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| **Canadian Nuclear Safety Commission** | **Commission canadienne de sûreté nucléaire** |
| **Public meeting** | **Réunion publique** |
| **April 6th, 2016** | **Le 6 avril 2016** |
| Public Hearing Room<br>14th floor<br>280 Slater Street<br>Ottawa, Ontario | Salle des audiences publiques<br>14e étage<br>280, rue Slater<br>Ottawa (Ontario) |
| **Commission Members present** | **Commissaires présents** |
| Dr. Michael Binder<br>Mr. Dan Tolgyesi<br>Dr. Sandy McEwan<br>Ms Rumina Velshi | M. Michael Binder<br>M. Dan Tolgyesi<br>Dr Sandy McEwan<br>Mme Rumina Velshi |
| **Secretary:** | **Secrétaire:** |
| Mr. Marc Leblanc | M. Marc Leblanc |
| **General Counsel:** | **Avocate générale :** |
| Ms Lisa Thiele | Me Lisa Thiele |

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Ottawa, Ontario / Ottawa (Ontario)

--- Upon commencing on Wednesday, April 6, 2016, at 3:44 p.m. / La réunion débute le mercredi 6 avril 2016 à 15 h 44

**CMD 16-M10**

**Opening Remarks**

**M. LEBLANC :** Bon après-midi, Mesdames et Messieurs.  Désolé pour le retard pour le début de cette réunion publique de la Commission canadienne de sûreté nucléaire.

We still have simultaneous interpretation and we would ask all participants to keep the pace of speech relatively slow so that the interpreters have a chance to keep up.

Des appareils d’interprétation sont disponibles à la réception.  La version française est au poste 2 and the English version is on channel 1.

We would ask that you please identify yourself before speaking so that the transcripts are as complete and clear as possible.

This proceeding, as the previous one, is being video-webcast live and archives will be available on our website for a three-month period after the closure of the proceedings.

Please silence your cell phones and other electronic devices.

Monsieur Binder, président et premier dirigeant de la CCSN, va présider la réunion publique d’aujourd'hui.

President Binder.

**LE PRÉSIDENT :** Merci, Marc.

Good afternoon and welcome to the meeting of the Canadian Nuclear Safety Commission.

Mon nom est Michael Binder.  Je suis le président de la Commission canadienne de sûreté nucléaire.

Je vous souhaite la bienvenue and welcome to all of you joining us via webcast.

I would like to introduce the Members of the Commission.

On my right is Monsieur Dan Tolgyesi.

On my left are Dr. Sandy McEwan and Ms Rumina Velshi.

We have heard from our Commission Secretary, Marc Leblanc.  We also have with us Ms Lisa Thiele, Senior General Counsel to the Commission.

**MR. LEBLANC:**  The *Nuclear Safety and Control Act* authorizes the Commission to hold meetings for the conduct of its business.

Please refer to the agenda published on March 23, 2016 for the complete list of items to be presented today.

In addition to the written documents reviewed by the Commission for this meeting, CNSC staff and other participants will have an opportunity to make presentations and Commission Members will be afforded an opportunity to ask questions on the items before us today.

As we have started to do as a new process recently, we are striving to, on the record, close items or address items that have been addressed in earlier proceedings.

I would like to take the opportunity to now deal with three of those items opened in the context of earlier Commission proceedings.

**Closing of Action Items**

First, concerning the nuclear package incident in Bathurst, New Brunswick, where a package containing a nuclear substance was damaged, the CNSC Duty Officer filed a report to the Secretariat on February 22nd. The President requested more information on the CNSC’s response to this event.  The briefing note from CNSC staff was filed on March 8th and provided to the Commission

Members, providing information on the chronology of the event and a discussion on good practices and potential improvements.

I would like to now ask if the Members are satisfied that this matter has been adequately addressed or are there any remaining questions, seeing that we do have the specialists in the room?

**THE PRESIDENT:** Ms Velshi.

**MEMBER VELSHI:** I do have just one question on the briefing note that was provided, and it was around the timely information on the contents of the package.

The CNSC duty officer got a call at 1549, and it wasn't until 1720 that they actually were able to figure out what was inside potentially the package that was damaged. I didn't see any recommendations come out around that.

Were you satisfied? Were there any learnings around how can we more promptly identify what's inside these packages?

**MR. MOSES:** Colin Moses, Director General of Nuclear Substances Regulation, for the record.

Just to clarify on the timing, the contents of the package on all air shipments, consistent with the *International Air Transport Regulations*, are present on the manifest that's provided to the pilot of the aircraft, and that manifest also provides the contact information for additional information on the package.

I believe the timing between the initial discovery of the damaged package and that was related to the time to confirm that there was no breach of the package and there was no external contamination, and the delay there is a result of the time it took to have the qualified staff brought on site to the airport, with the appropriate equipment, to make that confirmation.

**MEMBER VELSHI:** As I look at the note, you know, the -- I'm trying to see who the CNSC officer spoke to. He spoke to the stewardess, spoke to the co-pilot, maybe, I think, spoke to another third person, and then each of those times -- or the operations manager of the Emergency Operation Centre, but none of them had information on what was inside the package.

**MR. MOSES:** Colin Moses, for the record.

I think one of the lessons learned, that we did highlight in this note, is that the duty officer was required to converse about the event with a number of different individuals. The requirements are actually pretty clear and maybe Mr. Sylvain Faille could add some additional details on that. But since then we have reached out to the carrier to clarify reporting structure and responsibilities, in terms of the different carriers and the different structures of Air Canada, and I'll leave it to Mr. Sylvain Faille to add some additional information.

**MR. FAILLE:** Sylvain Faille, for the record.

In this particular case there was some confusion with some of the people involved at the airport, because it's a very small airport, and I guess the people that were contacting the duty officer were not necessarily the ones that are -- usually the ones that the duty officer deals with. As a result of that, we have reached out, as Mr. Moses mentioned, to Air Canada.

Actually, we have a meeting with them scheduled next week to go over their structure because there's lots of companies that have the same name as Air Canada. There's Air Canada, Air Canada Jazz, and there's Air Canada Red and Air Canada Cargo, and they all have the same Air Canada, but they're not exactly the same company. There's some reporting structure that we want to get a better hold on, too.

So we're meeting with them next week to go over that and see how we can improve in the future for such cargo when they go on board Air Canada flights that are not necessarily operated by Air Canada or Air Canada only.

**THE PRESIDENT:** But just to be clear -- I want to understand -- there was a document that described what's in the package. At least the pilot should have been able to say, "We know what's in it."

**MR. FAILLE:** Sylvain Faille, for the record.

Actually, the document was attached to the package itself --

**THE PRESIDENT:** That's right.

**MR. FAILLE:** -- and that's a requirement. The pilot has information about the packages that are on board, but not the details. But there's a phone number that he can call to get that information, because a copy is kept at the control centre. They didn't contact the right control centre at the time.

**THE PRESIDENT:** So they didn't use the phone number that was on the package?

**MR. FAILLE:** That's correct.

**THE PRESIDENT:** Why not?

**MR. FAILLE:** That's something that we -- we didn't have the information right away, but that's something we want to clarify with them as well.

**MEMBER McEWAN:** But there should be an identifier on the package itself, that should be relatively clear and straightforward to see, shouldn't there?

**MR. FAILLE:** Sylvain Faille, for the

record.

As part of the packaging there's a label attached to the package which shows the isotope and activity. Also, like I mentioned, there was a shipping document that was attached to it. For some reason nobody went close by to the package to get that information. They were trying to get it from other sources.

But you're correct, there's information on the package available to anybody to look at.

**MR. LEBLANC:** Are there further questions and are the members satisfied that this matter can be closed?

--- Off microphone / Sans microphone

**MR. LEBLANC:** So matter closed? Thank you.

**THE PRESIDENT:** Sorry, one last thing.

I thought that eventually you posted a chronology, a detailed chronology, of what happened at Bathurst on our web or somewhere. Was it not done?

**MR. MOSES:** Colin Moses, for the record.

I wouldn't say we posted a detailed chronology of all the different steps that are outlined in this memo. What we did post is information around the closure of the airport, and the circumstances around that, and that was posted on our website, yes.

**THE PRESIDENT:** Okay, thank you.

**MR. LEBLANC:** The second item is about the implementation of regulatory limits for uranium, molybdenum, and selenium in effluents. This was an action arising from a January 2011 meeting of the Commission.

**THE PRESIDENT:** So I really would like to see an independent presentation on this to the Commission. There's a lot of material in there and a lot of bottom-line decisions as to how we're going to proceed ahead, with or without Environment Canada and Fisheries and Oceans, on regulating selenium and molybdenum in our space.

So can we have something -- this very useful note translated into a presentation to the Commission let's say in June?

Who can answer? Who can take it on?

**DR. NEWLAND:** Dave Newland, for the record.

For the record, acknowledged, and we'll work with Mr. Rinker to see if we can manage June.

**THE PRESIDENT:** Okay, thank you.

**MR. LEBLANC:** So the third item is concerning the summary of corrective actions implemented by Cameco Corporation following four action-level exceedances that occurred in 2014 in their Blind River refinery.

In this respect CNSC Staff filed a memo on

February 26th, 2016, to the Commission members. Staff reported having reviewed the investigation conducted by the licensee, where Cameco identified corrective actions to prevent recurrence, and additional steps are now being undertaken by Cameco to enhance worker dose control measures.

So are the Commission members satisfied with the measures taken so that the file can be closed or are there further questions on this topic?

--- Off microphone / Sans microphone

**MR. LEBLANC:** So given there's no further questions, this file is closed.

Thank you.

**THE PRESIDENT:** I would like now to proceed for the adoption of the agenda by the Commission members as outlined in document CMD 16-M.11.

**CMD 16-M.11**

**Adoption of Agenda**

**MR. LEBLANC:** Do we have concurrence? For the record, the agenda is adopted.

Before moving to the approval of the minutes of the January 28th Commission meeting, I wish to note that CNSC Staff filed a memo with the Secretariat on

March 30th to provide an update to the Commission on the transport accident involving uranium concentrate near Swift Current, in Saskatchewan. This was requested at the January 28th Commission meeting.

I understand that Mr. Mooney and Mr. Charette from Cameco are joining us via teleconference regarding this update.

Cameco, can you hear us?

**Verbal Update from CNSC staff**

**MR. MOONEY:** Yes. It's Liam Mooney, for the record. I can hear you clearly.

**THE PRESIDENT:** Okay. So I'll turn the floor to Mr. Moses for an update.

**MR. MOSES:** Thank you.

Good afternoon, Mr. President and members of the Commission.

My name is Colin Moses, and I'm the Director General of the Directorate of Nuclear Substance Regulation.

With me here today are Mr. Sylvain Faille, Director of the Transport Licensing and Strategic Support Division; Monsieur Martin Thériault, Transport Officer of the Transport Licensing and Strategic Support Division; and

Mr. Robert Buhr, Project Officer of the Nuclear Processing Facilities Division.

We're here today to provide you with an update on the transport event that occurred near Swift Current, Saskatchewan, on January 11th, 2016, and presented to the Commission in CMD 16-M8 on January 28th, 2016.

Before I get into the presentation I would just like to note one correction to page 7, second paragraph, of the memo that was provided. This is the paragraph that reflects the doses that Cameco workers received in their cleanup to the event.

The paragraph should read that the accumulated dose over the two-day cleanup for each worker was 0.036 millisieverts, 0.074 millisieverts, 0.091 millisieverts and 0.098 millisieverts, so they were missing zeros in all those four numbers, which does still represent 0.2 percent of the regulatory effective dose limit of 50 millisieverts in a one-year dosimetry period.

So this slide provides an overview of my presentation, starting with background information on the event, and the initial response, as was reported to you in January. I'll then run through the initial setup and assessment, and subsequent recovery operation, that were carried out at the Blind River refinery in Ontario, and conclude with CNSC Staff's assessment of Cameco's activities.

So as you may recall, on January 11th, 2016, the CNSC was notified that a shipment of natural uranium concentrate was involved in a road accident on Highway 4 approximately 10 kilometres north of the city of Swift Current, Saskatchewan, and 260 kilometres south of Saskatoon.

Police and first responders, including the fire department and paramedics, were immediately called to the scene to respond to the accident, and secured the site. Within a few hours responders from Cameco were on-scene and assessing the accident, joined shortly thereafter by a CNSC inspector from the CNSC Saskatoon office.

Due to the increased risk to health and safety of working in the dark, responders decided to begin the recovery operation the next morning. The highway remained closed and site security was arranged for the night to ensure constant surveillance of the accident scene.

The vehicle carrying the container drifted onto the shoulder of the road, overcorrected, and ended up off the road and overturned. As the truck slid forward, the container rolled onto its end.

The driver of the vehicle had minor injuries as a result of the accident, suffering from a bruise on his shoulder caused by the seatbelt. The driver was treated on-site by emergency personnel and did not require hospitalization. No other vehicle was involved in the accident.

The pictures on this side show the final resting position of the vehicle and the container after the accident. As shown, the container detached from the front of the trailer and ended with the doors of the container in the upright position.

During the initial recovery operations one area around a visible breach in the side of the container shown on this slide was identified as having contamination. This was cleaned with a HEPA vacuum and the breach was sealed using expanding foam. No other external contamination was identified.

This slide shows personnel cleaning the exterior surface of the freight container using a HEPA vacuum and the picture on the right shows staff carrying contaminated material to be placed in a package to be sent for disposal.

Once the ISO freight container was removed, Cameco staff conducted further radiation surveys of the grounds in the area where the accident occurred and confirmed that there was no residual contamination. Further, samples collected from the accident site near

Swift Current, Saskatchewan by Cameco confirmed that there was no contamination on the ground.

Once contained in a steel overpack, shown on this slide, the container was initially transported to Cameco's Saskatoon transit warehouse until the necessary oversize and overweight permits were received, before shipping the container to Cameco's Blind River refinery.

Once at the Blind River refinery, in preparation for the unloading of the container, Cameco removed the overpack and placed the container against one of the loading bays of the facility warehouse as seen on this slide. Cameco staff sealed the container against the bay to prevent the spread of contamination outside the work area.

In order to determine the extent of the damage to the steel drums within the container, Cameco staff made a small opening on the doors of the container to gain access to the inside and assess the condition and position of the steel drums within. The hole that's shown on the left picture and the right picture is one taken through that hole showing the initial position of the steel drums.

Based on their observations of the inside of the container, Cameco developed a job hazard analysis in preparation for the work to be done and developed work instructions for the tasks to be performed.

The tasks covered the work instructions, including the setup of the work area to prevent possible uranium concentrate dust migration, ensuring that tools and equipment required to perform the work were available, procedures to access and leave the work area, and drum cleaning and removal procedures.

Hazards that were identified in relation to the radiological properties of the material included the potential spread of the contamination outside the work area, the potential spread of contamination on workers' clothing, and potential inhalation of uranium concentrate.

All personnel entering the work zone where contamination was expected to be present were therefore required to wear personal protective equipment, including hardhats, safety shoes, disposable coveralls, paper booties, and disposable gloves to prevent contamination.

In addition, powered air-purifying respirators were worn in the work area to mitigate the risk of potential inhalation of uranium concentrate. CNSC Staff reviewed the work instructions and job hazard analysis and confirmed that they were acceptable.

As good safety practice, and for the protection of workers against hazardous substances, the warehouse was divided into three zones for the purposes of contamination control. The area where the work was conducted, including the inside of the container, was classified as Zone 3. The majority of the work was conducted inside the container to limit the spread of contamination.

Zone 2, shown on the right here, was established as a transition area for personnel to take off their personal protective equipment and monitor for contamination. Also in Zone 2 was a real-time air monitor to ensure that the concentration of uranium in air was safe for personnel prior to removing their respirators.

Zone 1, or the clean area, which is shown on the left, was located at the entry/exit points of the warehouse, where personnel would put on their personal protective equipment and take breaks.

On February 18th, 2016, Cameco began the unloading of the drums and recovery of the uranium concentrate. Mr. Robert Buhr, Project Officer in the Nuclear Processing and Facilities Division, and Monsieur Martin Thériault, Transport Officer in the Transport Licensing and Strategic Support Division, from the CNSC, were present on site to observe the opening of the container and drum removal and to oversee Cameco's operations in order to verify that the recovery was proceeding in accordance with the proposed approach.

This slide shows Cameco staff unloading a drum from the container on the left and Cameco staff cleaning and sealing a damaged drum on the right.

On this next slide, on the left, you'll see two cleaned and decontaminated drums showing damage that was sustained during the accident.  On the right, Cameco staffers can be seen cleaning the interior of the container.  Note that the yellow powder seen here is uranium concentrate.

CNSC Staff were on site throughout the recovery operation to ensure that Cameco staff performed the work safely and in accordance with the work procedures and CNSC requirements.  The work was completed on February 19th, 2016.  This slide shows the drums following their removal from the ISO freight container within the warehouse building at the Blind River refinery.

In summary, all 63 drums had various degrees of damage.  Out of the 63 drums inside the container a total of 16 were either open or showed varying signs of leakage.  Of those 16, seven were placed in salvage drums, which is a large drum that can be used as an overpack, for ease of movement within the refinery.  The remaining drums did not fit within those salvage drums due to their shape, and therefore their contents was transferred to new drums.

Overall a total of 251.9 kilograms of loose uranium concentrate was collected using a HEPA vacuum. This is the contents of approximately one and one-quarter drums.

The uranium concentrate and the steel drums have since been dissolved and used in the process to refine the uranium concentrate into uranium trioxide at the Blind River refinery.

For your information, the refining process at the Blind River facility does use iron as part of the refining process to optimize the uranium extraction process. As such, Cameco routinely dissolves these used drums that contain the concentrate and other metals and add this to the process to optimize extraction. Given the condition of these drums, Cameco added the entire drums and their contents directly into the refining process.

The drums used were designed for routine conditions of transport as defined in the *IAEA Regulations for the Safe Transport of Radioactive Material*, 2012 Edition, and met the requirements for a Type IP1 package in accordance with the *CNSC's Packaging and Transport of Nuclear Substances Regulations, 2015*.

In this particular event, although the drums were subject to severe accident conditions above those specified in the regulations for this type of package, only a limited amount of uranium concentrate escaped from the drums as a result of the accident and subsequent transfer from Swift Current to Blind River.

All workers and observers were required to wear dosimeters to determine external radiation exposures. In addition, the four Cameco workers directly involved in the cleanup wore electronic direct-reading dosimeters to determine the effective dose received during cleanup. Internal exposures were ascertained using Cameco's urine analysis dosimetry program and post-shift and pre-shift urine samples were collected for all workers and observers to determine internal radiation exposures.

Urine results for all of the observers were below the detectible limit of 0.5 micrograms of uranium per litre. The highest post-shift urine result for the four Cameco workers was 3.1 micrograms, or approximately 5 percent of Cameco's weekly action level of 63 micrograms.

The total accumulated dose over the two-day period for the most exposed worker was 0.098 millisieverts. The highest dose is approximately .2 percent of the regulatory effective dose of 50 millisieverts in a one-year dosimetry period.

CNSC Staff oversaw all parts of Cameco's recovery operations and can therefore confirm the regulatory requirements were respected throughout the operation, from the recovery of the container at the accident site, its transport and unloading in Blind River, as well as the recovery of the uranium concentrate within the container.

Because only a limited amount of uranium concentrate escaped from the packages as a result of the accident, and subsequent transport from Swift Current to Blind River, CNSC Staff concludes that the Type IP-1 packages used for the transport of uranium concentrate performed adequately under the conditions that they were subjected to during the accident.

Internal and external effective doses were ascertained by Cameco using licensed dosimetry providers for internal and external exposures.  Doses to observers and workers were below Cameco's established action levels and well below the regulatory effective dose limit.

As part of the recovery operations, Cameco adopted acceptable work practices to prevent contamination and maintain doses as low as reasonably practicable.  To limit the risk of contamination, the majority of the work was conducted inside the container and all staff entering the area was required to wear personal protective equipment and respirators.

CNSC Staff concludes that the actions

taken by the workers throughout the unloading and cleaning activities were appropriate.

Further, as noted during a January 2016 Commission meeting, samples collected at the accident site near Swift Current, Saskatchewan, by Cameco confirmed that there was no contamination on the ground and that external contamination was limited only to a small area of the surface of the container that was contained and cleaned.

CNSC staff reviewed the results of the samples and clean-up activities and concluded that Cameco's response to the initial transport accident and recovery exercise was adequate and effective.

Information related to the January 11th, 2016 transport accident was posted by the CNSC on the same day and updates were provided throughout the initial recovery operation.

It should be noted, however, that Cameco did not undertake any communication activities related to the recovery efforts. CNSC staff have communicated to Cameco the importance of proactive communications about its nuclear-related activities.

In conclusion, CNSC staff can confirm that there has been no radiological impact on the health and safety of workers, the public or the environment as a result of this event.

Staff remain available to address any questions that the Members may have.

**THE PRESIDENT**: Thank you. Mr. Mooney, do you have any comments to add?

**MR. MOONEY:** It's Liam Mooney, for the record.

Marc-André Charette is on the line as well. Unfortunately, we are in two different locations.

But I think I can summarize by simply saying that the recovery operations at the Blind River Refinery were a success. A planned and delivered approach was implemented. The people and environment were protected. The doses were ALARA and the CNSC onsite confirmed that Cameco met all regulatory requirements in undertaking that work.

**THE PRESIDENT**: Thank you. So let's get into the question session starting with Mr. Tolgyesi.

**MEMBER TOLGYESI**: Merci, Monsieur le Président.

Before my question I should say that accidents are always unfortunate as was this one. On the other side, on the positive side that they saw there were rapid coordinated actions from intervenors; provincial emergency -- emergency, Cameco, CNSC, contractors were there. So there was only a minor injury and thanks to prompt intervention there was no harm to the public nor to environment.

So that is a kind of general statement.

Where I have a question is on Slide 4. First of all, do you have any idea at what speed this accident happened?

**MR. MOSES:** Colin Moses, for the record.

In our reporting requirements, licensees are required to submit an initial report. A subsequent more detailed report was received within 20 days of the event. That report did get into causes of the accident. As was reported in January to the Commission, it did not identify speed as a factor. In addition, the driver was subject to drug and alcohol testing and the results were negative. So largely, the event was attributed to driver error so, as was indicated, the driver deviated off the shoulder, over-corrected and that was the ultimate cause of the accident. So we do not believe that speed was a factor in this accident.

**MEMBER TOLGYESI:** Usually what you observe in similar accidents when you go along the highway due to high speed or wind or curves, the trailer and the tractor are laying usually on the side in a ditch, but the container usually it is fixed on the trailer.

When I am looking at this picture here,

looking at this slide how the container was fixed on the trailer? Because when you look at this slide, it seems that it revamped, which is the doors. It's still attached to the trailer but not the front end which is laying on the floor on the ground. So was the container fixation on the trailer or the attachment investigated?

**MR. MOONEY:** It's Liam Mooney, for the record.

If you would like I can answer that that the methods to secure the sea container in question to the vehicle were twist locks which are standard industry practice for securing sea containers on a chassis such as you see in the pictures on Slides 4 and 5.

**MEMBER TOLGYESI:** So what you are saying is that a twist lock in the front of a container close to the tractor was broken but not revamped?

**MR. MOONEY:** Liam Mooney, for the record.

Yes, that's what we saw on site.

**MR. MOSES:** Colin Moses, for the record.

Now, just I mean this is pure hypothesizing on the circumstances of the event, but what likely happened is due to the speed of the vehicle when it tipped over, the container dug into the ground which caused it to detach from the front end of the trailer and the momentum carried the container up into an upright position.

But again, this is pure hypothesizing.

**THE PRESIDENT**: Ms Velshi...?

**MEMBER VELSHI:** Thank you. And I'd like to thank you for the update. Love the pictures. They really helped explain what happened and what was done about it.

A question for Cameco. So I have got some very quick questions only.

What were the airborne contamination levels in the shipping container or in Zone 3?

**MR. MOONEY:** Liam Mooney, for the record.

I don't have that information at hand. I know Marc-André Charette was present at the time it was unloaded at Blind River and perhaps he could add some additional colour in that regard.

**MR. CHARETTE:** Hi. It's Marc-André Charette here for the record.

I do not have values for the airborne contamination inside the sea container. I don't believe there was much, but I don't have any values. And I know the detector that was in Zone 2 indicated that the airborne -- there was no airborne contamination.

**MEMBER VELSHI:** But while taking samples in Zone 3 as well, correct?

**MR. CHARETTE:** No, Zone 3 was -- it's

Marc-André Charette here for the record.

Zone 3 was being monitored as well, yes.

**MEMBER VELSHI:** And what is the status of the shipping container? Were you able to clean it up enough to just send it to regular waste or was part of it still contaminated and you had to find other ways of disposing it?

**MR. MOONEY:** Liam Mooney, for the record.

On the sea container the decontamination of it had been initiated so it's in progress. But it has not yet been completed. At this time we think we will be able to successfully decontaminate it to the point that it can be free-released.

**MEMBER VELSHI:** Thank you.

**MEMBER McEWAN:** So again just a couple of very simple questions.

If I look at the image on Slide -- sorry, I should have moved to that -- where you have the drums that were not able to be fitted into the salvage containers, it looks as if there were about seven or eight of them. Would one of the lessons learned from this not be that the salvage containers should be bigger to take account of distortion of the drums in an accident like this?

**MR. MOSES:** Colin Moses, for the record.

I'll leave Cameco to answer that question maybe more directly since they are the ones who use and design those drums.

I think the salvage drums; again, Cameco can probably speak to their purpose. I think they were there and available to contain the drums that weren't largely deformed.

**MR. MOONEY:** So it's Liam Mooney, for the record.

In the recovery operation, the focus was on minimizing the handling of the damaged drums and getting them -- and the drums and their contents processed as soon as we could.

Given that we were unloading it in the environment of the Blind River Refinery they were all going to be processed through the Blind River plant in any event. So there was no point in trying to transfer the damaged drums into new drums when they could be just processed through the plant itself.

So we did leave the ones that didn't fit into the salvage packs but, ultimately, they didn't impede the recovery operation and the processing of that material.

**MEMBER McEWAN:** But in other circumstances which would be less controlled than in the refinery, might it not be valuable to be able to put the badly damaged containers into a salvage drum as well?

**MR. CHARETTE:** It's Marc-André Charette here, for the record.

Yeah, we -- there is a possibility. We have a variety of sizes of drums that can be used in salvage operations you know, if the drum is quite damaged. There are larger sizes that can be used as well.

**MEMBER McEWAN:** Thank you.

**THE PRESIDENT:** M. Tolgyesi...?

**MEMBER TOLGYESI:** I have one.

During transportation are these drums containing yellowcake fixed, wrapped, attached or they are just placed in a container?

**MR. MOSES:** Colin Moses, for the record.

Cameco can feel free to add.

But you may recall in January and I apologize for not including that slide, we showed a typical configuration for this type of container. In this case the drums were fixed and strapped and there was two rows -- two levels of drums.

**MEMBER VELSHI:** A question for Cameco. It's on Slide 18 where staff make a recommendation on improving proactive communications. Can you comment on that and why was that not done?

**MR. MOONEY:** It's Liam Mooney, for the record.

In this instance the material in question was from a customer of ours that was being shipped to Blind River. We were listed as responders as part of the emergency response assistance plan approved by Transport Canada. We worked quite closely with the relevant local authorities, particularly the Swift Current fire chief to provide him with information. The information was running quite well and effectively through that particular resource. We were identified as being involved in the recovery operation in the neighborhood of Swift Current and responded to any immediate inquiries that we received.

So we had some concerns about posting the event given balancing our customers' interests with the already quite complete record that was being published in that regard.

**MEMBER VELSHI:** Staff, any comments on that?

**MR. MOSES:** Colin Moses, for the record.

I can appreciate Mr. Mooney's considerations of the commercial.

From our perspective, it really was a missed opportunity. Canada's shipment was destined for Cameco's facility. Cameco was involved in the clean-up and I think this was an opportunity for them to be very clear and public about the recovery operation that they had underway.

CNSC in this case filled the gap. We had a number of postings and pictures made available throughout the recovery operation on our Twitter feed and on our website.

**THE PRESIDENT:** Well, you may appreciate their position. I don't.

Who is the importing licensee? Is it Cameco who holds the importing licence? It came from Australia, right?

**MR. MOSES:** Colin Moses, for the record.

Yes, the importer is the destinee, the receiver of the material and Cameco --

**THE PRESIDENT**: Which is?

**MR. MOSES:** Cameco.

**THE PRESIDENT:** Good. So Cameco is responsible for everything that goes on to this particular activity?

**MR. MOSES:** Colin Moses, for the record.

Yes, that's correct, and all shipments are required to provide contact information for responders and Cameco was identified as --

**THE PRESIDENT:** So once again, Mr. Mooney, please explain to me what is the type of proactive disclosure you don't understand?

**MR. MOONEY:** It's Liam Mooney, for the record.

Again, in the particular circumstances we were somewhat sensitive around the customer nature of the material. Different circumstances if it was our material. But we did work very closely to ensure that the information that was provided by the local authorities was accurate and responded to meet any inquiries.

**THE PRESIDENT:** Why are you leaving it to the regulator to disclose what's going on, on your behalf?

**MR. MOONEY:** It's Liam Mooney, for the record.

That's not our preference in that regard but we do work with the CNSC to ensure that the information that's provided is accurate in those circumstances.

**THE PRESIDENT:** So staff, what are you going to do the next time such events going to happen? Are you going to issue an order here?

**MR. MOSES:** Colin Moses, for the record.

Maybe I will just take a step back and speak to our graduated response to any non-compliances. And in this case we looked at that and we strongly advised Cameco. We communicated to them our expectations.

Their performance in this event will enter into our considerations of our response the next time we look at compliance history when deciding the appropriate regulatory response. So you know whether or not we issue an order really depends on the circumstances of the event. But we do take performance into consideration when making that decision.

**THE PRESIDENT:** Anybody wants to ask any other questions?

Well, I got to tell you, I think staff are being very nice when -- by the time I heard about it, it was too late. But I have got to tell you this is just to -- just to let you know how we feel about this. You better re-read what proactive disclosure means to us.

Anything else on this? Okay, thank you. Thank you very much.

Since we already have the Cameco people here and we have some CNSC staff available, can CNSC staff provide to the Commission a verbal report on a nitric acid spill at Cameco facility?

**DR. NEWLAND**: So Dave Newland, for the record.

We have indeed a short verbal update with respect to a nitric acid spill at the Port Hope Conversion Facility.

I would just like to take this opportunity to introduce a new director, Ms Kavita Murthy of the Nuclear Processing Facilities Division. Ms Murthy will be doing the verbal update.

Thank you.

**MS MURTHY:** Good afternoon, President Binder and Members of the Commission.

For the record my name is Kavita Murthy and I am the Director of Nuclear Processing Facilities Division. With me is John Thelen, Senior Project Officer.

The following is an update to a recent reportable event at Cameco Corporation's Port Hope Conversion Facility.

Cameco Corporation operates this facility under operating licence FFOL3631.00/2017. The operating licence expires on February 28, 2017.

With respect to this event, at approximately 1:15 a.m. on Friday, April 1st a tank in the UO2 plant at the Port Hope Conversion Facility that was undergoing cleaning using dilute nitric acid solution leaked and released an estimated 1,850 litres of dilute nitric acid into secondary containment within the plant. The nitric acid being used was a diluted concentration of about 25 to 30 percent with water. The spilled liquid was directed via the sloped floor towards the sump located below the tank. All released liquid was contained within the plant. The leak was quickly identified by Cameco workers in the vicinity of this activity. These workers immediately donned respirators and started the clean-up activities. Cameco's emergency response team was also placed on standby but was not activated.

Cameco notified the CNSC, the Ontario Ministry of Environment and Climate Changes Spill Action Centre and the Municipality of Port Hope on the morning of April 1st. This event was publicly disclosed on Cameco's website as well as CNSC's website later on the same day.

Cameco has commenced its investigation of the event and in the interim has suspended all cleaning activities until effective corrective actions are identified and implemented.

Based on the information provided in Cameco's preliminary reporting of this event, staff conclude that there are no immediate concerns to workers, the public or the environment as a result of this event and overall, Cameco's response was deemed to be timely and adequate in accordance with the requirements of the *Nuclear Safety and Control Act*, its associated *Regulations* and Cameco's operating licence.

As far as next step, Cameco will provide a full report to the CNSC within 21 days as required under the *General Nuclear Safety and Control Regulations, Section*

*29*.

CNSC staff are now available should you have any further questions. In addition, Cameco is online to answer any additional questions.

Thank you.

**THE PRESIDENT:** Cameco, do you want to add any comments?

**MR. MOONEY:** It's Liam Mooney, for the record.

We concur with respect to the response to the particular event. People were protected and that there was no measureable impact to the environment. The systems in the plant functioned as designed as well as the training for the operators.

As was referred to by CNSC staff we are in early days, having an investigation of the event in accordance with our corrective action process. And of course, the event was posted the same day as it was reported to CNSC staff.

**THE PRESIDENT:** Posted on your website?

**MR. MOONEY:** That's correct.

**THE PRESIDENT:** Why is this different than Swift Current? I am mixing two files here.

**MR. MOONEY:** It's Liam Mooney, for the record.

We saw these events differently, having regard for the care and control of the product in question and the fact that there was also subsequent discussions with CNSC staff around expectations with respect to reporting in addition to the 12-2 requests that had been issued by the CNSC staff in relation to that particular issue.

**THE PRESIDENT:** Okay, thank you.

Questions? So we are going to hear -- we are going to get an update once you know the nature of the root cause.

Staff, is that the plan?

**MS MURTHY:** Kavita Murthy, for the record.

Yes, we will give you an update once we have received the report from Cameco.

**CMD 16-M13**

**Approval of Minutes of Commission Meeting held January 28, 2016**

**THE PRESIDENT:** Okay, thank you. Thank you very much.

I would like to call now for the approval of the Minutes of the Commission Meeting held on January 28, 2016. The minutes are outlined in Commission Member

Document CMD 16-M13.

Any comments, additions? Mr. Tolgyesi...?

**MEMBER TOLGYESI:** I have just two questions. One is related to paragraph 34 on page 9 where in the last four or five lines you are saying that CNL's investigation had found a weakness in the cascading of the engineering requirements to the process of procurement as well as a weakness in quality assurance and surveillance of the manufacturing. This was identified as an area that needs to improve.

Is there a delay to propose or implement improvements or any steps?

**DR. NEWLAND:** Dave Newland, for the record.

So I assume this is in reference to the caddy event.

**MEMBER TOLGYESI:** Yeah.

**DR. NEWLAND**: Perhaps Mr. Kehler could make a few remarks about CNL's planned improvements with respect to procurement and their oversight of that cascading chain?

**MR. KEHLER:** Kurt Kehler, for the record.

There is not a delay in implementing those changes. We already started changes with engineering and specifically quality control onsite even prior to this event occurring, and so in establishing some different responsibilities at the site.

And specifically this event, we actually as I mentioned earlier, changed some of the inspection requirements that came out of engineering, you know, to solve potential future issues specifically here and then looked across the site at other safety class procurements where we, you know, need to investigate if similar issues would occur.

**THE PRESIDENT:** I think this was described in the staff briefing note quite a bit. So I think we have already dealt with a lot of those issues.

Do you want to comment?

**MEMBER TOLGYESI:** Yeah. And the question was only that should we have a kind of delay or some timeline or timeframe for these actions? It's the same for paragraph 38 for those two questions is that should it be their kind of timeframe to complete actions.

**THE PRESIDENT:** CNL, is there a time kind of deadline? Is there a time plan for implementing some of those observations?

**MR. KEHLER:** I'm just not prepared at this moment to address that, so I'll have to come back with some information on that response.

**MR. MOSES:** Colin Moses, Director-General of Nuclear Substance Regulation.

Just if I, perhaps, could help.

In the root cause analysis, it does identify a number of corrective actions. Those corrective actions have dates for completion, and CNSC staff is monitoring CNL's progress and in implementing those corrective actions.

**THE PRESIDENT:** Okay. Any other comments on the minutes?

So do we have concurrence?

So for the record, the minutes are adopted.

So the first real item on the agenda is the status update for Canadian Nuclear Laboratories prototype waste facilities and Whiteshell Nuclear Laboratories as outlined in CMDs 16-M12 and 16-M12.A.

We have representatives from Canadian Nuclear Laboratories, and I understand that Dr. Newland begin this presentation.

**CMD 16-M12/16-M12.A**

**Oral presentation by CNSC staff**

**DR. NEWLAND:** Good afternoon. My name is Dr. David Newland, and I am the Director-General of the

Directorate of Nuclear Cycle and Facilities Regulation.

With me today are Ms. Karine Glenn, Director of the Waste and Decommission Division, Mr. Robert Barker, Senior Project Officer with the same division.

We are here today to present CMD 16-M12, the status update for CNL prototype waste facilities and Whiteshell Nuclear Laboratories.

As part of CNSC staff's commitment to keep the Commission informed on the status of major projects, this CMD provides an update on the Status of CNL's facilities that are undergoing decommissioning.

CNSC staff last updated the Commission on the status in January 2011 in CMD 11-M11 and in December 2014 for the Whiteshell Laboratories in CMD 14-M79. Going forward, CNSC staff will present status updates for these projects on an annual basis, and the next update is planned for spring 2017.

This update is for information only, and no decision is requested of the Commission.

The three three shut down power Reactors are licensed as prototype waste facilities. These include Douglas Point in Tiverton, Ontario, Gentilly-1 in Bécancour, Quebec, and Nuclear Power Demonstration in Rolphton, Ontario.

These facilities are called prototype because of their former role as prototype power reactors rather than prototype designs for waste management facilities.

The three sites are licensed under a single waste facility decommissioning licence that the Commission issued in 2014. The licence only authorizes activities related to storage with surveillance.

Also included is Whiteshell Laboratories, a nuclear research and test facility located near Pinawa, Manitoba. This site is licensed under a nuclear research and test establishment decommissioning licence that was first issued by the Commission in 2008.

The licence authorizes decommissioning and dismantling activities, but the WR-1 reactor, a major component of the facility, is in a storage with surveillance state.

The next slides depict the decommissioning timelines for these facilities.

The timelines for the shut down power reactors represent currently approved timelines drawn from preliminary decommissioning plans and interim end state reports for each of the facilities.

For Whiteshell Laboratories, timelines are drawn from detailed decommissioning plans and the updated implementation schedule that CNL provided to the Commission in 2008 at the time of licence renewal.

This slide depicts the current decommissioning timelines associated with the shut down power reactors. The plans were developed in 2003 by Atomic Energy of Canada Limited, AECL, who was the licensee at the time and described the completion of decommissioning of Douglas Point within 100 years, and between 50 and 100 years for Gentilly-1 and NDP.

Please note that the CMD 16-M12 erroneously reports the end dates for NDP as being three years later.

The scale for the diagrams covers the period from 2016 on the left and to 2110 on the right.

The current licence period is shown in blue, and the remaining storage with surveillance period in grey. The final dismantlement period for each reactor is shown in orange.

The reason for two tracks as shown for G-1 and NDP is that CNL's current plans state that dismantlement will be completed between 50 and 100 years in the future as of that date of the plan in 2003.

This slide depicts the current decommissioning timeline associated with the Whiteshell

Laboratories. The timeline was provided to the Commission in 2008 at the time of licence renewal in CMD 08-H24.

The end of the licensing period is shown in blue on the left, and the final dismantlement period is shown here in orange. In light purple on the right is a 200-year period of institutional control which begins after decommissioning is completed and which extends out to 2237.

CNL has informed CNSC staff that it intends to accelerate decommissioning of Whiteshell and NDP.

For Whiteshell, CNL has expressed its intention to advance decommissioning by 12 years, ending in 2025, while for NDP, decommissioning is proposed to be advanced by 32 years, ending in 2021. Currently, decommissioning timelines for Gentilly-1 and Douglas Point remain unchanged.

Additionally, CNL will be proposing changes to decommissioning approaches for Whiteshell and NDP as well as changes to the proposed end state conditions.

Based on CNSC staff's review of CNL's preliminary information, the proposed changes will require future Commission proceedings.

The three shut down power reactors and the WR-1 reactor at the Whiteshell Laboratories are being decommissioned using CNL's three phase approach.

Phase 1, bring the facility to a safe, sustainable shutdown suitable for storage with surveillance. This has been achieved for all reactors.

Phase 2, the storage with surveillance period which is the current status for these reactors.

And finally, Phase 3, decommissioning where the facility achieves its final end state.

The dates by which this is planned vary for each reactor.

The CNSC requires that each facility, including those that are in storage with surveillance, be maintained safely and that physical systems and programs that are required for surveillance, inspection, servicing and maintenance be maintained.

For example, programs include radiation protection, environmental protection, occupational health and safety, training and aging management.

Physical systems may include electrical power, emergency lighting, heat and ventilation, drainage, security, fire alarm and remote monitoring systems.

All of these sites are similar in age, although different in design, and have similar oversight programs. Some aspects are site specific, such as the surveillance route and water sampling locations, while some are corporate-wide programs such as radiation protection and fire detection.

All three shut down power reactors and Whiteshell's WR-1 reactor have remained in a Phase 2 storage with surveillance state since the 1980s. In addition to surveillance, CNL improves safety and reduces hazards and liabilities in preparation for decommissioning.

These activities include facility maintenance and repair, monitoring radiation hazards and the environment, and maintaining and updating equipment and systems.

CNL also reduces hazards in advance of decommissioning when authorized using a common-sense approach.

CNSC staff oversee CNL's compliance by conducting desktop reviews of annual reports, programs and plans and by conducting on site baseline compliance inspections.

These are conducted annually for the shut down power reactors, and every six months for the Whiteshell Laboratories. In addition, other focused inspections such as those related to radiation protection, security or safeguards are conducted on an as needed basis.

The table on this slide provides a summary of CNSC compliance effort associated with these facilities from April 2011 to December 2015.

Information reported includes the number of inspections and desktop reviews conducted and the total person days of compliance effort for each licence.

I will now pass the presentation to Ms Glenn to discussion the shut down power reactors.

**MS GLENN:** Thank you, Dr. Newland.

Good afternoon, Members of the Commission, Mr. President. My name is Karine Glenn, and I am the Director of the Waste and Decommissioning Division at the Canadian Nuclear Safety Commission.

I will provide an update on the status of the three shut down power reactors.

This slide shows their location. From west to east, Douglas Point is the western-most facility on the left-hand side of the map. NPD is next, shown just east of Algonquin Provincial Park. And G-1 is the eastern-most facility, shown on the right side of the map.

Douglas Point, G-1 and NDP were licensed in the 1980s under individual waste facility operating licences. At that time, the storage with surveillance site state was approved by the Atomic Energy Control Board, the CNSC's predecessor.

In 2014, AECL requested that these three facilities be consolidated together in a single waste facility decommissioning licence.

The Commission issued this licence with an associated Licence Conditions Handbook in October 2014, with an expiry date of December 31st, 2034.

Then, in November 2014, as the result of a Government of Canada moving to a government-owned contractor-operated model, the Commission approved the transfer of the licence to Canadian Nuclear Laboratories, CNL, a wholly-owned subsidiary of AECL.

I will now discuss the status of each of the three reactors, beginning with Douglas Point.

The Douglas Point shut down power reactor is located on the Bruce Power site between Kincardine and Point Elgin in Tiverton, Ontario.  It is a 200 megawatt CANDU power reactor that was put into service in 1968 and permanently shut down in May 1984.

Phase 1, which is preparation for safe storage, was conducted from 1984 to 1988.  Since that time, the facility has been maintained in Phase 2, storage with surveillance state.

The turbine and service buildings have been emptied, although the reactor building still contains most components.  Used nuclear fuel was transferred out of wet storage from the irradiated fuel bay into dry storage at the concrete canister storage facility that is located in an exterior area of the site.

This slide shows a drawing of the concrete canister storage facility at Douglas Point. The overhead crane was removed after canister loaded -- loading was completed in 1988.

CNL has made improvements at Douglas Point in a number of areas. They include reconfiguring the transition areas between nuclear and non-nuclear areas to improve flow and to provide more room to apply and remove personal protective equipment.

CNL is also reducing the amount of stored non-contaminated items and furnishings through recycling and conventional disposal.

With respect to low level radioactive waste, CNL has reduced inventory by transferring it to Chalk River Laboratories for storage.

Reducing the inventory of conventional and radioactive waste on site also reduces both fire hazard and decommissioning liability. In addition to achieving reductions in fire potential, CNL is also upgrading the Douglas Point fire detection system.

Asbestos investigations have been conducted on site, resulting in projects to remove or address these hazards.

An inventory of moderator and heat

transport system purification resins, also known as ion exchange resins, remain on site. These resins are radioactive, and are stored in stainless steel tanks underground -- in underground concrete vaults that are designed with access ports for leak detection.

CNL has initiated a procurement process to issue a contract for the transfer of the ion exchange resins stored at Douglas Point to Chalk River Laboratories for storage. Until the resins are moved, CNL continues to monitor and verify the integrity of the storage tanks, which continue to perform well.

This slide shows the ground level floor of the Douglas Point reactor building before and after drums of low level radioactive waste were removed. In addition to reducing on-site waste inventory, removal of the wooden pallets and the contents of the drums reduces potential for fire.

I will now move on to Gentilly-1.

The Gentilly-1 shut down power reactor is located adjacent to Gentilly-1 in Bécancour, Quebec on the shores of the St. Lawrence River, 15 kilometres east of Trois Rivières.

G-1 is a 250 megawatt light water reactor that was put into service in May 1972 and operated until 1978.

Between 1984 and 1986, Phase 1, or preparation for safe storage decommissioning activities were conducted. Since that time, the facility has been maintained in a Phase 2, storage with surveillance, state.

The licensed area of the facility includes the reactor building, the service building basement as well as the spent fuel canister area and the south volume area, which are both located within the turbine building.

The other areas of the service building and the turbine building were decontaminated and transferred to Hydro Quebec for other uses in 1993.

Used nuclear fuel was transferred to the spent fuel canister area located inside the turbine building.

As at other sites, CNL has improved radiation protection practices at G-1, including the installation of new radiation protection instrumentation. CNL has reduced the amount of stored non-contaminated items and furnishings through recycling and conventional disposal and has also reduced the volume of low level radioactive waste stored on site through transfer to a CNSC licensee.

As at Douglas Point, these waste removal activities reduce both the potential for fire and -- but also reduce decommissioning liability.

CNL is also upgrading the fire detection system and conducting asbestos investigations to mitigate hazards to staff.

Tenting has been installed to protect workers entering the reactor building and additional safety requirements have been put into place such as additional protective personal equipment when entering hazardous areas.

CNL plans to continue with asbestos abatement projects in the reactor building in 2016.

G-1 also stores ion exchange resins in sub-surface vaults, and CNL has also initiated a procurement process to issue a contract for the transfer of these resins to Chalk River Laboratories. Until the resins are moved, CNL continues to monitor the tanks, which at this site also continue to perform well.

I will next discuss NPD.

The Nuclear Power Demonstrate shut down power reactor, also known as NPD, is located in Rolphton, Ontario adjacent to the Ottawa River, approximately 25 kilometres upstream from Chalk River Laboratories.

It is a 20 megawatt CANDU reactor that was put in service in 1962 and remained in operation until shut down in 1987.

Phase 1 preparation for storage activities were conducted from 1984 to 1986, and since that time has been maintained in a Phase 2 shut down with surveillance state.

The main components of NPD were the reactor building, the training centre and several support buildings.

Most of these were taken down immediately after shutdown, and currently only the reactor building and gatehouse remain.

Within the reactor building, the turbine and office areas are vacant, although, at lower levels, reactor components remain.

The ion exchange resins and used nuclear fuel are not stored on site. They were transferred to Chalk River Laboratories after shutdown of the reactor.

As at CNL's other shut down reactor sites, improvements to programs and systems at NPD are being made. These include improving the transition areas between nuclear and non-nuclear areas and reducing stored waste inventory by recycling and disposing of non-contaminated items and by reducing the amount of stored low level radioactive waste on site.

As for other sites, the removal of waste reduces fire potential and liability. In order to improve fire protection and emergency management, CNL has reduced combustibles at NPD and upgraded the road to enable access to the river for firefighters.

In addition, fire detection systems are also being upgraded.

CNL has conducted asbestos evaluations at NPD, resulting in projects to address this hazard such as asbestos removal campaigns and installation of temporary tenting to allow access to unremediated areas.

CNL plans to proceed with asbestos abatement projects in the NDP boiler room in 2016.

New radiation monitors and a self-contained emergency shower are being installed and, to address occasional power losses at the site, diesel power -- a diesel power generator was installed to provide an independent source of back-up power.

CNL is also painting certain structural members on site to reduce their rate of corrosion. The following slide shows some of the improvements that are being made.

This slide shows a new radiation monitor on the left and a new self-contained emergency shower that's being installed to the right. The whole body monitor provides a quicker, whole body contamination check than was provided by the previous equipment. And the emergency shower provides a decontamination option for workers that was previously not available at NPD.

The picture on the left of this slide shows a reconfigured radiation zone transition area that allows easier personnel access.  On the bottom right we can see a newly installed fire detector that has been upgraded to current technology.

And this slide shows repainted structural supports in the top photo, while the bottom photo shows the newly installed backup generator.

And in relation to asbestos, this slide shows before and after pictures of asbestos mitigation activities that were performed at NPD. Asbestos mitigation was conducted by specialized contractors working under supervision of CNL's Radiation Protection Staff.

I will now pass the presentation on to Mr. Barker to discuss Whiteshell Laboratories.

**MR. BARKER:** Thank you and good afternoon. My name is Robert Barker.

As shown in this slide, CNL's Whiteshell Laboratories are located between Pinawa and Lac du Bonnet in Manitoba, about 100 km northeast of Winnipeg.

The Whiteshell Laboratories began operating in the early 1960s, but I will limit the licensing history to decommissioning.

The Commission first issued Whiteshell's decommissioning licence in January 2003 for a six-year period. It was then renewed by the Commission in November 2008 for a 10-year period at which time the decommissioning schedule proposed by AECL was accelerated.

This was later followed in 2010 and 2012 by several licence amendments that pertained to changes in report submission dates, revisions to codes and standards, and updates to action levels and document references in the licence appendices.

In October 2014 the Commission approved the transfer of the decommissioning licence from AECL to CNL as a result of the government moving to a government-owned contractor-operated model.

And recently, in January 2016, the Commission approved an amendment request to issue the licence in the revised format with the Licence Condition Handbook.

This slide shows the Whiteshell main campus. It consists of the WR1 reactor, research laboratories and facilities and other support buildings and infrastructure.

This slide shows the cross-section of building B100 where the WR1 research reactor is located. The reactor core in this picture is highlighted here in red.

The other main area of Whiteshell is its radioactive waste management area that is shown here in this slide. It contains spent nuclear fuel in above-ground canisters, as shown in the bottom-left of this photo. And low and intermediate-level radioactive waste in storage buildings, trenches, in-ground containers, and bunkers.

Some of these features are not visible, as about half of the in-ground containers are buried below the surface, being located in the brown disturbed area in the central-lower part of the photo.

Also not visible are the low-level radioactive waste trenches which appears in the mowed grassy areas on the right-side of the photo, extending up to the end of the large shielded modular above-ground storage building near the top.

At Whiteshell, CNL continues to conduct many separate projects related to decommissioning. These include demolition of stages 4 and 7 of the main research building, which is called B300, taking out of service and preparing for decommissioning the decontamination centre, and reconfiguring the services elsewhere, and taking out of service and preparing for demolition the liquid intermediate-level waste circuit at the Liquid Waste Treatment Centre and preparing for and initiating dismantlement of the SLOWPOKE reactor.

CNL has completed its mitigation of

asbestos in the above-ground levels of building B100, which is the WR1 reactor building. Inside the waste management area CNL is performing condition assessments of certain in-ground containers or standpipes and bunkers prior to developing plans to open the structures and extract certain waste for repackaging.

CNL's also retrieving, sorting and repackaging low-level radioactive waste from the early decommissioning of the WR1 reactor that is stored in wooden crates. In order to facilitate this, CNL reconfigured another building in the waste management area into an asbestos-controlled work area that allows for the safe opening, sorting and repackaging of these wastes.

This reduces waste inventory as uncontaminated materials are segregated into more appropriate waste streams while low-level radioactive waste is repackaged into metal waste storage containers.

Whiteshell also conducts many other smaller projects associated with decommissioning. For example, they have reconfigured the main gatehouse and installed a remotely-controlled access gate, relocated radiation portal monitor for vehicle inspections. They have also rerouted the liquid low-level radioactive liquid waste line to allow for the decommissioning of building B300 and had dismantled and removed the meteorological tower and its services.

One recent work package covered the demolition or removal of six storage sheds. And the following slides show some of these projects.

This slide shows a picture of the main research building B300, it houses labs, offices and areas for large engineering projects. The building was constructed in seven stages and decommissioning is to be conducted in stages as well, as areas of the facility must remain in service to support decommissioning in other areas. The first two stages to be dismantled are stages 4 and 7 which are shown here circled in the photo. In preparation for decommissioning rooms in building B300 had their contents removed, including loose items, furnishings, ceiling, services and doorframes. Areas were surveyed for contamination and, if present, it was removed by CNL staff.

These before and after photos show the extent of the work that was conducted in a typical laboratory in this area.

In this slide the top photo shows the liquid intermediate-level radioactive waste storage tank that was removed from its vault at the Active Liquid Waste Treatment Centre. The tank had been substantively decontaminated prior to removal from the vault and was intended to be transferred to a licensed contractor.

Due to the amount of residual contamination, it could not be transferred and it was later returned to the vault. CNL's currently assessing its options for completing decommissioning of this tank.

The lower photo in this slide shows the new replacement laundry facility that was installed in building B300. The existing active laundry facility was put out of service to allow decommissioning to proceed in building B411, which is the decontamination centre.

The laundry is now only used for uncontaminated fabrics and all materials must be cleared by the automated radiation scanner shown in this photo prior to being laundered.

Now when the Whiteshell staff enter an area with potential for contamination, disposable protective personnel equipment is worn.

In this slide we see before and after pictures associated with the dismantlement of the remaining infrastructure of the SLOWPOKE demonstration reactor. The end state for this project is to leave only the concrete pool, its liner and the pool cover for future decommissioning. This will occur when the rest of building B100 is dismantled.

These photos show close-ups of some of the below-grade structures under investigation in Whiteshell's waste management area. In the upper photo the tops of the in-ground containers or standpipes are shown. While the lower photo shows the tops of the intermediate-level radioactive waste bunkers.

Some of these structures which were developed early in Whiteshell's history are known to be flooded. Condition assessments are being conducted in advance of plans to retrieve and repackage these wastes. Environmental monitoring to date shows that the wastes are not impacting the environment.

This slide shows photos from the repackaging activities associated with the waste from the Phase 1 decommissioning of the WR1 reactor. The upper photo shows the wastes in their wooden containers before repackaging while the lower photo shows the waste repackaging area that is also configured as an asbestos-controlled area.

This projected has benefitted reducing fire hazard since low-level radioactive wastes are repackaged into metal containers. And also reduced contaminated waste volumes as uncontaminated waste can be extracted, sorted, and redirected into the appropriate waste streams.

This slide shows the project to redevelop the site access gate. Project activities include the removal of the gatehouse shown in the top photo, relocation of the truck monitor, which is not shown, and the construction of a replacement remote-controlled gate shown here in the bottom photo.

And in this slide, the top photo shows the rerouting of the liquid low-level radioactive waste drainage line that was required to allow for the demolition of the first two stages of building B300.

The bottom photo shows the remnants of the partially decommissioned meteorological tower that has now been dismantled and removed.

I will now turn the presentation back to Dr. Newland.

**DR. NEWLAND:** Thank you.

CNSC Staff are continuing regulatory oversight to ensure that CNL is maintaining the prototype waste facilities and Whiteshell Laboratories safely.

In preparation for the proposed accelerated decommissioning of NPD and Whiteshell CNSC Staff are assembling a dedicated team in anticipation of CNL's submissions to assess the proposals for safety, protection of the environment, and compliance with the *Nuclear Safety and Control Act* and its Regulations.

CNSC Staff conclude that CNL is

maintaining the prototype waste facilities and Whiteshell Laboratories safely. CNL is making progress on decommissioning activities and decommissioning planning at the Whiteshell Laboratories and CNSC Staff are preparing for accelerated decommissioning projects.

As mentioned at the start of the presentation, this update is for information only and that no decision is requested of the Commission.

And with that, this concludes our presentation and Staff are available for any questions that the Commission Members may have. Thank you.

**THE PRESIDENT:** So before opening the floor to questions, I'd like to see if CNL has any comments.

**MR. KEHLER:** I'd like to make an opening statement. Thank you.

Good afternoon, President Binder and the Commissioners. My name's Kurt Kehler, Vice-President of Decommissioning and Waste Management for Canadian Nuclear Laboratories.

With me today is on my right is Dan Coyne, head of the Whiteshell Laboratories Closure Project. On my left is Stephen Kenny, Facility Authority for the prototype reactors. And in the row behind me, are Meggan Vickerd, the NPD Operations Manager, and Allan Caron, the Whiteshell

Operations Director.

I appreciate the opportunity to make a few opening remarks. First, I want to emphasize our commitments to safety, security, the environment and to stakeholder engagement.

The CNL team represented here today brings renewed emphasis on these commitments based on our many decades of international experience safely performing similar work scopes.

Personally, I have more than 35 years experience in DWM, including major decommissioning, waste management, and environmental remediation projects in both the U.S. and the UK. In all cases, values of safety, the environment and stakeholder engagement have been key ingredients to your success.

And as noted in the CNSC Staff CMD, one of our objectives is to reduce the cost of Canadian nuclear liabilities. But in doing so, we will not compromise safety and our commitment to the environment. And we will engage stakeholders frequently and effectively. In fact, our experience has overwhelmingly demonstrated that the safest organizations are the best performing organizations.

We also recognize and understand the importance of Canada's international safeguards obligations, and I can assure the Commission that our decommissioning and waste management activities will respect these obligations.

CNSC Staff CMD talks about our plans to accelerate decommissioning of Whiteshell and NPD. This is correct, and we have established dedicated project teams reporting directly to the President of CNL, Mark Lesinski, the President and CEO. That's to ensure these important projects receive appropriate oversight and executive support.

It is my responsibility to also deliver the low-level waste disposal facility at the Chalk River site which will receive low-level waste. This is part of an integrated strategy to accelerate decommissioning at Whiteshell, NPD and Chalk River while reducing the costs of decommissioning and waste management activities concurrently with improving safety and protection of the environment.

With respect to Douglas Point and G1, our plans are to continue with hazard reduction, but we have not yet made plans for the accelerated closure of these sites.

To achieve this accelerated pace we have supplemented the expertise already at CNL with substantial experience and best industry practices from CNL's shareholder companies.

Throughout our culture change initiatives we will improve the safety culture and operational performance.  We will implement best management and work management practices.  We will apply a risk-informed graded approach to DWM activities consistent with CNSC's policies.

Finally, perhaps most importantly, we are proactively engaging stakeholders and seek  frequent engagement with CNSC in a planned and controlled manner.

I realize these are just words and you may have heard promises like this before.  We are prepared to let our actions speak for themselves and we, over the course of time, expect to be back before you with our successes and demonstrating we have met our commitments.

In fact, we would very much appreciate an opportunity to come back in the coming months to provide an overview of the entire decommissioning and waste management strategy, scope and plans with the belief that having the big picture would be helpful for when we reappear for specific licensing decisions.

Thank you for this opportunity and we'd be please to answer any of your questions.

**THE PRESIDENT:**  Thank you.

Okay.  I'd like to move to question period with Mr. Tolgyesi.

**MEMBER TOLGYESI:**  Merci, monsieur le président.

In regulatory oversight page 4 you are saying that the Baseline Inspection Program is tailored to the specific risks of each facility.  And you are saying that shutdown power reactors are visited or annual baseline compliance is once a year and Whiteshell is on a semi-annual basis.

What's the difference of risks in Whiteshell compared to shutdown power reactors?

**MR. BARKER:**  Robert Barker, for the record.

The shutdown power reactors typically have very few staff on site, the activities are primarily related to surveillance.  While Whiteshell still has quite a number of activities, they've got a large staff compliment, I believe they're in the order of around 370 people on site.  They have an active waste management facility.  They are conducting a decommissioning operation.

So the activities there are substantively different than at the shutdown power reactors.

**MEMBER TOLGYESI:**  Besides the dismantling, is there some other activities, research activities or something else?

**MR. BARKER:**  There are some research activities that are still being conducted at Whiteshell, yes.

**MEMBER TOLGYESI**: And these activities, once dismantled, Whiteshell closed, what will happen? They will stop also?

**MR. KEHLER:** Kurt Kehler, for the record.

Yes, Whiteshell's a closure project, and so those activities will cease at that site to support the closure project.

**THE PRESIDENT:** Thank you.

Dr. McEwan.

**MEMBER McEWAN:** Thank you, Mr. President.

You discuss in several of the slides and in one of the images that you show reconfiguration of the transition zone. Why was that necessary and how much work has it involved, and what improvements did that reconfiguration make to the safety of the workers there?

**MR. BARKER:** Robert Barker, for the record.

The previous transition zone at NPD was just outside a room. Basically, it was several square feet right on the edge of a stairway. It was appropriate, it was not the best location, but it was okay for the number of staff that had to access the facility.

The reconfiguration and the reopening up of the transition area serves several purposes. It makes access and the ability to don and take off personal protective equipment much easier. It allows more people to go through at the same time as well. And should people be contaminated, it provides more space for decontamination.

So it's a general improvement that was conducted both at NPD and at Douglas Point.

**THE PRESIDENT:** Ms Velshi.

**MEMBER VELSHI:** Thank you.

A question for CNL around decommissioning timelines and your plan to accelerate decommissioning for two of the facilities. Maybe you can, based on your experience outside Canada, talk about is that the trend towards decommissioning, accelerating it, and what drove you to make that decision for these two facilities? And why just these two, and not all five of them?

**MR. KEHLER:** Kurt Kehler, for the record.

These two specific facilities were addressed coming out of the contract and the proposal period as put forth by the Government of Canada. So we were specifically asked in that proposal period to address the acceleration of Whiteshell and NPD as target-cost projects. And so those projects received quite a heightened, you know, interest from us and the bidders, and going and understanding the sites, researching the issues and putting in fairly detailed baselines and estimates as part of the proposal process. And then the other sites did not, at this point, receive that type of overview.

That's not to say as we go through to develop our five and 10-year strategy plans we don't now go to the other sites and look at the acceleration which is possible at the other sites as well.

**MEMBER VELSHI:** So maybe staff knows. Is it because the other three coexist with existing nuclear facilities? Like why would these two have been picked for accelerated decommissioning?

**MS GLENN:** Karine Glenn for the record.

Whiteshell was always the reactor that was scheduled to be -- or the facility that was scheduled to be decommissioned the earliest. If you look at the timelines, it had already previously been accelerated in 2008. And so the proposal will be moving that decommissioning up by 12 years. So it's not a substantial shift in time.

With respect to NPD, it is, out of the three prototype reactors, the site that lends itself the most to an accelerated decommissioning at this point in time if only for the fact that there is no fuel remaining on site, the resins are gone, so there is very little left of the facility. A lot of the dismantling was done at the time of shutdown and so it is probably the simplest and most straightforward site to decommission.

**MEMBER VELSHI:** Thank you.

Remind me of the timeline for G-2 because they're going for accelerated decommissioning as well, are they not? I'm sorry. No, I meant Gentilly-2.

**MS GLENN:** Karine --

**MEMBER VELSHI:** Oh, we don't know. Okay. Yes. I thought their indicative timeline was earlier dismantling and I just wondered the implications for G-1, but maybe it's not for discussion today.

**THE PRESIDENT:** But piggybacking on this, I just saw the IAEA report or some NEA report or European report that there is now a trend to move faster. So is it because of the fuel, let's say, in Douglas Point that nobody is in a rush to dismantle it because the fuel is on site and we still haven't got a place to put fuel? Otherwise, why not Douglas Point? And, you know, what's complicated about that and Gentilly-1 -- and by the way, while I'm asking the question, are you talking to Hydro-Québec to do Gentilly-1 and Gentilly-2 at the same time, in the same location? There's lots of questions there. Who wants to start?

**MR. KEHLER:** I can start. Kurt Kehler for the record.

From CNL's standpoint, it's simply just taking the time to go look and put good plans in place at

Douglas Point and G-1. They are much -- more the facilities are there, more the hazards are there. So it will become the cost of decommissioning and the overall budget for the decommissioning waste management project when we lay out our five- and 10-year plans, but it is my intent to accelerate those sites. It is very expensive to continue to keep them in storage, surveillance and to replace roofs and update fire detection systems and keep staff there just to, you know, babysit empty space and keep the hazards. And as the sites get older and older, keeping them in a safe and stable condition gets harder and harder and harder and harder because that's just the way facilities are as they get older. So we will be looking at accelerating those sites.

And then what was the next question? Oh, Hydro-Québec.

We have been having some conversations and I'd probably ask Stephen Kenny to maybe address some of those conversations we've been having with Hydro-Québec about that possibility.

**MR. KENNY:** Stephen Kenny, for the record, I am the Facility Authority for Prototype Reactor Decommissioning.

We do have quite frequent discussions with Hydro-Québec monthly right now over a number of items. We do have agreements in place and we have co-shared our preliminary decommissioning plans and we do talk a fair amount about integrated services. I mean we are embedded on their site. Hydro-Québec owns the property, we own the facility, so it's really important that we monitor and keep apprised of each other's progress on discussions with the CNSC and decommissioning plans and so forth. So we do have quite frequent conversations with them.

**THE PRESIDENT:** Staff, do you want to add anything to this?

**DR. NEWLAND:** Dave Newland for the record.

I'm trying to tread some careful ground here because I really don't want to speak on behalf of the Government of Canada, but the two target cost projects, NPD and Whiteshell, I think were being used as an opportunity to see how quickly sites could be brought to closure because there was a recognition that keeping these sites open for extended periods of time under storage and surveillance is not the best way to go and we've seen internationally that making more rapid progress results in a lot of savings to taxpayers' dollars. And so I think they had identified these two sites in particular because they thought that they were most amenable to a target cost project and for the greatest dollar savings.

That does not mean to say that G-1 or

Douglas Point is not amenable to the same but that would have to be a conversation that would go back to AECL.

**MEMBER TOLGYESI:** I will go back a little bit to Whiteshell. On Slide 8, you are saying that for Whiteshell decommissioning will be accelerated to 2025 from 2037, which means if it's 2025 and if there is research work, it should end before you do all the dismantling. So when do you expect that you will end all that research, et cetera, work not related to decommissioning?

**MR. KEHLER:** Kurt Kehler for the record. I would ask Dan Coyne, the manager of that site, to address that.

**MR. COYNE:** Good afternoon. For the record, I'm Dan Coyne, the General Manager of Whiteshell Labs Closure Project.

The slated -- the research that's going on out at Whiteshell, there is an end date in our contract of 2018 where that research is going to be completed out there, and there's a couple of small little research activities that happen out there and they will be gone also by 2018 to support our closure.

**MEMBER TOLGYESI:** So is this research done by your own employees or it's contracted, the space is contracted and somebody else is doing the research?

**MR. COYNE:** Dan Coyne for the record.

The research is being done by personnel assigned to Chalk River, the big lab, and they are -- they live in Whiteshell and they report to Research and Technology Division of Chalk River.

**MEMBER TOLGYESI:** And so the staff is covered by the three R approach: retain, retrain and redeploy? Because 2018 is very close. So do you have any difficulties to keep them, retain them or you have a problem with departures?

**MR. COYNE:** Dan Coyne for the record.

If we have open opportunities, they will have the opportunity to take a new position and be retrained for it. In some cases, there may be opportunities back at Chalk River and that's where this research is more than likely going to end up. Back at Chalk River, there may be opportunities for them there but that's a couple of years down the road. These are early days but there will be options for the people.

**MEMBER TOLGYESI:** So you don't have a problem with the safety culture, maintain attention to the work and low accident frequency?

**MR. COYNE:** We have an excellent safety record at Whiteshell. We have gone 500 days without lost time injury. So we have a good safety culture and we're trying to make it stronger. In light of all this bad news of a site closing, you know, that's something we focus heavily on, is our safety culture. It's something we're very proud of. And I know the last time the presentation was here, they had five lost times that year going into that last presentation in 2014 when I watched it. So we're very proud of that and that is our focus right now. If it can't be done safely, we don't do it.

**THE PRESIDENT:** Thank you.

Dr. McEwan.

**MEMBER McEWAN:** Thank you, Mr. President.

Again, just sticking with Whiteshell, on page 16, the waste management area, I'm just looking at the projects that you identify here and the work that seems to be implied in those projects. Is that going to be a risk to your accelerated decommissioning timelines and the decommissioning process? Page 16 of the CMD. Sorry. That seems to be a fairly significant amount of work that has to be done. Is there a risk of impact?

**MR. COYNE:** Dan Coyne for the record.

Yes, it is probably on our -- it is on our critical path of our schedule that we're in the process of getting approved through AECL right now, is the waste management area, and we've got a lot of history in dealing with waste management areas that have a bunch of legacy waste put in there. Our risk management plan is heavily focused on the activities that are going on in the waste management area. So yes, there's a lot of risks here with the waste management area, to answer your question, and that's why we're trying to get started as soon as possible going out there and characterizing the waste management area and preparing it for decommissioning.

**MEMBER McEWAN:** So the characterization of the area, are you effectively starting from ground zero or is there some data that you can go back to to sort of help accelerate that process?

**MR. COYNE:** Dan Coyne for the record.

Yes, there is some historical documentation, but again, in the past, we like to also go and see with our own eyes. So we will do some -- you know, put some cameras -- we've done this before, put cameras down in the holes and breach bunkers and go in there and see what we have in there and not rely on data from the past, use it as just a guideline as you prepare your characterization.

**MS GLENN:** Karine Glenn for the record. If I could just add.

The accelerated timeline to 2025 for Whiteshell is a proposal by CNL at this point in time and CNSC staff have not received the application for that nor seen the documentation for that and this will require

Commission proceedings because it involves also a change in their decommissioning strategies for part of the site. As well, the Whiteshell licence will be up for renewal in 2018.

**THE PRESIDENT:** And there's some tough issues for you to come in front of us to discuss, whether you're going to bury it on site, you're going to transport it out of site, bring it back to nature, all those things that I don't know what the answer is yet. You're planning to come to us to do this, right?

**MR. COYNE:** This is Dan Coyne for the record.

We've already come to you, I believe it was two weeks ago, with a new project description and WR1. And we plan to come to you -- again, we're getting our plan, our baseline, which is the eight and a half, nine-year schedule, we're getting it together through AECL right now, getting approvals from AECL, and we plan to come to you and show our integrated, I want to say the integrated approvals we're going to need. Because we're working closely with Kurt and Pat Daly at NPD so that you don't get a ton of paper dropped on you all at once, to put it lightly. So we're trying to have an integrated schedule where we approach you with our changes in our decommissioning plan so it works out for both sides.

**THE PRESIDENT:** Thank you.

Ms Velshi.

**MEMBER VELSHI:** Thank you.

Your offer of coming in front of us to give us this overall plan, I think, would be most welcome before we get hit with an application to look at.

In the written CMD, there are a number of places where there's statements that CNL expects to do so-and-so by the end of March, whether it's dismantlement of stages 4 and 7 of Building B-300 or dismantlement of the slowpoke demonstration reaction and so on. Just to get a sense of how well are you meeting those timelines and are those done?

**MR. COYNE:** This is Dan Coyne for the record.

The SLOWPOKE reactor demonstration reactor is done. The only thing left is a steel liner, which safety-wise, the best way to pull that out is when you have the equipment there to tear down Building 100, when you have a big piece of equipment, trying to rig this, doing a complicated hoisting and rigging evolution. So that is done, the SLOWPOKE demonstration reaction. That was very successful.

Building 300, stages 4 and 7, they were supposed to be done by March 31st. We had a few changes with the subcontractor which pushed the subcontractor out till May. So the anticipated date is May and there is a number of safety issues that we wanted to make sure got covered. So we're okay with the May of this year date. And it's typical with contracts if they go in and find something that -- you know, we found some piping in there with water in it and stuff. So you find changes and that actually will kick your schedule out. But we're planning -- we're watching it closely and we're planning to be complete in May of this year.

**MEMBER VELSHI:** You've done a lot of dismantling activity and cleaning up already and this is probably the first major decommissioning activity undertaken in Canada for nuclear facilities. So have there been any major surprises so far?

**MR. COYNE:** No. I mean this is -- it was very well cleaned, the building was, with regards to contamination. A lot of the contamination was removed during the deactivation process. We really haven't been surprised by much.

What we're really focusing on is subcontractor oversight because, going forward, we don't have the capabilities on site to run the large equipment that demolishes the bigger buildings. But really, no surprises. Things have gone pretty much as planned.

Again, we found little things. Like the contamination below grade is -- you know, that's typical where it will be larger than what you anticipated. So that slows us down a little bit. But doing the right thing and getting it cleaned up to meet the standards is important. But we really haven't found too many surprises on this. This one is relatively straightforward.

I'm interested to see the subcontractor who we have brought on, who has worked around Canada quite a bit, to see their capabilities when we get to the point where the building starts coming down, which we're going to closely watch.

**LE PRÉSIDENT :** Monsieur Tolgyesi.

**MEMBER TOLGYESI:** You know when you're looking, there's lots of waste, low or intermediate, maybe low waste and ion resins from Douglas Point, Gentilly, NPD, all this will be moved to Chalk River Labs. Does the Chalk River licence provide provision to store this volume or should it be revised with the time?

**DR. NEWLAND:** Dave Newland for the record.

Yes, the Chalk River Laboratories licence does have that authority included in it.

**THE PRESIDENT:** When will the shipping start and how radioactive is this stuff?

**MR. BARKER:** Bob Barker for the record. I can speak to the radioactivity aspect of it.

First of all, for Whiteshell, the low level waste that is in the ground trenches will not be shipped to Chalk River. There's quite a volume there. The original decommissioning plan anticipated that they remain in situ and that is why there is a 200-year institutional control period.

The amount of waste that then would be transferred to Chalk River, for example, from Whiteshell would be limited to the intermediate level waste and the fuel waste. And actually the proposals for transferring the fuel waste have not been fleshed out yet. But basically where you have the very large volumes of material is with the low level waste. When you get into intermediate level waste, the volumes are much less.

**THE PRESIDENT:** Talking specifically the ion exchange resin?

**MR. BARKER:** The ion exchange resins are in the volume of several hundred cubic metres combined from Douglas Point and from G-1. So these are not very large volumes and they're intermediate level waste. They are quite active. They primarily have Cesium and some Cobalt.

**THE PRESIDENT:** But do they need special containers? You know, it's transportation issues here.

**MR. BARKER:** They will likely be

transported in type B certified containers which are approved for intermediate level waste transport.

**THE PRESIDENT:** Thank you.

Monsieur Tolgyesi.

**MEMBER TOLGYESI:** You were talking about waste. I will go back to Appendix A and B. I was looking at that and I had some difficulty to correlate these two because on one side, in Appendix A, you are talking about estimated decommissioning waste, radiological -- what does it mean, radiological -- whereas in Appendix B, you are talking of the classification of waste, low or intermediate or high level, and after, number of bundles or volumes. So when you are looking at these two, I have a hard time to correlate that. Could you...

**MS GLENN:** Karine Glenn for the record.

In Appendix A, we're giving an overall volume of the waste and whether it is anticipated that the waste that will be generated will be clean or whether it will be radioactive. The level of activity will depend and will be classified once the dismantling of those installations begins.

With respect to Appendix B, that's the actual waste that's already packaged and stored on site, and that classifies under one of the three categories of waste, either high level waste, intermediate level waste or low level waste. And when we talk about bundles, it's because we're talking specifically about fuel.

**THE PRESIDENT:** What does it mean "N/A" against bundles? There's no activity there? What is this?

**MR. BARKER:** Bob Barker for the record.

There is quite a bit of activity there. It's just not reported in the table.

**THE PRESIDENT:** I guess. So what's the meaning of "N/A"? Not applicable, not available?

**MR. BARKER:** In this case, not available.

**THE PRESIDENT:** Not available?

**MR. BARKER:** Yes.

**THE PRESIDENT:** Why is it not available? You cannot figure out what a 22,000 bundle activity is?

**MR. BARKER:** The activity in any fuel bundle is based on the burnup, how much time it spent in the reactor, the decay period since it's been removed from the reactor. I don't think the data was tracked in that level of detail for all these fuel bundles.

**THE PRESIDENT:** I'm sure eventually you will give us a complete table, right with all the characteristics?

**MR. KEHLER:** Yes. Kurt Kehler for the record.

Before we ever get into moving it, we'll have to know exactly what it is.

**THE PRESIDENT:** Okay. Thank you.

Who is next? Dr. McEwan?

**MEMBER McEWAN:** No.

**THE PRESIDENT:** Ms Velshi?

**MEMBER VELSHI:** For Slide 28, I just needed some clarification. I was a little confused about the third bullet there, "Reactor components remain." You didn't have that for the other two power plants. So remind me again what was meant by that and why is it different for NPD?

**MS GLENN:** Karine Glenn for the record.

It is -- because all three of the shutdown power reactors, the reactor components remain in place. NPD has undergone a significant amount of dismantling. So, for instance, the turbine areas are completely vacant, but the reactor components that are below grade remain in place.

**MEMBER VELSHI:** Fair. So I mean, it's the same at all three. Okay. You need to specify that because here you talk about turbines.

Thank you.

**THE PRESIDENT:** M. Tolgyesi...?

**MEMBER TOLGYESI:** On page 16, just about the Figure 11, the last bullet, you are saying that the waste are being sorted. Does it mean that right now the waste is mixed, it's radiological or non-radiological, it's mixed. How you will sort it?

**MR. COYNE:** It's Dave Coyne for the record.

You're talking about waste re-packaging activity we're doing in Building 421 --

**MEMBER TOLGYESI:** Yes.

**MR. COYNE:** -- at the waste management area?

**MEMBER TOLGYESI:** Yes.

**MR. COYNE:** The waste is -- basically right now the waste is sitting in wooden containers and the wooden containers have been there for quite a long time and they're not in the greatest of shape.

So when you say we're -- it isn't mixed, there is some items we're sorting so that we can size reduce them and reduce the amount of waste we're going to have to get rid of, but it's low level waste that's out there and it's demolition -- or deactivation debris from WR1 reactor.

So when we talk about sorted, some of it may require size reduction to get into a B-25 waste container.

**MEMBER TOLGYESI:** So there's no question of radioactivity, it's question just size or the nature maybe, wood, steel, whatnot, rock?

**MR. COYNE:** Yes, waste minimization is what we're sorting it for and then we were using saws and that type of stuff to get it to fit in the waste containers and maximize our efficiency with regards to waste packaging.

**MEMBER TOLGYESI:** And you are proceeding with asbestos investigation and mitigation, you are removing that. So what do you do on the sites with asbestos; do you store it somewhere, bury it, what do you do?

**MR. COYNE:** If it's non-radioactive asbestos we have disposal capabilities at Whiteshell; if it's radioactive, it gets packaged like the radioactive waste for when the repository opens.

**THE PRESIDENT:** Dr. McEwan...?

**MEMBER McEWAN:** No, thank you.

**THE PRESIDENT:** Ms Velshi...?

**MEMBER VELSHI:** No.

**THE PRESIDENT:** Back to you.

**MEMBER TOLGYESI:** I've run out of questions.

**THE PRESIDENT:** That's good.

--- Laughter / Rires

**MEMBER TOLGYESI:** No, I am finished.

**THE PRESIDENT:** It's okay.

So I have two quickies. Is IAEA still visiting all those sites, the IAEA inspectors? How intense inspection is going on for --

**MR. BARKER:** Bob Barker for the record.

Well, the IAEA would be visiting Whiteshell and Douglas Point and G-1 where the spent fuel is located.

The frequency of the IAEA inspections is equivalent to other nuclear facilities, perhaps even less than an operating fuel packaging facility like you'd have up at Western Waste Management facility.

**THE PRESIDENT:** Okay. And just out of curiosity, why was the crane removed from Douglas Point? Was there a security measure or did they thought it will never, ever be needed again to retrieve this stuff? Anybody knows?

**MR. BARKER:** Bob Barker for the record.

I really don't know the answer to that question, but I believe it could be related to the fact that if the crane was maintained on-site it would have to continually be inspected, it would have to continually be re-certified as operational.

I don't believe at that time they felt

there would be a further need for it until quite some time in the future and so the intention was to rebuild it at some point, if it was needed.

**MR. KENNY:** Stephen Kenny for the record.

In addition to what Mr. Barker said, the crane was dismantled out of the request by the IAEA, so the gantry is still there, but the actual hoist and that was removed for safeguards or --

**THE PRESIDENT:** For safeguard reasons?

**MR. KENNY:** Yes.

**THE PRESIDENT**: Okay. Thank you.

Anything else?

Okay. Thank you, thank you very much. Thank you for your patience on this.

And we are continuing...

We'll take just a break to allow the next presentation to set up. We'll be back here at six o'clock.

--- Upon recessing at 5:53 p.m. /
Suspension à 17 h 53

--- Upon resuming at 6:03 p.m. /
Reprise à 18 h 03

**THE PRESIDENT:** We left the best for last, even though you emptied the room practically.

--- Laughter / Rires

**THE PRESIDENT:** So I'm going to be very formal, as usual. The next item on the agenda is a presentation by CNSC Staff on the Bystander Effect in Radiation Biology and its Relevance to Radiation Protection in Uranium Mines and Mills as outlined in CMD 16-M14 and 16-M14.A.

And I understand that Dr. Thompson will try to take us through this.

Over to you.

**CMD 16-M14/16-M14.A**

**Oral presentation by CNSC staff**

**DR. THOMPSON:** Merci, Monsieur le Président. Donc, je vais le faire en équipe. C'est beaucoup plus facile.

Donc, bonsoir, Monsieur le Président, Madame et Messieurs les Commissaires. Mon nom est Patsy Thompson. Je suis conseillère scientifique à la Direction générale du soutien technique.

I'm accompanied by Mr. Alan Du Sautoy, Director of the Radiation and Health Sciences Division and by Ms Julie Burtt, a Radiation and Health Sciences Officer in that Division.

We are here today to present CMD 16-H14 in response to a request from the Commission following the public meeting held in October, 2014.

As a result of intervenor comments, the Commission sought further information on the relevance of the bystander effect to radiation protection of uranium mine and mill workers.

The CMD provides an overview of the state of the science on bystander effects and other closely related non-targeted effects of radiation, their potential impact on the dose response relationship between radiation exposure and cancer incidence and, finally, their significance for radiation protection of workers and members of the public.

I will ask Ms Burtt to make the Staff's presentation.

**MS BURTT:** Thank you, Dr. Thompson.

My name is Julie Burtt. As mentioned, I'm a Radiation and Health Sciences Officer with expertise in the exciting field of radiation biology.

Before we begin, I'd like to take the time to highlight the main international agencies who contribute to the radiation protection regulatory framework as I will be discussing their role and scientific position on certain matters throughout today's presentation.

First off, the United Nations Scientific Committee on the Effects of Atomic Radiation, or UNSCEAR, provides the scientific basis for the radiation safety regime.

Secondly, the International Commission on Radiological Protection, or ICRP, takes the information from UNSCEAR, the international scientific literature and socioeconomic factors and provides protection philosophy, principles and units.  We often refer to these collectively as the ICRP recommendations.

Next, the International Atomic Energy Agency, or IAEA, develops safety standards and protection programs for member states to adopt.

Finally, the Canadian Nuclear Safety Commission, or CNSC, uses all of this information to develop Canada's regulatory framework which is based on the best available science.

Perhaps the most critical part of this figure is that CNSC Staff provide expertise to all of these international agencies, whether it be from Staff serving as delegates, sitting on working groups or providing comments on draft publications.

CNSC Staff are very involved when it comes to shaping the international regulatory framework.

Furthermore, the CNSC can deviate from

international guidance and recommendations to ensure Canada's best interests are being met. Similarly, other countries have developed their framework based on what is best for their country.

Historically the best available science has taught us that according to the classic target theory of ionizing radiation, deleterious effects such as mutations or cancer are attributed to radiation damage to a cellular target, usually identified as nuclear DNA.

This occurs due to the direct absorption of radiation energy, the consequences of which are expressed in the surviving irradiated cells.

The image on the left shows ionizing radiation passing through the nucleus of one cell and only damaging that nucleus.

The image on the right shows a normal cell being hit by radiation creating a mutation. That same mutation is passed on to progeny or daughter cells after each cell division.

These two images are both demonstrating the targeted effects of radiation.

However, most of the time when radiation causes damage, the cell dies or is repaired. Very rarely the cell is not repaired properly and possibly leads to a mutation. It's important to note that not all mutations lead to the development of a cancer; in fact, it takes on the order of 20 mutations before a cancer develops.

Based on this understanding of how radiation behaves and affects cells, a dose response model was developed to describe how the risk of cancer varies with radiation dose.

A dose response model is a theoretical model that has been established from what we know about the targeted effects of radiation in populations with moderate exposures.  A dose response model is not intended to calculate individual risk of developing cancer from radiation exposure.

An assessment of individual risk requires information on a person's radiation dose, the dose rate, that person's age and sex, as well as other lifestyle, genetic and environmental factors that could impact their total risk.

Despite this information, cancer, if it occurs in an individual, cannot unequivocally be attributed to radiation exposure because radiation exposure is not the only possible cause and there are no generally available biomarkers that are specific to radiation-induced health effects.

The graph on this slide shows the different types of radiation dose response models where the risk of cancer, which is on the Y axis, increases with increasing absorbed dose, which is on the X axis.

The X and Y axis meet at the baseline risk of a health effect, so everything shown on this graph is on top of the natural risk level of developing cancer.

In Canada, the baseline risk of developing cancer is between 40 and 45 per cent. The data points on the graph are shown as open circles with vertical uncertainty bars. These data points come directly from epidemiological studies for which sound data becomes available at approximately 100 millisieverts.

Error bars for each data point demonstrate the wide range of data used to establish the average data point. The lowest dose at which excess cancers, or cancers caused by radiation and not some other factor, have been observed in adult populations is approximately 100 millisieverts.

The different lines on the graph show possible radiobiological mechanisms acting at low doses. The regulatory dose response model currently used to describe how cancer risk varies with radiation dose is called the linear non-threshold model, or LNT for short, shown here as line B.

The LNT model assumes that harmful effects occur in directly hit or targeted cells and the risk from developing cancer from these effects increases as the dose increases. Most types of cancer follow a linear dose response relationship at moderate doses.

There's also strong scientific evidence for other types of dose response models. Line A is supralinear. This model suggests that there is a greater risk of developing cancer at lower doses. Line C is linear-quadratic. This model suggests that repair mechanisms may be more effective at very low and low doses than at higher doses.

For example, this is the model adopted internationally to estimate the risk of leukemia. Line D has a threshold. This model suggests that below a certain dose there is no risk. For example, this is the case for bone cancer from exposure to radium 226. Line E shows the hormesis model which suggests that exposures to low doses induces a protective or beneficial effect.

The basis for the LNT model comes from epidemiology and radiation biology studies. The epidemiological studies which have been found to support the LNT model include the atomic bomb survivor studies, studies of the Chernobyl cleanup workers, studies of patients treated with radiotherapy for non-cancer diseases, studies of minors exposed to radon decay products, and studies of nuclear energy workers. The LNT model is a prudent, conservative model for regulatory purposes. It is not appropriate for risk determination.

Radiation biology studies refer to studies done on cells or animals. They are used to inform dose-response models when no sound epidemiological data is available in the low- and very low-dose region. Both epidemiological and radiation biology studies are reviewed and considered in the development of international reports, like those of UNSCEAR and the IRCP.

Next, we will discuss two types of effects of radiation and cells not directly hit by radiation, what are called "non-targeted effects." These are important because they do not respond linearly to a dose of radiation.

So far in the presentation we've been talking about the targeted effects of radiation. In the last two decades the existence of non-targeted effects have been reported in the scientific literature. These effects are radiation-like effects that have been observed in cells that have not been directly hit by radiation.

Many different types of non-targeted effects exist, including the bystander effect, genomic instability, adaptive response, gene expression, low-dose hypersensitivity and inverse dose-rate effects. This presentation will focus on two types: the bystander effect and genomic instability, which I will discuss in detail on the following slides.

Non-targeted effects can be induced by radiation or other stressors and they are not unique to uranium mines and mills workers. These effects, often referred to as low-dose effects, occur below 1 gray, which is essentially equivalent to 1,000 millisieverts for the purposes of this presentation, and can be induced by different types of radiation, including alpha particles, x-rays, and gamma rays.

Radiation-induced bystander effects are defined as "biological effects that occur in cells not directly hit by radiation, but rather in cells that are in close proximity to irradiated cells." These biological effects range from chromosome damage to cell death, but the entire list of possible types of damage is quite lengthy.

Bystander effects are triggered when only a fraction of the cells present are hit by radiation at doses below about 1 gray. These are moderate to lower doses. At high doses most of the cells have been directly hit by radiation.

In image A you can see the nucleus of one cell getting hit by radiation. This is illustrated by the blue healthy nucleus turning red. In image B you can see that the nuclei of many cells have turned pink, to illustrate that, although they have not been hit by radiation, they have received damage signals from the red nucleus.

The bystander effect as a whole depends on the type of radiation, high or low linear energy transfer, meaning densely or sparsely ionizing, the dose and the dose rate, and the time of analysis after exposure. Again, repair and other mechanisms will ensure that the probability of a cell becoming carcinogenic is extremely low.

Bystander effects depend on communication between cells. A signal is sent from a directly irradiated cell, shown as the signalling cell in the image above, and is received by a cell that did not receive any radiation, shown as the receptor cell in the image. The receptor cell then triggers a biological response to the signal.

The bystander effect is mediated by two main forms of communication: gap junctions and secreted soluble factors into the extracellular space between cells. As seen in the top picture, gap junction signalling occurs when two cells are right next to each other and their cell membranes may actually be touching. A gap junction is a tunnel-like opening that can allow movement of molecules from one cell to another. As seen in the bottom picture, paracrine signalling occurs when the signalling cell sends molecules that can act locally by diffusing inside other cells that are in the close environment.

The other non-targeted effect that we are focusing on today is radiation-induced genomic instability. Genomic instability refers to the accumulation of different types of alterations or changes in the genome being transmitted to progeny or daughter cells. As seen at the top of this figure, the red cell has been directly hit by radiation and the beige cells have not. After cell division you can see that at different time points the beige cells are turning different colours, representing different forms of damage.

The light blue cell has developed a micronucleus, which is a small structure containing genetic material inside the cytoplasm, away from the nucleus. The green cells have developed a mutation. The black cells have died. The large dark blue cell has failed to go through mitosis, or cell division. The purple and red cells have suffered changes in the structure or number of chromosomes in the organism. Again, approximately 20 gene mutations are needed before a cell can become carcinogenic.

The detailed mechanism behind genomic instability is not fully understood at this time. What is understood is that epigenetics and chronic inflammation play a major role in the perpetuation of genomic instability. Epigenetics are changes in gene expression that take place without physically changing the DNA sequence.

An example of this type of change is adding a methyl group, which is a carbon atom bound to three hydrogen atoms, to DNA. Binding this small molecule to DNA has the power to turn gene expression off and effectively stops the gene from doing its job.

As part of the immune response, inflammation plays an important role in defending the body against pathogens, such as bacteria and viruses; however, inappropriate activation of inflammatory processes is an underlying contributor to many common diseases, including playing a role in tumour proliferation and metastasis. An example of this type of response is the ability of inflammatory mediators, like reactive oxygen species, also called free radicals, to destabilize the genome by inducing DNA damage or affecting DNA repairs systems or even altering the cell cycle.

If we pause here to recap, the difference between targeted and non-targeted effects can be shown nicely by putting these two images side by side. Targeted effects of radiation are where the progeny cells contain the same mutation as the parent cell, as shown on the left, and non-targeted effects of radiation are where the progeny cells display different types of damage which were not expressed in the parent cell, as shown on the right.

The reason non-targeted effects are important is because they do not follow a linear dose-response curve. It is not known with certainty whether non-targeted effects are harmful or beneficial. The studies concluding that non-targeted effects could decrease cancer risk are observing high levels of apoptosis or cell death. As shown in black on this figure, a high level of apoptosis results in radiation-induced damage, like mutations, not being perpetuated during cell division. On the other hand, the studies concluding that non-targeted effects could increase cancer risk are observing an accumulation of genomic instability, shown in pink as the first instability event on this figure. An accumulation of genomic instability could then be passed onto the cell's progeny.

It should also be noted again that not all radiobiological effects will lead to cancer. The exact shape of the dose-response curve at low and very low doses is not known and more research is needed to better define the mechanisms of non-targeted effects in plausible scenarios for typical human exposures. UNSCEAR has identified the need to integrate radiobiological and epidemiological research to enhance the understanding of radiation-induced health effects and associated inferred risks related to the induction of cancer, non-cancer effects, and hereditary diseases.

The reason why this presentation does not solely focus on the bystander effect and includes genomic instability is because there's new scientific evidence that supports the hypothesis that these two non-targeted effects interact with one another, and together may facilitate cancer development, as shown on this slide, which we will go through in a clockwise manner.

At the top, in frame A, you can see a cell nucleus being directly hit by radiation, shown by a red nucleus. On the right, in frame B, healthy blue nuclei have turned pink to show that they have received damage signals from the red nucleus.

Reactive oxygen species are considered to be one of the main molecules in the chain of events that leads to the propagation of the bystander effect. If one of the affected bystander cells undergoes cell division, as shown on the bottom in frame C, inflammatory mediators could impede DNA repair or cause the cell cycle not to be completed properly, resulting in genomic instability. In other words, the bystander effect can induce genomic instability, as shown in the left, in frame D.

A possible outcome from frame D is a

possible increased cancer risk. Another possibility is that epigenetic regulation is causing a positive feedback loop between frames D and B, where bystander events can cause more genomic instability, or vice versa, where genomic instability is causing more bystander events, all of which have the potential to facilitate cancer development.

Bear in mind that, as mentioned previously, throughout these processes other processes, such as repair, are stopping cells from becoming carcinogenic and acting against cells getting to frame D. This figure is taken from a recent paper published by CNSC Staff in the Journal of Radiological Protection.

According to the United Nation Scientific Committee on the Effects of Atomic Radiation, the extent to which the bystander effect can modify cancer development is not known, nor has it been established with any certainty whether these effects increase cancer risk by generating more DNA damage in neighbouring cells or decrease cancer risk by defective cells undergoing apoptosis, and therefore stopping the perpetuation of DNA damage. Since the publication of this report in 2012, studies have been published in support of both of these hypotheses.

UNSCEAR concluded that a gross underestimation of the risk from low and very low doses using various dose-response models is very unlikely because this would have been detected by epidemiological studies. Further, UNSCEAR maintains their view that the LNT is an unproven hypothesis, but recognizes the need for a pragmatic tool for radiation protection purposes. Most countries, including Canada, have adopted the LNT model for radiation protection purposes.

Similarly, the International Commission on Radiological Protection is of the opinion that, although there are uncertainties at low doses and low-dose rates, direct epidemiological measures of radiation-induced cancer risk includes the risk from all non-targeted effects.

Of note, in ICRP Publication 99, the ICRP state that due to uncertainties in the low dose region extrapolation from high-dose effects for low-dose exposures may not be justified in all circumstances. The ICRP conclude that the LNT, combined with a reduction factor, is a prudent approach for radiation protection. A reduction factor accounts for the higher biological effectiveness of high doses at inducing damage when predicting damage due to low doses from simple extrapolation.

With the discovery of bystander effects and genomic instability largely occurring in 1992 much has been done to define the determining characteristics of these non-targeted effects. The current research efforts are aiming to determine to what extent different types of non-targeted effects interact with one another, determine whether non-targeted effects increase or decrease cancer risk, develop more relevant in-vivo models and 3D tissue models to accurately portray human exposure scenarios, determine how genetic sensitivity and epigenetic changes induced by high, medium and low doses of radiation can influence risk among many other important areas of research.

Throughout the entire presentation we have been discussing the uncertainty and estimating cancer risk at low and very low doses of radiation. To bring the discussion into a practical setting rather than experiments performed on cells or animals in a laboratory setting, we can look at uranium mines as a good example.

Strict control measures are enforced to reduce potential risk to all nuclear workers in Canada. In uranium mines there are modern ventilation systems, strict regulations and standards specific to the type of facility, stringent and well-monitored radiation protection programs, and of course the application of the ALARA principle, which means keeping doses as low as reasonably achievable considering social and economic factors.

The ALARA principle is implemented by having management control over work practices, training of personnel, control of occupational and public exposures to radiation, planning for unusual situations, and other measures such as radiological performance targets.

The risk to Canadian uranium mines and mills workers has been assessed in several CNSC published reports. In 2014 CNSC Staff compiled information on exposures and risks to uranium mines and mills workers since 2000 for the Government of Quebec's Bureau d'audiences publiques sur l'environnement, or BAPE for short. This report found very low doses, below 0.5 millisieverts per year for every year since 2000.

In 2013 levels of radon decay product exposures for uranium miners were almost 1,000 times lower than what they were in the 1940s and 50s.

In 2003 the CNSC funded a feasibility study that considered modern miners to determine whether it was feasible to estimate the risk of developing lung cancer due to low doses of radon decay products. The study found that the risk of lung cancer at these very low radon decay product exposures would be less than 1 in 24,000, above the baseline lung cancer risk. Such low risk would be practically impossible to detect given the lung cancer risk of the general population due to tobacco smoking and residential radon exposure.

In today's uranium mines doses are so low that the risk is extremely low. As a result any impact non-targeted effects may have on cancer development is impossible to assess in a mine setting, but overall the risk of lung cancer remains very low.

In summary, the current radiation protection framework is adequately protected for members of the public and all workers. As for international guidance, the CNSC Regulatory Framework uses the LNT model to set dose limits and ALARA requirements. Individual cancer risk is not assessed using the LNT, but rather requires information on a person's radiation exposure, the dose rate, their age and sex, different lifestyle choices, their genetic background, as well as certain environmental factors. At this time is it not possible to attribute a cancer to low and very low radiation exposures.

Non-targeted effects are not impacting the health or safety of members of the public or nuclear energy workers. The shape of the dose-response model is not known at low and very low doses. The combination of dose limits and the ALARA principle provides a conservative precautionary approach to radiation protection. For example, at doses below about 100 millisieverts any impact of non-targeted effects should be minimized with the use of the ALARA principle and at doses above about 100 millisieverts any impact of non-targeted effects are captured in epidemiological studies looking at cancer incidence and mortality.

In conclusion, CNSC Staff will continue to stay apprised of all current science and how it could impact our regulatory framework.

I would like now to pass the presentation back to Dr. Thompson.

**DR. THOMPSON:** Thank you, Mr. President, and members of the Commission. This ends our presentation and we're available to answer questions.

**THE PRESIDENT:** Thank you.

Let me start with Ms Velshi.

**MS VELSHI:** Thank you.

Your title is for just uranium mines and mills, but this applicable to all nuclear energy workers, is it not?

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

That's correct. We included in the title "radiation protection of uranium mines and mills" because this issue was raised by an intervenor in October 2014, during a Commission proceeding on the report on the uranium mines and mills performance, but it is essentially the radiation phenomena that applies to all cells and essentially workers and members of the public.

**MEMBER VELSHI:** And in your both written submission and in the slides you say most regulators use the linear non-threshold model. Which ones don't?

**DR. THOMPSON:** I would say that regulators use ICRP recommendations and the LNT for the purposes of dose limits and setting ALARA requirements. There have been groups of scientists essentially, scientific academies, for example the French Academy of Science, that have essentially concluded something different.

The BIER VII Committee report indicated that the LNT was still the most appropriate model for radiation protection purposes. The French Academy of Science concluded that the LNT has no basis in science at the low- and very low-dose range and is probably not appropriate.

Their position, essentially, was taken to offset some of the impacts that the LNT has had in terms of people shying away from diagnostic or therapy treatments that bring more benefits than risk. But for essentially regulatory purposes the LNT is the model used internationally.

**THE PRESIDENT:** Dr. McEwan.

**MEMBER McEWAN:** Thank you.

This must have been a very hard paper to write, I think, trying to balance a regulatory framework with very, very uncertain science and trying to give a balance, which I think you've achieved very well.

You mention sort of other mechanisms which you called "non-targeted effects." I'm not sure that I'd agree, that is hypersensitivity was entirely a non-targeted effect or, indeed, inverse dose-rate effects.

As I've read it three or four times, I've struggled a little bit with the paper because I think maybe by focusing purely on the bystander effect you've sort of lost some of the opportunities to discuss around that very low dose and dose rate part of the curve, that I think it would have made it a more complex lay document and more interesting paper.

But it may be helpful just to briefly give an overview of the low-dose hypersensitivity inducible radioresistance model so that there is a context to that part of the curve. You sort of briefly run over it and don't really go in beyond, right? I think it would be helpful for us to actually understand that part of the curve as you start talking about the bystander effect.

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

You're right, we did only mention in passing other phenomena, such as radioresistance, hypersensitivity, hormesis and other phenomena that have been observed, not just in relation to radiation, but also other chemical toxicants.

Essentially, we focused on the bystander effects but it's something that intervenors have brought in front of the Commission repeatedly as essentially scientific evidence that CNSC and other regulators are underestimating the effects of radiation, and therefore we are not protecting members of the public and workers sufficiently, and so that was the reason for focusing on bystander and genomic instability, and the fact that they now are believed to be acting together.

We could have a more comprehensive report if that would be the wish of the Commission, focusing on the very low-dose effects where there's more information coming out in terms of some of the -- especially with the new genomics and proteomic tools, there's a lot more research being done at the very low doses to try to understand these phenomena, and certainly there has been some research, in France and elsewhere, in terms of hypersensitivity, especially in relation to cancer treatment, for example, and radioresistance.

So it's something we could do, if the Commission wished us to do it, and have a more comprehensive report, but we certainly focused on bystander effects because of the issues raised by intervenors in terms of us not regulating strictly enough.

**MEMBER McEWAN:** Yeah, I'm just thinking that there have been a couple of comments by intervenors, on the hypersensitivity phenomenon in particular, and clearly a lack of understanding of the relationship between hypersensitivity and inducible resistance. So I commend you on this. I think, Mr. President, it might be helpful just to have a slightly, with time --

**THE PRESIDENT:** I'm always for increased knowledge and research but I have to tell you, if you are going to look at hypersensitivity and all this, you had better look at my other favourite topic and that's on hormesis because you know they are this little hormesis sect. I don't know if that's the right way to describe them but those people believe in it and, you know, some of them are real believers.

If they are right, we have imposed, you know, even in a new presentation a layman can reach a conclusion that 100 mSv is a protective level. Why are pushing 1 mSv or go below that because everything -- you reach a conclusion is that below 100 I cannot really detect or cannot have a cause-effect relationship.

So I am coming back to, you know, one of my favourite kind of topics is look what happened in Japan. Then if 100 mSv is the right number, maybe we shouldn't have evacuated so many. So all those questions are being coming out if we don't really know what's going on below 100 mSv.

So that's a long-winded way of saying absolutely, cover the whole territory. Put the point on all those models and let some people argue. But until -- and this is one observation -- until the medical profession, and I was surprised not to see the WHO that one of those models is the one that we should proceed with, which I think they have gone with a linear no threshold, then we are going to stick with a linear threshold with ALARA on it.

So this is my conclusion of reading all this stuff

**DR. THOMPSON:** So Patsy Thompson.

If I could summarize, we could do an information report like we have done for RADICON, for example, or SARP where we would look at the different models and the radiation science at the low and very low dose range and see essentially the weight of the evidence for each of these models.

Hormesis, I know there is a cult but hormesis has been shown to be a real effect, not just with radiation but other chemical toxicants. So it's a real phenomenon normally understood to be a physiological response to stress essentially, a protective mechanism for organisms and when it's triggered and when it stops and essentially leads to toxic response varies with cells, varies with tissues and individuals.

So it's one of the reasons why it hasn't made its way in terms of regulatory philosophy. But we can certainly cover the different angles and provide the weight of evidence behind each of the models.

In terms of whether we have -- the industry has been over-regulated by having essentially those limits of below 100 mSv, you know that the limit for workers is 50 mSv per year and 100 mSv in a five-year period. So it does take into consideration the information we have from epidemiological studies.

I see 1 mSv and ALARA the equivalent as essentially the Pollution Prevention Principle where if you can prevent releases of contaminants to the environment through cost-effective means, it’s a reasonable thing to request and ALARA is a similar type of principle.

So I think it's reasonable to expect that the industry will limit exposures when it's feasible to do so. They have essentially shown over the last decades that it's quite economically feasible to do so. Whether it makes sense in terms of dealing with contaminated sites and post-emergency situations I think everybody would agree that 1 mSv target in those types of situations is not reasonable and causing people to be concerned and scared of going home when levels are above 1 mSv is probably not doing the public any good.

**MEMBER McEWAN:** I mean just on that, what is the background in somewhere like Kerala where it's significantly higher than a milliSievert?

**DR. THOMPSON:** So it's a challenging concept.

Patsy Thompson for the record. I'm sorry.

It's a challenging concept to portray and you have seen people come in front of you saying that, you know, the levels of -- the high cancer incidents, the baseline cancer incidents is essentially caused by natural background radation.

And even if you try to say that in some of the areas where, you know, natural background is considerably higher and cancer rates are not higher, it's a hard sell.

**THE PRESIDENT:** I just saw a study. Somebody sent in a study just on that. They did global epidemiological studies about those high locations where a high level of background radiation, and again they reach the same conclusion, that they couldn't detect any variation in cancer or in mortality in those areas.

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

UNSCEAR is working on a report now that looks at all the studies that have been done in low -- in natural background areas or in areas contaminated at background levels or similar to background levels. It has been a challenging report to finish, because although there is a lot of studies, the study designs are not necessarily robust. The simple analysis isn't robust.

So it's a report that is being worked on but it has had, I would say, very robust discussions around the interpretation of those studies. But it's a report that is under consideration at the June session again.

**THE PRESIDENT:** Mr. Tolgyesi...?

**MEMBER TOLGYESI:** Merci, Monsieur le Président.

Before I will jump on something what I don't really know too much, in your conclusion I have a comment. It's before or second paragraph; one, two, three, fourth line from the bottom, you are saying, "Typically, epidemiological studies of modern uranium workers". I have a kind of a bad perception of this expression because if it’s the miners we should say that epidemiological studies of workers using modern uranium mining methods because modern uranium workers, maybe they are not modern. They are working in a modern, you know, environment but they not necessarily modern.

--- Laughter

**THE PRESIDENT:** You made several comments.

**DR. THOMPSON:** I understand what you're saying, Mr. Tolgyesi. It's essentially probably an expression that is neither in good English or in good French but it's essentially referring to cohorts of miners with exposures from 1970s onwards.

**MEMBER TOLGYESI:** Yeah.

**DR. THOMPSON**: So in the modern mining area -- no, I agree.

**MEMBER TOLGYESI:** Okay. When I am looking, you know, it says Slide 16, source of page 10 where you are talking about those four pictures and demonstrating that direct ionization and radiation event whereas one ray hitting one cell. It reminds me that it's more as a targeted or medical approach because you target one cell or a bunch of cells which are really close together. But when you are working in uranium mines or in industry, this radiation is coming not only one ray but it's a large bunch.

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

Not necessarily. So at certain doses the phenomena, the physical phenomena can be limited to one cell. But I would also be speaking on something I don't know much about, so I'll ask Mr. Alan Du Sautoy to perhaps talk about the physics of radiation exposure and how cells are targeted like one cell or more cells.

**MR. DU SAUTOY:** With the radiotherapy although you are hitting an organ usually, so you will hit basically all the cells in that organ if you can, so it's very much like this situation A/V where you have lots of radiation which hits all the cells.

In a mine situation you have got a much lower exposure rate so it's much more like this situation where you hit one cell and then there is a lot of un-hit cells around it, untargeted cells around it. So the bystander effect is much greater in the mine situation than it is in a radiotherapy-type situation.

**MEMBER TOLGYESI:** (Off mic) how we could protect or limit in the case of miners or workers that -- what kind of protective measures or instruments or equipment we could supply them that there would be a limited, very limited -- as much limited as possible? Because if you have only one cell which is hit you limit the communication between those cells or transmitting the signal, whereas if you have lots of them the communication transfer will affect a much larger number of cells.

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

I will try to maybe with -- if you look at Frame A on the top --

**MEMBER TOLGYESI:** Yeah.

**DR. THOMPSON:** -- essentially if you had high doses as Mr. Du Sautoy mentioned, in radiotherapy, for example, all the blue cells -- all the cells with the blue nucleus would be hit and would become red.

**MEMBER TOLGYESI:** M'hmm.

**DR. THOMPSON:** And so if all the cells are red there is no un-impacted cell for the signal to go to.

**MEMBER TOLGYESI**: Right.

**DR. THOMPSON:** And so at low doses or lower doses where you have cells that may not have been impacted then that signal can go from the red cell, the irradiated cell to non-irradiated cells. But in uranium mine workers with current radiation protection methods and ventilation systems, exposures are very low. So the likelihood of having a cell irradiated is low and if there is irradiation then there is very few cells that would be hit.

**MEMBER TOLGYESI:** Okay.

**MEMBER VELSHI:** I'm going to jump anyway.

**THE PRESIDENT:** Sorry. No, you are right.

I jumped the queue here.  Ms Velshi, sorry about that.

**MEMBER VELSHI:** So I know that this -- people want to put the issue to rest but what are your plans for disseminating it and making it available and has there -- do you need to go through a public peer review of it?

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

As you saw, we provided essentially I think it's Reference 99 where we did -- Julie Burtt, myself and Dr. Robert Lafrenie publish a peer review paper in the Journal of Radiological Protection on this subject.  So essentially the content, the scientific content has been peer-reviewed through that process.

And we will, if that is the wish of the Commission, prepare a document for posting on our website that would take this but also expand it to the other dose response models and low and very low dose radiobiological effects.

**THE PRESIDENT:** I've got to tell you, listening now to Julie go through this slide deck, I think we have captured your voice here.  I think -- I don't see, unless you tell me it's not a good idea why we shouldn't put it up on our website.  Because the bottom line is here nobody -- we are not going into the deep science of irradiation physics and the biochemistry and all this stuff. It is explaining something has been raised with us a couple of times and we come up to a conclusion that we believe that our model captures that effect. That's all, and I don't see why we wouldn't do that.

I have seen a couple of your videos. You are now a regulatory star. Why don't we do this if you think it's a good idea?

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

We will work with our communications colleagues and make that happen.

**MEMBER McEWAN**: Can I just put a caveat on that?

**DR. THOMPSON:** M'hmm.

**MEMBER McEWAN:** I think that Figure 3 needs to be very, very carefully explained.

**DR. THOMPSON:** So Figure 3 in the slide deck?

**MEMBER McEWAN**: No, Figure 3 in the document. I'm sorry, Slide 16.

**THE PRESIDENT:** It's definitely not designed for Dr. McEWAN-type people who will not read it.

But I think that -- I have got to tell you I understood what was trying to be said here, so I actually thought it was not a bad explanation.  Yes, it can be misinterpreted.  You heard about people looking at it.  But whether it's one cell or one ray, we are talking about a body with billions of cells.  We are talking about radiation where lots of kind of radiation hits.

So we haven't done -- this does not depict the physics of what is likely to happen in the mine but as an illustration of the phenomenon, I thought it did a good job.

**MEMBER McEWAN:**  Again, with respect, Mr. President, I think this is clearly based on in-vitro modelling and in-vitro radiation effects and taken from there.  So I think as you explain it, and I think that was one of the things that I found difficult in the document, that difference between the in-vitro and the in-vivo I think needs to just be made a little bit clearer around this.

It’s a very, very good -- it’s a very good snapshot of what happens.  I think it lacks the context as Mr. Tolgyesi said of the in-vitro to the in-vivo.

**DR. THOMPSON:**  Okay.  Well, we'll make sure we cover that.

**MEMBER TOLGYESI:**  Yes.  Yes.  Yes.  It's quarter to seven, eight to seven.

You know, on Slide 7 you say that LNT is not appropriate for risk determination.

On Slide 6 while you have that graphic those circles mean epidemiological data, okay, which means that there is kind of -- you measure relations between those and the risk. So why you cannot say that, okay, this is additional risk? I'm an engineer. So you know when you go on the curves like this you say this is my dose which I absorb. This should be my risk, increased risk and this is additional risk to the baseline risk which is 40-45 percent having cancer.

So that means that those who are using these data or using in operations, they could say, okay, gee, this is what's a risk, additional risk or what we should watch, because otherwise how you could establish that this "b" line, dotted line which is a linear non threshold has this shape? It could be much more flat or much more steeper. You have -- you base that on this epidemiological data which means there is a correlation between those and the risk.

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

You are right on Slide 6. If you look at the various models from A to E the epidemiological data that is about 100 mSv with the open circles and the uncertainty bands that's data taken from epidemiological studies of tens of thousands of people.

So there is, you know, very good evidence --

**MEMBER TOLGYESI:** Yeah.

**DR. THOMPSON:** -- that if tens of thousands of people are exposed to doses of 100 or 200 or 500 mSv you get an increased risk of cancer. You get an increased number of cancers in those tens of thousands of people. That's the basis for the open circles.

And so if you take that data and then you say, okay, what is the risk at lower doses, the prudent conservative model is to assume that the dose essentially if you continue to be --

**MEMBER TOLGYESI:** Yeah.

**DR. THOMPSON:** -- linear you get an increased risk, linearly with increased dose. But you also have other experimental data that shows that perhaps it's not a straight line.

**MEMBER TOLGYESI:** No.

**DR. THOMPSON:** It's A or C or D or E.

**MEMBER TOLGYESI:** Yeah.

**DR. THOMPSON:** What we are saying essentially is that if you have -- if I was exposed to 200 mSv the LNT would not be able to -- should not be used to assess my risk of developing cancer for that exposure.

**MEMBER TOLGYESI:** Yeah.

**DR. THOMPSON**: If 10,000 of us are exposed then you can make assumptions using the LNT on potentially the number of increased cancers you will see in that population.

But from my individual cancer, if I do develop cancer, no one would be able to say whether it's just bad luck or if it's because of the radiation exposure I had.

**THE PRESIDENT**: But you know but we all understand that but it's totally being abused, not only the calculated risk of this graph. Then they multiply it by, you know, 300 million population and X number will die. That's the headline. They are using those models and, in fact, not only antinuclear people but some doctors will now --

**MEMBER TOLGYESI:** Yeah

**THE PRESIDENT:** -- want us to collect cumulative kind of effects on dosage either associated with CT scan and all kinds of other -- you know kind of radioactive procedures based on something like this that every time you get one of those things your risk increases and it's cumulative.

So again the cumulative effect on top of that.

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

So UNSCEAR, ICRP and other reputable organizations have all said that the LNT should not be used to estimate the number of cancers in populations at low and very low doses. Having said that everybody does it, including some of those reputable scientists.

But collecting information on does for patients, for example, and if we have information on thousands of patients being exposed to radiation and then we can do robust epidemiological studies, it may help us better understand the relationship between radiation and cancer incidents. But it should not be used to estimate an individual person's cancer risk.

**THE PRESIDENT:** Do you want to raise this?

**MEMBER McEWAN:** No.

**THE PRESIDENT:** Any other question?

So thank you. But I also would like to say formally to you, Patsy, we are going to miss you. Thank you for all the years of providing expert advice and guiding us through some very complicated kind of data. Wish you all the best with one caveat. We reserve the right to recall you back for certain files that I am sure we will have to revisit in one of our future hearings.

So on behalf of all my colleagues here,

all the best and thanks for the support.

**DR. THOMPSON:** Thank you very much. I am not leaving because I hate my job. It's just that, you know, family and other things I want to pursue. It's been a great 23 years and I have had the good fortune of being surrounded by great people and great colleagues. Thank you to you.

**LE PRÉSIDENT :** Alors, c'est fini pour aujourd'hui?

**M. LEBLANC :** Oui. Nous allons continuer demain à 9 h 00.

**THE PRESIDENT**: So we are going to restart tomorrow at nine o'clock. Thank you.

--- Whereupon the meeting adjourned at 7:00 p.m., to resume on Thursday, April 7, 2016 at 9:00 a.m. / La réunion est ajournée à 19 h 00, pour reprendre le jeudi 7 avril 2016 à 9 h 00