not allow any waste to emplaced. The uncertainties associated with construction and operational risks have been adequately identified and handled with a definition of trigger criteria based on the geotechnical verification activities.

CNSC staff have also found that with respect to the long-term post-closure safety, OPG has adequately identified the uncertainties. OPG has bounded the uncertainties with a large degree of conservatism and/or shown that they are irrelevant to safety and OPG has adequately shown that the uncertainties do not impact long-term safety.

At this time, OPG's updated GVP conforms to international best practices and will provide the basis for any design modification to ensure safety during construction, operation and reduce the uncertainties related to long-term safety.

CNSC staff have assessed OPG's response to information request EIS 12-511 and

the updated GVP attached to that response. CNSC staff conclude that OPG has adequately planned the verification activities that are needed to achieve the objective of the GVP.

The verification activities would address or reduce uncertainties associated with geoscientific aspects of the DGR and the DGR safety case.

The information provided in OPG response and the updated GVP also allowed CNSC staff to conclude that the response to recommendation number 19 in PMD 13-P1.3 and the revised response to recommendation number 20 in Undertaking 15 have been adequately captured in the updated GVP, and those recommendations are no longer needed.

If the DGR is licensed to proceed, CNSC staff will, as part of the compliance verification program, verify the acceptability of the detailed test plan for each verification activity of the updated GVP, monitor the licensee's implementation of the GVP throughout the construction phase and verify that the repository design adequately takes into account the results of the GVP activities to

ensure pre-closure safety.

The GVP will provide data that CNSC staff can use to verify against the bounds of the post-closure safety case. Through independent research, CNSC staff have developed a set of modelling tools that can be used to interpret the GVP data and to verify that the observed properties and performance of the DGR system fall within the safety envelope, also called the licensing basis.

Merci, Madame la présidente et messieurs les commissaires pour votre attention. Je passe maintenant la parole à Mme Thompson.

DR. THOMPSON: Thank you.

And Madam Chair, this completes CNSC staff's presentation. We're available to answer questions.

THE CHAIRPERSON: Thank you very much.

We will now continue directly with the presentation by Natural Resources Canada, which is PMD 14-P1.6.

Mr. Clarke, are you there?

MR. CLARKE: I am on the line. Can you hear me, Madam Chair?

THE CHAIRPERSON: Thank you. Please proceed.

PRESENTATION BY / PRÉSENTATION PAR:
NATURAL RESOURCES CANADA

MR. CLARKE: Good morning, Panel Members. For the record, my name is John Clarke, C-l-a-r-k-e. I am the Director of the Environmental Assessment Division at Natural Resources Canada in Ottawa.

The Joint Review Panel requested on August 15 that Natural Resources Canada representatives make an oral presentation summarizing our July 7th written submissions, review and conclusions relating to OPG's update to the geoscientific verification plan.

I will provide that brief presentation this morning, following the slides available on the CEAA registry as PMD 14-P1.6A.

With me today to answer the Panel's questions are two of the research scientists at Natural Resources Canada who contributed to the written submission and the presentation material.

First is Dr. Alexander Desbarats, a research scientist with the Geological Survey of Canada specializing in hydrogeology. And second is Dr. John Adams, a seismologist with the Geological Survey of Canada.

Both Dr. De Barras and Dr. Adams have presented to this Joint Review Panel in person, in fact, September 17th and 18th of last year, and have responded to questions from the Joint Review Panel via telephone since then as recently as Tuesday.

I will now ask to turn to slide number 2, which is NRCan's role in the environmental assessment.

For context, Natural Resources Canada is a federal department that works to improve and enhance the competitiveness of the natural resource sectors and increase their contribution to Canada's economy. We do this through supporting the sustainable development of Canada's resources and by applying our knowledge and expertise of Canada's land mass to support the safety and security of citizens.

NRCan has been involved in this environmental assessment process since at least -

- or since 2007. Documents on the CEAA registry reflect both our early involvement, providing advice to Canadian Nuclear Safety Commission staff, and the review of technical documents and our more recent testimony before the Joint Review Panel.

Within the scope of expertise available at Natural Resources Canada, three are relevant to the review of the geoscientific verification plan: geology, hydrogeology and seismic hazards.

I will now turn to slide 3 and go through the first of those three subjects.

As the Joint Review Panel has already heard this morning, the revised GVP's proposed future data acquisition activities are classified according to two objectives, verification of the geotechnical design parameters and verification of the geoscientific parameters for the safety cases.

From the perspective of NRCan's geology [technical issues] that is, the stratigraphy and sedimentology of the sandstone and shale bedrock, NRCan is satisfied that the activities proposed and the information -- and

we're satisfied with the information provided by OPG.

This information does not affect any of the conclusions that NRCan has drawn in relation to the DGR project, and we do not have any additional recommendations related to geology.

I will now turn to slide 4, which addresses hydrogeology.

With respect to hydrogeology, the updated GVP provides significantly more details on planned hydrogeological verification activities. In particular, our written submission notes that, for the verification of geotechnical design parameters, activities include probe hole drilling and observation of groundwater seepage during shaft sinking and seepage water collection during lateral development.

With respect to the verification of the geoscience parameters, proposed activities include characterizations of hydraulically active faults and permeability measurements in the excavation damage zone during shaft sinking and long-term solute diffusion tests in the Cobourg

formation.

These activities should contribute to OPG's finalizing of the design of the DGR, the identification of additional mitigation measures, if necessary, and improved data for the updated performance safety case analyses.

NRCan is satisfied with the information presented. It does not affect any of the conclusions that NRCan has drawn with respect to the DGR project, and we do not have any additional recommendations related to hydrogeology.

I'll turn now to slide 5, which addresses seismic hazards.

From a seismic hazard perspective, NRCan's written submission provides the conclusion that the modifications to the geoscience verification plan are appropriate. The planned activities will improve the monitoring of rock stress and resulting deformation of the rocks, which should serve to increase confidence that the geological integrity is as required.

Our written submission reflects

that NRCan is satisfied with the information presented, and this information does not affect any of the conclusions that NRCan has drawn in relation to the DGR project.

Our written submission does offer one recommendation for Ontario Power Generation, that they consider including near field micro-seismic monitoring as part of the geoscience verification plan.

Near field micro-seismic monitoring may provide timely information for the assessment of deformation and rock -- sorry, the assessment of deformation and stress changes should such changes exceed defined triggers.

I will now turn to slide 6 for a brief summary of what near field micro-seismic monitoring implies.

Slide 6, micro-seismic events are earthquakes with a magnitude of less than zero. The magnitude of these events would be far too small to be felt on the surface, but they may be heard underground.

Micro-seismic events can occur as a result of human-induced changes to the stress distributions in the rock mass. The result of

these increased stresses can be tiny slips or shears which release energy.

Micro-seismic monitoring tracks where and how frequently the micro-seismic events occurred, and their size.

Current technology allows these events to be localized to within a few metres. In comparison, the current regional seismograph monitoring of the DGR vicinity can locate events down to about magnitude 1 and give locations to within a few kilometres. Micro-seismic monitoring would provide, however, additional timely data relevant to the contemporary changes in rock stress.

I'll now turn to slide 7.

In reviewing our written submission for this presentation, we wanted to provide clarification for the Joint Review Panel. Our recommendation was not intended to suggest that a micro-seismic system is needed at the DGR at the start of the construction phase.

Rather, we were recommending to Ontario Power Generation that, should rock deformation issues arise, for example, changes that exceed a pre-defined trigger, micro-seismic

monitoring system provides timely information about the redistribution of rock stresses which could guide further excavation.

Now, turning to the final slide, I'd like to thank the Panel for the opportunity to provide this submission, and we would be pleased to answer any of the Joint Review Panel's questions.

Thank you.

THE CHAIRPERSON: Thank you, Mr. Clarke.

We will be taking a 15-minute break, and after we reconvene at 10:30 we'll proceed with questions from the Panel.

--- Upon recessing at 10:14 a.m. /
Suspension à 10 h 14
--- Upon resuming at 10:32 a.m. /
Reprise à 10 h 32

MS MYLES: We would like to resume, so if everyone could take their seats please?

THE CHAIRPERSON: We will now proceed with the Panel questions, and we are

going to begin with Dr. Muecke's questions from yesterday addressed to the Saugeen Ojibway Nations regarding your expectations around the Geoscience Verification Plan.

Dr. Muecke?

MEMBER MUECKE: Would you like me to repeat the question?

MR. MONEM: Alex Monem, for the record.

Can I confirm that Dr. Bob Jackson is still on the phone?

MEMBER MUECKE: Excellent. So the question was --

UNIDENTIFIED SPEAKER: Just wait. They want to confirm if the experts are on the phone.

MR. MONEM: Dr. Jackson, are you still on the phone?

THE CHAIRPERSON: It doesn't sound like he is on the phone.

MEMBER MUECKE: Okay. We will wait with that one?

THE CHAIRPERSON: Yes, okay.

MEMBER MUECKE: So I have a question for OPG and CNSC.

Will there be a third-party review of the Geoscience Verification Plan similar to that proposed for the Waste Inventory Verification Plan?

MR. JENSEN: Mark Jensen, for the record.

I am sorry, Dr. Muecke, could you repeat your question please?

MEMBER MUECKE: Yes, I will.

Will there be a third-party review of the Geoscience Verification Plan similar to that proposed to the Waste Inventory Verification Plan?

MR. WILSON: Derek Wilson, for the record.

The Geoscientific Verification Plan that is in front of the Panel now has been peer reviewed. That document was peer reviewed prior to submitting it to the Joint Review Panel. Dr. Derek Martin performed the peer review of the Geoscientific Verification Plan as it sits now.

Our intent is to continue to have that peer review through iterations of the Geoscientific Verification Plan as we move forward.

MEMBER MUECKE: Sorry, maybe I wasn't listening. Who is the third party involved?

MR. WILSON: Derek Wilson, for the record.

Dr. Derek Martin performed the peer review of the GVP that is in front.

MEMBER MUECKE: Thank you.

THE CHAIRPERSON: CNSC, could you also respond to that question please?

DR. THOMPSON: Patsy Thompson, for the record.

At this time we are not planning third-party review of the GVP, essentially because Dr. Son Nguyen and Dr. Grant Su, who are the CNSC lead on the verification of the GVP are internationally recognized experts and their experience from participation in international activities gives them the expertise to review and make informed judgement on the proposed GVP.

We would work with, for example, the experts at NRCan who have been involved in the review of the proposed GVP moving forward to make sure that their interests and concerns are being addressed.

MEMBER MUECKE: This is another question to OPG. During shaft sinking there will be a strong incentive to progress because of equipment and labour costs. Scientific and geotechnical procedures may take longer than expected.

Who would decide priorities and how would these priorities be agreed upon?

MR. WILSON: Derek Wilson, for the record.

I think we had a bit of discussion around this when we discussed the GVP at the last hearing days.

The Geoscientific Verification Plan and the activities associated with those will be part of the bid package that goes out for the construction of the shafts in the lateral development. As such, that it is a clear expectation as to what those geoscientific verification activities are, as well as to see how we can incorporate the existing equipment and resources of the contracting company in supporting us in executing those.

So the geoscientific verification activities will be actually embedded in the

schedule, they are going to take priority, safety takes priority. We have had a lot of discussion around the safety culture.

And so whether it is the geotechnical activities with respect to design verification or construction safety such as the requirements for ground support or shaft liner installation, those are paramount. And, as such, the safety of the facility and the safety of the objectives around the GVP will override production efficiencies.

MEMBER MUECKE: Thank you, Mr. Wilson.

THE CHAIRPERSON: Dr. Archibald.

MEMBER ARCHIBALD: Thank you very much.

I would like to deal a little bit with the geotechnical field verification activities. In table 4 on page 13 to the EIS 12-511 response mention is made of preliminary values and states trigger value based on rock strength as one standard deviation lower than the strengths determined from core testing in DGR-8 is borehole is given.

It is known that there can be

large variations in strength on the order of one standard deviation or greater between specimens, even in close proximity to each other.

Could OPG justify the application of the arbitrary trigger level of one standard deviation strength difference below that of the previous core strength measurements?

DR. CARVALHO: Joe Carvalho, for the record.

One standard deviation represents about 80 per cent reliability. That is a reasonable measure in terms of assessment of the rock mass response. If we get below that value, that will trigger a re-evaluation of the support and the impact that it has on the coming loads on the liner.

The initial impact of such deviation is probably a readjustment of the primary support and the focus is basically on the remnant load that remains that will impact the final concrete shaft liner support.

MEMBER ARCHIBALD: That also presupposes a large sample population for testing I presume?

DR. CARVALHO: Depending on the

horizon, there are some horizons that are only two metres thick, and probably won't traversed in one single blast. The horizons that are of more significant thickness have a larger population of testing.

MEMBER ARCHIBALD: It is also known that larger diameter core samples of similar rock materials will often display lower unconfined strength relative to smaller diameter core specimens. Is that true?

DR. CARVALHO: That is the current understanding. Typically, larger samples have more probability of more defects and, as such, usually result in slightly lower strengths and, of course, up to a certain size, beyond that size it basically stabilizes.

MEMBER ARCHIBALD: With that in mind then, will the unconfined compressive strength that is determined for previous DGR-8 borehole samples or the proposed upscale sample strengths be size scaled to reflect he size effects of testing in order to yield more comparable strength values?

DR. CARVALHO: Joe Carvalho, for the record.

Yes. We intend to test the larger samples basically to verify the reduction in strengths that occur from the large samples.

But more importantly, the ultimate test is in the actual excavation itself. So the response of the excavation could be considered as the ultimate large-scale test that will provide the information to calibrate models.

MEMBER ARCHIBALD: In that instance then, on page 10 of the revised GSV document dating January 2014, it is stated that the size of retrieved core materials that are to be used for upscale tests are stated to be 305 millimetres.

In a previous response section to EIS 12-511 samples at a size of 160 millimetres diameter were mentioned. This is on table 4, page 15.

And on page 13 of the revised GSV it is further noted that the previous DGR-8 core samples drilled vertically were sized at 76 millimetres diameter.

So now we have the mention of three different sizes of core. My first question in this series is is it feasible, using current

drilling technology, to acquire sufficient lengths of intact very large diameter core materials for testing, that being the core samples at the 305 millimetre diameter?

What planned hole depths and sample numbers would be anticipated for each site of measurement?

DR. CARVALHO: Joe Carvalho, for the record.

Yes, there is technology to drill large diameter samples up to six inches using thin wall tubing. I have done that myself. And you can get long enough samples to test.

With that said, the samples that are 305 millimetres in size are meant to be sub-cored and different orientations to establish an anisotropy. Samples of that size and of significant strength would require quite a large loading frame, and I don't know if those exist.

MEMBER ARCHIBALD: Not to get into the science of the testing, but there are some very significant problems associated.

Would the upscale test samples be drilled in shaft construction as well as the horizontal construction or only during the

horizontal development?

DR. CARVALHO: Joe Carvalho, for the record.

They would be drilled in both instances.

MEMBER ARCHIBALD: And therefore, anisotropic features could be inferred between the strength values, vertical, horizontal and such, using the associated horizontal and vertical drilling?

DR. CARVALHO: Joe Carvalho, for the record.

Yes, that is correct.

MEMBER ARCHIBALD: And, in fact, will the 305 millimetre diameter cores be used to derive the strength scaling? Will actual test samples be created to that size or will sub-cores at 160 millimetres only be used for the size scaling?

DR. CARVALHO: Joe Carvalho, for the record.

At this point the 160 millimetres are the targeted samples for the upscaling simply because of the demands on the loading frames.

THE CHAIRPERSON: Dr. Muecke, I

believe the SON expert is now on the telephone. So we will return back to Dr. Muecke's question.

May we please confirm, however, that the expert is indeed now on the telephone?

DR. JACKSON: Yes, I am here. I apologize, I had a battery problem.

THE CHAIRPERSON: I am very familiar with that issue, thank you. So we will proceed with Dr. Muecke's question.

MEMBER MUECKE: I shall restate my question.

What level of detail do the SON consider necessary in the Geoscience Verification Plan prior to commencement of construction of the proposed DGR?

DR. JACKSON: For the record, my name is Dr. Robert E. Jackson, I am a geoscientist and advise at the SON. I have had many many years of nuclear facility construction and regulation in my background.

I think your question is difficult to answer in some ways without knowing all of the technical detailed assumptions made in the model by the proponent, or at least not

having immediate access to them.

It would be difficult for us to create an independent construction of a matrix of the assumptions made versus any adverse parameters which would be detected during shaft construction.

Now, my comments will focus more on the post-closure issues, not on the pre-closure safety trigger points that have been mentioned in the conversations this morning.

Now, OPG has indicated a few of these trigger points in a positive effort in the latest documents. But it still appears that they would be capable of constructing a much more detailed matrix that would be in place and easily reviewable during what I call the heat of construction schedule pressure.

As an example, one of my colleagues has mentioned earlier that if there were mobile water discovered at any stage at the depth, then this would be a major conflict with the model assumptions made and should trigger a significant reconsideration of the model and probably an indefinite pause in construction.

Other similar concepts such as

geologic mapping guide which defines what should be examined as the shaft construction proceeds and describes the types of items or issues that should require a hold in construction for further examination should be provided.

As an aside, Dr. Jensen mentioned this morning a geoscience trigger of .5 metres of differential offset, which would convert to 18 inches, as a reportable event. But that would be addressed and reported on in the operating licence application, which would be well after any immediate activities could take place.

I think the proponent plans to do much of this in terms of the test plans and obviously test plan involvement by interested parties such as SON would be very helpful.

I think that although the proponent plans to do this, my experience has shown that once construction is underway there is huge financial momentum to maintain advancing the shaft at the expense of follow-up studies needed unless an outside regulator comes in, issues a stop-work order to allow for further analysis.

That is why it is important to know what these trigger points are ahead of time

so that the scientists involved can make quick decisions on a pause in construction activities.

This latter point supports the need of your question yesterday about having an open process to review and observe the progress against any such matrix in real time. Because of the construction momentum to push on through can be overwhelming to the data gathering and analysis elements by the scientists.

So I think that is my general comments. Again, they are focused on being able to do as much ahead of time as possible. And obviously, something has to be done later on. You know, there is a lot of unpredictability in the geosciences parameters. And so test plans have to be constantly updated.

But it seems like a very thorough analysis of trigger points versus assumption made would be very beneficial.

Thank you.

MEMBER MUECKE: Perhaps, as a bit of a follow-up and maybe it is somewhat repetitive, the Panel would be interested to know what is SON's evaluation of the appropriateness of the observational method, particularly with

respect to possible input by the SON?

DR. JACKSON: I think the observational method is very important in terms of if there is an allowance of time to be able to observe these parameters during an accelerated construction process. To be able to review this at a later date, let's say at an operating licence phase, I don't think would be beneficial.

I don't know if that responds to your question or not.

MEMBER MUECKE: In part. Obviously we are interested in the timing of the information passing to the SON and in terms of the SON being able to respond to that.

DR. JACKSON: Alex, would you like to comment on that?

MR. MONEM: Alex Monem, for the record.

To make the SON's participation in this process effective I think builds into the Geoscientific Verification Plan and its implementation would need to be necessarily pre-established mechanisms where results that come through something like the observational method would be made quickly available to SON and we

would have to have sort of standby technical assistance so as not to hang up the process.

But I think the question is, would there have to be a process in place to allow for a quick deployment of this kind of result to SON or presumably others? And the answer is, yes.

THE CHAIRPERSON: Thank you.

Dr. Archibald?

MEMBER ARCHIBALD: If I may resume with OPG please?

On page 14 of the revised GVP it states that strain gauges will be embedded in the concrete, that would be the concrete liner in the shaft construction, and the strain gauges will be oriented circumferentially.

My question is could OPG explain what will be the purpose of installing strain gauges within the concrete liner and how will information determined from these gauges be used in conjunction with other information obtained from embedded pressure cells to assess geotechnical parameters?

DR. CARVALHO: Joe Carvalho, for the record.

The intent of the strain gauges in the concrete liner is primarily for those formations that we have considered have the potential to impart loads, long-term loads on the liner and, as such, we need to have a measurement of those.

The liner has been designed such that the delay of its installation will require that it won't carry the initial load in the rock, that has been the design. But in the shell formations, due to the time dependency behaviour of that rock, we need to monitor the build-up of stresses on the liner.

MEMBER ARCHIBALD: So this installation will give confirmation of pressure cell data that will also be included at the same sites?

DR. CARVALHO: Joe Carvalho, for the record.

That is correct. so the pressure that is imparted onto the liner radially from the contact with the rock will have to be corroborated by the increasing pressures or stresses in the circumferential direction in the liner.

MEMBER ARCHIBALD: Thank you. And on page 18 it is stated that stress measurements will be performed in the main shaft excavation by the overcoring method that you have described and that CNSC has described.

And it is stated also that there will be no stress measurement in the ventilation shaft because it is located about 80 metres from the main shaft and, therefore, stress conditions are not expected to be different.

Could OPG justify why it is a reasonable assumption to make that in-situ stress will not vary in any significant fashion between sites?

DR. CARVALHO: Joe Carvalho, for the record.

The nature of the site that has been chosen, that being a sedimentary site, and the continuity on the rock formations and strata, gives us the confidence that the behaviour of the strata is fairly uniform across a great lateral extent.

MEMBER ARCHIBALD: In a secondary section, on page 28, there is a description of lateral development in-situ stress determination

testing where such testing is made.

A statement is made that it is expected that a test conducted at a repository horizon will have a greater chance of successfully yielding representative results than an equivalent test in a shaft excavation and the preferred location for such a test would be in the geoscience room.

Could OPG explain why an in-situ overcore or other stress test conducted at the repository horizon would have a greater chance of being successful than in the shaft and, therefore, why are shaft tests being conducted?

DR. CARVALHO: Joe Carvalho, for the record.

There is better opportunity for orientation of the boreholes in which the tests are going to be conducted and, therefore, to have corroboration from measurements taken in different orientations. The USBM method is a method that only measures stresses perpendicular to the orientation of the borehole.

So in the shaft, basically, we are testing as we sink the shaft vertically down. And the spatial flexibility is much larger in the

latter development.

MEMBER ARCHIBALD: I will just ask one other question at this point.

On page 25 in geomechanical testing it is stated that strength and stiffness of rock at the repository horizon may also be determined using noncored samples. And this is "alternatively, block samples of the limestone may also be obtained for laboratory testing."

My question to OPG is, is this a standard test? And how will undisturbed block samples of rock be acquired, transported, and tested for characterization in order to compare previous DGR-8 drill hole core test results?

DR. CARVALHO: Joe Carvalho, for the record.

During construction there is the opportunity of collection of large samples that are a result of the excavation technique, and those samples would be transported and tested either by sub-coring or larger samples, larger sizes.

There is no standard method for larger samples, but the opportunity to grab larger samples is greater at the horizon.

MEMBER ARCHIBALD: Therefore, such samples would be excavated in very careful fashion using drilling and blasting techniques or mechanical excavation.

Is there any explanation as to the obtainability of such a viable rock sample by such methods?

DR. CARVALHO: Joe Carvalho, for the record.

These samples would be collected as a result of the excavation techniques and the careful blasting techniques. There is no plan to actually do mechanical excavation to obtain such samples.

MR. WILSON: Derek Wilson, for the record. If I might as well.

As we discussed previously, the requirements of the geotechnical and the Geoscientific Verification Plan is again embedded in the contracting strategy and we would be working with the contractors.

For these specific types of examples of large block sizes we may actually have to alter the excavation for a round or two rounds in order to be able to get these types of

samples available to us.

And that is how we would work that in with the contractors in the scheduling of these events to be able to satisfy our needs around the geotechnical aspects as well as, you know, maintaining the control that we expect on the openings.

THE CHAIRPERSON: Dr. Muecke?

MEMBER MUECKE: Question is for CNSC.

Today's verbal presentation, the Panel understood that there were telephone conversations between CNSC and OPG that resulted in enhancements to the Geoscience Verification Plan. Is this perception correct?

DR. THOMPSON: Patsy Thompson, for the record.

It is not just a perception, the teleconference was conducted after an initial review of the updated GVP. The results of the teleconference, the topics of discussion, have all been documented in the CNSC sufficiency review. And it is document on the registry as entry 1867.

MEMBER MUECKE: So are these

changes which are reflected in the Geoscience Verification Plan that is before the Panel or are they embedded in commitments?

MR. WILSON: Derek Wilson, for the record.

They are embedded in commitments and so, therefore, in the next iteration of the geo-scientific verification plan they will be incorporated.

MEMBER MUECKE: Thank you.

Back to CNSC, particularly to slide 8 in which CNSC staff requests that OPG consider the use of geophysical methods to verify the presence or absence of major fracturing outside the DGR footprint.

The Panel's questions are, what geophysical methods are envisioned for this, from CNSC?

DR. THOMPSON: Patsy Thompson, for the record.

Dr. Nguyen will respond to the question.

DR. NGUYEN: Son Nguyen, for the record.

When we were suggesting and

recommending that -- giving that recommendation to OPG, I was involved in some collaboration with the IRSN, the French research organization for the regulatory agency in France and they actually use some geophysical methods. I don't exactly remember the details of the methods at the present time, but I can get this information for you, where those methods are used underground in order to detect fractures outside the footprints of the opening.

So that was what we recommended OPG to look at in order to verify the absence or presence of major fractures that might occur, that might exist outside of the footprint of the proposed repository.

MEMBER MUECKE: Would it be possible to have more information on this by late this afternoon -- by the afternoon?

DR. NGUYEN: Son Nguyen, for the record.

I would get that information. There are a few papers from the IRSN on that particular subject and that proposed not only a method, but the method to interpret the resource from the geophysical interpretation.

MEMBER MUECKE: Could you provide the Panel with some indication of how far outside the DGR footprint the studies are to be extended?

DR. NGUYEN: From the results of the safety assessment for the disruptive scenario where a fault -- a major structure is assumed to be located at different distances from the repository, so I think the critical distance is in the order of 100 metres, so if it is further away than the 100 meters from the edge -- the footprint of the repository, there is not much inference on the results of the safety assessment.

So fractures which are like major fractures which are within tens of metres from the footprint would be one that would cause concern and maybe an update in the safety case.

MEMBER MUECKE: So we are talking tens of metres, okay.

And what degree of fracturing would CNSC consider as major?

DR. NGUYEN: Major fracture zones has to be hydraulically conductive, so in case some features are detected, it has to be hydraulically characterized in order to see what

inference it has on the safety case.

Having said all that, there are strong indications from geochemical and hydrogeologic data that would not be major fracture zones within at least hundreds of metres from the planned repository.

There was some modelling performed by our contractor, our research collaborator from Queens University that shows that if a major fracture zone with hydraulic conductivity, which are like three or four orders of magnitude higher than the host rock, this would be detected by the hydrogeological information, like the pore pressure distribution would be affected and from the site investigation from the eight boreholes we haven't seen this phenomenon.

THE CHAIRPERSON: Dr. Archibald...?

MEMBER ARCHIBALD: Thank you very much.

Question to OPG. In the GVP it is stated that:

> "One over-core test is planned within the Cobourg

> formation as shaft development progresses into that formation and during repository level development and in a lower site within the Sherman Fall formation decline a second over-core test would be planned." (As read)

Could OPG explain why consideration for over-core stress testing has only been given to siting at or near the shaft island zone and not to the broader repository horizon limits?

DR. CARVALHO: Joe Carvalho, for the record.

The reason that the tests were chosen to be conducted at those locations is simply because we need the information as early as possible before we start actually excavating the lateral development. So if there is a need for some readjustment of orientation, it can be addressed timely.

MEMBER ARCHIBALD: And I realize also that there would be interference from

lateral excavation, structures and so on, on the measurement, but would it also be in the future plans during repository development to get additional assessment of in-situ stress by taking further afield tests?

DR. CARVALHO: Joe Carvalho, for the record.

Not currently. There are other instrumentation that would indicate the level of stresses based on the response of the excavations.

MEMBER ARCHIBALD: Thank you.

In section 4.2.3 where you talk about geological characterization, this being specifically on page 35, it is stated that:

> "Detailed mapping of excavation surfaces will provide information that can be used to study the extent and geometry of the EDZ around the shaft excavation." (As read)

My question is to OPG, if this mapping is only of the geologic surface features and not through use of ground-penetrating radar

or tele-viewers and boreholes, et cetera, could you explain how mapping of shaft surface features can be used to assess the extent of the EDZ and its geometry?

MR. JENSEN: Mark Jensen, for the record.

The EDZ is part of a characterization program where we will be using ground-penetrating radar and geophysics and other means to understand the EDZ at eight locations as we go into the shaft.

MEMBER ARCHIBALD: My confusion, then, was that I read this as surface mapping would be used to do this. Would you confirm that that is not true?

MR. JENSEN: Mark Jensen, for the record.

I can confirm that's not true.

MEMBER ARCHIBALD: Thank you very much.

I do have a question to Dr. Nguyen and this is based upon a statement made by Mr. Monem from the SON yesterday.

Based upon the submission, a statement was made that the GVP needs to have a

clear go/no-go decision-making function and not just to facilitate engineering fixes. This is a paraphrase for the last part.

To Dr. Nguyen, this morning on slide 16 you had mentioned some recommendations that CNSC would be making concerning a no-go situation -- various no-go situations for the planned repository, one of which would be if natural resources were found to exist that could potentially harm the future development of this.

Could you restate the three conditions that you had mentioned on your slide number 16, please?

DR. NGUYEN: Son Nguyen, for the record.

Those are the three conditions that we have identified as which could have a major impact on the safety case. So the number one is the low permeability of the host and caprocks; number two is the absence of major fractures, and we discussed about that; and number three is the absence of economically viable resources.

MEMBER ARCHIBALD: Thank you very much, sir.

And now to OPG, are there or will there be any clear go/no-go decisions built into the GVP based upon these conditions or other conditions that OPG is formulating and for operating design cases that could initiate if significant trigger indicators develop.

And could you potentially give me any examples above and beyond what CNSC has stated?

--- Pause

MR. WILSON: Derek Wilson, for the record.

I think in Mr. Jensen's delivery of the presentation this morning we used an example of, you know, a fault of .5 metres and significant groundwater inflows. Those were just for examples, those are not hard said trigger values at this point.

As Mr. Jensen mentioned that there is -- it is more of a mechanistic modelling approach around the safety case that has a lot of the features that we will be monitoring and measuring that would go into the assessment.

But the intent of that discussion was to indicate the types of activities that

would trigger a pause and a re-evaluation of the safety case to see whether or not there is an impact and if there was an impact what that impact would be and whether or not there were mitigation activities that could be in place to offset those findings.

Again, those we see as being ones that we would inform the CNSC of and then again re-evaluate the situation. But we haven't set a trigger to say that if the inflow of -- if we saw an inflow of 18 litres a second versus 25 that that would be acceptable, we haven't gone to that level of detail.

MEMBER ARCHIBALD: Thank you very much.

THE CHAIRPERSON: On the same topic of triggers and go/no-go decisions, I would direct this question to CNSC staff.

Has staff discussed or prepared an understanding of your recommended tolerable decision error around the triggers for both during construction in terms of safety -- worker safety, and also in the longer-term case regarding the safety case?

In other words, by how much do

triggers, whatever they are, have to be exceeded to trigger regulatory action and would you please provide the Panel with specific examples of by how much triggers would have to be exceeded?

--- Pause

THE CHAIRPERSON: Heads up to OPG. I will be asking you similar questions embedded within your management plans and what corporately you would normally use for triggering, especially in the near-term worker safety case.

I understand in the longer term it's a little bit more involved, but if you could be prepared to answer, that would be great.

DR. THOMPSON: Patsy Thompson.

Dr. Swanson, if it would be okay to --

THE CHAIRPERSON: Yes, please proceed.

DR. THOMPSON: Okay.

So the proposed updated GVP identifies triggers that are related to the pre-closure safety which, in some of the triggers, relate to safety of workers during the construction operations. The benchmarks are

related to post- closure safety.

So in terms of the triggers that are related to pre-closure safety, some of the examples that we have provided in our presentation, for example, the 40 degree stress deviates from plus or minus 40 degrees from the estimated northeast direction, the measured maximum horizontal stress exceeds 34 megapascals. Those are firm numbers that the CNSC would use to trigger enhanced regulatory compliance activities, because to us those would be indications of the values that, if exceeded, would likely -- or not likely, would potentially put worker health and safety risk.

So those would be triggers for us for enhanced compliance verification activities either by inspectors in our Waste Decommissioning Division or we also have on-site inspectors on the Bruce site. So the compliance verification activities are built around the activities of the licensee so that we are there when we need to be.

In terms of the benchmarks for the post-closure assessment and the --

THE CHAIRPERSON: Dr. Thompson, if I could interrupt you, because I think you

kind of missed the main point of my question, which is -- and so to make my point I will use the example you just gave us for a trigger.

So the trigger you gave us was 34 megapascals. My question is, how much over 34 do you have to be; 34.1, 35? This is what I mean in my discipline by tolerable decision error.

And, staff, when you are advising licensees or your own management in terms of exceeding triggers, the Panel would appreciate knowing the decision precision that is required (a) for worker safety, and then later on we can discuss the safety case.

Do you understand now my question?

--- Pause

DR. THOMPSON: Patsy Thompson, for the record.

My understanding, and these are absolute values that would trigger regulatory action.

THE CHAIRPERSON: I assume, just to redirect, plus or minus measurement error in an instrument; is that correct?

Where I'm getting at is -- again,

this is not my discipline so the Panel is struggling to understand this, but in my discipline if you exceed a trigger value the tolerance is directly proportional to the hazard or the risk, but you always still have to account for precision of an instrument, for example.

So could you just please explain to me to what extent that applies, first of all in the worker safety case, and then later on when we come to major decisions around whether or not the safety case itself is jeopardized?

--- Pause

DR. THOMPSON: Patsy Thompson for the record.

As you know, this is not my area of expertise either, so the measurement of error around, for example the pressure measurements, so I will ask Dr. Nguyen to explain what the process would be to consider the triggers.

DR. NGUYEN: Son Nguyen, for the record.

I believe the process is when you find a value which exceeds that trigger which is, let's say 34 megapascals, then you have to verify the validity, the reliability of those measures

by maybe performing some additional measurements, some near the same point where you get this value and you have to test, you have to verify the accuracy of the measurements before you get into the decision of going into the contingency measures which were defined previously.

THE CHAIRPERSON: I'm going to press the pause button because I think it would be helpful to switch over to OPG for part (a) which is the safety during construction case.

And if OPG could help the Panel understand what your sequence of events is, including with your contractors if for -- let's take the hypothetical, that you get a pressure measurement above 34 megapascals and how quickly you run through that sequence such that you maintain your safety requirements.

--- Pause

MR. WILSON: Derek Wilson, for the record.

I think maybe just a couple of statements before we get to that specific example. The triggers that we have identified are set on a database of information that has been evaluated based on -- and I think Dr.

Carvalho mentioned some of the aspects that went into the database and the trigger setting.

The safety level is above that of the trigger value; the trigger value is not set at safety.

So that this is an opportunity based on -- these are observed, or these are predicted values that we don't expect to be observed, they are conservative and they are greater than that of what we expect to actually measure in the field. So that is the first piece. We have --

THE CHAIRPERSON: Could I ask you to just forgive me, but tell me what layer of safety is added? What's the difference between your trigger and the actual threshold for safety, again just for example, with the 34 megapascals?

--- Pause

MR. WILSON: Derek Wilson, for the record.

Again, each of the parameters has a different impact, but just in discussions with my colleagues, you know, if you look at the rock at the Cobourg formation it's 120 megapascals. We have set an expected stress at 34 based on all

the evidence that we have.

There is a huge margin of safety there in this particular case with respect to the 34 megapascals. However, 34.5 would not be acceptable. If it hits 34 it has to be evaluated and reconsidered in the context of the use in its modelling and the use that we have.

So I don't know if that helps, but for us the trigger -- and I think you have already spoken about the sample. An individual value doesn't determine and over-exceedance, as you say, it could be the test method, it could be the equipment used. We would validate that either through one or more measurements to confirm that that is the actual measurement.

But in the event that it was and it was determined to be above the trigger, then a course of action would take place and that course of action would be embedded in our quality construction assurance and our field testing inspection processes, as well as the detailed field investigation plans that Mr. Jensen mentioned earlier.

THE CHAIRPERSON: Thank you.

So to paraphrase and maybe extend

it a little further, and please confirm whether I have this right, that margin of safety between your trigger and the actual safety threshold gives you the time to do the extra sampling and confirm?

MR. WILSON: Derek Wilson, for the record.

That is correct. And I think we went back and said that safety is the key priority, and so if there was need to validate that information we wouldn't progress with -- you know, we wouldn't progress forward without having that validation in that particular instance.

And this one feeds into larger, but if you think more about the triggers that we have set with respect to ground control, for instance, those triggers are set in such a way that we have time to evaluate and use the appropriate ground control going forward, it's the observation, we have our mapping, we have our physical, we can then look and see what is the most appropriate ground support system to the rock conditions that we are in and what we expect to see moving forward.

So there are various elements and

each one of them has a very specific application to the type of testing that we are going to be undertaking or, again as Mr. Carvalho mentioned with respect to shaft liner design. So again, if the deformation is something that we have a need to consider, we have time to do that. We are not going to put the liner in jeopardy, we have time to consider.

THE CHAIRPERSON: Thank you.

So back to CNSC, and now we are switching over to part (b) of my question, which has to do with triggers that pertain to the safety case and the validity of the safety case.

So again I repeat my question: How sure does CNSC need to be?

Now we are at your three topics which are the low permeability of the caprock, so your trigger would be it's not as permeable as we expected; (b) the absence of major fractures, so the trigger would be there is one; and (c) the presence of economically viable resources being confirmed.

So the Panel's question is: How much permeability in the caprock would trigger? How major is major, to echo Dr. Muecke's

question? How much hydrocarbon resource, et cetera, and where with respect to the DGR? Is this kind of thinking already underway and we have heard a reference very briefly to remodelling.

So can you please step the Panel through the process so we can understand how sure you need to be before you determine that this safety case is no longer valid?

DR. THOMPSON: Patsy Thompson, for the record.

So we have identified the three major factors that have a major influence on the safety case and so deviation from the expected measurements based on the site characterization information that has gone into the safety case to date, so the process is through the Geo-Scientific Verification Plan and other activities, one of these three factors are not validated.

The expectation is that this is a reportable event that the licensee has to report to the Commission. CNSC staff would, through an initial event report, bring this forward to the Commission for their information. A reportable

event requires a detailed assessment from the licensee, and so the expectation is that the new evidence discovered by OPG would be remodelled in their safety case, would be remodelled, an updated safety case would be submitted to CNSC staff for review and all the accompanying validation, there would be a technical review of this report to the CNSC, we would present it to the Commission.

Depending on the findings of this assessment we have given essentially two outcomes. One outcome is that with the information that has been provided the new findings from the geo-verification program, the licensee has been able to put mitigation measures in place that will ensure long-term safety.

The other option -- yes, the other option is that it would require a major change to the design to move forward with a safety case.

So in the case that the long-term safety could not be insured with mitigation measures, we would go to the Commission with a recommendation that this project cannot continue forward. If the findings with design changes,

for example, would be able to maintain the safety case, then there would likely be a requirement for an amendment to the licence or changes to the design that would trigger a regulatory process.

That process of going to the Commission with this type of information is fairly significant. The licensee would also bring forward their case and this would be discussed in a public forum.

If the outcome is that an amendment to the licence or a major change in the design, this would likely trigger a fairly significant process.

THE CHAIRPERSON: Thank you, Dr. Thompson.

So one final follow-up question, and I have asked this question different ways at different times, so I will ask it again. How much of a change in the safety case?

So for example, right now under normal evolution we are many orders of magnitude below the 1 mSv per year dose limit for the general public. So let's for argument sake say we are 100,000 times below, what if it changes to 10,000 times below versus 1,000 times below?

What constitutes a significant enough change to trigger that very significant process that you have just described to the Panel and on what basis does staff make those judgment calls?

This comes back to what I keep calling in my discipline tolerable decision error, and of course it is directly proportional to uncertainty.

--- Pause

DR. THOMPSON: Patsy Thompson, for the record.

So we have been talking about the safety assessment. There are also the elements of the safety case with the other arguments and the lines of reasoning that build the confidence in the safety case.

So for example, we have identified 0.3 mSv for the normal evolution scenario as being the safety criteria. And, as you mentioned, with the current safety case and lines of evidence, there is about 100,000 safety margin around that number.

Given the long time frames there would still need to be a fairly significant margin of safety, but what Dr. Nguyen was telling

me is that just looking at the number may be misleading because you may have the same number but your other lines of evidence reduce the confidence in that number that you have.

So it's the number, but there also has to be a margin of safety around that number that is supported by the other lines of evidence.

You had asked, Dr. Swanson, and I think we had committed to come back after lunch to look at the risk criterion and the process, but perhaps that would help as well. But essentially the key message is that 0.3 mSv is the safety criteria that has been recommended for example by the ICRP, 1 mSv with a dose constraint of 0.3, but given the very long time frames and the uncertainty that will not be reduced significantly unless we have lots and lots of data.

They would still need a margin of safety around that 3 mSv -- that 0.3 mSv. It may not need to be hundreds of thousands, but it would need to be significant.

THE CHAIRPERSON: Thank you.

I believe Dr. Muecke now has a

question for NRCan.

MEMBER MUECKE: This is for NRCan. Stepping back from the geo-science verification plan to the relative risk analysis by the Independent Expert Group, and the Panel is directing this question to Dr. Desbarats.

Dr. Desbarats, could the Panel ask you for your assessment of the conclusion by the Independent Expert Group regarding the suitability of a granite body in the Precambrian Shield versus the Cobourg formation?

The Independent Expert Group based its analysis on a better than average granite in terms of fracture density, apertures, predictability, et cetera, and concluded that for these parameters the Cobourg formation would be more favourable.

Could you comment on that?

MR. DESBARATS: Alexandre Desbarats, Natural Resources Canada, for the record.

I wasn't under the impression that the Independent Expert Group had actually made a recommendation of the Cobourg formation over the granite disposal concept. My

understanding is that from the geo-science perspective and from a hydrogeological perspective the IEG's main conclusion was that a granite DGR would have fractures surrounding it, whereas the Cobourg Bruce DGR appears to have far fewer fractures, if any.

So there is no doubt that based on experience at the URL and at other sites that the presence of fractures is an issue.

And more to the point, the problem with a granite site is one of characterization of certainty with respect to the hydraulic properties.

The sedimentary sites, like the Bruce site are inherently easier to characterize, so in that respect perhaps I can understand that the IEG might lean towards the Bruce site simply on the basis of our ability to characterize such a site which is easier compared to a site in granite.

I don't know if that answers your question or provides some understanding.

MEMBER MUECKE: Yes, thank you, it does.

Perhaps I can ask you one more

rather specific question. You note, and so does the Independent Expert Group, that porosity of granite is lower than that found -- generally lower than that found in the Cobourg formation, but that effective diffusion coefficients are lower, and you mentioned that in your written submission.

Do these values apply for the "better than average granite"?

MR. DESBARATS: I don't think it's generalized. I think it would be essential to measure the porosity and diffusion coefficient at any site. There are variabilities at any given site.

For example, at the URL they may have measured porosities that range, maybe not over an order of magnitude, but over a certain range and diffusion coefficients similarly will exhibit a certain variability depending on where the sample is taken.

So I don't think you can make any generalization with that with respect to those properties. Essentially you have to go into a site and take the measurements.

MEMBER MUECKE: Thank you,

Dr. Desbarats.

THE CHAIRPERSON: I would like now to return back to the theme that I was pursuing with CNSC, but now I am going to redirect along the same theme to OPG, but of course the context for OPG is as the proponent these tolerable decision errors would be corporate decision errors in terms of when your Geo-Science Verification Plan would yield data that trigger returning to your post-closure safety case and recalculating (a); and (b) how much your safety case would change to trigger a notification to CNSC and also your own management.

So can you help the Panel understand your normal corporate procedures in this regard?

--- Pause

MS SWAMI: Laurie Swami, for the record.

In the normal course of doing work, any changes that would be triggers would require notification internally as well as externally.

The way our system works, and I

described this earlier, when we have low level events or large events we report these routinely. Sometimes we would look for trends in that result, or sometimes they would trigger an immediate reaction.

And the way that works is, they would be reported the day that it was found. The example that we used earlier was the 34 megapascals. If there was a measurement that would be reported immediately, it would go into our system, we would then take the steps to look at if that was the right result, et cetera, as Mr. Wilson explained.

So that part of the reporting process automatically would notify our management that there had been a change in some parameter. The parameter in and of itself would not be sufficient to say there is a change to the safety case without doing the appropriate analysis.

So when something like that happens part of the action coming out of the event, if you will, would be to assess what the impact would be on the safety case and as we went into that process we would look at what would the effect be, how significant was that and if it was

significant, of course, we would be reporting to the CNSC, but before we got into reporting to the CNSC, OPG and NWMO through contracts would look at what are the options to mitigate that.

So the intent would not be to just simply say that affected the safety case and, therefore, let's continue, it would be to look at how can we mitigate whatever that result was so that the safety case would remain intact. That would be our first response, if you will.

If that was not possible, and as Dr. Thompson talked about, if it required a significant design change that would need to go back in front of the Commission in this case, then we would begin to notify the CNSC of what that would be, we would go through the design evaluation process, determine if it was in fact possible to make a design change that would change or reduce the change, we would propose that to the CNSC staff for their review and then we would obviously determine our own internal review of that, CNSC would have their review and then, as Dr. Thompson described, it would be presented to the Commission for decision-making.

So there is sort of a continuum

of results that we would look at. So it's not just one trigger or one event that would cause this type of a review, it would have to be done on -- and I wouldn't say a continuous basis, because obviously we are not going to go re-run safety analysis every time we see something, but we would consider that, test whether it was a significant change to the safety case and then perform that analysis with appropriate reporting to the regulator.

THE CHAIRPERSON: So I'm going to make one more attempt to get a little better understanding of what you mean my "significant".

So I always like to think in terms of concrete examples. So let's say 'what if'. What if your measurements of the characteristics of the caprock indicated that there was a substantial change in your understanding of the degree to which diffusion dominates -- now, I am not a specialist here, so I'm not going to say more than that or I will get myself into trouble, but essentially that something has substantially changed in terms of your understanding the caprock.

You run that through your model

and instead of getting results that show 100,000 times below 1 mSv per year, you are now 10,000 times below 1 mSv per year. Has OPG gone through the thought process of whether that is "significant" enough to go through the process just described by Ms Swami?

--- Pause

THE CHAIRPERSON: If I could interject. It's okay to say no, you haven't gone through the thought process yet.

--- Laughter / Rires

MS SWAMI: Laurie Swami, for the record.

So I think that my 'no answer' might be a little longer than 'no'.

The no answer is, because what the result is at that time will determine the reaction, so it's very hard for us to say 10,000 versus 100,000 because we will have different information at that time, so you may change the uncertainty evaluation around that number and be more certain, so that might make a difference on whether that was the appropriate number or not.

And so I think that the point that we would like to stress is these things

would bubble to management and it would be through open dialogue with the regulator that we would ensure they knew also when these changes, you know, were taking place. So it's not a matter of us, you know, we're squirreling away, doing engineering calculations in the back room and saying, "Oh, yeah, everything is good". I don't want to leave that impression.

I want to leave the impression that we're going to do these tests. There are certain triggers but there are also certain amount of dialogue with the regulator on an ongoing basis so that they have the opportunity to, say, go through that same process of assessing, "Well, that sounds a little more significant and we'd like more details on that". So we would continue to have that dialogue.

It is part of our regulatory process with the Canadian Nuclear Safety Commission that on a regular and routine basis we share information on our operations, on our Western Waste Management Facility operations so that they can assess themselves the performance for our licensed activities.

THE CHAIRPERSON: Thank you.

I have one last question and then I'll turn it back to Dr. Archibald.

And again, this is to both OPG and CNSC. Did you consider whether microbial studies should extend to the cap rock sequence and even perhaps other formations along the shaft in order to complement the shaft seal performance studies?

First, OPG, please.

DR. GIERSZEWSKI: Paul Gierszewski, for the record.

That was part of the understanding of the shaft seal behaviour. We do plan to have tests that would be in the shale materials. We haven't defined them as specific microbial- oriented tests but they would -- we try to be in the actual conditions so that we would have appropriate influence of microbes on those to the extent that they were relevant to the overall performance.

THE CHAIRPERSON: Okay. So, just to confirm, the natural bugs will be there anyway and they'll be doing their thing during your testing. Are you going to actually have some hypotheses in attempting to distinguish among the

various causative factors for some of the responses in the rock? I'm thinking especially geochemistry.

MR. JENSEN: Mark Jensen, for the record.

We have conducted some microbiological studies certainly within the cap rocks and in the Cobourg as part of the drilling of DGR-8 and have essentially found nothing. It's due, in part, to the low activity of the water, 0.75 and so there doesn't appear to be a lot of microbiological activity. But these tests that we're doing now would be used to develop the methods for any future tests in the geoscience room or during the shaft excavation.

THE CHAIRPERSON: And Dr. Jensen, does that include when it becomes wetter because you're going to be using water and producing water during construction?

MR. JENSEN: At present, the work is on characterizing the microbiological communities in the rock at present.

THE CHAIRPERSON: CNSC...?

DR. THOMPSON: Patsy Thompson, for the record.

Dr. Goulet who was here last week is a biogeochemist and he's been essentially leading the review in terms of microbial process.

When you asked an earlier question on external review of the GVP, the updated GVP from OPG, it's actually one of the areas where we have relied on external third party support for CNSC staff and is likely something that we would also do in the future to make sure that we are covering the aspects that need to be covered.

But I don't have an answer to that question as we didn't anticipate it and Dr. Goulet isn't here. But the sense we had was with the recommendation that was made to OPG in terms of consideration of microbial processes and their GVP and their acceptance of that work that they would cover the aspects that the CNSC experts found important.

THE CHAIRPERSON: Dr. Archibald...?

MEMBER ARCHIBALD: Thank you very much.

This is to OPG. In section 4.2.6 of your description of sealing material tests to

be conducted within the Queenston or Blue Mountain formations during shaft sinking, I believe the proposal is to drill boreholes into large block samples and do sealing tests in those blocked materials. Is that true?

MR. JENSEN: It is correct that we will do seal tests within the Queenston and the Georgian Bay. The precise nature of those studies is yet to be determined. Quarry blocks is one option.

Another option perhaps may be to actually drill boreholes horizontally into those formations from the shaft. And another option may be to conduct experiments in a very similar underground research laboratory elsewhere.

MEMBER ARCHIBALD: Thank you very much. That was exactly what I was leading to, because I was going to ask whether there had been test trials done elsewhere in Europe, for example, using similar technologies.

Because for the Cobourg formation you'll be doing large in-room tests and therefore the difference may be substantial in the kind of results that you get. But as the testing is not underway yet, that's fine.

I do have a question then, and this is to drill down to the subject. I've been waiting to use that phrase all day.

--- Laughter / Rires

MEMBER ARCHIBALD: This is based upon CNSC's submission PMD 14-1.2 page 16 where proposed trigger levels for various geomechanical properties determined shaft sinking and horizontal formation work are laid out.

For example, on page 16 during shaft sinking the trigger level, based upon unconfined compression strength and elastic modulus of the rock is stated to be one standard deviation lower than the mean value determined from DGR-8 boreholes sample testing. That is, there will be a variation based upon historic data that had been achieved from strength and Young's modulus testing in previous work. This is the CNSC document PMD 14-1.2 page 16.

For lateral development the geomechanical property trigger level criteria for these same parameters are stated to be when the UCS and the modulus values are less than 80 megapascals and 30 gigapascals respectively. So the trigger level criteria are different for

shaft and for horizontal repository developments.

When you go to the appropriate section on the trigger levels for opening convergence, for shaft convergence, trigger level is set when incremental shaft while deformation greater than 5 percent of the total predicted deformation by modelling occurs. For lateral development this occurs when convergence of the opening exceeds 10 millimetres or the change in site stress is greater than 5 megapascals. So you can see there is a difference here.

When you come to in-situ stress conditions for shaft construction trigger level is such that stresses are greater than 20 percent of the current predicted values; for lateral development when the horizontal stress exceeds 24 megapascals.

So my question to OPG is: Why are the trigger level criteria for the same parameters either different in magnitude or defined differently for each stage of construction? Is there a rationale for the variation?

DR. CARVALHO: Joe Carvalho, for the record.

I believe it's just the choice of how the trigger values were presented. For instance, 80 megapascals in the Cobourg versus the average value of all the samples in the Cobourg does translate to one standard deviation lower than the mean.

So I think what has happened is that the definition of the trigger values was expressed in absolutes instead of percentages. So in that sense I don't think we have changed the criteria but just other criteria was presented.

MEMBER ARCHIBALD: There is a great sense of confusion when one reads this and one would expect that at this level of presentation they would be better represented. Thank you.

The last question is based upon the presentation by Natural Resources Canada this morning, and on their written submission, PMD 14-P1.6. And this is based upon the recommendation that Dr. Muecke had mentioned before by NRCan that the proponent should consider including near-field microseismic monitoring as part of the GVP as this may provide timely information for

the assessment of deformation and stress changes should such changes exceed triggers.

My question to OPG and based upon the fact that a microseismic monitoring system has not been considered as part of the GVP, and this is not in your presentations at this point, would you have knowledge of the types of triggers or inferences that could be anticipated to result from the implementation of such monitoring devices?

MR. JENSEN: Mark Jensen, for the record.

My understanding of the microseismic system is that it would provide spatial evidence of where microseismicity is occurring where things are critically stressed and are potentially in a fail position. I think we would agree with NRCan that if trigger values or other values and waste understands the stability of these openings and, of course, this DGR has been designed for stability -- it has been designed with large pillars and the like -- that implementing a microseismic system would be a sensible idea.

MEMBER ARCHIBALD: To your

knowledge, is there any basis from mining practice or previous repository research to validate this is a useful method of supporting the geotechnical design and safety case features of the GVP? By this I would refer you back to the Pinawa example.

MR. JENSEN: Mark Jensen, for the record.

We're not aware of any application.

MEMBER ARCHIBALD: Thank you. And I would turn the same question to CNSC for response.

Would this be anticipated to be a useful mechanism or feature for analysis of the safety case and long-term geotechnical features of the repository?

DR. NGUYEN: Son Nguyen, for the record.

It would be useful. It would be -- from staff's assessment it would be nice to have, but we believe that the stability of the underground opening has a very high factor of safety so it's not absolutely a necessity to have.

MEMBER ARCHIBALD: Thank you very much.

The reason why I made reference to mining practice is that practically every underground mine in this province must have a rockburst monitoring system which is equivalent to a microseismic system such as this.

MR. WILSON: Dr. Archibald, if I could?

MEMBER ARCHIBALD: Yes.

MR. WILSON: Just for clarity, our understanding of the Natural Resources Canada recommendation is in the event that we observe -- I believe we have provided an IR response with respect to the potential for rockbursts at the DGR facility and given, again, the low stress and the high strength of the rock, we don't anticipate that we're going to have such events at the DGR facility.

So when Mr. Jensen suggested that it was a reasonable approach that was under the assumption that we had observed some conditions that would suggest such a system would be employed.

MEMBER ARCHIBALD: I apologize.

The inference was that rockbursts and damage would not be occurring, but the Natural Resources Canada's original statement in their written document was that it would be nice to have to build up on their regional seismicity network. So it would be a "nice to have", not a necessary requirement.

Thank you.

THE CHAIRPERSON: Thank you very much. This concludes the Panel's questions based on the previous three presentations.

We will continue with the agenda.

Next on our schedule today are two 30-minute oral presentations. We will proceed with the first presentation before lunch and then the second presentation after lunch.

As previously explained, the Panel will direct its questions to presenters following each presentation. The Panel will consider, time permitting, questions submitted by registered participants at the end of the day.

I would ask each of the individuals and groups making oral presentations this morning and this afternoon to remain available until the end of today's session, if

possible, in the event that we have time available to consider questions from registered participants.

--- Pause

THE CHAIRPERSON: The first 30-minute presentation is by Save Our Saugeen Shores which is PMD 14-P1.41 and 41A.

As in previous days, for a 30-minute presentation the amber light will come on when you have five minutes left and then the red light will come on when time is up. If the red light comes on, I will ask you to wrap up as soon as possible.

--- Pause

THE CHAIRPERSON: Ms Taylor...?

PRESENTATION BY / PRÉSENTATION PAR
SAVE OUR SAUGEEN SHORES, JILL TAYLOR
AND ROD McLEOD

MS TAYLOR: Thank you, Madam Chair and Panel. My name is Jill Taylor, President of Save Our Saugeen Shores and with me is Rod McLeod, Director of SOS.

We are here to object to the

construction of a DGR-1 at the Bruce Nuclear site. Having presented our opposition before the Panel in 2013 we return to address the significance of residual effect, geoscience plan, DGR expansion, waste inventory, alternative means of risk analysis in two parts, Part A, science; Part B community acceptance. I will deal with Part A and Mr. McLeod will address Part B. We will then have a conclusion.

SOS was formed in 2012 in opposition to our town council's decision to enter into the DGR-2 siting process for used nuclear fuel. This January, Saugeen Shores was eliminated from the siting process due to size, geological settlement and VEC factors.

The APM and observational method are no excuse for OPG's reluctance to present fact or to repeat 2013 data with an unacceptable number of unknowns. Although there is no precedent of such a project anywhere in the world, OPG puts forward a predesigned case that includes unknowns such as the unknown character and quantity of waste, the ability of the site to accommodate above and below grade components, the geoscience of the rock.

In addition to the inadequacies of data an analysis, there is an unacceptable bias and overconfidence of approach that is a hazard to the project and its safety case. With so many consequential risks and so little reason, the DGR licence should be rejected by the Panel.

We pause to note that although you have heard from many intervenors, the public has been limited in its ability to participate in these September hearings. Public notification was made through electronic means to the 2013 participants. It is possible that many members of the public may have wanted to speak and were not notified through mail or email. Also, there was an extremely short timeframe to prepare for submissions.

Topic one, "significance of residual adverse effect". OPG was asked by you to provide logic of reasoning, context for predictable, measureable change and conclusions that were to be the result of clear decision trees. The rationale for analysis of significance of adverse effect was to be transparent, credible, defensible, clear, reliable and appropriate. The precautionary

principle was to be used and the consequence of being wrong about the significance of a particular effect was to be described.

OPG chose definitions of adverse effect based on FEARO in 1994 where an adverse effect may be considered significant if it is major or catastrophic, widespread, long term and/or frequent or irreversible. Conversely, adverse effects that are inconsequential or minor, localized, infrequent or of short duration or reversible may be considered not significant.

We ask why choose FEARO 1994 when more appropriate definitions are available? In our opinion, OPG resorts to these criteria so that they can design scenarios to suit a "no significance adverse effect" conclusion.

For example, a test case of adverse radionuclide exposure is described using one receptor, a human, at the boundary of the Bruce site for a short duration timeframe. Using this model, OPG concludes the effect of exposure is not significant. We ask not significant to whom and why?

We also ask how does this compare to scores of people at the fenceline? Does the

scenario assume that people will know they have been accidentally exposed and seek help? Is the model based on a catastrophic event or a silent leak of radionuclides through air or water and what if the exposure was measured in hours or days as it was at WIPP?

The third-party reader cannot determine how OPG's imagine scenarios are modelled or how the decision not significant was established through narrative evaluation. Lack of transparency and inconsistent approach are root problems of scenario assessment and the application of the FEARO labels and the OPG never answers the Panel's question: What is the consequence of being wrong?

There are many examples where measuring of effects results in questionable conclusion. We will discuss by example hydrogeology, stormwater features, effect on the lake and groundwater, climate, air and noise.

Take for example OPG's evaluation of effect on water quality to establish a "no significant adverse effect".

The contiguous nature of the watershed in the lake is ignored, isolating the

site study to only a small portion of the local watershed area, allowing the claim that the effects do not extend into streams, sea or Lake Huron beyond the point of discharge. Yet, IEG then describes radioactive diffusion potential through the Cobourg and aquifers to the lake far beyond the boundary of MacPherson Bay.

For normal and abnormal climate and climate change, OPG ignored the climatic factors in the pre and post-closure phases.

There is no reliable study of the effect of construction excavation activities on groundwater levels. Yet, definitive changes in groundwater levels should be predicted at the site due to drilling, the fracturing of the surface, the disruption of water table at the two vertical shafts and the construction of the waste rock management area monoliths.

The Panel asked for a definitive backup for the OPG responses. Contextually accurate information should be provided. However, in the section on hydrology OPG cites previous reports and then only adds three sources unrelated to the site and its contextual lake and groundwater hydrology.

This points to a lack of contextually pertinent responses and new evidence to better evaluate significance of effect.

Averaging is often used to minimize peak levels of effect. For example, average data on particulate concentrations and frequency cause underestimation of true air quality adversity for the local and regional impact of construction. There is exceptionally poor accounting for dispersal of contaminated particulate within the outside -- within and with outside the Bruce site over long periods -- excuse me -- over periods of 24 hours a day construction that would last three decades.

As with other aspects of harm that are not cumulatively assessed, the analysis of noise doesn't reflect cumulative effect and noise from construction in combination with air quality degradation, vibration from construction of blasting over the 100 years-plus project.

In a very disturbing attempt to downplay the adverse effect of noise, OPG tells us that such noise is typical of rural environments.

The conclusion of "no significant

effect" is is poorly constructed. It demonstrates its inconsistent decision trees and no reliability of risk analysis. Despite assertions, it is not precautionary and it never considers the consequence of being wrong.

Topic two, geoscientific plan. OPG has not adequately updated this geoscientific plan, has no intent to provide further verification before a licence application and little before construction. OPG says this is acceptable because, I quote:

> "During the construction of earth or rock structures, for example, dams and underground rock openings, the observational method can be applied as a continuous managed and integrative process of design, construction, control, monitoring and review." (As read)

The observational method is not suited to this non-mine, non-dam project because of significant unpredictability and the

significant consequences of failure at any time in its planning through closure phases.

The tenuous case for the project is reflected in the exceptional number of unknowns shown in OPG's Table 3.1, including rock mass quality, groundwater inflow, excavation deformation, rock loading, geomechanical qualities, in situ stress and rock pillar integrity and response.

What we still ask is what triggers will be used to determine if a line has been crossed or if below grade safety measures and culture are gone awry.

An example of inadequate data available to design and then just guessing, considering an approach -- for consideration is the rock pillar design upon which all size predictions for the two and four panels of the DGR are based. I quote:

> "It is expected that vertical stresses in the centre of these thick pillars will be well below the compressive strength of the Cobourg formation limestone."

OPG says that closure walls of the containment rooms are strong enough to withstand explosion. What about the rock pillars, the ceilings, floors and corridors?

The project has been expanded three times since 2004. Ten (10) years later, there is no substantive improvement to the geoscience.

Topic 3, DGR expansion plans.

Emphasizing the phased project is -- that the phased project is sequential, OPG ignores factors that will cause expansion to have significant adverse effects on infrastructure and safety case in pre and post-closure.

The doubling of physical size above and below ground will result in layout and engineering design changes at precarious depths between the old and new panel array. There will be doubling of potential hazard to VECs, increase in radiological inventory and further disruption to the cultural and socioeconomic stability of the region.

This increased risk to worker and public health during construction, doubled by doubling the phases of construction, doubling of

waste, weighting on the surface, double burden in emplacement enclosure all point to increased significant risk.

Claiming that the second phase will only be twice the size of Phase I, OPG avoids accurate definition of the expansion scenario below or aboveground.

OPG falters on the size of the panels. They don't know about the rock room structure or size, or the number of rooms required by the waste generated by the dormant plants.

OPG knows that the physical expansion will extend far beyond their site. The double-sized DGR will not fit within the boundaries that were established, and expansion will extend under the WWMF facility and potentially into the Bruce B site.

We would describe this expansion, among other things, as widespread expansion.

There is inadequate planning for expansion that results in observations of no description of the emergency exit system required by doubling, no accounting for long circulation routes, no discussion of effective construction

on the surface facilities of the WWMF from below.

The expansion of the temporary and permanent waste rock management area for the expanded DGR has not been risk assessed. The doubled area will have consequential effects on the planning of the construction area, air quality, water quality and health effects.

If the DGR is doubled, the excavation will likely last a decade. Then there will be a break period of 40 years, after which construction will ensue for another decade.

The build-up of the waste rock management area will be continuous, 350 days a year, 24/7, with dust being dispersed, dragged as rock and contaminated waste is skipped to the surface and trucked to the waste management area.

Why is this expansion not classified as widespread and catastrophic in significance?

There is a casual approach to expansion of the stormwater management pond that is not precautionary. The layout and capacity of the pond cannot have been sized for the full volume of process and surface water during decommissioning because neither is known.

The below grade expansion area is not credible. If the main and ventilation shafts are blocked, what strategy is there to reach the half-emplaced waste below and used fuel storage area -- below the used fuel storage 600 metres above, and how do people get out?

Look closely. The new Panels 3 and 4 will be blasted under the Western Waste Management nuclear storage tanks.

OPG is currently anticipating 135,000 cubic metre volume of decommissioning waste, but we are -- but they are rounding up to 200,000 cubic metres. More accurate projections can certainly be made of the waste from remote buildings so that we can assess if the movement of decomm waste to the site is possible or impossible to accommodate.

If it is not -- if it cannot be accommodate, why are they considering a DGR, an expanded DGR on a site with so many limits to growth and why put Pickering and Darlington down this expensive hole, or try to, after trucking it all the way to the WWMF starting in 2040, only to find that it doesn't fit?

Has OPG told the whole lake

community and the 40 million residents who rely on water and sustenance from Lake Huron that all the decommissioning waste from almost all of Ontario is coming to the Bruce and that it will be abandoned here forever?

On their behalf, we ask, if decommissioned waste is brought to the WWMF in 2040, will that waste take priority over low level waste produced at the Bruce? If so, will the DGR 1 be filled with waste from remote sites and then another two panels required to accommodate the decomm waste from Bruce A and B?

Will low level waste then be left on the surface in perpetuity? And if no solution to high level waste is found, will we find Pickering and Darlington stuffed down our DGR with the low level and high level waste still standing around waiting for a home?

The plan to enlarge a DGR by doubling for decommissioning waste should be prohibited now and new solutions for decomm waste found.

Topic 4. The slides are on waste character. The footer is incorrect. I'm sorry.

The waste characterization plan

includes known and unknown waste and hazard. Of great significance to the OPG submission across the discussion of this project as a whole is the update that says 75 percent of the waste is low level waste and 25 percent is intermediate level waste, but that radioactivity is -- of the waste is 20:1 in ratio, intermediate waste to low level waste.

During the public information sessions and on the OPG web site, the public has been continuously misled about the character of the waste and its quantity of long-lived intermediate level waste that will be abandoned and placed in the DGR.

Section 9 describes a plan for waste characterization that is inconclusive, incomplete and will not be finished until construction and emplacement.

The methodology of verification demonstrates over-confidence that increased risks and is a methodological threat in itself.

For example, the OPG text is unclear in the description of how retube will be accommodated on the site and within the emplacement schedule. As a result, aspects of

waste verification will persistently affect the requirements of progressive design.

As changes to the inventory are made and dose levels upgraded, new construction schedules, distances and shielding will be required mid-project.

Our confidence in the safety case is exemplified by scenarios such as cage fall with retube waste accompanied by package breach. Described as highly unlikely, no consideration is given to the unsealed shafts exposing workers, the mine, the public and the aboveground environment as well as the below grade aqueous and solid environment to exposure through breach over a long period as could occur.

Such a culture of over-confidence leads to the conclusions -- leads to conclusions that are not reliable enough to run the analysis of risk and harm of waste package breach at the facility.

Through the whole of the pre-closure section, explanation of other key inventory subjects lack consistency, diligence, transparency and clarity.

OPG uses very loose narrative

rather than using science and reliable evidence-based proofs. For example, they describe the waste packages that are safe because they are "tightly sealed", "designed not to fail, robust", and then deny that the nuclear material will be a risk if packages are breached.

We cannot believe these unproven generalizations, especially when, later, the IEG explicitly warns that the same containers could, under explosion, cause gaseous radionuclides and fine particulate to be released.

Topic 6, risk analysis of alternative means.

There are many methodological flaws in the IEG report that have been well described by others and are clearly evident, including that IEG took verbatim the research and conclusions that had been reached and did not question any of the material that OPG generated for them and that stretches the case in one direction. I quote, for example:

> "The Bruce site has been intensively studied."

IEG does not acknowledge the indeterminate factors at the Bruce.

Their study of enhanced storage is non-existent -- excuse me.

Their study of enhanced storage is non-existent and of granite DGR is superficial despite the charge of the Panel that they were to consult the body of literature and case studies in alternate storage, mining and geoscience that exist in abundance.

Judgmental reporting, lack of thorough reading of material and misunderstanding reflected in numerous examples -- are reflected in numerous examples of the IEG report.

For example, their description of the suitability of the geology of the Bruce provides a platform for acceptance of the WWMF as an almost perfect host for DGR 1, when later revelations indicate insufficiency, porosity and the potential for limestone such as this to be fractured.

The comparative difference between granite and limestone geologies is exaggerated:

> "The rocks are so strong and the design of the Bruce DGR is so conservative that there

> will be no instability over time -- over the time the repository is actively being used (and for many hundreds of years thereafter)."

Even OPG admits that they don't know that this is true.

However, at the same time, the IEG submits proofs that the Bruce DGR is not a perfect host in their comparative review for transport of radionuclides through site aquifers and at the lower depths where there has been -- where there will be permeability through rock mass.

Our grave concerns are reinforced as IEG compares granite and limestone:

> "Because groundwater exit points would be most certainly under bodies of water, a further dilution will take place. The amount of water already in Lake Huron is over 4 million cubic metres, so the dilution capacity is significant."

And further, if a gas phase managements to reach the surface dilution with the atmospheric flux -- surface dilution with the atmospheric flux will take place rapidly.

The dissolution of radionuclides and rock in air and groundwater or lake is unacceptable over either the short or long term, especially when the other storage options are available on land and not so vulnerable to adverse effect.

Saugeen Shores was ruled out as a candidate for DGR in part -- DGR 2 in part because of geotechnical characterization. How could a discussion of unsatisfactory geology not be mentioned in the IEG analysis of risk if, 12 kilometres away, the geophysical properties were unsuitable for a DGR?

The lack of suitability at the Bruce and the Cobourg near a lake and population should point OPG and CNSC far away from the Bruce as the best host, but because IEG has performed an analysis that rates granite hosts as lower overall than limestone, there could be an anti-granite bias that becomes a sly way of promoting Bruce County as the best host for DGR 2 as well.

Does the fundamentally flawed IEG report stand as a testament that will point to the unsuitability of a granite DGR for intermediate level waste or a high level waste?

Has NWMO abandoned the granite sites in the face of this report?

The measurable risk in reading this report and thinking is that -- is that thinking the DGR has passed some kind of test when all the test did was raise increasing doubts and clarify the extent to which this site is unsuitable for a DGR.

MR. McLEOD: Madam Chair, Dr. Muecke, Dr. Archibald, thank you.

Slide 1 indicates to you what my task is. It's to assess the adequacy of IEG's relative risk assessment of community acceptance.

Slide 2 just repeats the mandate that you gave to OPG and, through them, to IEG and that is well known to you.

Slide 3 indicates that IEG identified four indicators of community acceptance. I will deal with each of those four in order.

My thesis is found on page 4,

paragraph 7. OPG, IEG's -- slide 4 -- attempted execution of their mandate discloses serious deficiencies.

My plan is to identify for you at least 12 deficiencies and then characterize their net effect. Deficiencies or errors or omissions.

Number 1, V on that same slide, no apparent relative risk assessment directed to the other three sites re community acceptance. They were asked to do all four sites, and they didn't.

Error number 2, paragraph 6, no apparent analysis of community acceptance outside the regional study area.

Slide 5, I refer you to paragraphs 1.2 and 1.3. The plans for DGR 2 were not made public until 2011.

If the community had known, I ask rhetorically, in 2003 that OPG would later try to locate DGR 2 in Bruce County, would the responses to the 2003 survey have been the same? I think not.

IEG gave no consideration to the points on that page and that, in my view, is error number 3.

Error number 4 is found on slide 6 where we outline six statistical or language and content deficiencies not discussed at all in the IEG report. I don't need to take you through all six. It's clear the questions were not very good, to be fair.

Nothing in the survey about intermediate level waste that could remain radioactively toxic for hundreds of thousands of year. Nothing in the survey about decommissioning waste. And perhaps worst of all, in the questions itself, they assume the ultimate issue. They say all three can be safely constructed and operated at Western Waste Management Facility.

Error number 5 is on page 7. They fail to consider the nuclear oasis phenomenon, which has been the subject of other submissions to you.

Error number 6, they fail to cite academic references that were easily available to them with respect to the frailties of telephone interviews or surveys.

Now, IEG's indicator 2 is found on slide 8. They claim it's an indicator, but in

my submission, the fact that it is is an error because they give no reason why it would be. There's nothing in the report to tell us how this affects community acceptance.

Error number 9, I direct your attention -- I'm sorry. Excuse me. Let me go to the fact that we have to move from indicator 2 to indicator 3, and that's up there on slide 9.

Three point one (3.1) outlines a chronology relating to the Kincardine vote. You will notice that in April of '04, there was a vote, but subject to community consultation.

In October of '04, Mayor Sutton signed the hosting agreement, but the community consultation didn't take place as indicated in paragraph (c) until January.

The next error, in my view, is that there was no analysis of this at all by IEG.

Move to slide 10, please.

Lastly, with respect to this, I direct your attention to paragraph 3.3. There was nothing in the OPG IEG analysis showing that they looked at the Gibbons 2013 JRP submission disclosing multiple defects in the 2005 survey.

Moving on to indicator 4 on slide

11, this was the question of the Mayor's support, both initially and by way of testimony.

I direct your attention first, if I may, to paragraph 4.2, where we point out what we believe are serious problems with the host agreement. It was cash for support. There was considerable peer pressure, one municipality to the other, because of the rule that if one cancelled, it could result in a cancellation of the money for all the rest of them.

Saugeen Shores, for example, was not authorized by Council for 10 years. Bruce County Council voted itself some financial benefit for its parallel support.

If we go to paragraph 4.1, you'll see that there is absolutely nothing in the IEG report to show that IEG even knew of, let alone considered, these effects of the 2004 hosting agreement.

Next, on slides 12 and 13, I direct your attention, first of all, to 4.3. The IEG report contains no analysis of two very important sources of information.

The Bluewater Coalition submission, for example, makes significant

reference to the content of the Bruce County closed meeting complaint filed by SOS and SRA May-June of 2013 and the OPG notes, but details with respect to that -- those notes are found on slide 4. I will leave it for you.

But I go lastly in this list of 12 errors to paragraph 4.5 on 14. This makes it clearly not only did they miss their first major error, the important points about the cash for support deal, but they also missed the idea that the CCAG subsequently found to be illegal series of Bruce County meetings by the Bell Chamber report can fairly easily, in my submission, to have tainted the weight, if not the credibility, of the Mayor's testimony.

What does all this mean? What's the net effect?

Three points. OPG bought the Mayor's support in 2004 at a time when the people of Bruce County, including the Mayors, had every reason to believe DGR 2 was going to be in the Canadian Shield and, therefore, not in Bruce County.

Rhetorical question, I've already mentioned it to you, would the result have been

the same if people knew what they knew as of 2011?

Number 2, by the time OPG and NWMO told the Mayors about their new desire to locate in DGR 2 in Bruce County, the Mayors were hooked on the ongoing money from the hosting agreement.

Number 3, the Mayor's testimony was conceived by, coordinated by and polished by OPG in secret, illegal meetings as found by the Bell Chamber report.

Now, if IEG had considered any of these things -- and I grant the Bell Chamber report was after their report, but the Bluewater Coalition report had most of the material relating to it in.

If IEG had considered this material, they might well have characterized the net effect differently than I do. That doesn't really matter.

What matters is they didn’t even bother to look at it and tell you anything about it.

Slides 14 to 16 give details about the Bell Chamber report and how it confirms

the earlier material. I don't have to take you there.

My conclusion, Madam Chair and Panel Members, is the thesis I propose has been proven.

Thank you.

THE CHAIRPERSON: Thank you very much.

We will now stop for a lunch break, and we'll resume today's hearing at 2:00 in the afternoon.

At that point, the Panel may have questions and then, after that, we'll proceed with the presentation by Mr. Hazel.

--- Upon recessing at 12:35 p.m. /
Suspension à 12 h 35
--- Upon resuming at 2:01 p.m./
Reprise à 14 h 01

THE CHAIRPERSON: Good afternoon. The Panel will have no questions for the previous presenters.

Before we proceed with the next presentation, I would like to confirm wit Mr.

Haddon that the Panel has received the three undertakings earlier assigned by the Panel.

MR. HADDON: This is Dave Haddon, for the record.

Yes, we have received three undertakings. Yesterday we received Undertaking 73 from the Canadian Environment Law Association and that is posted as Document No. 2127 on the registry. And we have also received Undertaking 72 and 73 from OPG, and they will be posted shortly.

THE CHAIRPERSON: Thank you, Mr. Haddon.

The Panel has received and reviewed these undertakings and finds them satisfactory. The undertakings are accepted.

We have no further requests of the submitters on these topics.

I believe CNSC is ready to return with answers to some previous questions?

DR. THOMPSON: Patsy Thompson, for the record.

I will ask Ms Kiza Francis to speak to two of the matters that you requested further information on late yesterday; one is

related to the fire discussed in the Beyond Nuclear oral intervention and related was a request for the CNSC staff to review any unusual reports from CNSC licensees relating to zirconium fires.

So Ms Francis will speak to both of those.

MS FRANCIS: Thank you, Kiza Francis, for the record.

So in relation to PMD 14-P1.19, that was the Beyond Nuclear intervention that mentioned a zirconium fire in Oregon. We went back to Ottawa, asked Ottawa to look into the zirconium fire that the intervener had discussed in his oral presentation.

And upon review of the written submission, PMD 14-P1.19, CNSC staff found no mention of the fire that was listed in the oral presentation.

However, we did do a media and a web search and the following information was obtained and reviewed.

So the incident that was referred to happened in Prineville, Oregon on November 27, 2012. And this is the information from our

specialist, Mr. Ram Kameswaran:

> "Has no relevance whatsoever for the zirconium retube waste proposed to be placed in the DGR. In Prineville, Oregon the company in question, EnviroTech Services, stored a by-product that contained zirconium in a form that is susceptible to ignition and was present in an open pit. There was a source of ignition in the form of a spark from shovel or scoop on a machine, not a hand shovel, which started the fire." (As Read)

CNSC staff were not aware of this incident due to the fact that this incident has no connection with the nuclear industry and, hence, was not flagged by a media scan.

But through the web search about the incident it was found that the de-icing product manufactured by the company has zirconium as one of the ingredients. And since this is a

proprietary chemical formulation, there is no information on the precise quantities.

Also, there is no information available on the chemical composition of what was in the pit, which involved in the fire accident.

Taking all of this into consideration, CNSC staff concluded that this incident again has no relevance on the DGR safety assessment. And with respect to zirconium, we know what is going into the DGR and how it would be handled.

So that was the first intervention.

The second request was CNSC staff were asked to return with information on unusual reports from CNSC licensees relating to zirconium fires. And what we learned is that we have a lot of staff in Ottawa watching the webcast and helping us out.

So the information we found was that, since the request, CNSC staff back in Ottawa have provided us with a couple of examples, just in the last couple hours really. We asked them to provide some context to these examples and to put things into perspective for

you for the DGR project.

So the four examples, and that was all we could get or that people said existed where zirconium material was present, three of them were from the same facility called Mississauga Metals & Alloys. And I will give you a quick one-liner about them.

On June 13, 2006 there had been a small fire in the zirconium alloy sandblasting unit. The fire was extinguished and no radioactive material had been involved.

On September 7, 2006 a metal tray containing metal shavings and a flammable substance caught fire. The tray was hanging from an I-beam track under the roof deck supported from a hoist. The suspicion was that the fire may have been started from a spark from the hoist. Once the fire started a forklift truck was used to bring the tray down to the ground and then transported out the back of the building about 20 feet away. Fire extinguishers were then used to put the fire out. The tray was then moved another 30-35 feet away.

And the third one was one that didn't involve radioactive material at all

either. An order was given to Mississauga Metals & Alloys from the Brampton Fire Department on November 26, 2007. Zirconium turnings were being swept up and somehow ignited, the fire was quickly put out.

And the last one, the fourth example, was from the Point Lepreau Generating Station and it was only related to the handling of zirconium. So this one was a small fire that occurred in 2009 during refurbishment within a pressure tube waste volume reduction machine when sparks and/or a hot zirconium piece came in contact with a foam panel located inside the machine.

And it was the foam panel that caught fire, but it was surrounding the zirconium. So the fire was put out within minutes, but there was no evidence of zirconium material ignition. But we still thought it was important to include that one since it was related to zirconium.

So for all four of these examples the conclusion provided by our staff was that these examples would not occur at the DGR facility, since they were all related to the

handling of zirconium when they were in metal shavings or dust or going through a process of some sort

The zirconium for the DGR facility is in billet form, not dust form, and is in closed containers.

And we also need to point out that strict regulatory action has been taken with Mississauga Metals & Alloys and a cease and assist operation order was given.

The order was eventually amended when Mississauga Metals & Alloys made a commitment to store all zirconium outside and therefore away from any radioactive materials.

And since they store and possess radioactive materials, once all of that material has left their location, their licence will actually be revoked.

So that is the four that we found.

DR. THOMPSON: Patsy Thompson, for the record.

I will go through, I can't remember what day now it was, but we were discussing gas generation in the context of the

pre and post-closure -- in the context of post-closer safety assessment.

And you requested that we provide our assessment of the gas generation in the context of the pre-closure safety assessment.

So our review of the pre-closure safety case did not trigger any gas generation issues based on the use of conservative modelling approaches to predict the initial behaviour of waste placed in the repository under constant air ventilation conditions.

Confidence in this interpretation is high, given many years of environmental monitoring of tritium and carbon-14 are already in the waste stored at the Western Waste Management Facility.

Levels of these gasses, tritium and carbon-14, will be monitored during the operations from 2018 to 2062 with the proposed project. Hence, the presence or radionuclides in the air as well as potentially explosive gasses such as methane and hydrogen will be monitored during operations of the DGR.

This monitoring will also provide additional data through time that would capture,

to some extent, some of the processes that could contribute to gas generation. This monitoring could continue once closure walls are in place.

The other aspect related to pre-closure safety is protection of workers. And an important reason for monitoring levels of radioactivity in the DGR during a pre-closure period is for radiation protection of workers. And it has been mentioned on a number of occasions ventilation and other radiation protection measures would ensure that worker doses are low and ALARA.

The other item is a follow-up from information that Dr. Nguyen provided this morning in relation to work being done at IRSN. And one of the recommendations that was discussed with OPG during the teleconference this summer related to their Geoscience Verification Plan, and Dr. Nguyen has the information.

DR. NGUYEN: Son Nguyen, for the record.

With respect to the geophysical method being used by the IRSN, the method is the seismic tomography. The IRSN is the l'Institut de Radioprotection et du Sûreté Nucléaire.

They are the organization that provides the technical support to the French nuclear regulator. So they operate an underground research lab at the site called Tournemire in the South of France.

So that underground research lab is actually an old railway that they transformed into a research laboratory and it is located approximately at 250 metres underground. So that was the fault zone, which is called an F1 fault zone which cannot be detected from the surface using geophysical manners such as seismic tomography.

So they went underground, they used some of the galleries to put the sources, and those sources are at a distance between 25 metres to 50 metres from that F1 fault zone.

The resolution they obtained from using that method and using a method to interpret the data called seismic fullwave form inversion, the resolution was very good in the sense that they can detect complex fracturing of the argillite, they can detect secondary fracture zone and also small fractures at a smaller scale compared to the large fault zone.

So in other words, that method seems to be promising to be used underground.

DR. THOMPSON: Patsy Thompson, for the record.

The last request deals with the question related to the risk criterion of 1x10-5 that has been used in relation to the post-closure safety case.

The safety assessment quantifies the post-closure impact of the repository system on human health and the environment. The impact is compared to protection criteria, and the criteria are as follows.

The radiological impacts on persons calculated by long-term simulations of the expected evolution of the DGR system are judged against a design target of 0.3 millisieverts per year.

For disruptive scenarios, calculated impacts are judged against the current public dose limit of 1 millisievert per year or by adopting a human health risk criterion of 10-5 per year.

CNSC staff have accepted the proposed protection criteria. This acceptance

was based on CNSC G-320 the 2007 recommendations from the International Commission on Radiological Protection and the IAEA geological disposal of radioactive waste safety requirements WS-R4.

A recent publication by the ICRP, which is ICRP-122 published in 2013, recommends the following radiological exposure situations in the post-closure stage, which corresponds to the situations where no oversight is provided which is equivalent to what we would call loss of institutional controls.

And so for the design basis evolution, which corresponds to the normal expected or normal evolution, 1 millisievert per year dose limit for public exposures from all sources and 0.3 millisieverts per year dose constraint for waste disposal.

For potential exposure of the public in case of the application of an aggregated approach, a risk constraint of 10-5 per year is recommended.

For the non-designed basis evolution, which we would call equivalent to disruptive scenarios, and the inadvertent intrusion scenario, reference levels of between

20 and 100 millisieverts per year are recommended.

ICRP considers human intrusion as equivalent to an emergency situation with recommended reference levels of between 20 and 100 millisieverts per year which have been adapted, for example, in the recent IAEA basic safety standard and IAEA guidance on the emergency response programs.

The acceptance criteria for the DGR therefore falls within the levels recommended by the ICRP. But the ICRP does not recommend the calculation of a risk for the disruptive and human intrusion scenarios.

Disruptive scenarios consider events that could lead to the penetration and/or abnormal degradation of barriers. This could result in the waste no longer being contained. Disruptive scenarios are considered to be unlikely to occur and are used to test the robustness of the waste management system.

The human intrusion scenario is considered to have a low probability of occurrence. Low probability is based on the important characteristics that we discussed this

morning, the absence of economically viable resources.

Post-closure safety relies on multiple barriers and characteristics such as low permeability of the host rock and cap rock, the absence of major fractures, and the absence of economically viable resources.

Together, those barriers lead to a robust waste management system. Given the difficulty in quantifying with any reasonable certainty the likelihood of highly improbable scenarios such as the human intrusion scenario and, hence, abstaining a risk factor with any confidence, it would be more appropriate that the licensing basis for the post-closure phase be linked to the integrity of multiple safety barriers and maintaining potential exposures within the ICRP emergency reference levels of between 20 and 100 millisieverts per year for disruptive scenarios.

Taking due consideration for the probability of occurrence of the disruptive scenarios given the multiple barriers in the safety case.

Licensing and compliance criteria

and activities can be developed to confirm the presence and effectiveness of these barriers through, for example, geoscientific and geotechnical verification. Given the highly speculative nature of calculating the likelihood of the disruptive scenarios, a risk benchmark of 10-5 would not be an effective verifiable and enforceable licensing basis.

However, compliance with the 20 to 100 millisieverts reference levels, together with the integrity of the barriers, is verifiable and enforceable.

And so in the context of the discussions we have had this morning and, to some extent, last year as well, we have looked at what would be a compliance verification framework for updated safety cases to take into consideration findings from the Geoscientific Verification Plan.

You noted this morning we had difficulty giving sort of a margin of safety around the 0.3 millisieverts per year. Our sense is that giving you a number like 0.3 millisieverts is likely not the responsible right thing to do, because we could come up with

different scenarios that would give 0.3 millisieverts with some safety margin, but would still include deterioration of some important safety barriers.

So we believe that the more responsible approach from a regulator is to consider the criteria that are available in a system that looks at safety and the safety case.

And I believe this was the last item that the CNSC had to come back on.

We do have Dr. Richard Goulet available on the phone I believe to speak to your question in relation to the Geoscientific Verification Plan in relation microbial activities.

THE CHAIRPERSON: Thank you.

Dr. Goulet, are you there?

THE CHAIRPERSON: The Panel actually had two questions for you. The first is whether or not CNSC had considered the advisability of extending the microbial investigations in order to understand shaft seal performance beyond the cap rock sequence?

And the first actually more general question is what is CNSC's overall

understanding of the most important microbial processes that could affect shaft seal integrity, but also affect potentially the geochemistry of poor water vis à vis the safety case?

DR. GOULET: I am Dr. Richard Goulet, for the record. I am a biogeochemist at the CNSC.

I guess there is two parts of the question. But in terms of the primary microbial processes that we have looked at it, we have looked at it, as Dr. Thompson mentioned, in the past within a workshop with international experts on microbial activity deep rock formations.

And one of the main areas that we have looked at was generation of carbon dioxide and hydrogen sulphide that can be generated by microbial activity and that can dissolve into formation water or infiltrating water that comes into the DGR chamber, which would create the generation of acidity and would promote carbonate mineral dissolution in the host rock.

But also, as you asked, what they call the carbonation of portlandite, which is essential degradation of concrete, and so this phenomenon was one of the main processes that

would likely affect the porosity and the degradation of concrete in the shaft.

Then I guess what we have looked at is that that phenomenon was judged to be, you know, in terms of assumption and the modelling that was done, it would be probably very limited because bacterial activity in the modelling was assumed to have all nutrient required, all organic carbon required.

So basically OPG assumed that the nutrient in the waste and the organic carbon in the waste would be available to be used by the bacteria and transform into carbon dioxide, and then produce that acidity in the poor water.

And also the other assumption was that water was not limited. So these assumptions were judged very conservative. A discussion of that will be available in a paper that we just submitted to the Geomicrobiology Journal in early September.

So I think that is my answer to the primary microprocesses that could affect performance of the seal and affect the long-term performance.

Then I think your second

question, perhaps you can remind me, is related to the Geo-Science Verification Plan?

THE CHAIRPERSON: That is correct. And the role of microbiological studies within that plan.

DR. GOULET: Okay. Again, Richard Goulet for the record.

OPG basically has committed to study the effects of the construction, the operation periods when oxygen will be freely available in the repository environment and the introduction of low and intermediate level radioactive waste, which has a potential new source of nutrient and energy on the microbial population in the future repository performance.

So they have kind of committed to study that, the performance of how the microbial community will affect its performance.

Although of general nature, CNSC staff accepted the commitment with the intention that we will develop our own research studies based again on the advice we have received from the work group. One of the main research areas that we are going to start focusing on in 2015 and at least for the -- and three years after

that is that we are going to look at the effect of carbon dioxide concentrations and increased volatile fatty acid, assuming absence of methanogenesis, which is a very conservative assumption, on the dissolution of the host rock and the shaft shale material.

We also look at the possibility that the sulfur in the host rock could be converted to hydrogen sulfide, so it is a weak acid, or even sulfuric acid and the effects of such acid on DGR rock wall permeability and dissolution also of the shaft shale material.

So we plan -- again, as I said, we plan to conduct this research starting in April, 2015.

THE CHAIRPERSON: Thank you, Dr. Goulet.

A follow-up question for you. Has the work group also considered during the pre-closure phase the role of microbiological processes in affecting the quality of water pumped to the surface and having to be managed in the stormwater management system?

DR. GOULET: Richard Goulet, for the record.

We actually were more interested in generation of gas within containers, like tritium and carbon-14 and how that could be generated and affect, you know, the repository atmosphere.

In terms of thinking that there would be like -- you know, that gas would go and dissolve in water and then pumped at the surface, no, we didn't look at that.

THE CHAIRPERSON: Thank you, Dr. Goulet.

Dr. Thompson, my notes anyway indicate there was one further clarification regarding a discrepancy on CNSC slides and this had to do with the response to Dr. Greening's new information. That's all I have in my notes.

DR. THOMPSON: Patsy Thompson, for the record.

I'm going to ask Kiza Francis to respond to the question.

MS FRANCIS: Kiza Francis, for the record.

So we weren't sure if you were going to come back with this and our understanding was OPG might have answered it, but

our understanding is that our slide said 2,000 degrees Celsius, whereas OPG's slide said 900 degrees Celsius. Our slide was talking about the actual flame temperature of the blowtorch, whereas OPG's slide was the actual surface temperature of the zirconium.

THE CHAIRPERSON: That solves that. Thank you.

Mr. Leonardelli, are you on the phone?

MR. LEONARDELLI: Sandro Leonardelli, for the record.

Yes, I am. I am here with Anita Wong, who is our air issue specialist.

THE CHAIRPERSON: Thank you.

So the Panel's question is, Mr. Leonardelli, you referred -- in your presentation to the Panel, you referred to the fact that the Canada-wide standard for PM2.5 is now either in the process or already has been superseded by new standards, so we would appreciate some clarification involving the exact situation when it comes to the standards or criteria that now apply to particulate matter.

Thank you.

MR. LEONARDELLI: Okay. So the new Canadian Ambient Air Quality Standard for PM2.5 which were announced in 2013, they will be replacing the existing Canada-wide standard. It is going to take effect starting January 1, 2015. Until then, the existing Canada-wide standard remains in effect.

THE CHAIRPERSON: Could you please inform us as to what the new standard will be as of January, 2015?

MR. LEONARDELLI: Okay. So the new standard is going to be -- well, okay, let's start with the existing standard. The existing standard is a 24-hour standard which is 30 micrograms per metre cubed. The new standard which takes effect in 2015 will be 28 micrograms per metre cubed, that is the 24-hour standard. And in addition, they have established an annual standard which is 10 micrograms per metre cubed.

THE CHAIRPERSON: Thank you.

I believe that takes care of the carry-over questions, so we can now proceed with the next 30-minute presentation, which will be by Charles Hazell, PMD 14-P1.58 and 58A.

Mr. Hazell, please proceed.

PRESENTATION BY / PRÉSENTATION PAR:
CHARLES HAZELL

MR. HAZELL: Madam Chair, Members of the Panel, thank you very much.

I will begin quickly. The first item has to do with methodology and I will read from the text as I proceed.

The application of the adaptive management approach is increasingly seen as the basis for science-based study of the environment. The 1992 CEAA recognized this -- that's the Canadian Environmental Assessment Act -- recognized this and it was eventually re-affirmed again in 2012 in the form of Operational Policy Statement: Adaptive Management Measures. This document provides counsel on the increasing influence, use and misuse of adaptive management and environmental impact statements in law and policy-making.

Importantly, it includes guidance on how the misapplication of the adaptive management process, which is central to obtaining science-based knowledge that is pertinent to

decision-making, is the basis for rejection of an EIS application and licence to construct.

The Joint Review Panel is very familiar with this document and its relevance to their work and responsibilities. There is a tendency for the adaptive management strategy when it is incorporated into an institutional framework such as the OPG or the NWMO to become locked in and resist influence for the stake of entrenched corporate goals. Science-based knowledge and its representations become influenced by this.

In this context changing conditions in technology and societal expectations are viewed as problematic. Mitigation is aggressively used to manage these situations.

Adaptive management principles which are at the root of go/no-go decision-making becomes a blanket used to mask entrenched corporate goals. The effect of this on the EA process can be to hollow out scientific content and undermine the EIS review process. So this is a kind of dark side of the science.

The devaluing of scientific

content by differing to post-approval processes such as adaptive management presents special challenges for the Joint Review Panel as it considers this application. Forwarding highly qualified recommendations under these circumstances discounts the science-based content and makes their recommendations prone to purely political influence at the ministerial level and this conflicts directly with the CEAA and this is examined in the referenced earlier document.

The observational method: the design investigation and science that should have been rigorously applied to the EA process in this case has now become incorporated into the observational method referred to in the OPG earlier submission. So it is a transfer of the methodology.

The observation of the adaptive management strategy into a project delivery method. The observational method is a child of adaptive management. Its purpose is to, in fact, minimize cost of construction while preserving safety. It is a construction method of choice because it accommodates the deferral of science-based information in the absence of a design

precedent for the proposed, in this case, the proposed DGR in sedimentary rock. So it is a strategic construct.

The observational method is very specific, is commonly used in mining and earthworks construction. The application of this method to a highly technical and inherently experimental task such as constructing a DGR in two phases of construction in a populated environment is questionable. It is prone to increases in construction cost -- and we heard some of that this morning in terms of methodology go/no-go decision-making, and monitoring by authorities having jurisdiction. The observational method post-rationalizes the adaptive management approach.

If this is correct, the question has to be asked as to how the EIS submission can be considered compliant with the CEAA requirement for the highest science-based standard and the cautionary remarks of the Operational Policy Statement on adaptive management measures.

I am going to the next item, please. Next slide.

Geo-Scientific Verification of

the Town of Saugeen Shores and Arran-Elderslie:

Canadians, it is our privilege to create respectful and meaningful environments. Population density and preservation of development opportunities, accountability and robust development frameworks are put in place so that communities' best interests are always preserved.

This applies to rural small/large communities and it also applies to the industrial site known as the Bruce nuclear site.

On January 9, 2014, the issue of technical -- there was a Technical Memorandum issued that outlined the reasons why the Town of Saugeen Shores and Arran-Elderslie were no longer being considered as having the potential to host a DGR.

Foremost in their considerations was the intent to select what would support -- and this is in the words of NWMO -- "robust safety and community well-being requirements for the project". They did not find this to be available in the geology and near the moderate population centres of Saugeen Shores.

The question is, how can

something 14 kilometres away result in the disqualification of a DGR and how would you apply that knowledge or the standard that comes out of that to the DGR that we have before us?

I will go into how that process could be considered. The removal of 200 metres of Devonian and upper Silurian rock by glacial action 18 kilometres to the north of the DGR 1 site comprised the critical function of caprock enough to disqualify that municipality from being suitable to host a DGR 2.

The DGR 2 criteria for storing radioactive waste in sedimentary rock is exactly the same as that used to justify the low and intermediate storage on the proposed DGR 1 site geology.

The Collingwood and upper Ordovician shale caprock is common to both DGR 1 and DGR 2. The difference in the two locations is in the low -- in the additional 80 to 100 metres of salina formation or just above the midpoint of the brecciated seam composed of broken rock fragments. Below that the salina group is characterized as carbonate, open vuggy porosity and permeability at its top and shows

oil hydrocarbons seeping from its base.

The point here is that the 200 metres that I identify is that difference in absence of geological formations over the disqualified site as compared to the formations that are over the DGR 1 site. Those formations feather away as you go north and towards Saugeen Shores. It's that caprock which I have identified as the potential glacial -- the effect of glaciers over time on the two drawings that you have on the slides.

The effect, though, is to suggest that the consideration of the effect of glaciation on the DGR 1 site must include the feathering away aspect of materials as you go further north; i.e., you get to a zone where it is disqualification which occurs, and that is 12 to 14 kilometres away.

The 80 to 100-metre zone for the Silurian formation is crucial to the integrity of the caprock. It is logical that there should be a detailed science-based description of its role up to the point of its exposure to the elements. So it is a highly strategic component of the sedimentary -- of the stratification that we have

here and it could be removed in glaciation.

The rejection of a DGR 2 in Saugeen Shores by NWMO based on caprock coverage has created the term of reference that must be applied to the DGR 1 in order to re-confirm the viability of the caprock in that location.

I should also mention that the population density was another factor and the density of the area that was disqualified is moderate, the density on the DGR 1 site is up to between 2,000 and 4,000 people, depending on the time and the situation that is occurring there in terms of employment and activity. So it is a high density condition, industrial condition.

Item No. 4, the next slide. Design Criterion Site Development:

Since the Bruce site has undergone massive development over the past 50 or 60 years, the technology and function of the site has led to the concentration of very large infrastructure projects. The planning of the site to accommodate and integrate these functions has led to constraints in opportunities and, like any development site, it is important for the overall functioning of the site that each

component is provided with the land and adjacencies that allows it to develop in a safe and logical manner.

The proposed DGR site is located between the WWMF, the waste management facility and transmission towers to the north. To illustrate this we have some images here.

The first one involves just the basic layout of the site. The green -- the light green is the OPG project site which includes the waste management facility and of course the DGR site. Those areas are --

And the next image. This indicates the enhanced occupancies, or the occupancies on the site. The purple has to do with the Bruce A and Bruce B, the red has to do with transmission line rights-of-way which crisscross the site and of course you have the heavy water decommissioning lands next to the lake.

The DGR site is wedged between these competing functions and it represents the developments, high level of development of this very large but very active site. It's a site which consolidates important infrastructure

components. It adds to that complexity in a way that isn't, in our view, necessary or even recommended. The site becomes congested.

The next image, please. There you have the layering of the expanded DGR on that site underground and clearly you couldn't make it any -- you couldn't make that facility any bigger, it is definitely pushing at the limits.

Next. This is the detail of the image that you just saw. It indicates a comparison between the aboveground and the below ground, showing the surface features and the below ground features which I will discuss in two or three of the images to follow.

The first one has to do with the size of the DGR facility underground. The image on the left is the OPG depiction of the site. What is odd here is the distortion of the property lines around the DGR site, for some reason that I can't -- I have some idea about why it might be, but it is distorted for some reason. There is a corrected image above that's on the left, on the right is the corrected image which shows the DGR site in fact and the expansion of the facility has two panels in the correct

relationship to that site and then has four panels with the proposed extension to the bottom of the drawing.

One of the potential reasons why this has occurred, other than it is completely misleading, is that it might be that the site is being prepared for divesting to private ownership or lease, much as the Hydro One transmission facility has been to some extent and the Bruce nuclear has. It is a site preparation technique that we see in other forms of development which of course we are involved with as architects. But that is to be answered by OPG perhaps.

Next image. This has to do with another corrected image which continues to show the DGR at, in this case, twice the depth that it actually is in terms of a scale drawing and it points out again the expansion plans in the right-hand image at the right scale. Put at the right scale it actually is a fairly fragile relationship to what's on the surface and of course the lake.

And that's, again, one of the points that we are making is that there is a culture of creating images which mislead and

misrepresent the project in an effort to secure agreement and we find that to be pervasive in the documentation.

Next please. This is the detail of what actually appears to be a fairly fragile zone, the Cobourg formation. The Cobourg obviously has fascinating attributes, but it is a very narrow piece of -- a narrow formation. If you go to the back of the parking lot the formation is as thick as the -- tall as the antenna at the back of the parking lot, that's the height, it's about 100 -- 30 metres and that is exactly the height of this formation or about a little more than the width of this room. That is the zone in which this massive development is to slip itself and it is going to be a tight fit.

The brilliance of the engineering is what we are counting on and the question is, does that defy some of the threshold of credibility.

One of the other factors that is represented here is the extension of the shafts down through the Sherman and Kirkfield formations. It extends down to them and there is a ramp. The ramp has not been adequately

described from what we have determined and it is approximately 800 metres long, perhaps even a kilometre, we are not able to get the exact distance, but it is not described in any way significant although it penetrates the very layer that we are talking about being so important to maintain in terms of integrity.

There is very little to discuss, very little in the documentation to discuss the methods used to secure the ramp as it moves diagonally through these lower formations which have significant petroleum content. I should mention, the Collingwood formation has up to 17 percent petroleum content in it.

Go to the next one, please. Another observation has to do with extreme weather events. How am I doing on time here? Not too bad. Thank you very much. That's great. Last time I went terribly over.

Extreme Weather Events:

The Joint Review Panel has placed emphasis on the need for detail on the effect of extreme weather events and climate change as it affects the DGR site. The intent is to identify the nature of the risk so that these can be

quantified and evaluated in terms of significance and preparedness.

The OPG response does not provide any expanded evidence-based information that would enable higher appreciation of the impact of such an event on the site or the effect of climate change in terms of severity and duration of extreme weather events. By taking this position, they miss the opportunity to demonstrate conformity regarding their obligations at this site in the approvals process. The risk to human life, damage to property and the cumulative effect of a single event on the adjacencies and the effect of severe weather events on the proposed DGR site are significant, are borne out by recent events.

The OPG's dismissive attitude to the impact of such an event on the site is a serious omission and raises concerns about other factors for which they have direct responsibility.

The OPG EIS describes the incidence and intensity of tornatic activity in Ontario and it is basically a dismissive description. I won't go into it.

On August 17, 2011 the Town of Goderich was struck dead centre by an F3 tornado coming in from Lake Huron. One person died, 37 were injured and there was $100 million worth of damage. The wind exceeded 300 kilometres per hour; they had 10 minutes' notice.

The diagram is interesting because it shows the path of the tornado. It's several hundred kilometres across and it engaged the town with force. The tornado struck Goderich, but it could just as well have struck the Bruce nuclear site, which is the point that we are making, and that is 60 kilometres away.

So you see the difference is really -- the trajectory is exactly the same, the proximity to the water is exactly the same, the suddenness of the event would be exactly the same and the point is, how would that trace itself through a site which is loaded with the infrastructure such as we have right here, notwithstanding the National Building Code and the suggestion that it could overcome such things. There would be substantial damage on that site and there is no interest, it seems, on the part of OPG to take that obvious example and

to run that through a few scenarios to see how it might affect the site in general and the DGR site in particular.

We suggest that that would have a very significant impact and that that would as well cause special conditions to occur around the site and adjacencies such as the transmission towers and the dispersal of materials that would be in transit at that point and also the waste rock management and the pond -- whatever is in the way basically would be definitely affected by a 300-kilometre wind.

I go to the next image. Windborne Particulates, Measurement and Site-Specific Conditions;

This image is going to be used for two purposes; one, to make some points about windborne particulate matter, and also some focus on the storm, what is called the stormwater management pond to the upper left.

The windborne particulates are a very interesting subject and I think the interest really comes from the measurable effect that they can cause to human health. OPG in IES shows a tendency to rely on incomplete and qualified

statistical information. One example of this is how it examines and assigns significance of particulate matter or PM10 and PM2.5, which we have just heard a little bit about. The number refers to particulate size and the entry into lungs or the ability to ingest particulate matter in terms of the pathology of it.

Regarding data, it notes that while periodic monitoring is done in Ontario on the continuous PM2.5, monitoring is available electronically for review. OPG is in error to eliminate PM10 data which is identified as a contributing factor to determining human health effects.

I should just go on to say that there are very excellent standards which are available in this health category. Some of the best examples of practice which we would expect to be taken up actively by the proponent are available through the Toronto Public Health people and it has to do with one study in particular, "Path to Healthier Air: Toronto Air Pollution Burden of Illness Update."

Just as a big city, this site is susceptible to particulate matter, to ozone

issues, to transfer of pollution conditions from the south to the site and there are days when there are high levels of pollution.

The point is that the particulate matter related to the waste rock management site under wind conditions is significant. The wind conditions are perhaps represented very clearly by -- I should first read on.

One of the observations made by international studies is that particulate matter drawn into the lungs is responsible for 69 per cent of premature fatalities, which in Toronto amounts to 900 people, and 33 per cent of hospitalizations are attributed to pollution as well. So it is very significant.

Another is that the effect on the population rates varies with sensitivity and it is greatest in infants and the elderly. You heard a bit of that a little earlier from other presentations.

We have also heard that these counts are limited to the border of the site and, in fact, the site will -- this particulate matter will carry over to beyond the border, well beyond, and there really needs to be wind

modelling studies of this feature. This is very standard for large objects and that it has not been done to date is extraordinary. No project that I am aware of that is large and significant and has an impact on people of this nature would be allowed to proceed to approval or site plan approval without some sort of a wind study to be accurate rather than speculative about the effects of windblown conditions.

Next image, please. Stormwater Management, Climate Change in the Two and 100-Year Storm Events:

This is a series of images which explores the scale of the DGR and the stormwater event occurrences that will develop on the site. A mean average is used for the calculation of capacity.

Our review, a very simple review of stormwater events is clear in that the holding capacity of that settlement pond -- pardon me, stormwater pond is several times too small in terms of capacity to retain what is now increasingly very standard extreme stalled rainwater events.

You can see some depiction of

that one and two and three times' capacity. That extra capacity must be taken up on the site somehow, it either is in the form of an overflow condition, which is breaching of the sides of the existing pond that is proposed, or it is in the letting loose of the overflow into Lake Ontario in the event of a -- Lake Huron, pardon me. It will end up in Lake Ontario though.

But the difficult thing in this as well is that the stormwater that is retained in this is contaminated water and potentially a shutdown scenario where there should be no release of the effluent into Lake Huron.

In that case the operator is somehow going to have to decide on a go/no-go scenario, whether to release it into the lake or to allow the size of the pond to breach and flood the site. Neither scenario is one that anyone should have a responsibility for making that kind of decision.

Next image, please. That is a detailed study of the -- no, next one. These are all illustrations taken from the OPG report.

This study has to do with the carrying capacity of the stormwater management

pond and the values that are identified here are taken in terms of stormwater events are from last year -- actually from this year in the spring and that is a stalled weather system in I believe Manitoba and it yielded 108 millimetres of rainwater -- no, over 108 hours it yielded volumes that would exceed the capacity of the existing facility by two and a half times under a closed condition scenario.

There are other conditions where we have received in Ontario almost twice that amount in half the time.

I will go on to the last point, which is provincial and municipal jurisdictions. I'm sorry to be rushing this.

By enabling the modification of the size and material content of DGR 1 project as described in the hosting agreement by a factor of eight -- not 16, pardon me -- the OPG compromises the ability of the municipality to enact bylaws that protect the safety of its citizens now and in the future in order to preserve the ability of future generations, the safety and health of future generations.

The EIS, by offloading the design

and quantification of the project to after the licence is granted, effectively distances the community from understanding the actual risks associated with the DGR project. This is in direct conflict with the Provincial Planning Act to which the municipal government is accountable. So I will leave that as the municipal -- the effect on municipal jurisdiction.

The Provincial Jurisdiction:

As suggested next, there are many other aspects of it, but this is one of them. Deferring science-based design to the post-EIS stage increases the obligation of the province to monitor by the province and its ministries, including the Ministry of Northern Development and Mines, Ministry of Natural Resources and Fisheries, and Fisheries and Ministry of the Environment and Climate Change, because it obligates them to provide an intermediate level of involvement for review and inspection and they do not have the budgetary capacity to commit.

On a federal level, the federal government and the Joint Review Panel cannot give approval to the EA application where it can be demonstrated that the applicant has offloaded

design and other criteria that are necessary to understanding the project's effect on the environment and public health and this puts them, meaning Panel, in contravention of the CEAA and I'm sure they will not do that.

That's the end of my deputation, and thank you.

--- Applause / Applaudissements

THE CHAIRPERSON: Thank you, Mr. Hazell.

Panel, do we have any questions? Thank you very much.

We will now proceed with three 10-minute oral presentations. The Panel will direct its questions to each presenter following all of the presentations.

--- Pause

THE CHAIRMAN: The first 10-minute presentation is by Steve Frishman, who is an affiliate of Northwatch and who is joining us by telephone. The submission is PMD 14-P1.47 and 47A.

I understand, Ms Lloyd, that you will be running the presentation.

PRESENTATION BY / PRÉSENTATION PAR:
STEVE FRISHMAN, NORTHWATCH AFFILIATE

MS LLOYD: That's right. Thank you, Dr. Swanson. Brennain Lloyd from Northwatch.

Mr. Frishman was retained again for this phase of the hearing to review the updated Geo-Science Verification Plan and he was jointly retained by Northwatch and Save our Saugeen Shores.

Mr. Frishman...?

DR. FRISHMAN: Thank you.

Madam Chair and Members of the Panel, I appreciate the opportunity.

My written report reviews information contained in OPG's reports and other documents prepared since the September, 2013 hearing in which I presented comments regarding natural and engineered barriers intended to prevent loss of waste isolation.

The key to any deep geological repository design and potential performance is the effectiveness of the barriers that are intended to prevent loss of waste isolation once

the repository has been closed with appropriate seals in place.

In a September, 2013 hearing, my presentation included comments on two topics regarding barriers that have been the subject of further consideration by OPG since that hearing. First, characterization and treatment of the excavation damage zone, or the EDZ, and testing of proposed shaft materials and design.

Regarding the EDZ, the DGR safety case relies to a great extent on the shaft seals as a barrier to loss of waste isolation. The shaft seal must interface with the rock wall of the shaft and the bulk permeability of the excavation damage zone of the shaft is critical to the demonstration of the safety case.

In the 2014 Geo-Science Verification Plan it provides some additional detail and methodology for characterization of the shaft EDZ beyond that considered in 2013, but the plan still does not provide a sufficient basis for test plans to characterize the shaft EDZ and to attempt to understand its evolution through time.

In addition, the Geo-Science

Verification Plan retains a design element that could contribute to radionuclide release from the repository if the performance of the shaft seals and the shaft EDZ is less than expected in the repository safety case.

As designed, the highly damaged inner zone, or the HDZ of the EDZ in the area of the planned cement monolith at the base of the shafts is not intended to be removed, but the HDZ is planned to be removed from the shaft wall because it would provide a high permeability zone for radionuclide transport adjacent to the shaft seal.

The HDZ in the area of the monolith essentially provides an open pipeline for radionuclide transport between the waste emplacement area and the shafts, with hydrologic conductivity through the HDZ at about four orders of magnitude greater than the surrounding rock mass. With this condition, the shaft seal system and the adjacent shaft EDZ is the only barrier to release of the radionuclides from the repository.

This brings us to the question of post-closure and defence in depth. All nuclear facilities are expected to demonstrate defence in

depth against radionuclide release greater than that demonstrated in the safety case in conformity with the safety criteria. Multiple barriers provide for defence in depth and, in this case, the shaft seal system and its interface with the shaft EDZ constitutes a single barrier because the safety analysis in a severe shaft failure scenario involves the failure of the shaft seal system. The individual components of the shaft seal do not represent individual barriers, because in the severe shaft shield failure scenario, the failure of any part of the seal results in a failure of the seal system.

Failure of a single barrier resulting in violation of the safety criteria and non-conformance with the safety case indicates the DGR design does not provide defence in depth through multiple barriers preventing loss of waste isolation.

Now, regarding shaft seal performance. Severe shaft seal failure remains a conspicuous failure mode for the DGR.

The 2014 Geo-Science Verification Plan does not describe a shaft seal performance testing program, other than retaining the

previous plan for in-situ testing in the Cobourg formation. It is implied that testing at other formations exposed in the shaft could be done, but there is no description of where such tests would be performed and the overall testing rationale. The Geo-Science Verification Plan should include a commitment to and detailed description of a robust and comprehensive shaft seal performance testing program that would be continued through the full period of repository operation if construction and operation are approved.

The CNSC, in its evaluation and submission, describes alternatives for testing in addition to in-situ tests at the Cobourg formation, but even this general description is not consistent with the test plan described in the Geo-Science Verification Plan. As we heard this morning, this might have been discussed in the phone conference with OPG, but it is not sufficient to -- but referring to it there is not sufficient to defer this matter for possible inclusion in a future Geo-Science Verification Plan. This information is critical and is necessary to be understood at this stage of

decision.

The shaft seal performance analysis is indispensable to the validity of the DGR safety case and the safety case must be supported by site-specific comprehensive data collection and analysis.

In summary, the deep geological repository design as proposed by Ontario Power Generation does not adhere to the principles of defence in depth.

In addition, the supplementary information provided by OPG in response to the Joint Review Panel's Information Request does not adequately detail the Geo-Science Verification Plan and does not satisfactorily respond to design deficits regarding the EDZ and the shaft seal testing in earlier stages -- that were described in earlier stages of this review.

Thank you.

THE CHAIRPERSON: Thank you, Dr. Frishman.

Panel Members, did we have questions? Dr. Muecke...?

MEMBER MUECKE: Could OPG clarify its plans with respect to the HDZ over the

monolith that would be eventually in place?

--- Pause

DR. GIERSZEWSKI: Paul Gierszewski, for the record.

We discussed this last year and the position was that, again, the shaft seal -- there is 500 metres of low permeable material, so although in our safety assessment we conservatively assumed that the entire 500 metres failed, in fact only a small portion of that would need to be retained to actually provide the sealing function.

In our assessment -- so the next step down then is the horizontal section over the concrete monolith at the repository horizon, which is what Mr. Frishman is speaking about. So that is backfilled with concrete, that is there to provide a mechanical support to fill in that space and also the ramps in the bottom of the shafts to provide that mechanical support. That's the primary function of that, it is not intended to be a seal.

There will be an HDZ because that is an area that will be open for a period of time, it is a large area in a large excavation.

It wasn't our intent to try to remove the HDZ afterwards because we felt we had appropriate in the vertical shaft seals and there are also some issues with respect to worker safety when you try to move HDZ in a large cavern and move the ground supports that you would need to do so.

So it's our judgment that the appropriate balance had been provided.

MEMBER MUECKE: Thank you for reminding us.

THE CHAIRPERSON: Dr. Archibald...?

MEMBER ARCHIBALD: Just another short follow-up. Without removal options, would there be any other mitigative measures for sealing such as grouting the HDZ? Is it feasible to do that?

--- Pause

MR. WILSON: Derek Wilson, for the record.

I suppose there would be an option to grout the HDZ around the shaft area in the main -- we are talking about the main shaft station in the high-rise, but again, in the long term that grout would degrade over time in any

case and that pathway would still exist, very similar to the concrete monolith.

The concrete monolith itself, from a structural perspective, will eventually fail in time as well. So I mean one could consider grouting of that section, but again, I'm not sure about the long-term effectiveness of such.

MEMBER ARCHIBALD: Thank you.

THE CHAIRPERSON: Thank you. So that concludes the questions from the Panel for Dr. Frishman.

Thank you very much, Dr. Frishman.

So the next 10-minute presentation is by the Canadian Nuclear Workers Council, which is PMD 14-P1.30 and 30A.

Mr. Shier, please proceed.

PRESENTATION BY / PRÉSENTATION PAR:
CANADIAN NUCLEAR WORKERS COUNCIL, DAVID SHIER

MR. SHIER: Thank you. Good afternoon, Members of the Panel and to everybody else. My name is David Shier. I'm the President

of the Canadian Nuclear Workers' Council.

And assisting me today with our presentation is Mr. Howard Phorson who is a worker at the nuclear power station. He is an authorized nuclear operator. He is also our Nuclear Workers' Council site representative for the Bruce site. And he is also a resident, a farmer, et cetera in the area.

Also assisting me to my left is Mr. Kevin MacKay who is our past Nuclear Workers' Council representative on the site. He's a retiree. He's also Vice President of the Grey-Bruce Labour Council and he's known as a community activist. He's in contact with a lot of people in the area for many, many years.

Just quickly, our nuclear council is -- we're a council of nuclear unions in Canada. Two of our member unions you've already heard from, the Society of Energy Professionals and the Power Workers' Union which would be the unions at the DGR site. And we have member unions in five provinces and starting with uranium miners in Saskatchewan working east and finishing up at the Point Lepreau station. Our main goal is to ensure that the voice of -- the

collective voice of unionized workers is held in any nuclear debates and forums.

So our presentation will be brief. We'll talk briefly about risk assessment -- Mr. MacKay will help us out on that -- the waste inventory and my colleague Mr. Phorson will help us on that. And we'll also talk about our views around the Waste Isolation Pilot Project, or better known as WIPP, and then provide you with some of our conclusions.

So quickly, in regards to risk assessment, we view this as that all the facts have to be given to people and workers at the site, very important that their views be heard as well.

And with that, I will turn it over to Mr. McKay.

MR. MacKAY: Thank you, Madam Chair and Committee.

For the record -- excuse me -- for the record, my name is Kevin McKay.

Our local population within the Grey-Bruce area is made up of many people whose livelihood is made from work contrived on the Bruce nuclear site. These workers have assessed

the risks of working and living in the shadow of the world's largest nuclear power facility and with the knowledge and education provided by the industry, their employers and their unions they decided to set up households, raise and educate families and many of those offspring have become second and third-generation nuclear workers at the Bruce site.

This is not the result of a malicious disregard for personal health and the safety of family and friends, but rather an educated decision based on a 40-year history with knowledge of the nuclear industry that the benefits of living and working in the nuclear business outweigh any associated risks. Not a whole different than making the decision to fly to Florida for the winter rather than drive your car using the knowledge of the risks involved with either decision.

The silent majority who live, work and play in the Grey-Bruce-Huron counties have considered the risks, perceived or otherwise, and have voiced no complaints while the current OPG Western Waste Management Facility has operated and do not have any issues with the

proposed DGR. In my opinion, they are satisfied with how the entire Bruce site is managed and how the provincial and federal authorities oversee these facilities in their best interests.

Thank you once again for the opportunity to speak in support of the proposed Deep Geological Repository for low and intermediate level waste at the Bruce site.

MR. SHIER: Mr. Phorson...?

MR. PHORSON: For the record, Howard Phorson.

The Canadian Nuclear Workers' Council is very encouraged by some of the re-characterization of the waste headed for the DGR. There is some anecdotal evidence from OPG and from Point Lepreau where people have gone into, shall we say, legacy waste that perhaps wasn't sorted perfectly 30 years ago or has decayed radioactively to something that's benign with reductions in the waste footprint, certainly north of 50 percent and possibly heading towards 80 percent. So we would like to see OPG and the waste that's going underground to be minimized by continuing with this.

The other thing we'd like to

comment on is the characterization of waste by Dr. Greening. We don’t think that there is any significant impact on the safety case for the DGR or for our employees that will be working underground.

MR. SHIER: Dave Shire, for the record.

I would like to share our views on the situation or the events at the WIPP site in New Mexico. As you probably heard from one of our other member unions, the Power Workers' Union, we were involved with the discussion with the unions at the site in New Mexico and I'm going to share with you some of our conclusions.

First of all, I think you've heard about the conventional safety issues, so we'll talk a little bit about oversight. As you're probably aware, the site in New Mexico is regulated by the Department of Energy and we did -- in discussions with the union there, we compared the oversight of the Department of Energy versus the oversight of the Canadian Nuclear Safety Commission which will be, naturally, the regulator for the DGR. We find that it's very superior. The CNSC regulations

are much higher -- a much higher level of oversight.

We also believe that with the nuclear regulator in the United States that the Canadian regulator is -- we're not sucking up to the CNSC, but we feel that their regulations are much superior and, from our experience, we have noticed this in several different sites.

So we did a kind of comparison with the uranium mining industry looking at the WIPP site and the DGR. If you simplify it they are both mines and we have a lot of experience in Canada with the mining industry and our nuclear regulator naturally has experience at the uranium mines. So we did a comparison with the workers' safety levels between the involvement of the unions at WIPP and the unions at the uranium mines.

Again, we found a much higher level of participation and safety in Canada. A couple of reasons there. Our legislation for workers' safety is better and also the involvement of the CNSC versus the DOE is much, much different.

So overall there's always some

lessons learned, I guess, from incidents and we always support that issue. But we feel that the WIPP incident, even if it's a similar operation but it has not effect on the actual DGR because of the other issues that I talked about, as indicated, I think, on conventional safety that we're way ahead. And I'm sure you've heard about that from the Power Workers' Union.

So basically, in conclusion, the Canadian Nuclear Workers' Council feels that with all these new issues coming up that they do not have new environmental effects than what we heard last year. We still feel this is the proper way to go. It's good for the community and our nuclear council is in full support of the proposed DGR project.

We'll conclude with that and we'd be happy to answer any questions that you may have. Thank you.

THE CHAIRPERSON: Thank you very much.

Panel Members, do we have questions?

I have a couple of questions for the Nuclear Workers' Council. Was your

submission reviewed and approved by your general council membership?

MR. SHIER: Yes. What we do is when we put submissions together we deal right with the other unions. For example, Mr. Phorson is also a representative with the Power Workers' Union. The Steel Workers' Union is very active in our council and the steel workers are also the union that was at the WIPP facility as well.

So our executive is aware of our presentations and we get input from them. So they're fully supportive of all our unions and our council.

THE CHAIRPERSON: Thank you.

My second question is earlier during these hearings last week and this week, the Panel has heard from people who expressed concerns on behalf of nuclear workers regarding the quality and nature of the health baseline for nuclear workers both for Bruce Power and for OPG. Does your council have any concerns regarding the nature of the health baseline for nuclear workers at the Bruce site?

MR. SHIER: Dave Shier, for the record.

Yeah, we were saying today we're very -- it's nice that people are concerned about workers' safety and health, but we feel that's the role of the unions.

The unions that are in the industry are very -- it's a very, very high priority, the health and safety of workers, and we've worked strongly to make sure that that is at the forefront. Overall, I think there are studies that show that nuclear workers have a healthier baseline than workers in other industries.

I'll ask my colleagues if they want to comment on that any further.

MR. PHORSON: Well, this could get complicated.

When you're hired to be an atomic radiation worker there is actually a fairly rigorous medical on the way in. So one thing is if you select from fairly healthy 20-odd year olds in your hiring criteria it sort of might carry through. It doesn't always necessarily give you a snapshot of the entire population. I like to think that we're probably healthier at higher than an average selection of the

population and that probably indeed carries through.

THE CHAIRPERSON: And my final question which continues on with the health concerns which were expressed on behalf of the workers, but I want to hear directly from representatives of the workers, is what are your primary health concerns for nuclear workers in general, either radiological or non-radiological?

MR. SHIER: That's a hard question. We don't -- we have a lot. Sorry, Dave Shier, for the record.

I spent many years and my previous job was I was a health and safety officer for the Power Workers' Union and my primary role was dealing with the workers at Pickering, Darlington and Bruce Power, assisting the elected workers or the elected representatives with health and safety issues.

These are large industrial establishments so you naturally have the typical industrial types of hazards. Radiation isn't actually a hazard. But over all those years I can only recall one incident way back in the eighties where there was basically a radiological

incident where somebody was --got overexposed.

So we don't have any -- I don't think we have any claims in to workers compensation or anything else around radiation issues with our workers which is naturally one that sticks out.

Other issues, I think our health and safety programs are very robust and things are looked after. So again, I think the workers in the industry are above the averages when you start looking at the statistics for different injuries.

So I think it's safe to say that we don’t have any major health and safety issues other than the ongoing normal industrial-type issues. There's lots of programs in place where workers have input on Grey's protection and conventional health and safety to deal with those issues.

I'm also involved with other industry networks of international nuclear workers and it seems similar across the globe.

THE CHAIRPERSON: Thank you very much. That concludes the questions from the Panel for this presentation.

We will now take a 15-minute break and we'll reconvene at quarter to four.

--- Upon recessing at 3:25 p.m. /
Suspension à 15 h 25
--- Upon resuming at 3:44 p.m. /
Reprise à 15 h 44

THE CHAIRPERSON: Welcome back. Our final 10-minute oral presentation is from Michigan State Senator Hoon-Yung Hopgood who is joining us by telephone. The submission is PMD 14-P1.38.

Senator Hopgood, are you there?

SEN. HOPGOOD: Hello, yes.

THE CHAIRPERSON: Welcome, and please proceed.

PRESENTATION BY / PRÉSENTATION PAR
MICHIGAN STATE SENATE, SENATOR HOON-YUNG HOPGOOD

SEN. HOPGOOD: Thank you. Good afternoon, Chair Swanson, Panel Members.

I am Michigan State Senator Hoon-Yung Hopgood from District 8th's 10 communities

and 250,000 residents from downriver in Metro Detroit along the Detroit River.

I'm proud to come from the Great Lakes state where our motto is "If you seek a pleasant peninsula, look about you".

I appreciate the opportunity to come before you again to express my strong opposition to Ontario Power Generation's proposed Deep Geologic Repository for nuclear waste which would bury millions of cubic feet of radioactive waste below ground next to Lake Huron.

Last year I indicated that OPG's nuclear waste dump greatly threatened the status and image of the Great Lakes, especially impacting Michigan's Great Lake's economy. The possibility of having radioactive-contaminated Great Lakes water would be devastating to our manufacturing, tourism and agriculture industries.

This year the story is no different. The Anderson Economic Group 2014 report "Innovating for the Blue Economy" quantifies the impact of water-related industries on Michigan's economy. More than 20 percent of Michigan's jobs are based on the Great Lakes and

access to water.

For instance, tourism, one of our states' largest industries, generated $17.7 billion of direct spending, $1 billion in state taxes and 200,000 jobs in 2011 alone.

The Great Lakes fisheries provides another example, valued at $7 billion annually and providing 75,000 direct jobs. Over five million people fish it annually.

While just scratching the surface, these numbers reiterate that the Great Lakes are absolutely crucial to Michigan's economic wellbeing. Our top industries and our state's economy as a whole would be in serious jeopardy if our lakes are threatened by a nuclear waste dump.

There continues to be no process offered by OPG to include public participation by Michigan citizens. OPG has not hosted one public event in Michigan. Nonetheless, state and federal elected officials as well as numerous statewide groups have expressed opposition to this faulty plant.

Notably, the United Tribes of Michigan, an organization of 12 sovereign

federally-recognized tribes has joined in opposition. Further, since the hearing last year some 76 communities in Michigan alone have passed resolutions opposing the project -- 76.

This proposed facility would never be permitted under Michigan law which effectively prohibits the underground disposal of nuclear waste. We know that when it comes to our Great Lakes the risks are simply too dangerous, a strong belief that transcends political parties.

I think it is important for us to remember that the Panel's own consultant, Dr. Peter Duinker, solicited to evaluate OPG's approach and methods in its environmental assessment, gave a very damning report. Dr. Duinker concluded that OPG's analysis was not credible, not defensible, unclear, not reliable and inappropriate.

Thousands of additional pages of information have been provided at your request. Despite that no one has, can or will guarantee that radioactive contamination from this unproven and untested method will not occur. They cannot guarantee that our drinking water supplies will remain safe and Michigan's economy and its vast

industries will not be harmed.

OPG's own consultant indicated that leakage from the DGR is absolutely possible. As Michigan State Representative Terry Brown stated in his submission, no known level of radioactive release into the Great Lakes should ever be acceptable.

The fact that this Panel has and continues to have more questions for OPG and that we are today reviewing methodology illustrates that the utility has not made a convincing case for its proposed plan. Simply put, the longer this Panel listens to what is being proposed the more concerns there seems to be.

One of the remaining issues looming over this proposal of course is still it was originally proposed to include low and intermediate level nuclear waste. However, OPG has repeatedly made references to plans to double the facility to accept decommissioned waste. Again, this constitutes a dangerous expansion of the project that deserves to be addressed in this current review process and not in subsequent proceedings.

Despite statements that this

facility will not accept high level nuclear waste, the reality is that there is nothing to ensure that this will not occur at some point in the future. Most agreements can be amended with a stroke of a pen. What about the rest of us?

In regards to the report submitted by the Independent Expert Group for the relative risk assessment in IR EIS 12-513 it was determined that there was insufficient evidence to conclude if there was in fact Canadian acceptance for the proposed DGR. I would suggest that given the past marks -- math that was shared with you recently showing communities in Ontario and all Great Lakes' states that don't support the project, the question has been answered. Lack of community acceptance is obvious in Michigan as congressional and state-elected officials across party lines have agreed that the proposed plan is not in the best interests of its citizens or communities they have been elected to represent.

Thus, multiple pieces of legislation have been introduced or expressed in opposition to OPG's nuclear waste dump and to encourage the engagement of additional parties to

study and address the questions at hand.

By considering only one side, a state that poses a serious and direct threat to our Great Lakes, OPG clearly failed to look at alternative sites. It is a glaring and unacceptable omission that a site not in proximity to the Great Lakes was ever even contemplated, again an omission that should not be tolerated by this Panel. Other locations must be considered. Your process demands it.

Michigan's law expressly requires consideration of three alternates before finally deciding where low level waste can be identified, which it never was. As a Michigan senator concerned with the health and safety of the citizens that I represent who drink the water that is shared with Lake Huron, it is unacceptable that OPG did not consider any other sites. The fact that they are now including information about a hypothetical granite DGR in response to the Panel does not change the fact that they did not conduct a thorough search for an actual alternate site.

To fulfil the EIS Guidelines they would have had to provide information on

alternatives when submitting their application. OPG has negligently missed a vital step in the process and surmising the suitability of a fictitious site now does nothing to address the shortcomings.

It is worth noting that in 1986 Canadians opposed efforts from the U.S. to consider locations for a nuclear waste site from near the border. At that time Canadians expressed concern that such sites were in shared drainage basins that flowed into Canada and, indeed, somewhere in the Great Lakes Basin. Canadians made it clear that they opposed any site that did present a transboundary threat to their welfare or to the integrity of their environment. Honouring their request, it was agreed that no area would be selected that posed a risk and threats that drew Canadian concern.

Almost 30 years later, Michigan and the other communities and other Great Lakes states are now expressing serious concern about the transboundary threats posed by the proposed site situated in our shared Great Lakes Basin.

Today, we are asking you to grant us the very same courtesy that was granted then.

We are asking that the Panel require OPG to undertake a comprehensive screening process of multiple alternative sites that do not pose a threat to citizens in Michigan and throughout the region and to our environment.

Dr. Greening, a retired nuclear scientist, presented evidence during these hearings that described many concerns and raised serious doubts about OPG's estimations concerning the radionuclide inventories to be buried in the DGR. For example, in a recent interview Dr. Greening indicated that OPG's contractors seriously underestimated the potential impacts of malevolent events where for example a bomb was detonated in the vicinity of pressure tubes that had been removed from reactors and stored as waste.

The potential impact of OPG miscalculating the storage of such hazardous materials increases the potential risk of contaminating the Great Lakes which would be catastrophic for the millions of Michigan citizens who live downstream from the proposed repository.

The Panel does not need to look

long or far to see that the history of DGRs have had enormous problems in the areas of structural geology. There are efforts to remediate both sites in Germany at the cost of billions of dollars and spending decades to come with no assurance that they will succeed.

In regards to the Waste Isolation Pilot Plant it has been reported that the February fire and contaminant release to have involved human error. While the possibility of human error remains here, the root cause of the release at WIPP has not been determined.

So is it really possible to prevent or mitigate a similar event when the cause of WIPP is still unknown? OPG can't be confident that they have addressed the fundamental concerns that WIPP has asked. You shouldn't be either. It would be foolish to approve the project without knowing more.

Recent history shows us that radioactive releases from DGRs have occurred despite assurances to the contrary. As we have seen with WIPP, releases happen, accidents happen and the assurances that this would never happen are meaningless after the fact. WIPP is in the

middle of the desert.

Any risk of radioactive contamination here is an unacceptable threat and risk to the health and safety of the citizens who live near and depend upon the Great Lakes. This process, your process has uncovered several serious damaging questions which we remain unanswered and unresolved, if not exacerbated. Perhaps even more questions have been raised as a result of the intervening months and your due diligence. For that, I thank you.

I ask you to see these issues through. I ask you to not look aside or away. This proposal is obviously not ready to be approved. I don't know if it ever will be ready to be approved.

Permanently burying nuclear waste next to the Great Lakes just doesn't make sense but the flaws that remain are too serious to sweep under a rug. The risks and threats that this project poses to our water, our health and welfare, lives and livelihoods, our qualities of life and our identities as residents within the Great Lakes Basin is at stake and for our shared water and our shared interests. Stop this DGR.

Thank you.

--- Applause / Rires

THE CHAIRPERSON: Thank you, Senator Hopgood.

Panel Members, did we have questions?

I have one question and it is addressed to Ms McKay of Environment Canada. Ms McKay, are you there?

MS McKAY: Yes, ma'am, I am.

THE CHAIRPERSON: Thank you.

The Panel would like to know whether there have been any recent meetings between Canadian and American representatives pertaining to the Great Lakes Water Quality Agreement and the proposed DGR.

MS McKAY: Jennifer McKay, for the record.

The last time the Great Lakes Executive Committee met was June of this year, 2014. We did mention the Deep Geological Repository at that meeting.

And previously in the, sorry, December 2013 meetings of the Great Lakes Executive Committee we did discuss the Deep

Geological Repository.

THE CHAIRPERSON: Thank you. And to follow up, Ms McKay, were there any particular concerns or subjects raised at either one of those two meetings?

MS McKAY: At the meeting in June 2014 the Canadian Nuclear Safety Commission representatives just provided an update on the status of the Joint Review Panel process.

THE CHAIRPERSON: And did that generate any questions from either Canadian or American representatives?

MS McKAY: I would have to check the minutes of that meeting.

THE CHAIRPERSON: Thank you.

I understand CNSC may be able to assist us with the answer to this question. Ms Francis...?

MS FRANCIS: Kiza Francis, for the record.

CNSC staff had a representative at that meeting. It was Mr. Andrew McAllister and he helped provide the update as well. He said there were no questions.

THE CHAIRPERSON: Thank you very

much for that.

Thank you very much, Senator Hopgood.

We now have time for a few questions from registered participants. Participants are reminded that questions must relate to today's presentations and are not to be used as an opportunity to make a statement. I understand from Secretariat staff that we have five people who have asked for leave to present a proposed question.

I will now begin with Mr. Monem.

MR. MONEM: Alex Monem, for the record.

Thank you, Madam Chair. I have very few questions.

For the benefit of our experts who are following along, could I ask that OPG just repeat what the planned activities would be to measure the permeability of the cap rock?

THE CHAIRPERSON: OPG?

MR. JENSEN: Mark Jensen, for the record.

In addition to the many measurements that were taken from boreholes and

reported in the submission, the intent is to look at the permeability through the EDZ work program that is going to be looking at the Queenston and Georgian Bay.

THE CHAIRPERSON: Thank you.

Mr. Monem?

MR. MONEM: I assume that's as much detail as we have at the present time?

THE CHAIRPERSON: Well, we do have the written submission and the presentations from this morning, and we will have the transcripts for some pretty detailed questions, so I think it would go well beyond what you've just heard.

Was there anything in particular your experts would like to know?

MR. MONEM: I was only told that from today's testimony it was still not clear what the actual activities would be, but if that subject has been covered in greater detail, I'll leave it at that.

THE CHAIRPERSON: OPG, did you have anything more to add?

MR. JENSEN: Mark Jensen, for the record.

The activities are described in Section 2 -- sorry, 4.2.4 EDZ characterization, and it's the subsection on permeability in that section that describes in a photograph or an artist's rendering of where the permeability measurements will be made. And the locations of those measurements are shown on Figure 4.1 of the same document.

THE CHAIRPERSON: Thank you.

Mr. Monem?

MR. JENSEN: Thank you, Mr. Jensen. That was helpful.

This question could be posed to CNSC.

I've understood from the testimony today that there are -- CNSC views there being three sort of critical natural barriers, one being the low permeability of the host rock and cap rock to the absence of major faults and, three, the absence of natural resources.

Am I correct to -- in my understanding that these have not been yet defined in a quantitative sense?

THE CHAIRPERSON: CNSC?

DR. THOMPSON: Patsy Thompson, for the record.

The three components we described this morning both in the presentation and after lunch are critical barriers to provide the long-term safety, and Dr. Nguyen will speak to the information that is presently available that supports the safety case.

DR. NGUYEN: Quantifying the -- giving clear value of permeability, for example, could be done in order to ensure that the cap rock and host rock would be diffusion dominated for transport of contaminant. This is possible, but that hasn't been done.

It could be easily done, but it hasn't been done.

For the rest, like the absence of major fracture zones, again, you can also quantify what is the -- what is the permeability or the extent, the characteristics of the fracture zone that can influence the safety case.

So in other words, the quantitative criteria could be determined for each of those individual elements, but they don't work in isolation. They have to work in

combination with the other characteristics in order to verify whether the safety case is compromise or not.

So it's very difficult to put a single criterion on one of those components individually. If you find something in one of those characteristics, for example, which are -- which are beyond the current understanding, we have to put it into the overall picture of the overall safety case and see how it affects the overall safety case.

THE CHAIRPERSON: Thank you.

Mr. Monem?

MR. MONEM: Do I understand that to mean that the CNSC will not be looking for any sort of quantified limits on any of these three factors?

THE CHAIRPERSON: CNSC?

DR. THOMPSON: Patsy Thompson, for the record.

That's correct. As I tried to explain earlier after lunch, it really is the criteria -- the safety criteria in combination with the information on each lines of evidence and how they come together to demonstrate safety.

THE CHAIRPERSON: Mr. Monem?

MR. MONEM: I'll move on.

I apologize of this has been covered already.

Could CNSC comment on if and in which circumstances they will rely on outside expertise to review the GVP and its impact on the safety case?

THE CHAIRPERSON: CNSC?

--- Pause

DR. THOMPSON: Patsy Thompson, for the record.

With the GVP as it is proposed now, the -- we have initiated a review based on OPG's updated submission, and we have not seen an area where we would require reliance on external expertise. We have the in-house expertise, and also from the research projects and experience we have.

I will ask Mr. Nguyen perhaps to talk about once the GVP is in place and the data starts to be collected and submitted, how the review would be done and how collaboration with other experts would take place.

DR. NGUYEN: Son Nguyen, for the

record.

The GVP comprised for the present time many important components, and a lot of those -- each one of these individual activities could be assessed by the CNSC staff. We intend also to use modelling tools in order to interpret the results of the different experiments which would be conducted, for example, the under excavation tests which, in our geomechanical jargon we usually call it the mine bite test.

We have the intention to simulate that test using our modelling tools and to -- in this way, we have -- we obtain confidence in understanding the data and see how it affects the -- how it could input into the safety case.

This is just one example. The other example which is of importance also are the shaft seal studies which would be performed by OPG. We would look at those results as well and we intend also to perform numerical modelling in order to calibrate the experiment and try to understand the processes which govern the experimental results.

At the same time, we also have -- we already started research studies on -- our own

research study on experimental -- experimentation of the long-term performance of shaft seals in the lab. And we already started that process and looked at, for example, the influence of very high salinity of the pour water on the long-term geomechanical and mechanical and hydraulic evolution of the bentonite.

So this -- those are the kind of activities that CNSC, through our research program, would -- in collaboration with universities both from Canada and from our international partners as well, would conduct in order to make -- optimize the use of the resource from the GVP.

When there is the need for external -- for expertise which falls outside our own expertise within the CNSC staff, then of course we will seek -- we're going to look for that expertise to complement our knowledge.

THE CHAIRPERSON: Mr. Monem?

MR. MONEM: Those are my questions. Thank you.

THE CHAIRPERSON: Dr. Storck?

DR. STORCK: Thank you, Madam Chair.

I have a question -- two questions, actually, please, one question arising from, I think it was, this morning.

In my reading of the updated geoscience verification plan, I was particularly interested in the observations that the concrete liners -- both the watertight and the upper 200 metres and the leaky liner below that depth were to be removed prior to closing the facility and also the heavily damaged zone was going to be removed, and that there would be an attempt to plug the excavation damaged zone around the highly damaged zone with a mixture of sand and bentonite clay which, at the time I read that, seemed counter-intuitive. Sand facilitates drainage. Bentonite would block it.

But the proposal was to grout the EDZ with a mixture of sand and bentonite clay.

I heard comments today that -- and no evidence that the liner would be removed and that a grout would degrade as well as the concrete monolith.

So my question is, how does OPG explain the contradictions in the statements we've heard today with what's in the verification

plan?

THE CHAIRPERSON: OPG?

DR. GIERSZEWSKI: Paul Gierszewski, for the record.

So let me just summarize the basis of the shaft seal design. It hasn't changed. The intent is to first remove the concrete liner that was in place during construction. And as part of that, we would also remove the heavily damaged zone that we'd expect to be adjacent to the liner.

Presently, we estimate that to be a half metre, but we would take what was necessary and -- when we actually get into the field to remove that.

That will instill a zone of excavation damage zone around that we refer to as the EDZ. That would be -- that would still be in place, and that is part of the model.

The hole that's left then by the -- from the shaft and the -- removing the concrete liner and the rock is then backfilled with low permeable materials, primarily bentonite sand. That's the primary material. There is a section of asphalt to provide an independent

redundant material.

But the primary seal is a bentonite sand mixture, and it is placed inside the shaft and compacted to a high density to provide the high permeability.

It has a small content, about 30 percent, of sand. The balance is designed to provide low permeability, and the small amount of sand gives it better handling and mechanical properties.

There are -- concrete is used -- primarily in the base of the shaft to provide a mechanical support. It initially provides a low permeable barrier in the short term, but in the long term, it's -- there is a physical barrier. In the long term, we don't rely on concrete as a permeability barrier. That function is provided by the -- as I said earlier, primarily by the bentonite sand seal in the shaft.

For clarity, there's no plan to grout the EDZ. There is some possibility that the EDZ in some portions may -- over time, may have some degree of self-sealing, but we haven't taken credit for that in the assessment.

We are not -- we won't physically

attempt to grout it with -- the primary fill, as I've said, is the low permeable materials within the shaft itself.

MR. WILSON: Derek Wilson, for the record.

I think maybe the confusion around the HDZ(sic) is the HDZ removal at the repository horizon, basically the crown of where it meets the shaft. And it's that area that we don't intend to remove the HDZ, but once we get into the vertical column of the shaft, the HDZ and the shaft liner would be removed.

So it's just the -- it's essentially the back of the shaft station that we did not intend to remove the HDZ.

THE CHAIRPERSON: Thank you.

Dr. Storck?

DR. STORCK: That clarifies some of the contradictions I thought I heard this morning, but in my mind, it still leaves open the question of how the excavation damage zone itself would be sealed.

I guess I would ask that as a question of OPG.

THE CHAIRPERSON: OPG?

DR. GIERSZEWSKI: Paul Gierszewski, for the record.

The -- it's a zone of variable properties. There's more damage right near the shaft and then it decreases back into the properties of the background rock. They'll take out the most damaged portion of that. The remaining portion we refer to as EDZ is characterized by processes described in the geoscientific verification plan. That is left in place, and that is included in the safety assessment as a potential pathway.

It's conservatively assumed to be a wide pathway based on mechanical modelling for different rock formations, and we've used the worst -- the worst thickness off that and assumed that that is still in place in the long term.

So it is -- it is -- I'm repeating myself.

The highly damaged zone is removed and the remaining EDZ is left in place and is included in the safety assessment calculations.

THE CHAIRPERSON: So Dr. Gierszewski, to paraphrase, is the Panel correct

in paraphrasing it as follows?

The EDZ will not be sealed -- deliberately sealed by any means. You have not taken credit for any attempt to seal it. And even though it isn't sealed and it does provide a pathway in your modelling, it does not result in an unacceptable dose at the surface.

Is that a correct paraphrase?

DR. GIERSZEWSKI: That's correct.

THE CHAIRPERSON: Dr. Storck?

DR. STORCK: Thank you, Madam Chair.

My second question is -- relates to the verification plan, of course.

In reading the update, I was struck by the necessary, but cumbersome, process of looking at differences between expected and observed as the excavation proceeds.

OPG thinks there's a remote event that any material differences will be seen, but when they do see them, they will assess them first for their reliability, they will ask for new analyses, they will interpret the analyses, the field measurements and try to reconcile any differences to yield a final recommended value.

That's a paraphrase of a process taken in the field to verify what they think -- what they see compared to what they think they might have seen.

There also seems from today ambiguities in the tolerance limits of the triggers, the geotechnical triggers, and in the three -- the three categories that CNSC will be looking at that might be go-no go triggers.

This is my question. That was a preface to my question.

Could OPG provide an example of a bidding clause -- the phrase was mentioned this morning -- a bidding clause that would provide time for the necessary geoscience studies during construction and also neutralize any pressures placed by the contractor on the verification plan and by upper corporate levels of OPG watching for escalating costs.

So basically, I'm asking the question, how would they write a -- in a bidding clause to provide time from pressures from the contractor and pressures from upper level management that would have different concerns?

THE CHAIRPERSON: Dr. Storck,

both Dr. Muecke and I actually asked a series of questions around -- that really are exactly the question you're asking except we didn't ask for a specific example of a bidding clause.

Could you help the Panel understand what you mean by that?

DR. STORCK: Thank you, Madam Chair.

The only reason I used the phrase "bidding clause" is because I believe Derek Wilson used that phrase this morning as a way of providing that time.

I immediately thought I would be interested to know exactly how that would be phrased.

THE CHAIRPERSON: OPG?

MR. WILSON: Derek Wilson, for the record.

We're some time away from preparing a bid package for this particular work. However, as I discussed previously, the requirements of the GVP, the requirements of the safety aspects around this project and the requirements for us to do some of these activities, which are typically not done to the

same extent in a mining operation, are things that we are going to be clearly setting the expectations for and looking for contractors to see how they can integrate into that.

And these activities will actually be scheduled into the schedule and the proposed -- and as we work with the contractor, we'll work on the appropriate scheduling of these.

So for the most part, the planned activities that are detailed in the GVP such as the various station locations within the main shafts that we'll stop and do some of our EDZ measurements or our over-coring and so on, those would be scheduled events. And they would be planned accordingly.

For the instances where we have a situation where we might have a value that's outside of the trigger range and we have to take some time to consider it, we'll have also in the contracts understanding of stand-by clauses for such events and we'll be able to understand what those would be.

So there's various mechanisms of how we would do that. It would not be just one

standard clause. It'll be -- essentially the plan will be provided to the contractors as part of the bid package and, in their proposals back, they'll show how they can integrate their activities with those.

Similarly, with -- and I think Ms. Swami spoke very clearly about the expectations of management in the processes that OPG has established for such a project.

THE CHAIRPERSON: Thank you.

Mr. Mann.

MR. MANN: Thank you, Dr. Swanson.

Initially, I want to thank Marie, Michelle and Lucille for assisting me as an intervenor here this past two weeks, and the wonderful security staff you have here, Pete in the lobby and the rest of the staff here and the technical staff led by Matt putting on this show here.

They all did a wonderful job.

I'm asking leave, Dr. Swanson, for this question to OPG and CNSC.

From 2005 through 2012, there were seven years of unlawful closed DGR community

consultation meetings conducted by Bruce County Council Mayors, OPG, NWMO, CNSC, Tom Mitchell, Ken Nash and Michael Binder shutting out Bruce County citizens out of the due process and DGR process.

My question to OPG and CNSC is, when are the citizens of Bruce County going to be able to participate, be educated and become fully informed over a period of at least seven years that we missed because of the unlawful meetings shutting the citizens out and not including the citizens in the DGR process, which was really contrary to the Independent Expert's Group that says -- that said you should meaningfully engage the citizens early and often and fully.

Thank you.

THE CHAIRPERSON: I'll start with CNSC. Could you have a brief reaction to that, please?

DR. THOMPSON: Patsy Thompson, for the record.

In relation to the Environmental Impact Statement, CNSC staff reviewed the information material that OPG was providing in the context of the environmental assessment to

look at technical content, understandability for a layperson, those types of things.

We were satisfied that the information sessions that were held, for example, in relation to VECs, and so the public engagement activities related to the EIS were reviewed by CNSC staff and found to be acceptable.

THE CHAIRPERSON: OPG...?

MS SWAMI: Laurie Swami, for the record.

In the last set of hearings we had a full discussion of the extensive consultation program that OPG had in place, giving an opportunity to educate and share knowledge and listen to the community. During that period, as described, we did host a number of events.

If you would like more details on that, I can ask Mr. Powers to go back through that information, but I think it is well on the record, the extensive work that OPG completed.

THE CHAIRPERSON: Thank you. No, it won't be necessary.

Mr. Mann...?

MR. MANN: Thank you.

My next question is, since the lateral predictability principle is crucial, why did OPG and CNSC not consider NWMO's findings and conclusions related to unsafe geology for a DGR a few kilometres away in Saugeen Shores and Arran-Elderslie?

THE CHAIRPERSON: OPG...?

--- Pause

MS SWAMI: Laurie Swami, for the record.

So the project that I think Mr. Mann is referring to is an NWMO project. I can't comment specifically on that project, but I can say that the DGR project has had a significant amount of characterization, we have put together a Geo-Science Verification Plan that will support that work and if Mr. Jensen would like to add to that, that would maybe help with some of the information.

However, I think for our project we have confidence in the safety case that we provided to the Panel.

MR. JENSEN: Mark Jensen, for the record.

One of the key aspects of the

site characterization program at the Bruce site was defining the lateral continuity of the caprock in the Cobourg and the underlying units. We drilled six boreholes and were able to find the stratigraphy as being laterally continuous without fault structures.

We have used site-specific analogues to look at the site and its evolution over hundreds of millions of years and this has all been documented in the geo-synthesis fairly I think extensively and provides a good body of information to explain the lateral continuity of these units.

THE CHAIRPERSON: CNSC...?

DR. THOMPSON: Patsy Thompson, for the record.

Our team of geo-science experts have been involved since the first submissions on technical support documents, they are related to a site characterization, including a review of all the documentation, the data, the models and the interpretation from the models derived from the boreholes, the geochemistry and other work that was done by OPG and by review of this information, running independent models, doing

some research, we are satisfied that the information that supports the EIS is robust.

THE CHAIRPERSON: Mr. Mann...?

MR. MANN: Thank you.

Since a minimum depth of 500 metres is preferred in order to maintain the integrity of a DGR within the Cobourg formation, why is 499 metres deemed not safe over geologic time?

THE CHAIRPERSON: So, Mr. Mann, I think what you are questioning is sort of that tolerance level around 500 versus 499?

MR. MANN: Right. Right.

THE CHAIRPERSON: Is that kind of the basis of your question?

MR. MANN: Right. And the reason Saugeen Shores was eliminated is because they had depths of only 400 metres, so that was deemed unsafe. So over geologic time me, as a citizen, ordinary citizen just thinks 100 metres over geologic time, nothing.

THE CHAIRPERSON: CNSC, the Panel would appreciate a brief but clear and in accessible language explanation, if possible, of the relevance, if any, of the NWMO findings

regarding Arran-Elderslie as it pertains, or not, to the proposed DGR project.

--- Pause

DR. THOMPSON: Patsy Thompson, for the record.

When this issue was raised last week, Dr. Julie Brown was here and provided an explanation of the findings of the NWMO in terms of the availability of -- the land-use availability on that site, as well as some of the characteristics of the geology, but we don't have the information that we would be able to provide this explanation again.

THE CHAIRPERSON: Perhaps OPG could be of assistance? We simply need a clear lay language explanation that helps the lay public understand why geology close by could be rated as unsuitable and geology at the site is suitable.

I hope that that is a fairly simple request.

--- Pause

MR. JENSEN: Mark Jensen, for the record.

Within Bruce County the

sedimentary sequence that exists beneath the Bruce site extends out to the east. The same bedrock formations occur throughout beneath Bruce County, the Cobourg formation is 25 metres plus or minus thick and the caprock is 200 metres plus or minus thick, but it rises to the Northeast.

So at the Bruce site it is around 680 metres and I think it is as shallow as 350 to the Northeast in Arran-Elderslie.

The decision in terms of the site to make a robust safety case, under extreme but unexpected glacial erosion you might expect 200 metres or more and it is sensible to move the site to a location where that sort of circumstance could not happen, so hence the siting of the Cobourg at 500 metres.

And then when you have it at 500 metres, then of course you have ground surface constraints with regards to surface facilities that come into play, protected areas and these sorts of things put on constraints and that is the geo-science reason for this.

THE CHAIRPERSON: Thank you.

Mr. Mann...?

MR. MANN: My last question for

today, Dr. Swanson, through you, related to your -- Dr. Swanson, you noted some tolerable decision errors and you had some questions regarding that and I guess, you know, if what they are proposing doesn't add up when they actually are digging and so on, what is the margin of error?

Does OPG and CNSC agree that the tolerable decision errors that Dr. Swanson questioned about will always be trumped and overridden by the all-consuming pressure to complete the DGR project for the ribbon-cutting ceremony, much like the Titanic, I guess?

THE CHAIRPERSON: Mr. Mann, that was really a rhetorical question.

--- Laughter / Rires

THE CHAIRPERSON: And we actually asked a question very similar to that earlier today, actually Dr. Muecke did, and Dr. Storck has just asked a very similar question as well.

Because beyond -- because the Panel recognizes that underlying your question is a very real concern about how the management system is set up to not let economic issues trump safety, both short term and long term, and the Panel is satisfied that we heard a very clear

response.

Dr. Greer...?

--- Pause

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

Well, speaking of major concerns, I do want to applaud the Panel for your continual rigor and astuteness in interrogating the OPG and CNSC in regard to getting answers and I appreciate Patsy Thompson and her colleagues identifying the three potential triggers that would require a revision of the safety case, and also appreciate the OPG telling us about possible mitigation options and so on, but I am really concerned that there is a lot of really critical, essential decisions being made after a licence might be given to this proposed project.

Therefore, is there anything that could happen during the preparation of the site and construction -- and/or construction that would actually stop the project from continuing, or is it an ongoing endless process of revisiting the safety case with more potential mitigation options offered?

THE CHAIRPERSON: So, Dr. Greer,

I think what the Panel is hearing you ask is, during site preparation and construction, what are the go/no-go category or topics.

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

But I mean no-go, I mean not looking at mitigation and revisiting a safety case to continue eventually, but just stop it, period.

THE CHAIRPERSON: Okay.

OPG, I think another way of putting it is complete failure mode. The question will be directed to CNSC.

--- Pause

MS SWAMI: Laurie Swami, for the record.

We had some discussion this morning about significance and I think this comes back to that discussion of, do we know precisely what is significant and what is not and that will have to be taken in the context of all of the elements of the safety case.

So I cannot pinpoint one thing that would be a go/no-go decision. But what I can say is that OPG would not continue to invest

if we found that this was just an unsafe project; we would stop the project.

In fact, as part of our application you will note that we have a decommissioning guarantee should we decide not to proceed with this project because that envisions that there could be something, I can't predict what it is, because at this time the safety case is sound for this project and we have put in place the framework, if you will, to test that safety case. So we have to get through that process to understand if there is something there but, as I say, it is a strong safety case.

You know, this is a good project from the rock perspective, it is a good project from the safety perspective and so it would be an unusual event for us to come to a point where we would need to say we are not going forward.

But that is not to say that we have completely thrown that aside because we do have this decommissioning guarantee in place.

THE CHAIRPERSON: Thank you.

CNSC, perhaps you could assist the Panel further with maybe drawing some comparisons to uranium mines and unexpected

eventualities?

--- Pause

DR. THOMPSON: Patsy Thompson, for the record.

I'm going to go through the process from EA as a planning to the phase licensing process, hopefully to put things in perspective and to give a good sense of where this CNSC would take strong measures and for what reason.

So the stage we are at now is the environmental assessment and the first phase of the licence, which is a licence to prepare the site and construct the DGR.

The environmental assessment, as a planning tool, also aligns with what is being done internationally in terms of looking at the whole lifecycle of the project that is for long-term disposal of radioactive waste.

We have received enough information with the site characterization work and the other work that has been done to have a good understanding of what the potential health and environmental issues would be for the whole project and we have a high level of confidence

with the information that exists now that the project can be carried out safely, can be closed and ensure long-term safety.

Should the EA decision be positive, the first licence that would be issued is a licence to prepare the site and construct. The licensed activities included in that work need to be carried out in accordance with the management system, the environmental protection program, the -- not the Radiation Protection Program, but the Worker Health and Safety Program to ensure that throughout those activities the CNSC's mandate in terms of protection of the health of workers, the health of the public and the environment are met.

Should OPG do anything that would compromise the health, safety or the environment during those activities, the CNSC has a range of compliance and enforcement tools at our disposal.

We mentioned in the presentation this morning that if there is an immediate threat to health and safety the CNSC would issue orders for immediately stopping the work. If there were other events or incidents less significant, then we have a process in place to enforce compliance

and events get reported to the Commission and dealt with in public.

The Geo-Scientific Verification Program that is also going to take place during that phase of the licence really is for OPG to collect the information to support their application for a licence to operate and to continue with the project.

We would expect that if the project continues to move forward and the licence application for licence to operate would have an updated safety case taking all of the geo-scientific verification work that has been done, that would have been verified by this CNSC and by OPG's own management and experts.

If during that period the geo-scientific verification information would reveal that the site is unsuitable for long-term waste disposal, the CNSC would not be able to issue an order to stop the work, for example, because it would not be an immediate threat to health, safety or the environment given the context of this licence; it would continue to be OPG's business risk.

But as the project moves forward

with future licensing, then the safety case becomes very important and the CNSC would not issue whatever licence is required at the end to decommission if all of the information that is available demonstrates that the site cannot be closed safely.

THE CHAIRPERSON: Thank you.

Dr. Greer...?

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

Well, I guess I'm talking about, you know, the unexpected, the unanticipated, for example an extreme weather event. So I guess we will just have to wait and see because that's just unpredictable and I guess I will just have to leave it there for now, and thank you.

THE CHAIRPERSON: Ms Lloyd...?

MS LLOYD: Thank you, Dr. Swanson. Brennain Lloyd.

My questions also relate to future decision-making. My first question is around I think decisions that are within the licence, which as I understand from discussions, particularly today and particularly they come out of slide 16 around the trigger criteria.

In that discussion -- so I have two parts to this question. One is, I think it was Dr. Thompson talked about three measures that could be taken, the second was mitigation and I'm wondering -- no, the first was mitigation, major change to design was the second. The example that I think was used was a major fracture.

And I can't in my mind think what the mitigation measure would be for a major fracture and I'm not convinced that in a project such as this there is a continuum from minor to major.

So I wonder if Dr. Thompson could speak to that. What, in CNSC's view -- having made that statement, what in CNSC's view would be an effective mitigation to a major fracture?

THE CHAIRPERSON: CNSC...?

DR. THOMPSON: Patsy Thompson, for the record.

What we actually said is not quite what Ms Lloyd has mentioned. What we said was if the Geo-Science Verification Plan shows deviations from one of the above important characteristics, that the deviation would be reported to the Commission in an initial event

report, OPG would do assessment of the findings, we would do an assessment and bring this to the Commission.

We mentioned two possibilities. One possibility is that through the updated safety analysis or safety assessment the long-term safety could not be ensured even with mitigation measures, that would be where we would make a recommendation that the project is no longer viable or we had used the word "abort" I believe.

The other option was a major change in the design of the DGR would be needed to ensure safety and that we said would likely -- we would bring this to the attention of the Commission and would require major changes to the project and would require likely an amendment to the licence.

THE CHAIRPERSON: Thank you, Dr. Thompson.

Ms Lloyd...?

MS LLOYD: All right. I don't know if I should try again on that particular one. I know what Dr. Thompson has just repeated, but there was in the discussion, in discussion of

preliminary triggers, CNSC had noted things that they would measure and I believe, Dr. Swanson, it was in response to one of your questions they had responded that the kind of things they would have as measures or triggers was around low permeability of the host rock, absence of major fractures, absence of economic value. So that was said at one point, and then at another point Dr. Thompson described the different options.

So it wasn't all in the same -- it wasn't all in the same moment, it was different. So I put the two parts of that conversation. So, you know, I will leave it to you whether you want to redirect the question to Dr. Thompson, but I think what Dr. Thompson restated was the second piece and I was interested in how the two pieces fit together.

And I will say that my handwriting deteriorates daily, so...

THE CHAIRPERSON: The Panel does recall the sequence of questioning and I do have some sympathy for sometimes the difficulty in connecting the dots between the questions and some of the statements that are disconnected in time. So, Ms. Lloyd, I think I will ask CNSC to

connect that particular dot.

So I think during questioning I eluded to the discovery of a major fracture as a "what if" scenario and so, Dr. Thompson, if you could take that and connect it to what you have just said, I think that would be helpful.

--- Pause

DR. THOMPSON: Patsy Thompson, for the record.

I will provide a regulatory view and then Dr. Nguyen will provide an example that would require essentially a change to the design and would be brought to the Commission for a decision on a licence amendment.

So the examples we gave this morning of characteristics that are important to safety are: one, low permeability of the host rock; secondly, the absence of major fractures; and thirdly, the absence of economically viable resources.

We said that if the Geo-Scientific Verification Plan showed discrepancies or deviations from the expected and what had been modelled in the safety case, the safety assessment, that we would expect or require that

OPG rerun their models and redo their safety assessment.

The results could lead to either no possibility of mitigation measures or changes to the project.

Dr. Nguyen can speak to the situation in Scandinavia where fractures are expected and what is contemplated and this would essentially, for the CNSC, result in a change in the design.

DR. NGUYEN: Son Nguyen, for the record.

My experience from Scandinavian countries like Finland or Sweden, we were talking about granitic rock there and the difficulty in characterizing or determining whether major fractures could be found from surface investigation.

So in one of the scenarios, one of the things that those countries would -- they put this into account in the design of the facilities so there might be an opportunity, for example, once you are underground and you encounter a major fracture zone you can change the configuration of the repository by relocating

the panels and the rooms a set distance, which is determined from safety assessment from the fractures so the repository would straddle the fractures on both sides, for example, with certain distances which are acceptable from the results of the safety case.

THE CHAIRPERSON: Thank you.

Ms Lloyd...?

MS LLOYD: Yes. Thank you, Dr. Swanson.

The second part of my question I think follows from part of Dr. Thompson's answer and that is around when decisions go to the Commission versus when they are staff decisions.

So this morning Dr. Thompson said that, when she was talking about mitigation measures, design change and if it was a design change it would move forward to a public forum.

If I can read my handwriting, and I think I can in this instance, she said a public forum. When I read section 3 of the Draft Licence Condition Handbook, it looks like it's a staff decision-making role and the final part of section 3 says it will be reported to the Commission. So it's not at all clear to date

what decisions actually become Commission decisions versus -- when you said a licensing amendment, it appears to me, both from Dr. Thompson's comment this morning and the Draft Licensing Condition Handbook, that the bulk of decisions, if not all the decisions past the licence are staff decisions.

So when are they not staff decisions and if they are going to a Commission meeting instead of the Commission hearing, generally speaking there is no opportunity for public engagement.

THE CHAIRPERSON: Got it, Ms Lloyd.

MS LLOYD: Okay. Thank you.

THE CHAIRPERSON: Dr. Thompson...?

DR. THOMPSON: Patsy Thompson, for the record.

There are -- as Ms Lloyd noted, in the licence there are certain things where authority is delegated to staff to take some decisions in terms of certain hold points, for example, or receiving program documents from the proponent, but it would be the licensee once the

licence is issued on programs that have not yet been fully developed. And so there are decisions that the staff can make, it's usually at the DG level or Director level that are delegated authorities from the Commission.

When events happen it is reported to the Commission in a Commission meeting, and so there is no interventions normally. There have been exceptions, but usually the meeting is not for decision-making, it is for information.

But in the situation where we are looking at a major deviation from the licensing basis, then this would be considered in a public hearing with public consultation, public engagement process. So it would be in a hearing for decision.

THE CHAIRPERSON: Supplementary to that, Dr. Thompson, can you give us a quick example of what a major deviation from a licence condition would look like?

DR. THOMPSON: In the case we have been discussing it would be that the DGR requires a change in design because the safety case cannot be maintained with the current design.

THE CHAIRPERSON: Thank you.

Ms Lloyd...?

MS LLOYD: Thank you, Dr. Swanson.

My second question, and it follows well from this, yesterday CNSC confirmed that there wouldn't be any future environmental assessment hearing so we are left with the licensing process.

I'm going to focus more in on the licence amendment because that sounds like, you know, the most we could expect in terms of changes within the design post the issuing of the licence.

I have just done a really quick analysis of decisions from 2006 to 2014 made by the Commission of the public hearing -- this isn't the Commission meetings, the public hearings, 60 percent of them were closed, looking at just the hearings; from 2014, two thirds of them were closed. That means there is no opportunity for public intervention.

In some cases, and I didn't have time to do a full analysis, in some cases we can do written comments, in some not even written

comments. All of the closed hearings in 2014 to date have been one-person Commission, there is one Member considers those licence amendments.

So I'm not comforted. You know, I am really not comfortable with all the decisions being made at staff level, but I'm not -- you know, I would like something from CNSC through you to say you are charged with making an EA decision, but you only are the decision-maker for the first licence, not for the licence amendments and not for the subsequent licence.

THE CHAIRPERSON: Yes, got it, Ms Lloyd.

MS LLOYD: Okay.

THE CHAIRPERSON: CNSC, I think we need to clear a few things up with respect to the process.

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

Yesterday the question was fairly focused on, would an expansion of the repository as it is planned now require an environmental assessment under the *Canadian Environmental Assessment Act 2012.*

What Ms Kiza Francis did was to

go through what is currently the designated project list where it states that an expansion of 50 percent of surface facilities would trigger an EA under the *Canadian Environmental Assessment Act 2012.*

We also said that an amendment for, as we were discussing, to include decommissioning waste and change the project from 200,000 cubic metres to 400 cubic metres, which has been discussed from the currently planned two panels to more panels would require a licensing decision by the Commission and would require an extensive environmental assessment of the proposed amendment.

It would not be done under the *Canadian Environmental Assessment Act 2012* because there is no requirement for it, but there is a requirement under the *Nuclear Safety and Control Act* that the Commission cannot make a decision unless it is satisfied that the environment will be protected, the health and safety of workers and the public.

There are requirements in regulations for licensees to develop environmental risk assessments, environmental

programs where essentially the project has to be described, the sources of stresses to the environment have to be described, they have to be assessed, levels of effects on people and the environment have to be described, mitigation measures to minimize or eliminate them have to be described.

That is essentially an environmental assessment as we know it and that would be done under the *Nuclear Safety and Control Act.* It would require essentially extensive work from the licensee.

We have had, for I believe three years now, the authority to have a participant funding program. That participant funding program would make funds available to the public and NGOs for participation and Aboriginal groups, and so it would be a fully transparent, open process and we were discussing the request to amend the licence to essentially change the project to one that includes waste from decommissioning activities and a larger volume of waste.

THE CHAIRPERSON: Ms Lloyd...?

MS LLOYD: Dr. Swanson, I don't

think that speaks to the issues raised about the licence amendment and the practice within CNSC of holding closed hearings, one Member, no public intervention, but I'm going to leave that.

It's the end of the day and I want to take the opportunity to thank you and Dr. Muecke and Dr. Archibald. You have shown yourself to be a very capable Panel.

I think one of my concerns about decision-making in the future is that this very capable Panel has a limited term. So, you know, ask what you need to ask and make the decisions you need to make.

I really thank you for your diligence and your perseverance. So thank you.

--- Applause / Applaudissements

THE CHAIRPERSON: The Panel sincerely appreciates that, Ms Lloyd. Thank you.

CLOSING REMARKS

THE CHAIRPERSON: So we have now come to the end of the proceedings for the reconvened hearing.

Before I make my closing remarks,

the Panel will deal with a request for a ruling submitted to the Panel prior to this hearing.

The Panel has received from Mr. John Mann, a registered participant, a number of e-mails containing various requests for ruling. The Panel has reviewed Mr. Mann's submissions and our detailed decision will be posted on the Panel's record and available to the public within the next week.

The Panel has determined that the requests do not contain any information that warrant granting the relief sought, therefore, the requests are denied.

This concludes the agenda for the additional public hearing days.

The Panel is now pleased to be in the position to invite registered hearing participants and the proponent to submit written closing remarks.

As I hope you recall, the Panel released the procedure for closing remarks by proponent and registered hearing participants on October 18th, 2013, it is document No. 1721 on the public registry.

In compliance with that

procedure, closing remarks from participants, including Aboriginal groups and government participants are to be submitted to the Panel by October 9.

The deadline for closing remarks from Ontario Power Generation is October 19, 2014.

Please note that closing remarks are optional and not a requirement. Written closing remarks are to summarize the position or opinions of the registered participant or the proponent on the proposed DGR project or any aspect of the review and are to provide support for this position based on information that is already on the record.

New information may not be presented in the closing remarks submission.

Once the Panel has reviewed the closing remarks, it will determine if it has all the information it requires to proceed with the preparation of its Environmental Assessment Report.

If further information is required we will ask for it. If no further information is required, the record for the

review will be closed and no further information will be accepted.

A Public Notice inviting closing remarks will be issued and sent to registered hearing participants and the proponent tomorrow, Friday, September 19th.

Within 90 days of the close of the record, the Joint Review Panel will submit an Environmental Assessment Report to the Federal Minister of the Environment outlining our conclusions on whether or not the proposed project is likely to cause significant adverse environmental effects. We will provide our rationale and our recommendations in that report.

Subject to the Government of Canada's decision, the Panel may then be authorized to make a decision on the application for a licence to prepare the site and construct the DGR.

Beginning with the appointment of the Panel on January 24, 2012, the Panel has collected information and held public hearings for the purpose of meeting its responsibilities for both the environmental assessment and the review of the licence application under the

Nuclear Safety and Control Act.

Should the Government's decision on the environmental assessment allow the Panel to proceed with a licensing decision, the Panel will determine if the information already on the record relating to the licensing application is everything the Panel needs to make a licensing decision. That determination will be made by the Panel once the government has provided its decision on the environmental assessment.

As we come to the end of this, the last public hearing date for the Deep Geologic Repository Project, the Panel acknowledges and thanks the Saugeen Ojibway Nations upon whose traditional territory these hearings were held.

The Panel also thanks the Historic Saugeen Métis and the Métis Nation of Ontario and acknowledges that the proposed project is located within Métis traditional territory.

We thank Kincardine for once again hosting this Panel and we especially thank the Kincardine Legion and staff for the use of their facilities, the daily lunches and snacks

and the very welcoming atmosphere.

We particularly want to thank the Legion for ensuring that special dietary requirements were accommodated. This was very much appreciated.

The Panel sincerely thanks all participants in the last eight days, as well as all of those who participated in last year's hearing. The Panel sincerely appreciates participants taking time out of their normal lives to attend, present submissions and to ask probing questions.

We express our thanks to OPG and to CNSC for once again demonstrating professionalism and commitment to provision of information to the Panel.

I thank the federal and provincial ministries who attended in person or by phone and provided the Panel with valuable additional information.

The Panel acknowledges and thanks the Panel Co-Managers, legal counsel, Secretariat staff, the audio-visual team, translators and transcribers and security personnel who all provided such excellent support to the Panel and

who ensured that this hearing proceeded smoothly.

Once again, you have demonstrated a truly impressive level of teamwork, dedication, stamina, skill and good humour.

I now adjourn the hearing and wish all of you a good evening and safe travels home.

--- Applause / Applaudissements

--- Whereupon the hearing concluded
at 5:09 p.m. / L'audience s'est terminée
à 17 h 09