Canadian Nuclear Safety Commission	**Commission canadienne de sûreté nucléaire**
Public hearing	**Audience publique**
McMaster University: Application to renew its Non-Power Reactor Operating Licence for the McMaster Nuclear Reactor, Located in Hamilton, Ontario	**Université McMaster:** Demande visant le renouvellement de son permis d'exploitation d'un réacteur non producteur de puissance pour le réacteur nucléaire McMaster, situé à Hamilton (Ontario)
May 8th, 2014	**Le 8 mai 2014**
Public Hearing Room 14th floor 280 Slater Street Ottawa, Ontario	Salle des audiences publiques 14e étage 280, rue Slater Ottawa (Ontario)
Commission Members present	**Commissaires présents**
Dr. Michael Binder Mr. Dan Tolgyesi Ms Rumina Velshi Mr. André Harvey Mr. Sandy McEwan	M. Michael Binder M. Dan Tolgyesi Mme Rumina Velshi M. André Harvey M. Sandy McEwan
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 resuming on Thursday, May 8, 2014 at 9:07 a.m. / L'audience reprend le jeudi 8 mai 2014 à 9 h 07

Opening remarks

LE SECRÉTAIRE : Bonjour, Mesdames et Messieurs. Bienvenue à la suite de ces audiences publiques de la Commission canadienne de sûreté nucléaire.

The Canadian Nuclear Safety Commission is about to resume its public hearings, with two hearings scheduled for today.

The Commission meeting started yesterday afternoon and will resume today after the completion of the two public hearings.

During today's business, we have simultaneous translation.

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

Please keep the pace of your speech relatively slow so that the interpreters have a chance to keep up.

I'd also like to note that this proceeding is being video webcast live and that the proceeding is also archived on our website for a three-month period after the closure of the hearing.

Les transcriptions seront disponibles sur le site web de la Commission dès la semaine prochaine.

To make the transcripts as meaningful as possible, we would ask everyone to identify themselves before speaking.

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

Monsieur Binder, président et premier dirigeant de la CCSN, présidera les audiences publiques d'aujourd'hui.

Mr. President

THE PRESIDENT: Thank you, Marc.

Good morning and welcome to the continuation of the public hearings of the Canadian Nuclear Safety Commission.

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

Je souhaite la bienvenue aux gens ici présents and welcome to all of you who are joining us via the webcast.

I would like to start by introducing the Members of the Commission that are with us here today: on my right, Mr. Dan Tolgyesi; on my left, Dr. Sandy McEwan, Ms Rumina Velshi and Mr. André Harvey.

We have heard from our Secretary Marc Leblanc and we also have with us here today on the podium Ms Lisa Thiele, General Counsel to the Commission.

The first hearing today is on the application by McMaster University to renew its Non-Power Reactor Operating Licence for the McMaster Nuclear Reactor located in Hamilton, Ontario.

Marc.

THE SECRETARY: This is a one-day public hearing. The Notice of Public Hearing 2014-H-03 was published on February 13, 2014, and a revised notice was published shortly after to correct the date of the hearing.

The submissions from McMaster

University and CNSC staff were due on March 7, 2014.

The public was invited to participate by written submission and oral presentation. April 7th was the deadline set for filing by intervenors. The Commission received three requests for intervention.

April 30, 2014, was the deadline for filing of supplementary information. I note that presentations have been filed by CNSC staff, McMaster University and an additional submission from one intervenor.

Mr. President.

THE PRESIDENT: I would like to start the hearing by calling on the presentation from McMaster University, as outlined in Commission Member Documents CMDs 14-H4.1 and 14-H4.1A.

I understand that Dr. Elbestawi will make the presentation.

Please proceed.

CMD 14-H4.1/14-H4.1A

Oral presentation by McMaster University

DR. ELBESTAWI: Thank you, Mr. Chairman.

Good morning, Members of the Commission. My name is Mohammed Elbestawi and I am the Vice President of Research and International Affairs at McMaster University.

I'm pleased to be here this morning to address the Commission in support of the renewal of the McMaster Nuclear Reactor's Operating Licence.

The University is respectfully requesting the Commission renew our Non-Power Operating Licence for a period of 10 years.

I am joined today by some of the key members of our team responsible for the safe and efficient operation of the reactor.

To my left is Chris Heysel, Director of Nuclear Operations; to my right is Dave Tucker, the University's Senior Health Physicist; behind us is Mike Butler, the Manager of Reactor Operations; Robert Pasuta, Reactor Supervisor; and Brandon Johnston, Manager of Quality Management and Training.

The McMaster Nuclear Reactor is an important asset to the University. It is at the heart of what makes us Canada's nuclear university. It is an invaluable research and teaching tool that is central to programs in nuclear engineering and applied radiation sciences.

The reactor continues to have an important role in the production of medical isotopes and it is a unique and essential tool for local high-tech industry.

We are very proud of the accomplishments that we have made at the reactor through over the current licence period. Most importantly, we have maintained our very strong performance in safety and security that is always our top priority.

We have made significant improvements in key areas that were identified as priorities at relicensing including fire safety, quality management and training. We have accomplished this during a busy period of increased facility utilization, expansion of research facilities at the reactor and significant renewal of our infrastructure at the facility.

The expansion and investment at the facility continues. We have several new research facilities planned for over the next licence period, which will continue to position McMaster at the forefront of university research in radiation sciences.

Infrastructure improvements will also continue in order to ensure safe, secure and compliant operation of the reactor for years to come.

Thank you for this opportunity to make our opening remarks and with your permission I will now ask Mr. Heysel to make our presentation.

MR. HEYSEL: Thank you, Dr. Elbestawi.

For the record, my name is Chris Heysel. I'm the Director of Nuclear Operations at McMaster University.

It is indeed my pleasure to address the Commission members this morning, members of the CNSC staff, and members of the public in support of the renewal of the university's non-power reactor operating licence.

The McMaster nuclear reactor is an important Canadian asset supporting research, education, and medical isotope production. MNR is operated in a manner that proactively and competently safeguards workers, the public, and the environment. A ten year licence is respectfully requested.

McMaster University is a medium-sized yet research-intensive university located in Hamilton, Ontario.

The university includes 21,000 full-time undergraduate students, 3,500 graduate students, and 7,000 staff members.

The annual research budget for the university is approximately $400 million, and the total university operating budget for year -- fiscal year 2013/2014 was $982 million.

The circle denotes the location of the university, and the white dot is the approximate location of the reactor.

McMaster University is Canada's nuclear university, with the most comprehensive suite of nuclear facilities at any Canadian university. There are a sizeable number of approved and funded projects being carried out of McMaster with the radiological safety infrastructure in place to support the wide range of activities occurring in radiation science and medical isotope research, development, and production.

MNR is the only research reactor in Canada with a full containment structure. This structure supports the strong safety and security case for the facility.

The reactor building is adjacent to the Nuclear Research Building, which contains a large suite of active laboratories and houses staff and researchers using the facility.

MNR is a materials test reactor, licensed to 5 megawatts, which currently operates between 2 and a half and 3 megawatts, 16 hours a day, five days a week.

MNR contains an array of research facilities, making it a flexible research and educational tool.

The reactor is an important supplier of medical and industrial isotopes.

The reactor is operated in an efficient manner to provide a reliable source of supply to our customers.

Cooling of the core is passive, the fuel is cooled by gravity flow. Heat of fission is removed from the primary system by two heat exchangers operating in series. The 400,000 litres of water in the pool provides cooling, shielding, and a massive heat sink for the shutdown core and the associated decay heat. No electricity or other services are required to achieve or maintain a safe shutdown state for the reactor.

MNR is aligned with the main missions of McMaster University. It provides students in a wide range of academic disciplines with a hands-on educational experience.

The reactor enables researchers at the university, throughout Canada and around the world to further their investigations through access to our unique suite of research facilities.

A variety of industries use the facility for R & D, non-destructive testing and analysis.

McMaster University prides itself in its community outreach commitment. Each year thousands of university and high school students tour the reactor and learn about nuclear and radiation sciences.

MNR has an array of commercial products and services. Revenues from these activities are used to support and enable research and education.

The local economy also benefits from MNR, 35 direct and over 250 indirect, highly qualified individuals are employed in the Hamilton area due to the reactor's continued operation.

The photo on the left is a slide of a neutron radiograph of a turbine blade taken to detect manufacturing defects in this part. Over 90 percent of all blades used in the manufacture of aircraft engines in North America are qualified using MNR facilities.

The reactor is a major global supplier of the medical isotope Iodine-125 and ships product around the world every week. The amount of this isotope produced at the facility each day is equivalent to that required to treat over a hundred dads, uncles, sons, or brothers.

MNR is also an important producer of other medical isotopes, which are supplied to Ontario researchers in the development of next-generation diagnostic and therapeutic agents.

The reactor has been very busy over the current licence period developing and implementing a "Systematic Approach to Training" for the reactor operator and reactor supervisor positions.

Over the period three certified reactor operators have retired from MNR and four assistant reactor operators have been hired.

Certification -- recertification exams were held for three reactor operators and one reactor supervisor, and all four candidates were successful in achieving recertification.

Six candidates were successful in achieving the initial certification for the reactor operator position.

The SAT training program was completely documented and all procedures describing the program were issued. The program meets all of the licence requirements.

Significant efforts have been made on the management systems at MNR over the current licence period.

The university has established a leadership role within the organization to oversee the Management Systems Program. Since 2011 accelerated progress and improvement have been achieved in all facets of the program.

The 2013 CNSC inspection focused

on the Management Systems Program, resulting in closing of all open actions in the safety and control area.

A consolidates database was implemented for nonconformance, operating experience, corrective action, and document control activities.

This database base is currently being expanded to include the areas of training and audit.

Also, the work planning and control processes were revised to improve how work at the facility is authorized.

Operating performance other the licence period has been strong. There were no unplanned -- no major unplanned outages.

Reactor availability was on target.

And careful outage planning resulted in meeting -- meeting or exceeding user demands during the implementation of the major infrastructure improvements executed during the current licence period.

The MNR Safety Analysis Report was revised in 2012 to allow for improvements to backup power supply for the facility. The single 35 kilowatt motor generator supply was replaced with access to four 1 megawatt university diesel generator sets, increasing reliability and redundancy of supply.

In response to the Fukushima accident, MNR engaged the services of a safety consultant to perform a Defence in Depth review of the facility.

The DinD review was a systematic and comprehensive review of MNR against required -- against requirements of applicable Defence in Depth standards.

The review concluded that: MNR has strong provisions for protecting workers, the public, and the environment against internal and external hazards.

Accident management and emergency response provisions at MNR are sound and can deal with Beyond Design Basis Accidents, including those with prolonged unavailability of external services.

No significant Defence in Depth gaps were identified.

Despite the fact that no gaps were

identified, to further strengthen the safety case of the facility a number of opportunities for improvement were identified during the review.

These opportunities were technically assessed and formulated into a set of recommendations.

The status of the recommendations are as follows:

A recommendation to provide a tie-in point for a mobile generator was completed during the extensive electrical upgrades conducted in 2011.

A Core Spray System was recommended for an incredible event where the pool inventory is lost and the core cannot be isolated. A spray system has been designed and installed to address this recommendation.

A Building Flood System was proposed to provide a separate and independent method to cool and shield the core. A new system has been installed.

An additional recommendation included a provision for remote monitoring of level and reactor parameters. A high-resolution camera with pan, tilt, and zoom capabilities has been installed in the MNR control room to address this recommendation.

It was also suggested that an inventory of university equipment available to deploy in an emergency be compiled. A detailed and comprehensive list has been created and is included in the supporting material for MNR emergency preparedness.

Additionally, it was recommended that the university extend its investigation into fuel-in-air cooling provisions. A review of the literature conducting during the defence in depth review indicates that air cooling is adequate to prevent fuel damage at MNR. The approximate decay heat would give off about .2 watts per centimetre squared. A research project has been initiated to verify this assumption that air cooling is adequate to prevent damage to fuel at MNR.

During the current licence period MNR has completed major refurbishments to a large number of MNR facilities. This was made possible largely due to a government Knowledge Infrastructure Program award to the university, focused on medical isotope research. This funding was helpful in accelerating many of the planned aging management refurbish. Projects at the facility.

During the current licence period MNR created an Aging Management Plan following international guidelines.

Major refurbishments have been completed as detailed in the CMD.

Non-destructive surveillance programs were initiated on the primary water system piping and the main heat exchangers. No significant degradation has been indicated.

Routine surveillance testing, like that shown in the containment air leak tests results graph continue to monitor and verify that systems are operating within technical specifications for the facility.

I will now call on Dave Tucker, the university's senior health physicist, to lead us through the next set of slides.

MR. TUCKER: Thank you, Mr. Heysel. Dave Tucker from McMaster University.

The safety of our employees, facility users, and members of the public is of paramount concern in every aspect of our operations. In the next few overheads I will review some of the highlights of safety performance at MNR during the recent licence period.

There were no lost-time accidents associated with the licensed activities during this period.

All doses were far below regulatory limits. There were two incidents at the facility, which have previously been reported to the Commission, during which action levels on dose were exceeded. Investigations of these events were completed and all corrective actions successfully implemented.

The figure at the right shows the collective dose by year for all of the groups with individuals exceeding 1 millisievert per annum, the "Significantly Exposed Groups". In every year this includes reactor operations staff, iodine production staff, and neutron radiographers. In one year, 2011, two other groups had individuals with doses over 1 millisievert as a result of major facility maintenance and active waste removal campaigns -- health physics staff and contractors, who completed extensive work in the pump room.

Through part of the licence period an upward trend in collective dose was observed as facility utilization was increasing. The peak value was observed in 2011 and collective doses have been steadily decreasing ever since, although facility utilization remains high.

As of 2013 the facility collective dose was down approximately 40 percent compared to the start of the last licence period. I will discuss some of the contributors to this decrease in the upcoming overheads.

One aspect of overall program improvement that occurred during the licence period was the introduction of a formal annual radiation safety program assessment. All available data and performance indicators are gathered and self-assessments against goals are performed by senior MNR and health physics staff. New goals are set for the coming year. The detailed assessment is then presented to our internal oversight committees, the Health Physics Advisory Committee and the Nuclear Facilities Control Committee, at a joint meeting. Results are updated and reviewed quarterly. This has been a helpful process in maintaining focus and priority on identified aspects of the radiation safety program.

In our CMD doses are presented in the context of dose limits and I know this data will also be presented in CNSC staff's presentation.

The next few overheads show you the performance tracked in a slightly different way, collective dose per normalized production. Given that doses are far below limits, which they are, this is the appropriate metric upon which to focus the facility ALARA program.

To illustrate the application of this approach to monitoring, consider the reactor operation staff. Operating hours and operating power can be adjusted according to demand. With more operation we would expect higher personal doses -- so simply tracking the collective dose is a poor indication of optimization. What we want is the most hours of operation at the highest needed power for the lowest reasonably achievable doses.

This figure shows the normalized operations staff doses, the collective dose per energy output at the facility. As indicated, this value is at its lowest in recent years and, in fact, it's the second lowest value in the operating history of the reactor.

This is the result of a number of areas of continuous improvement in facility conditions and procedures. The most significant contributor is believed to be suppression of the short-lived activation products in the reactor primary water, resulting in decreased ambient radiation fields.

This figure shows the collective dose for iodine production personnel, normalized to their output as relative production of the medical isotope Iodine-125.

The figure shows the history since production of Iodine-125 started on a large-scale basis.

Results for 2013 are at levels near to the lowest we have been able to achieve.

In part, this improvement is also the result of lower ambient radiation fields around the reactor pool, as previously mentioned.

Various other incremental improvements in procedures and equipment have also occurred.

The final slide shows the normalized collective dose for the neutron radiographers, where output is the relative number of films produced during their important work inspecting turbine blades for aircraft engines.

Exceptional improvements were achieved through 2012 and 2013.

This was previously the highest exposed group of workers at the university. Now many of the radiographers do not receive measurable doses.

This increase was the result of commissioning a new beam port with extensive shielding improvements, implementation of additional procedural controls, suppression of short-lived activation and imaging components, and increased staff awareness of sources of exposure.

Environmental protection is a high priority at MNR. We are extremely conscious of our location and strive to maintain all emissions at de minimis levels.

There have been no discharges of active liquid waste to the municipal sewer system since 1989. All active liquid waste is captured and conditioned for use in the reactor primary water system or evaporated.

Airborne effluents are maintained at a level that would result in doses of less than a microsievert for a person with continuous occupancy at the point of maximum ground level concentration.

No action levels or regulatory levels were exceeded.

And DRL calculations were updated to the latest CSA standard.

Continual improvement in the MNR Emergency Preparedness program continued through this licence period.

Significant investments in emergency preparedness infrastructure have been made at the university which have strengthened the facility's program. These include, for example, installation of a mass public address and alerting system; implementation of an automated notification system for facility personnel with emergency response duties, and a major upgrade to the two-way radio system on campus.

Close ties with the City's emergency responders and hospitals have been strengthened through extensive co-operative efforts in areas such as training, drills and exercises, procedure development, and equipment support.

An evaluated radiological fire exercise was conducted at the facility in late 2010 in conjunction with the Hamilton Fire Department, with participation from a broad range of City and campus emergency responders. Planning is currently underway for a contaminated casualty exercise planned for late 2014.

MNR personnel strive to make a positive contribution to the community's emergency preparedness capabilities, supporting activities, such as preparedness for the upcoming Pan Am Games.

Thank you. Mr. Heysel will now complete our presentation.

MR. HEYSEL: Chris Heysel for the record.

As shown in the CMD, extensive physical improvements have been made in the area of fire safety at MNR.

Additionally, a full Fire Hazards Assessment of the facility was completed. This independent assessment concluded that all nuclear safety objectives are met.

No credible fire can challenge the capability to establish and maintain the safe shutdown state of the MNR facility.

The assessment concluded that all environmental protection objectives are met.

No credible fire can cause a significant release of hazardous substances from the reactor building into the outside environment.

Further, the assessment concluded that all life safety objectives are met. Integral provisions for early evacuation of the reactor building are provided.

And finally, all radiological safety objectives are met. Public safety is achieved by meeting the environmental protection objectives. Worker safety is met by the timely evacuation of the reactor building, which is facilitated by the unique MNR capability to quickly establish a safe and you unattended shutdown state of the facility.

The assessment provided a set of recommendations to the university to enhance fire safety. All of these recommendations have been implemented.

A total overhaul of the security monitoring room was completed during the licence period, resulting in enhanced monitoring capabilities, improved ergonomics, and a significant -- and significant advances in technology. Prior to starting construction a second monitoring room was constructed and commissioned. This second monitoring room remains available as a backup to the primary location.

Other activities in the safety and control area included deployment of a new radio system, the purchase of a new emergency contact system, additional security infrastructure, and two updated site security reports.

Additionally, a number of key university staff members were cleared to Top Secret to allow enhanced communications between CNSC and other security groups directly with reactor staff.

Over the licence period several IAEA and CNSC inspections took place at the reactor, including "Physical Inventory Takings" and "Design Verification Inspections". No issues were raised as a result of these inspections and all safeguard obligations were satisfied.

In 2009 and 2012 MNR received fresh fuel shipments consisting of LEU standard and control fuel assemblies from our fuel manufacturer in France.

In 2008 a spent fuel shipment resulted in the removal of all HEU from MNR.

MNR ships and receives radioactive material in accordance with the "Packaging and Transport of Nuclear Substances" regulations. Staff are trained and certified to satisfy these regulations as well as those of the "Transportation of Dangerous Goods" regulations. No incidents occurred and all expectations were met or exceeded over the period.

Over the current licence period MNR made approximately 2,000 radioactive shipments consisting of mainly medical isotopes and research samples.

The most significant shipment made during the licence period was the 2008 spent fuel shipment.

McMaster University has a wide-ranging Public Outreach Program led by our Public Relations Department.

The university program is

supplemented by extensive outreach activities at the reactor.

MNR has a comprehensive website which provides important information to the public regarding MNR, including OPEX events originating at the facility.

The reactor hosts numerous list servers, providing professional and public dialogues on radiation and nuclear sciences and the sharing of OPEX.

Each year over 2,000 students and visitors get to view the "blue glow" of MNR. This firsthand experience with an operating nuclear core helps demystify nuclear technology for them.

A report containing annual doses and releases are published on the university website.

MNR is currently preparing a Public Disclosure Protocol.

The university's extensive media interactions provides expert opinions to the public regarding MNR and current events. Examples include the Fukushima events and the medical isotope crisis.

Responsible operation includes

responsible provisioning for decommissioning. The preliminary decommissioning plan and the associated cost estimate for MNR were updated in 2012.

McMaster University has established a Nuclear Reactor Restricted Reserve to fund the eventual decommissioning of the facility. The fund has shown steady growth over the licence period despite the global economic downturn. The university expects the restricted reserve to be fully funded during the upcoming licence period.

This table summarizes some of the significant investments made by the federal government and the provincial government at McMaster University in the areas of radiation sciences and medical isotope research and production.

These considerable investments demonstrate the strong current and future commitment by McMaster University, the government of Canada and the provinces of Ontario to nuclear technology R & D at the university.

Clearly MNR remains at the "Core of Discovery".

In summary, the McMaster Nuclear Reactor is an important Canadian asset, supporting research, education, and medical isotope production.

MNR is operated in manner that proactively and competently safeguards workers, the public and the environment.

A ten year licence is respectfully requested.

Thank you for your attention.

THE PRESIDENT: Thank you.

Before opening the floor for questions, I'd like now to move to a presentation from CNSC staff as outlined in CMD 14-H4 and H4.A.

Mr. Elder, I understand you're going to make the presentation. Please go ahead.

CMD 14-H4/14-H4.A

Oral presentation by CNSC staff

M. ELDER : Merci.

Bonjour, Monsieur le Président et Membres de la Commission. Mon nom est Peter Elder, directeur général de la Direction de la réglementation du cycle et des installations nucléaires.

Avec moi, à ma gauche, est Pierre Tanguay, agent de projet pour le réacteur de McMaster et directeur par intérim de la Division des laboratoires nucléaires et des réacteurs de recherche, qui fera la présentation aujourd'hui.

As well we have our team of specialists who have been involved in this review of McMaster's application for license renewal who are ready to answer any questions the Commission may have.

We will present today CNSC staff's assessment of the application by McMaster University to renew their operating licence for a period of ten years.

I will now let Mr. Tanguay provide background information on McMaster's reactor design from a safety perspective and overview of the performance of the facility over the last licence period, as well as CNSC staff's recommendation for the renewal of McMaster's operating licence.

MR. TANGUAY: Thank you, Mr. Elder.

Good morning, Mr. Chair, members

of the Commission. For the record my name is Pierre Tanguay. I'm the Senior Project Officer and Acting Director for the Nuclear Laboratories and Research Reactors Division, and I am responsible for the licensing and the compliance of the McMaster Nuclear Reactor.

The McMaster Nuclear Reactor, or MNR, is a pool-type research reactor located on the campus of McMaster University in Hamilton, Ontario. MNR is a light-water cooled research reactor and it can operate to a maximum of 5 megawatts thermal.

MNR has been operated since 1959, when it achieved criticality for the first time.

The reactor is enclosed within a thick reinforced concrete containment building, which protects the reactor from the environment, and also prevents any release of contamination to the environment should an incident occur within the reactor building.

MNR is used for teaching in the area of nuclear science and also for research in fundamental physics and materials science. It used six beam ports, sample irradiation devices, and one hot cell.

On this picture we can see the core of the reactor at the bottom of the pool. It is the only reactor in Canada where a live core can be observed in operation completely safely. There are two sections in the pool, which can be isolated from each other, and the reactor core can be moved to either section, if needed, adding to the safety features of MNR.

McMaster uses neutron activation techniques for geological science, such as mineral characterization, environmental science and archeometry.

Neutron radiographers perform radiography on a daily basis, notably on aircraft turbine blades for the detection of flaws.

McMaster is an important world producer of Iodine-125 used in cancer treatment and other medical applications.

The current licence was issued in July 2007 and will expire on June 30th, 2014. In December -- in September 2013 McMaster University made an application for the renewal of their operating licence for a period of 10 years. The application followed a standard format, discussing all Safety and Control Areas, as well as other matters relevant to this licence application.

CNSC staff have reviewed McMaster's application along with all background documents. CNSC staff are satisfied that the application is complete.

The application shows that McMaster University continues to maintain a comprehensive set of programs in relation to all 14 Safety and Control Areas and is making provisions for the protection of health, safety, security, and the environment, as well as the international obligations that Canada adheres to.

In the next few slides I will provide an update on the areas that were identified at the 2007 licence application hearing, as requiring improvement in the context of evolving standards and regulatory framework.

Areas for improvement were identified with the: Quality Management program, with systematic approach to training, nuclear criticality safety, radiation protection, and fire protection.

Improvements were undertaken by the licensee in all the areas listed above, and CNSC staff performed compliance inspections to monitor progress.

On the next few slides we will look at the details of these improvements.

The first area is on Quality Management, for which the implementation was assessed as below expectations in 2007.

Over the licence period McMaster University updated their management system documentation and many of their processes and procedures. They also created a key position in Quality Management and Training.

Important top-level documents were updated with their Policy Manual and the Organizational Structure documents, which now reflect more accurately the roles and responsibilities of personnel within the organization.

CNSC staff conducted three on-site inspections on the Management System to verify the progress and compliance.

Several desktop verifications were performed as McMaster University updated their documents.

In 2013 an inspection was performed to verify that all actions were completed.

With their revised program, documentation and updated roles and responsibilities, McMaster has a Management System that complies with CNSC expectations.

The next area identified as requiring improvement at the 2007 licence hearing is training. CNSC Staff had recommended that McMaster implement a systematic approach to training, or SAT, for their certified positions.

At the 2011 mid-term performance report, CNSC Staff reported that McMaster was making progress with the development of a SAT-based training program for reactor operators and reactor supervisors.

CNSC conducted an inspection in 2013 and with further updates to their training documentation, McMaster completed all actions as required and CNSC Staff accepted their training program. McMaster's training and personnel certification programs are now assessed as satisfactory.

The next area needing improvement in 2007 was on nuclear criticality safety. CNSC Staff had requested that McMaster develop a nuclear criticality safety program that complies with the evolving standards and regulatory framework. McMaster revised their program documentation in 2009. After a review of the new program documents, CNSC Staff accepted the revised program document. CNSC Staff conclude that McMaster has a nuclear criticality safety program that meets expectations.

The radiation protection program documentation was also identified in 2007 as requiring some improvements. Five compliance inspections were carried out at McMaster over the licence period with a focus on radiation protection. McMaster followed through with program improvements and updates to their RP documentation. These improvements included training requirements for MNR staff and additional program requirements for investigation of unusual radiological results and an annual review of the suitability of the action levels.

Further to the 2010 Alpha contamination incident at Bruce, CNSC requested McMaster to perform a detailed assessment of the potential for Alpha contamination hazards. The assessment confirmed that Alpha-emitting radionuclides do not constitute a significant component of the radiological hazard. However, McMaster made some enhancements to include additional training, as well as monitoring and trending of Alpha-emitting radionuclides within the facility.

These improvements were completed and the revised Radiation Protection Program Manual was submitted and accepted by CNSC Staff as part of this application for a licence renewal.

I will now discuss McMaster's performance in the area of radiation protection. There were two events which resulted in three action level exceedances over the licence period.

In 2007 there was an incident where an iodine technician was contaminated which resulted in an effective dose of 0.2 millisieverts. Then in 2011 an iodine technician received a minor wound to a hand with a contaminated object which resulted in an effective dose of 0.4 millisieverts and an extremity dose of 190 millisieverts. This was presented to the Commission in an early notification report in September, 2011. No regulatory dose limits were exceeded and there was no health impact to the worker.

McMaster undertook corrective actions which CNSC Staff verified for effectiveness.

I will now present some data related to radiation protection. These numbers show that doses to workers and to the public are very low, well below regulatory limits.

This graph shows the maximum effective dose to different categories of workers at McMaster over the licence period with a highest annual effective dose of 8.2 millisieverts which was received by a neutron radiographer in 2011. All the doses were well below the regulatory limit shown as a red line.

The following graph shows the maximum extremity doses to different categories of workers at McMaster. The highest annual extremity dose is 190 millisieverts and was received by an iodine production worker in 2011 as a result of a personnel contamination event as I explained in an earlier slide.

McMaster followed up with an action plan to reduce the likelihood of another similar incident. CNSC Staff inspected the implementation of the actions and we were satisfied with McMaster's response to this incident. The average worker extremity doses are low, well below the regulatory limit of 500 millisieverts.

This graph shows the estimated dose to the public from the operation of MNR. The estimated dose to the public is the maximum possible dose to a member of the public who would be standing at a location of the highest release for an entire year. The numbers range from 0.53 to .97 microsieverts which is a thousand times less than the regulatory dose limit of one millisieverts per year for a member of the public.

In concluding on McMaster's radiation protection program, CNSC Staff are satisfied that the radiation protection program is effective. Program documents have been updated to reflect current standards and no regulatory limits have been exceeded. Doses to workers are kept as low as reasonably achievable and action levels are set at a small fraction of regulatory limits so that problems are identified early. The dose to the public is very low, orders of magnitude lower than naturally occurring radiation.

CNSC Staff are satisfied that McMaster University is performing satisfactorily with respect to radiation protection.

Fire protection was identified as requiring improvement at the 2007 licensing hearing, mainly due to the high combustible loads within the facility. Since then, McMaster has made important efforts to reduce the combustible loads and improving housekeeping. This was verified during each inspection over the licence period.

McMaster has also submitted a fire hazard analysis and a fire safety analysis. CNSC Staff verified and accepted both documents.

McMaster submits third party reviews of their fire protection program on an annual basis. CNSC Staff have found these to demonstrate adequate provisions for fire protection.

Overall, CNSC Staff are satisfied that McMaster has made the required improvements and conclude that McMaster University is performing satisfactorily with respect to fire protection.

To conclude on the areas of

improvement, McMaster has made significant efforts to address the deficiencies identified in the areas of quality management, training, criticality safety, radiation protection and fire protection. Compliance inspections performed by CNSC Staff confirmed that McMaster completed the improvements identified for all of these areas.

I will now move to CNSC Staff's assessment of all 14 safety and control areas for McMaster presented on this slide and the next one.

These safety and control areas are standard for all licensees and represent important areas that contribute to the protection of health, safety, security and the environment, including measures for non-proliferation.

As you can see from this table, McMaster has achieved satisfactory ratings in management system, human performance, operating performance, safety analysis, physical design, fitness for service and radiation protection. Improving trends are also noted on management system, human performance, safety analysis and radiation protection. Other safety and control areas on this slide are shown to be stable.

All safety and control areas on

this slide are also satisfactory and security is assessed as fully satisfactory given the significant upgrades and improvements made to the program over the licence period. An improving trend was also observed in the areas of emergency management and fire protection.

In the next few slides we will look at some specific safety and control areas of particular importance at McMaster and that we have not yet discussed; namely, safety analysis, physical design, fitness for service, environmental protection and emergency management.

Pool-type reactors like MNR are widely used around the world under different names and designs and they are known for their simplicity, their reliability and the safety of their design.

The McMaster reactor operates at low power, a maximum of 5 megawatt thermal, making any severe accident extremely unlikely. The type of low enriched uranium fuel used in MNR cannot burn or produce hydrogen as Fukushima did should the core become uncovered. The reactor operates at near ambient temperature and pressure, eliminating the possibility of any significant release of energy in case of a system failure.

As one of the safety features, MNR uses forced gravity cooling which means that the cooling water flows downward through the core into a holding tank and the water is then circulated back to the pool after running through a heat exchanger. This forced gravity flow ensures that in the event of a power failure, the cooling water keeps flowing for a few minutes which allows for most residual heat to be evacuated. Once the gravity flow stops, cooling turns to natural water convection without any intervention from operators or any complex systems making it failsafe.

Although MNR has back-up power in case of power outage, it does not require any source of power or any other services to stay in a safe shutdown. In case of a prolonged power outage, and without using the power generators, the large pool of water would increase in temperature by about nine degrees and then cool down. The reactor core can also be moved to a different location in the pool and the two sections of the pool can be isolated from each other with a gate in the event of a leak in the pool or in the cooling system.

As another safety feature, the negative reactivity feedback inherent to MNR means that the reactivity, and hence the reactor power, tends to decrease as the core heats up. McMaster was converted to low enriched uranium in 2007, all HEU was safely repatriated to the US shortly after. Since then no significant amount of HEU is kept at McMaster.

The reinforced concrete containment building ensures that the reactor is isolated from the environment. During normal operations a series of charcoal and hepa filters ensure that the releases to the environment are kept to very low levels. With a power failure, or in the event of airborne contamination within the building, all ventilation shuts down and dampers close automatically, keeping the building in a boxed-in configuration and preventing any release of contamination.

Following the conversion of the core from HEU to LEU in 2007, CNSC staff requested McMaster University to perform analytical work to confirm that the safety analysis report remains valid. McMaster communicated their results to CNSC staff over the licence period, which confirmed the conservative assumptions used in the MNR safety analysis report. The report confirms that the design is robust.

In 2012, and as part of several upgrades made to the facility, McMaster upgraded their source of backup power from the original generator to the University's set of four diesel generators of one Megawatt each. This improves the reliability of the backup power. McMaster updated the safety analysis report to reflect this change in 2012 and the licence was amended to reflect the updated document.

Further to the Fukushima accident of 2011, McMaster University was requested, pursuant to subsection 12-2 of the *General Nuclear Safety and Control Regulations*, to review the lessons learned of the Fukushima accident and re-examine MNR safety case. And in particular, the underlying defence and depth, and to report on any plans to address significant gaps.

McMaster submitted a defence and depth analysis which confirmed that McMaster makes strong provisions for the protection of workers, the public, and the environment, even under an event of worst conceivable proportions. The design of MNR is inherently safe, meaning that it does not require the intervention of active systems to keep it safe.

Some improvement opportunities were identified, however, in the areas of emergency procedures and accident management, and McMaster has made the improvements. In particular, with their use of fire water as an ultimate solution to cool the core, in the extreme event that the pool would lose its water. Although MNR does not require any electrical power, or any other services to keep it in a safe shutdown, McMaster installed an external connection to bring in external power. Mostly for monitoring purposes should the backup power become unavailable.

Additional work is being completed to bring in a fire water outlet close to the core so that cooling could be maintained should the pool lose its integrity. These improvements result in an increase in defence and depth of an already very robust design.

I will now speak to McMaster's fitness for service. McMaster University maintains the MNR facility in accordance with the maintenance program, and an aging management program, that ensure the facility remains fit for service throughout its lifecycle.

In 2010 CNSC staff requested a report on the conditions of systems, structures and components. McMaster submitted a technical report that described the condition, the aging mechanisms and the inspection requirements for all systems important to safety. The condition of all systems was assessed as either good or very good.

Non-destructive examination was conducted on the primary cooling system and no significant degradation was identified. As part of MNR's aging management plan, McMaster performs several inspections and tests, including the annual containment building leak test. This test demonstrates that the building is maintaining its integrity. Also the safety shut down system is tested on a quarterly basis and the high power trip test is performed twice a month. CNSC staff review the results of these tests on a continuous basis.

As would be expected with an aging management program, McMaster has been proactive over the licence period with upgrade to several equipment components. They have upgraded their electrical distribution system, their primary and secondary cooling system piping and pumps, and their fire protection equipment.

McMaster also made important upgrades to their security monitoring system, upgraded their environmental monitoring system, and area radiation monitors. And they've upgraded their backup power from their single generator to the University's four diesel generators. CNSC staff are satisfied with McMaster's performance with regards to safety analysis, design, and fitness for service.

In the next few slides I will discuss McMaster's performance in the area of environmental protection. McMaster has an environmental protection program consisting of an effluent and emission monitoring program. There are five environmental monitoring stations around the facility.

Iodine-125 from isotope production and Argon-41 from the activation of naturally occurring Argon in the air are the only nuclear substances released to the environment in any measureable quantities. Charcoal filters minimize the release of radio iodines and hepa filters ensure that any particulates that could be present in the ventilation system are controlled to very low levels.

CNSC staff requested that derived release limits, or DRL, be calculated using the most recent CSA standard, N288.1 methodology. McMaster established DRLs as well as action levels for Iodine-125 and Argon-41. There are no liquid releases from the facility. Any water is treated within the facility through ion exchange and recycled to the reactor pool.

The following graph shows the annual release of Argon-41 over the license period. The trend has been mostly stable with annual releases about 10 times below the action level. The action level is set at a level corresponding to a dose of 12 microsieverts per year.

Similarly, this graph shows the annual releases of Iodine-125 over the licence period. The annual releases are less than 50 times below the action level. The action level is set at a level corresponding to a dose of 1 microsievert per year.

And this graph shows the releases of radioactive particulates over the licence period. The releases are extremely small, less than 1,000 times under the action level, which is set at a level that would cause a dose of .1 microsievert per year.

To conclude on McMaster's environmental protection program, CNSC staff are satisfied that McMaster University implements environmental protection measures and practices that comply with CNSC requirements and applicable regulations. The dose to the public is very low, less than the dose that we get from natural background radiation. McMaster is performing satisfactorily with respect to environmental protection.

I will now talk about McMaster's emergency management program. From an emergency management perspective, the risk associated with MNR is rated as low. It is a low-power reactor with a well proven, safe design, and it is fully contained within a containment building. McMaster is required to have an emergency preparedness program and they are required to demonstrate that they can respond adequately should a nuclear emergency occur onsite.

McMaster has a well-developed emergency preparedness program. CNSC staff have assessed McMaster's emergency plan and found it to be satisfactory. McMaster has trained responders on site, as well as the equipment required in case of emergency. CNSC staff assessed a full scale emergency exercise in 2010. The exercise revealed that McMaster is prepared to respond adequately to an emergency situation.

CNSC staff noted some improvement -- some areas of improvement and issued action notices to McMaster for their response. McMaster took action to correct these findings, which included the purchase of new emergency response equipment. CNSC staff performed a compliance verification in early 2014, which revealed that all actions from the previous exercise were completed.

CNSC staff were -- CNSC staff also verified McMaster's notification system and met with Hamilton's Fire Chief. McMaster will hold another exercise in the fall of 2014, which CNSC staff will be assessing. In concluding on this SCA, CNSC staff are satisfied that McMaster has an emergency preparedness program that meets expectations and they're assessed as satisfactory.

I will now speak to McMaster's financial guarantee. As for other Class 1 facilities in Canada, McMaster University is required to have a financial guarantee for the decommissioning of their reactor. As with other university-based research reactors, McMaster has been building up a fund for decommissioning.

Under McMaster's current guarantee, it is required to make contributions of $350,000 a year into a decommissioning fund. CNSC staff review the status of their fund every year. The current value of the fund is $8.5 million. The financial guarantee is based on the estimated cost of decommissioning of the reactor, which is documented in the facilities preliminary decommissioning plan, or PDP. This decommissioning cost was estimated at 12.5 million at the last revision of the PDP, and the PDP is revised every five years.

CNSC staff are satisfied the McMaster has acknowledged full liability for the reactor and will continue to contribute to this fund as per the agreed schedule. CNSC Staff conclude that the financial guarantee for McMaster remains acceptable.

In other matters of interest, McMaster University has a comprehensive public information program through which they keep the public informed of any important matters, such as release to the environment and unusual events. The information is available in McMaster's annual reports, which are posted on the University's website. McMaster is found to be very engaged with the community, participating in public information sessions, fund raisers, and hosting visits. They usually receive over 2,000 visitors every year, including high school students and other interested groups.

McMaster also engages the Hamilton Emergency Services in regular information and discussion sessions. The CNSC's regulatory document RD99.3 was issued in 2012, and describes the requirements for a public information program for licensees, which includes a disclosure protocol.

Although McMaster's public information program meets the expectations, proactive disclosure has only been one -- done on an ad hoc basis, such as their radiation protection event reported to the Commission in 2011. The development of a formal disclosure protocol is in progress and is expected to be submitted within the first year of the new proposed license period.

In concluding this presentation, CNSC staff are satisfied that McMaster has operated the facility safely and responsibly during this licence period and will continue to do so in the new proposed license period. McMaster has made several improvements to the facility under their aging management program that continue to enhance safety.

Their core programs are mature and meet the requirements under the licence, the NSCA, and all applicable regulations. McMaster Universtiy continues to make adequate provisions for the protection of the environment, the health and safety, security, and international obligations.

CNSC staff are committed to providing performance reports to the Commission on research reactors, including the slowpoke reactor starting in 2015. CNSC staff will include

McMaster as part of these updates to the Commission.

CNSC staff have developed a new licence following the standard format, which includes 28 licence conditions covering all 14 safety and control areas. This licence is accompanied with a licence condition handbook, or LCH, which documents the detailed verification criteria for the conditions listed in the licence. The LCH also provides guidance to the licensee for meeting the criteria and specifies the applicable reference documents, such a regulatory documents and standards. As is normal practice, the handbook will be finalized after the Commission's decision to ensure consistency with the decision and its basis.

Therefore, CNSC staff recommend that the Commission accept the recommendations outlined in the CNSC staff CMD, and approve the issuance of the operating licence for a period of 10 years, and endorse the delegation of authority to CNSC staff as outlined in the proposed licence condition handbook.

This concludes my presentation. We are now available to answer any questions that members of the Commission may have. Thank you.

THE PRESIDENT: Thank you.

Before going again to the question period, I'd like for us to start looking at some of the written submissions that we received so we have all of this material in front of us when we are going to the question period. So let me start with the first one, which is from the Hamilton Fire Department, is outlined in CMD 14-H4.2.

CMD 14-H4.2

Written submission from the Hamilton Fire Department

THE PRESIDENT: Commissionaires, anybody has any question about this particular intervention?

Let me then ask a question. If you look at the -- the last paragraph of this intervention, they make reference that:

> "I'm confident that with the ongoing commitment of the university that further improvements in emergency planning, [and] response and

> recovery can be achieved with a view to support the safe operations..."

What further improvement are we talking about here?

MR. TUCKER: Dave Tucker for McMaster University.

The Fire Chief, I believe, is referring simply to ongoing, continual improvement. We are, for example, extending our relationship with the emergency medical services, the ambulance service, and paramedic service, and now beginning to provide training to their personnel. There's not a specific action plan or agenda, or any demands that are unmet by the fire department on McMaster.

THE PRESIDENT: So that's a general comment here?

MR. TUCKER: Dave Tucker for McMaster.

Yes. That's, I believe, just a general comment about our continual improvement as we continue working more and more together.

THE PRESIDENT: Okay. Me. Harvey?

MEMBER HARVEY: Merci, Me.

President.

The previous paragraph, in the middle of the paragraph the:

> "Additionally, our personnel have engaged in joint training and exercise, participated in regular planning meetings..."

What is the frequency of those exercise and those meetings?

MR. TUCKER: Dave Tucker for McMaster University.

First, we have an annual emergency planning conference with the entire University and City emergency response community. So that's an annual, approximately half day meeting. We have had periodic ad hoc meetings with the fire department. I would say that on average we're meeting with them at least quarterly. We do annual training sessions for their personnel. That has been run now three separate times. We see them fairly frequently.

MEMBER HARVEY: Okay. Thank you.

THE PRESIDENT: Anybody else?

Okay. I'd like to move to the

next written submission from Mr. Siegfried Kleinau as outlined in CMD 14-H4.3 and 4.3A.

CMD 14-H4.3/14-H4.3A
Written submission from Siegfried (Ziggy) Kleinau

THE PRESIDENT: Questions? Dr. McEwan?

MEMBER McEWAN: So in this Mr. Kleinau makes reference to a significant incident 20 years ago. What was it and what was the outcome?

MR. HEYSEL: Chris Heysel, McMaster University.

The incident that occurred 20 years ago during refuelling the reactor and the reactor went critical when it was not planned, and as a result instantaneously exceeded our power licence requirement. The incident is -- to describe the incident as a near meltdown is, I believe, incorrect technically and misleading.

There were no -- there was no fuel damage as a result of the incident. There was no releases. There was no dose consequences of the incident. However, the University responded to the incident in a very serious manner. It took immediate corrective actions and is continually and vigilantly implementing those actions.

MEMBER McEWAN: So what would the root cause analysis have been of the cause of this?

MR. HEYSEL: Chris Heysel for McMaster.

The root cause analysis indicated that there was several procedural and administrative violations. There were no aging management issues as the intervenor alludes to. All of those root causes have been addressed and there's increased validation and verification during the processes of refueling at the reactor.

THE PRESIDENT: I'm curious. The intervenor claimed that that was registering as a two or three on the on the INES scale, which is the IAEA scale. Is that true?

MR. ELDER: Peter Elder for the record.

The event was documented -- was rated as a level two on an INES scale. Primarily because of the -- one of the -- the INES scale looks at the impacts on people, the environment, also the radiological barriers, but it also looks at defence and depth. And because the barrier of defence and depth was clearly defeated in the incident, that it was rated at a level two in terms of the safety system was required to -- did activate and was required to activate to terminate the event.

So any event that requires the activation of a space -- safety system to terminate a vent is automatically considered a level two on INES. Even though in this case there were no releases and no impacts to the public or the environment. So again, INES looks at a number of factors. On one of these factors it clearly was rated as a level two. The other thing I'd like you to know is that this event required McMaster, after this event, was required to do a comprehensive review of all their trainings of their personnel and led to a significant improvement in their certification programs around their certified operators.

THE PRESIDENT: Dr. McEwan, you done?

MEMBER McEWAN: So the -- I mean, in both presentations and CMDs there have been statements that a pool reactor is inherently a safe system. You have an automatic shutdown process. Does this negate that, or does this give any credence to a discussion around that inherent safety statement?

MR. ELDER: Peter Elder for the record.

I'll start in terms of inherent safety means that without intervention the system will turn itself around. That doesn't mean you -- that's how you operate. You usually operate just in making sure it doesn't get into such a situation, and if it does you have safety systems that will turn around much faster than nature would.

So in this case it did not, anything in that event, and there was detailed analysis after that event, would say that it was doing anything unusual in terms of that it would have turned itself around. But the safety system actually activated first in terminating it and shutdown the reactor quicker than the natural processes would have.

MEMBER McEWAN: But we can be certain that the natural processes would have taken over if the safety systems had failed?

MR. ELDER: The analysis and the safety analysis that was done previously to that event, including the more recent one with the different fuel type, demonstrate that, yes, it would have taken over.

THE PRESIDENT: I just want to make sure that I understand this in layman language.

You are telling me there can be no doomsday scenario by that kind of reactor? So, you know, a doomsday scenario; no water, no electricity forever, what happens?

MR. ELDER: Peter Elder, for the record.

One of the things McMaster is doing after Fukushima is -- the current information we have that that scenario, no water, nothing, no power, the fuel will cool, is not hot enough, just air cooling will work.

Obviously no one has actually tested that and we don't want to test it, but they are doing analysis to say how robust is that.

But we are not relying on that assumption, we are going back in and saying, you should have a way to add water to the pool. We don't have any credible evidence that there is any event that would actually lead to the pool draining or the containment.

In terms of the seismic loading of the facility in that one, you would need an earthquake or some even well beyond our understanding of current geology to get that sort of event.

But even in that case, there is evidence that suggests that without water the reactor -- air cooling would be sufficient to prevent fuel melting.

THE PRESIDENT: Thank you.

Dr. McEwan?

MEMBER McEWAN: So if I can follow the train, it sort of goes a little bit back to the presentation. In the McMaster presentation you talked about a literature review of air cooling. I must confess, I would be interested to know how you can do that sort of meta-analysis.

Is it on models, is it on experimental design, is it on actual experiments?

MR. HEYSEL: Chris Heysel, McMaster University.

The literature search has come up with experiments that have actually been done where they have removed MNR-type fuel into a hot cell, which has come out of the core, and has demonstrated that the fuel temperature does not reach the temperature to melt.

What we need to do is extend that literature search to make sure we understand exactly the fuel characteristics, make sure they are the exact same as MNR's and make sure every conceivable configuration of fuel can be air-cooled.

The analysis, the calculation, shows that the heat being generated per square centimetre of our fuel shortly after shutdown is in the order of, you know, half a light bulb. So it is hot, but we just need to verify that air-cooling is sufficient to keep it from melting.

MEMBER McEWAN: And is there any difference in the change to LEU? Does that affect that analysis and that literature review?

MR. HEYSEL: It will change it slightly, and that is one of the items we have to verify in the research we are doing. Chris Heysel.

MEMBER VELSHI: When you say, when critical, it sounds so severe and new controls or additional controls that have been put in place, whether it is training or procedures, seem much softer as opposed to safety interlocks or hardware and less dependence on human intervention.

So is that not possible to prevent something similar happening again?

MR. HEYSEL: Chris Heysel, McMaster University.

The root cause analysis indicated that the failures were around human performance. The corrective actions taken were to improve training, to improve verification, to add people who are focused on ensuring the parameters that need to be controlled during refuelling are dedicated to that task.

So while the corrective actions may sound soft, they are actually very resource-intensive and very focused on making sure the safety of the reactor is constantly monitored during these operations.

MEMBER VELSHI: So again, my question was what you are saying is a physical barrier is not something that is either advisable or possible then?

MR. ELDER: Peter Elder, for the record.

This was looked at. You are actively changing the fuel. And the same on this one, you do change the control rods at the same time. So you are actually taking your -- you know, there is a physical change going on, so you can't rely on the normal physical barriers other than the shutdown system that remains poised and available. And it did work in this case.

MEMBER VELSHI: So what is the worst case incident that could happen in a reactor of this kind? What is your beyond-design basis accident scenario?

MR. HEYSEL: Chris Heysel, McMaster University.

The worst perceivable accident for any nuclear reactor is to take the core and put it outside in the environment and let it melt.

At McMaster we feel that that is not a problem right now, so that would be more than beyond-design basis, that would be referred to as a severe accident, and may not meet that definition as fission products may not be released.

We are confident that the number and level of barriers that we have in place for a facility of our design, our power level and our operation are sound and very robust.

The other accident that can be postulated is a reactivity insertion event which doesn't cause fuel melting, but could cause a steam generation to dislocate the core.

The reactor containment building is designed to withstand that type of accident.

MEMBER VELSHI: So in your emergency planning, and the intervener alludes to this, do you envisage a scenario where there would be emissions of such kind that you may actually have to take actions in your surrounding area?

And, you know, the intervener specifically talks about distribution of KI pills, for instance. Is that part of your planning scenario?

MR. TUCKER: Dave Tucker, for McMaster University.

Our emergency plan is based on beyond-design basis. None of the accidents assessed in our safety analysis report could actually trigger the requirements for implementation of our emergency plan.

Nonetheless, the international standards for a reactor of our size or larger call for an emergency planning zone of 100 metres out from the building, and that doesn't credit the containment building that MNR has.

So we have an emergency planning zone that goes considerably beyond 100 metres. Around the central campus area we have plans for, if necessary, evacuation and establishing access control in that area, which would be more than adequate to address any emergency condition of the facility.

We do have supplies of potassium iodide maintained as part of our emergency supplies, and those are intended for use by emergency workers if they had to enter the facility or the controlled area.

MEMBER VELSHI: Thank you. And my last question --

THE PRESIDENT: Just on the KI. So you are not having enough supply for students on campus?

MR. TUCKER: There is no accident

case that would require administration of KI to members of the public in our --

THE PRESIDENT: That is not part of your scenario?

MR. TUCKER: Correct.

THE PRESIDENT: I am sorry.

MR. TUCKER: That is correct.

THE PRESIDENT: Ms Velshi?

MEMBER VELSHI: With regards to aging management, and we have heard about your aging management program, but what do you estimate as the life of the facility?

MR. HEYSEL: The design of our reactors is very simple, it is concrete and stainless steel piping. And the facility itself is operated in fairly benign conditions; atmospheric temperature, atmospheric pressure.

I think from a physical aging management perspective there is nothing that can't be fixed or repaired or maintained.

The real lifetime of a research facility is based on its impact it has on furthering research for the University. So we plan out 20 years, and in that 20-year planning horizon we don't see a change in the direction of research at the University that would preclude or not require the research reactor at this point in time.

So real lifetime is as long as we are supporting the missions of education and research at the University and the facility is operated safely and securely, we don't currently have an end of life for the facility.

MEMBER VELSHI: Thank you.

THE PRESIDENT: So about concrete, we also hear maybe more, here and Canada and some in the U.S., that they find some concrete becoming brittle, broken, whatever.

Do you see any indication of that? Does the actual concrete require some repair?

MR. HEYSEL: Chris Heysel, McMaster University.

The concrete structure is tested through leakage, and we see that our containment leak rates are equivalent to those of power plants. We do have to do maintenance on the concrete. We have resurfaced the outside of the building in around 2006. And we do routine maintenance on the seals of the access points to the facility.

We do do visual inspections on the concrete of both pool and the inside containment. And we do repairs and maintenance as required.

THE PRESIDENT: Thank you.

Questions?

Mr. Tolgyesi?

MEMBER TOLGYESI: You are saying that you do a visual inspection on the concrete. You don't do any coring to see what is happening inside? Because what the President was mentioning about concrete deterioration is that there is a kind of a bonding capacity which is decreasing within the concrete.

So probably you don't see that from visual inspection, but you should do some coring.

MR. HEYSEL: Chris Heysel, for McMaster.

We have taken cores through the containment structure recently to install some new electrical cabling. And I take your point, we should have those analyzed.

MR. ELDER: Peter Elder, for the record.

Obviously part of their aging

management program would be looking at those types of opportunities. I think what is important in this reactor as opposed to a power reactor is the actual design pressure of containment is much lower.

So what it has to do, it doesn't have to survive very high pressures. You know, it is actually designed to be able to survive very high pressures, but there really isn't -- all the scenarios that have been assessed, including some of the more extreme ones, show that you don't get a lot of pressure build-up in the reactor just because of the small amounts of radio activity in the core.

And I think a comparison would be, in terms of the actual amount of radio activity, and again heat generation, the McMaster core is less than one channel in a power reactor, and power reactors of hundreds of channels.

MEMBER TOLGYESI: My last question to this presentation. How often is the CNSC staff inspection done on the facility?

MR. TANGUAY: Pierre Tanguay, for the record.

We have a compliance inspection

plan where we try to evaluate every safety and controlled area on an ongoing basis. So, in general, that amounts to about two or three inspections every year.

THE PRESIDENT: So where the intervener, on page 5, makes the statement that CNSC rarely visit this facility, is that true?

MR. TANGUAY: Pierre Tanguay, for the record.

I can use the last year for an example. I believe that we were at McMaster at least five times just last year alone.

THE PRESIDENT: Thank you.

MEMBER TOLGYESI: Well, I think you are talking about disclosure plan also that you will do. Probably it will be a good thing to include that in disclosure plan that, you know, in the past year we had five inspections, you know. And so it will be public and it will show that there is no free ride.

THE PRESIDENT: Mr. Harvey.

MEMBER HARVEY: Just one question about the pool. The pool itself is just concrete or is -- and the walls, it is like a standard pool or..?

MR. HEYSEL: Chris Heysel, McMaster.

It is a standard pool, but with six-foot wide walls and a six-foot or a five-foot bottom and it is tiled.

MEMBER HARVEY: It is not standard. Okay, thank you.

--- Laughter / Rires

THE PRESIDENT: You can't go swimming in it I don't think.

Anybody else?

Ms Velshi?

MEMBER VELSHI: And I bring this up because the intervener has raised a couple other ones.

So on page 3 of his intervention where he talks about figure 8 and item 125, spikes. Actually I couldn't find that figure. So I don't think H(3), but is it part of a CNSC staff presentation? Perhaps you can show me. I just didn't find the item. Is it there? Well, if it is there, if you can tell me what the spikes are about then?

MR. TUCKER: Dave Tucker, for McMaster University.

I believe the intervener is referring to the figure on page 34 of the CNSC staff CMD.

MEMBER VELSHI: Right. Where is the spike there though?

MR. TUCKER: We could not find a spike. There is no spike.

MEMBER VELSHI: Sorry, that was my question.

His other question was around decommissioning, and I know you have raised concerns about decommissioning as well. So let me just get to all the decommissioning questions I had.

One was how much funds you have collected and how much you need to. And it seems like even your estimate seemed to be going up. So may be I will start off with staff first around adequacy of decommissioning funds and the expectation on when we would we expect them to be fully funded for whatever the estimate is.

MR. ELDER: Peter Elder, for the record.

First, is four research reactors, and I think we have had this discussion a bit around universities as well, as saying the approach we have taken is that they should have...

There are two parts of the approach that we have taken traditionally. Is that you should always have enough money immediately available to put the reactor into a safe configuration, which is essentially the money to ship the fuel somewhere else in this case.

After that, given the size of this liability, even for a public institution, we have looked at a case of them having some sort of fund or some sort of other guarantee that they build up over the lifetime of the reactor.

And also we have been more recently making sure that the universities, if that fund is not fully funded, that there is expressed acknowledgement of the liability. And because unlike other operators that we see, the University is not in the nuclear business entirely. They can obviously continue to be a university even if the reactor shuts down. So they are not dependent on the reactor as a source of revenue.

And in terms of a public institution, it is unlikely that public institution is going to disappear.

So we looked at it from a risk of this liability coming back to the federal government as being fairly low, as long as there was a clear acknolwedgement -- a real money fund that has been built up and a clear acknowledgement from the University that this liability exists.

MEMBER VELSHI: Thank you. And, McMaster, you have in your submission said you have some reservations about the CNSC's position around what is expected of you.

So what would you like to see?

MR. HEYSEL: Chris Heysel, McMaster University.

I would like to see a position by the Commission that reflects that with a lot of my competitors, if MNR was relocated 60 km south, to the U.S., the commitment in writing by the University would be enough to justify continued operation without building a fund.

I think the billion-dollar-a-year operating fund that the University has, the vast resources of trust accounts it manages and the stated, both legally and financially, the commitment the University has behind this should be enough for meeting this obligation in my opinion.

MEMBER VELSHI: Staff, do you want to comment on that?

MR. ELDER: Peter Elder, for the record.

I guess we are still relatively -- this is the first generation through a lot of these decommissioning funds and we still believe that having some money on hand to make sure that you can quickly put the facility into a safe state makes sense.

We are looking at, and we know we have to revise our regulatory documents around financial guarantees, and there will be opportunity for the universities and other public institutions to bring their opinions forward in those documents. And we do realize they are different than private companies that can go bankrupt overnight.

THE PRESIDENT: Is that what you meant by being discriminated with your competitors?

Are your competitors other universities or private sector, or the NRU?

MR. HEYSEL: My main competitors are national laboratories located in this country and others who don't have this financial burden on their operating accounts and universities in the U.S. that are -- have the same type of financial means that McMaster does and where the commitment of a university is recognized as good enough.

THE PRESIDENT: Do we discriminate -- all universities are treated the same way, are they not? Staff?

MR. ELDER: Peter Elder.

The universities are treated the same way. I think the difference would be is that we have -- the Commission has accepted from the federal government and other governments acknowledgement of the liability as being acceptable without requiring a dedicated fund.

THE PRESIDENT: So that would be like our Ontario government guaranteeing Hamilton University back-up.

MR. ELDER: And that has been difficult for universities to get. It's easier for a Crown corporation to get.

THE PRESIDENT: So there will be a period of review of this whole policy?

MR. ELDER: Yes. We have -- as the Commission is aware, we've been working on an approach to financial guarantee for the smaller -- the nuclear substance licences. Once that policy direction is clear, we plan to revise all our documentation and regulatory documents around financial guarantees.

THE PRESIDENT: In the meantime, this fund is earning some revenues, I assume. It's not a total loss here, right, to the university?

You can actually borrow against this if you get some -- not you, but your financial VP.

MR. HEYSEL: Chris Heysel, McMaster University.

The fund is doing exceptionally well, and it's something that I think we're very proud of. The number quoted in the CNSC presentation was the audited number at least fiscal year, April 30th, 2012. The actual number is closer to 9.25 million.

It's a lot of money for a little organization, and we're proud of it. And I think it reflects the commitment that the university has in acknowledging and addressing its liabilities.

It does earn money, interest, but the way the legal documents are set around it, it's only the CNSC that can authorize its use for specific operations in the PDP.

THE PRESIDENT: Speaking of money, are you fully cost recovered or what percentage of your operation is cost recovered?

MR. HEYSEL: Chris Heysel, McMaster University.

We strive to balance our operating budget against our revenues. The -- we get substantial indirect support from the university in their -- everything from security, human resources, financial accounting, so we strive to pay our direct costs.

THE PRESIDENT: Thank you.

MEMBER TOLGYESI: Just on the presentation of staff, you are saying that MNR is estimating the decommissioning costs at 12.5 million. It could be significantly higher.

What's the staff evolution? What's that "significantly higher"? Because we will see what's the difference, what could be covered or -- you know, by the university.

MR. ELDER: Peter Elder, for the record.

This is, again, an area where we've had discussions with universities and other organizations.

For private industry, we insist that the decommissioning be calculated as it's being done as by a third party. An operator disappears, someone else can step in and do it.

The universities are arguing, and I think there is some validity to this one, is that universities do not disappear overnight and, actually, they have a mandate to keep their capabilities so that even if there was a decision by the university to shut down the reactor, Mr. Heysel and Mr. Tucker would not disappear overnight.

And we have a tendency to agree that that is -- that some of this costing could -- costing methodology could reflect the -- that they are actually not only a public institution, but actually a teaching institution that has an interest in maintaining the expertise.

So what we've said in the CMD in McMaster is if you can demonstrate to us that you are actually maintaining that expertise, then we will let you have some credit for it because if they went out and said you have to go buy this on the open market, it would be considerably higher.

But we do recognize, especially in McMaster's case where they have a large amount of nuclear knowledge, is they really do have in-house expertise. In fact, Mr. Tucker is used by other licensees to do decommissioning work.

THE PRESIDENT: Okay. Before the break, I'd like to go through the next presentation, which is from Mr. Steve Staniek as outlined in CMD 14-H4.4.

CMD 14-H4.4

Written submission from Steve Staniek

Questions. Mr. Harvey?

MR. HARVEY: Merci, monsieur le président.

In the second paragraph, the -- in that submission, it's about the -- to water the core. What is written there is MRN plans to deal with the significant loss of reactor coolant by using a fire hose to spray water over the core.

The concern is why send a responder into an extremely high radiation area to water the core when an embedded plumbing, et cetera, et cetera?

So could you just comment about that?

MR. TUCKER: Dave Tucker for McMaster University.

As Mr. Staniek would know from attending numerous emergency planning meetings, use of fire water as makeup water has always been part of our emergency plan. Having a responder stand with a hose and spray the core has never been part of our emergency plan. It's not now, it never has been, it never will be.

MEMBER HARVEY: Okay. Thank you.

THE PRESIDENT: So sorry, so what does it mean?

So how does it -- so how -- so what does it mean using the fire spray?

How does it get into the -- in case of an emergency, how does it get into the building?

MR. HEYSEL: Chris Heysel, McMaster University.

The system is slightly complicated because our core and bridge move, so in order to have a fixed pipe, there's a fixed spray system that has been installed on the bridge to direct water to the core.

There's a quick disconnect connection which ties to the fire water hose that can be deployed in less than a minute to -- instead of filling the water -- filling the pool with water from just a fire hose, that fill mechanism is now directed as spray on the core to remove any doubt of heat removal for an uncovered core.

There are connections to the building where that supply can be replenished, so there's a number of ways to get water to the core quickly and simply.

THE PRESIDENT: But it's -- just so I understand, it's a manual connection on the outside to start with?

MR. HEYSEL: Chris Heysel, McMaster University.

No, the manual connection is from the hose station on the wall adjacent to the reactor pool, so if we are in the situation where we've been unable to -- where we've had a leak, we've been unable to move the core and isolate it from the leak location, then the idea would -- or the procedure is to manually connect the hose from the hose station within the building to the spray system and open the valve and abandon the building.

If that system were to fail, there's provisions to hook pumper trucks up to the outside.

THE PRESIDENT: That's the one I'm interested in, the last sentence.

How does that get done?

MR. HEYSEL: So if a -- if, for example, there was a break in the water -- fire water line coming to the building, then that supply would need to be supplemented by a mobile unit.

So attached to the containment structure, there are Siamese connections which supply the feed or supply water to the building fire water piping system.

There's a check valve on the fire system as it enters the building to its normal route that would ensure that the water being brought in by mobile pumpers does not just go out to the leak underground on the supply line coming to the building.

THE PRESIDENT: Mr. Tolgyesi.

MEMBER TOLGYESI: Adding this water -- additional water, will it close overflow and eventual spill or leakage to the environment because you're adding the water?

MR. HEYSEL: We can add the water -- the reactor core is about 15 feet underground in a large containment building, so it would take a fairly long period of time to get to a period of time where you're at great elevation.

MEMBER TOLGYESI: And it's leak tight so you will not lose -- okay.

THE PRESIDENT: Question? Other questions?

Okay. We'll take a break here for 15 minutes, 10 past 10:00 -- 10 past 11:00.

MEMBER HARVEY: There was some concern about --

THE PRESIDENT: Sorry. Are you still on the intervenor, Mr. Staniek?

MEMBER HARVEY: I don't -- well, my question was, well, what do you do -- where do you -- what is the -- first, what's the frequency of changing the fuel and what do you do with the spent fuel?

MR. HEYSEL: Chris Heysel, McMaster University.

We would change a fuel assembly once every couple months, once every three months.

The spent fuel is stored in the pool until it's -- until there's enough accumulated to provide -- to fill a spent shipping flask. It's then repatriated to the U.S.

MEMBER HARVEY: That means -- yeah, you ship it to U.S., but at what frequency?

MR. HEYSEL: Chris Heysel, McMaster University.

We do a spent fuel shipment every seven to 10 years, depending on operating power and history and time at power.

MEMBER HARVEY: So is it the same requirements -- I'm addressing the staff -- to keep that fuel in the water for a long period of time?

MR. ELDER: Peter Elder.

There wouldn't be the same types of requirements just based on the amount of activity. I think their period is actually more related to how long it takes enough fuel to actually fill the transport flask.

So again, as -- our initial calculations, you actually probably don't need -- you need very little cooling, a few weeks, before it would be safe to transport if you want.

But that would also depend on the requirements of the -- both of the transport flask as well and how much heat it was designed to cover.

But no, there isn't a multi-year cooling requirement.

THE PRESIDENT: But is it a special separate pool or is this in the same -- where is this, you know, fuel waste located?

MR. HEYSEL: Chris Heysel, McMaster University.

The large 400,000 litre pool is actually divided in two. There's a gate that can go in and isolate either pool if we're doing maintenance in one side and we have to drain the pool.

The spent fuel storage -- or spent fuel is kept in pool number 2.

MR. ELDER: Peter Elder, for the record.

It's within the same big pool. It can be isolated, but it's also all within the containment building. So the spent fuel is stored within the containment building.

THE PRESIDENT: When you sent the HEU to the U.S., when was that?

MR. HEYSEL: Chris Heysel, McMaster.

Two thousand and eight (2008).

THE PRESIDENT: Did you get any -- was there any kind of public reaction to it?

MR. HEYSEL: Chris Heysel, McMaster University.

No, there was no public reaction to that.

THE PRESIDENT: I guess you didn't advertise it.

MR. HEYSEL: Chris Heysel, McMaster University.

There was certainly security restrictions about routes and material. The -- we didn't advertise it, but it was an activity that was taking place on campus at the time. We kept people back from the construction area more for worker safety than for radiological matters.

THE PRESIDENT: So CNSC staff, it went through all the security plans --

MR. ELDER: That is correct.

THE PRESIDENT: -- the export/import requirements with the U.S.

MR. ELDER: Right. And it was gone through -- it went through approved flash, approved route, security plan, all the normal requirements for transport of this type of fuel.

THE PRESIDENT: Okay. We will break and come back at 11:15. Thank you.

--- Upon recessing at 11:04 a.m. /
Suspension à 11 h 04

--- Upon resuming at 11:18 a.m. /
Reprise à 11 h 18

THE PRESIDENT: Okay. I'd like to open the floor for rounds of questions from the Commission members, starting with Ms Velshi.

MEMBER VELSHI: Thank you.

I just want to confirm with staff. In your presentation did you say that we are now going to be getting annual reports on research reactors?

MR. ELDER: Peter Elder for the record. Yes, that is correct. You had asked for them after the Slowpoke license renewals last year. So we are in the process of putting that together starting next year.

MEMBER VELSHI: Okay.

MR. ELDER: And we would include McMaster in that report.

MEMBER VELSHI: So I have one question for McMaster. In your submission you had raised concerns around the *Nuclear Liability Act*. So it was the decommissioning fund and there was also the *Nuclear Liability Act* or the amendments to it, and whether you got an opportunity to submit your comments to it or whether you thought you weren't listened to, but I -- my question is more general. That as the CNSC comes up with different policies, different regulatory documents, how well do you think the consultation process with you works, and do you feel you get enough opportunity to be heard?

MR. HEYSEL: Chris Heysel, McMaster University. I really have noted lots of improvements in -- in the Commission's outreach program, to their websites, to their automatic e-mail notifications and I think the process has gotten a lot stronger.

I do feel I've -- I'm given opportunity to -- to review and comment, it's just sometimes hard because there's a lot of -- a lot of changes happening right now to keep up. But the answer is, yes, I do feel we are given ample opportunity.

MEMBER VELSHI: And do you, with your other sort of partner research reactors, sometimes join forces and maybe take turns in submitting or joint submissions?

MR. HEYSEL: Chris Heysel, McMaster University. We don't work as cohesively as a community as we should. We're -- geographically we're not close to each other and in some ways we've got different missions, but I think -- I would certainly welcome the opportunity to work closer with my -- my colleagues at other universities.

THE PRESIDENT: Can I jump -- you mentioned that there's many, many open pool-type research reactors globally. Is there no kind of conference where you guys share operation experience, ideas, et cetera?

MR. HEYSEL: Chris Heysel, McMaster University. There's a number of research reactor operating groups. There's the North American alliance, which McMaster partakes -- or participates in, and there is International Group on Research Reactors, which we also participate with to -- to exchange ideas and -- and learn from our colleagues. We don't see much attendance from -- from the Slowpoke operators at those conferences.

THE PRESIDENT: Ms Velshi?

Mr. Tolgyesi.

MEMBER TOLGYESI: Merci, monsieur le Président.

I -- I will go back a little bit to this presentation on power. And staff -- this is a staff report. And you are saying that in consideration of the lessons learned from Fukushima, although MNR does not require electrical power to remain safe, they will install a connection because if an external source is needed, used -- if the University diesel generation fails delivering the power. So you need the power or you don't need the power?

MR. TANGUAY: Pierre Tanguay for the record. They do not require power in order to remain safe. The external connection for additional power would be required mostly to monitor the -- the facility and -- but not with regard to maintaining the reactor safe.

MEMBER TOLGYESI: And when you were presenting your slide 22, "does not require electric power", you were mentioning that there is an option that you could move reactor from one pull to another one. So if it's no power, how do you move it? Push something a little bit hard.

MR. HEYSEL: Chris Heysel, McMaster University. The core itself is suspended from a bridge and the bridge is on rail tracks. And due to the gear ratios, you can easily move it using a hand crank and that's how it's -- that's how it's moved.

MEMBER TOLGYESI: I have after something about -- you know, on your page 22, on CMD from McMaster, you have your organizational chart. And you were saying that because due to small staff size you have some difficulties or to read some quality management systems, and in the next you are saying also that you have difficulties to meet the certification program because the staff is small.

This -- on page 22 the staff is 26. Okay? About. That's you're talking about the staff. What about contractors? Because a little bit further you are talking about, on page 39, that Nray radiographers, they are contractors. So they are not on this chart. So eventually how many people is there, how many is working and ...? And -- and eventually on one of the next slides, on your slides, you were saying on slide -- which one, it is 4 -- that there is 868 authorized users or workers. So, how it fits together?

MR. HEYSEL: Chris Heysel, McMaster University. The comment on quality management systems are -- there's just some subtle difficulties we have with an organization our size. So, for example, there would be four engineers that work at the reactor that will produce operating manuals and technical documents. I am one of them. But also as the director, I have to have approved them all.

MEMBER TOLGYESI: M'hmm.

MR. HEYSEL: So it -- with only

four of us, I -- I tend to author some myself. And so, in the strictest quality assurance, quality management system world, you can't authorize your own work. So those are the subtle difficulties.

On the training side, we may have 25 op-- workers at the reactor, but we only have a certain amount of people qualified to train certified positions. With small numbers there are some divisions of people who can give the training and those people that can set examinations. So, we're a small group, we have to do both of those activities. So, our small size gives us challenges and we have to work with CNSC staff to work -- to work on those to meet the intent of those standards. We have been successful with the CNSC to -- to do that.

The numbers that we talk about, the 25, 35 workers at the -- in the org chart work for McMaster University. The Nray staff are -- work for a separate company but work under McMaster rules when they are within the building. Anytime during the day there may be 20 or 25 -- 20 people in the building. The 800 or so people that have been trained to handle radiation --

radioactive material work in labs all over the university. So that just shows me how robust our -- our training and radiological training and health physics program is that we can train and provide oversight to that many workers working with radiation sciences.

MEMBER TOLGYESI: Staff, how much of these work-- or how many of these workers should be qualified as nuclear and energy workers or they will -- do they need some other type of licence?

MR. ELDER: Peter Elder for the record. So the -- whether they are nuclear energy workers or not actually goes into the Radiation Protection Program and looking at what sort of dose they could potentially relieve from the work. So anybody that has over a -- potential for a certain amount of radiation, so above the -- the 1 millisievert public limit should be identified as a nuclear energy worker and that would require additional radiation protection training.

In terms of the -- who is certified, the certification has been for reactors to the people who -- who do the activities in the reactor, so moving the fuel around or operating the reactor, and that's the way we have normally done it. It doesn't mean that anybody else doesn't need training. So anybody that -- that goes into the reactor would need training around procedures, radiation protection, wear their hazards, that in some cases would act-- you know, would be similar to what any occupational health and safety training would be expected. What we look at in certification is where they are doing specific activities that affect the safe operation of the reactor, and those activities then directly affect the safe operation of the reactor and that's where we look for the positions to be certified.

MEMBER TOLGYESI: The last in this round is --

THE PRESIDENT: On this question, a couple of times in your documentation you make the subtle point that CNSC staff are accustomed to NPP-sized organization. So, I'm going to ask you a direct question. The -- I think in also the Licence Conditions Handbook it's a pretty sized organization. What do you think about that? Is that appropriately sized to your size?

MR. HEYSEL: Chris Heysel,

McMaster University. I feel the Licence Conditions Handbook is -- is fairly complicated, making the transition from the traditional licence. However, we are working closely with staff to -- to better understand the document and -- and to better understand how it's going to be implemented at the university. So, any change there's going to be some reservations. I think -- I think the -- the -- certainly the philosophy behind the Licence Conditions Handbook is excellent and I fully support it. It's now implementing that philosophy in a -- in a -- in a manner that is useful to both the licensee and the -- and the CNSC, and -- and we're working on that and -- and we're -- we're learning as -- as we implement it.

THE PRESIDENT: Staff, are you taking into account that there are four people or whatever the amount of people who actually -- the primary people and they have to understand everything in those Licence Conditions Handbook? You don't want to make it so complicated so you know they're not going to be able to be compliant.

MR. ELDER: Peter Elder for the record. Yes, we do take that into account and we are working separately on a regulatory document about a graded approach. So this is how do you take a reactor standard and say this is how you use it for a research reactor as opposed to how you use it for NPP.

In absence of that document, we have actually had to -- what we have done is putting that grading into the Licence Conditions Handbook. And while it does lead to some complexity, it hopefully will avoid the debates of between us and McMaster about what one particular clause means. And a lot of the material that eventually we want to see with clear interpretation in a reg doc is now in the -- the Licence Conditions Handbook because some reg docs do not have that clear interpretation.

And I will give you an example around the training requirements. If you read our requirements for training, you can interpret this as -- as there isn't a lot of difference in the training requirements between NPP and a small reactor. There are some very almost subtle language in the document that says you can apply it differently. What we have then said, well, this is how we are going -- we see it being applied for McMaster. And we have been working on a document that says, well, that would be more explicit in our regulatory documents and how you do the grading.

THE PRESIDENT: Thank you.

Monsieur Tolgyesi.

MEMBER TOLGYESI: I understand that in those -- this organizational chart there is no human relations or communications because it's supplied by the university. That's -- am I right?

Okay. And the last one is that what you do -- because you were saying that these hundred -- or hu-- at least a hundred or -- or more visitors, researchers. So, how do you do the training? How do you do -- if they need certification because they are in a zone where the radiation is higher than -- than the limit, how do you do that?

MR. TUCKER: Dave Tucker from McMaster University. Any user who has unescorted access to the facility is declared a nuclear energy worker and they are required to complete our radiation safety training. So we have a structured safety training program that's tailored to people's work requirements, whether they're a beam port user or a production staff member, they have a -- a radiation safety program that's specific to them. If you are a visitor coming to work, you fill -- you do that training.

THE PRESIDENT: Or you should be escorted?

MR. TUCKER: Yes, or if you're -- if you're not going to do radiological work at the facility and you're going to be escorted, then you don't need to do training.

MEMBER TOLGYESI: So, staff, how do you do that? Do you have this type that visitors are coming for two months' period? I don't know what's the length of a research project.

MR. TUCKER: Sorry, just if I may clarify. Dave Tucker from McMaster University. People that are coming to do radiation work at the facility re-- are required to complete our training programs. There's -- there's nobody who's doing work at the facility who hasn't undergone our Radiation Safety Training program even if they're only staying for two months.

THE PRESIDENT: Thank you.

Monsieur Harvey -- or Mr. -- Dr. McEwan, sorry. I'm jumping the queue here.

MEMBER McEWAN: I'd like to stay with the radiation safety piece. I mean, in -- in slide 4 you've mostly conflated all of the radiation activities on campus. Clearly the -- the reactor is only a small portion of the broader campus radiation safety requirements. How does your radiation safety stream fit in with the others and -- and what's the ultimate reporting process through to the university and responsibility to a university officer?

MR. TUCKER: Dave Tucker from McMaster University. I'm the senior health physicist for the university. So I manage the Radiation Safety Program --

MEMBER McEWAN: Of course.

MR. TUCKER: -- for all of the activities.

MEMBER McEWAN: Right.

MR. TUCKER: I report to Dr. Elbestawi as my -- my manager, and I report to the Health Physics Advisory Committee as my oversight committee. Mr. Heysel reports separately to Dr. Elbestawi. So our lines of reporting only meet at the level of the vice president of research. Chris reports from an oversight point of view to a separate oversight committee, the Nuclear Facilities Control Committee. So we have strong and -- and separate reporting and oversight lines for radiation safety in operational and nuclear safety.

MEMBER McEWAN: Okay. And so a question for staff because it's not clear to me, looking at the regulations, that for a university structure is there a clear guidance or a clear regulation that identifies the reporting structure within a university framework?

MR. ELDER: Peter Elder for the record. Sorry, is the regulations do not have specific situations where we would look at this type of -- of situation. That said, we do and we are being much more conscious about making sure that we are not looking at parts of this Radiation Protection Program separately. So -- so that while we would come in and do a focus inspection on -- on the -- you -- the reactor radiation protection, we would also make sure that we are looking at the other inspections results on other aspects to look for any common trends that would affect the overall program. But we -- you know, what we were looking for is -- is there aren't specific requirements around a university Radiation Protection Program and -- but we have been making sure that we are doing more comparison and results between different inspectors who are looking at different aspects of the -- of the operation, of the -- the university.

MR. JAMMAL: Ramzi Jammal for the record. I'd like to complement a couple things, though. We do have radiation protection requirements that the licensee is responsible to ensure that the program is established in order to meet the safety requirements.

I believe your question, Dr. McEwan, is more broader than just the operator. How do you holistically, the CNSC, ensure that there are consistent radiation protection oversight by the universities or large institutions. And specific with respect to a university that has combined multiple activities from nuclear substances, research laboratories or even a reactor in the case of McMaster, we have seen the structure in place where McMaster has a radiation safety, quote, unquote, I'm paraphrasing here, Radiation Safety Committee and senior health physicist who is in charge of the program. And that's what we require universities to have in place. They establish their own radiation safety committees with the responsible radiation safety officer reporting to that radiation safety committee so that they are able to harmonize and check and put in place the radiation protection program. When our inspectors go out, we have multiple levels of inspectors. For example, the nuclear substance inspectors, they go verify the laboratory. The annual report that is being produced for the consolidated licences, there is always a cross-comparison with respect to inventory, any changes in the structure of Radiation Safety Committee, how the reporting is taking place.

So the -- the answer is our regulatory requirement is broad enough in its performance base so -- so that the institution will propose to us the structure that we'll put in place for us to ensure a holistic approach.

So the -- the control of inventory, the control of radiations, doses to the workers is the responsibility of the licensee.

And we review the program and then that's why you'd see right now in the licences that comes before you you have got multiple safety control areas. One of them is the radiation protection, inventory control and so on and so forth.

So a long answer to say our regulation is performance based and the institution is responsible to make sure that there is a holistic approach and an oversight right across the organization.

MEMBER McEWAN: So just -- just to be absolutely clear, so each of the different areas that you discuss would come through you as the university radiation safety officer, and then all of that flows through to the vice president of research. So would the expectation be that a senior officer of a university or an organization like that would be the person to whom ultimately the responsibility flowed through the radiation safe-- university radiation safety officer and Radiation Safety Committee?

MR. JAMMAL: Ramzi Jammal for the record. The answer is yes. Yes, the expectation is that the -- there is an authority of the RSO to shut down a facility, and the authority of the RSO to directly go to the senior executive in order to -- to address any issues. So that's the expectation. It's not written in the regulation.

THE PRESIDENT: Who is the holder of the licence? Who is named in the licence?

MR. HEYSEL: Chris Heysel, McMaster University. The licence is held by the president and vice chancellor of McMaster University.

THE PRESIDENT: Is that the right level? I'm just trying to figure out whether they -- whether they actually -- does he get involved, do they get involved in any of those nuclear discussions at all?

MR. HEYSEL: Chris Heysel, McMaster University. I've -- I've been given day-to-day authority to deal on -- on the reactor operating licence. The president is informed, the vice president is informed in -- in routine and detailed reports on the facility's operation. Dave Tucker gives the board of directors an annual report on radiation doses and environmental results from the reactor and all nuclear facilities and activities at the university. And -- and I believe they're -- they're well informed.

THE PRESIDENT: The reason I'm asking is because I am really interested in knowing, in case of an emergency, who has the power to shut down the machine without going all the way through the hierarchy to get permission?

MR. HEYSEL: Chris Heysel, McMaster University. The authority and responsibility to shut down the reactor manually resides with everybody in the reactor building. If they believe that there is any indication of unsafe operation, they are encouraged, they are directed to take that responsibility certainly -- seriously and shut down the reactor.

THE PRESIDENT: Dr. McEwan.

MEMBER McEWAN: So again, just following up that, though. So if -- if the RSO, the university RSO, felt that there was an issue with reactor operations or an issue with CPDC operations, you would have the authority to shut that down without going to the vice president, but you would have the vice president's implicit backing to be able to do that?

MR. TUCKER: Dave Tucker for McMaster University. Yes, I have the absolutely crystal clear written authorization to shut down any operation if there is a concern about the safety or compliance. And I would say I have the explicit support of the vice president of research in that.

THE PRESIDENT: Just -- how many licences are there? I mean, I -- I notice on slide 4 of McMaster there is six facilities, two other licences. So how many in total? How many licences McMaster holds from CNSC?

MR. HEYSEL: Chris Heysel, McMaster University. There is a licence for the reactor. There is a consolidated use licence. There is a human research studies licence. And there -- each accelerator is -- has a separate licence but it's consolidated under the McMaster Accelerator Laboratory licence.

THE PRESIDENT: So when you are going -- I know in your submission you talk about the positron beam that you're putting in. Would that require a separate licence?

MR. HEYSEL: Chris Heysel, McMaster. No, that would be a beam facility at -- within the reactor and operate under that licence.

THE PRESIDENT: So do we need all

those licences? I mean, I'm always curious about -- do we need each and every separate licence?

MR. ELDER: Peter Elder for the record. We have looked at this one and had some preliminary discussions with McMaster. One of the things -- we decided not to do this one. It would make the Licence Conditions Handbook even more complex because it would then have to add the specific conditions, especially around the accelerators, but we are still exploring this one with -- with McMaster, especially if they are looking at any new facilities, that there may be a chance to combine -- rather than, you know, if something new comes up, and I think they have some potential projects, there would be a chance to combine it into one of their existing licences rather than a completely new licence.

But as I said, the accelerator ones are already combined, the labs are already combined. So in -- in overall there are three or four licences.

THE PRESIDENT: Okay.

MEMBER McEWAN: So -- thank you. So, again, just staying with the radiation safety piece. On page -- slide 17, you alluded to this in your presentation and -- in the -- in the CMD, but what really struck me about this is that from 2004 to 2011 you had a -- an almost continuous, consistent, at the same rate increase in dose. It looks as if it's been primarily related to the neutron radiographers. And then you have this dramatic precipitated fall. I mean, there has to be a lesson in how you achieve that. And I presume it's -- it's a real fall because you're -- you're doing the -- you're doing the correlation with -- with activity as well.

MR. TUCKER: Dave Tucker from McMaster University. Absolutely it's a -- it's a real fall. The gradual increase observed in collective dose by that group primarily, they were the -- the drivers, was associated entirely with increased operations. More people, longer time, more shots, more parts handled. At a point we made the decision collectively that commissioning the second beam port with improved shielding was a desirable thing to do. There was a significant investment of effort and time to get that beam port turned on and that's the result that you see following 2011.

So it was a major investment of time and effort to get that physical improvement made to the facility.

The whole time through that time we worked with them to minimize doses per shot through training, awareness, they changed materials in their imaging components to reduce short-lived activation. So there were many other smaller improvements, the biggest one being the change in the mode of operating when we went to two beam ports and the improved shielding on the second beam port.

THE PRESIDENT: Thank you. M. Harvey...?

MEMBER HARVEY: Yes, monsieur le Président.

In 2010 to 2011 you conducted an extensive inventory reduction campaign and at the end of the exercise it is mentioned that the inventory was a small fraction of what it was at the beginning of the period.

What is the level of inventory now and what is in place to maintain the low level, if it is the case?

MR. TUCKER: Dave Tucker for

McMaster University. I don't have a specific number for you of what the inventory is, it's a combination of --

MEMBER HARVEY: But is the inventory about the same level that it was two years ago?

MR. TUCKER: Yes, it's very low. We make periodic shipments of waste, but there's an ALARA approach to making the waste shipments. For example, we want resins to decay and we want to collect enough volume to make an efficient waste shipment. So the waste inventory does oscillate somewhat; builds up, we make a shipment, it goes down.

What we haven't done is accumulated any long-term historic waste in the facility, we're keeping the waste inventory as low as we reasonably can. It's one of the parameters that we track in our radiological safety performance assessment. So we are putting numbers of the inventory up, looking at it and setting goals on it every year.

MEMBER HARVEY: Staff, are you satisfied with the current practice?

MR. ELDER: Peter Elder, for the

record. Yes, we are satisfied with current practice and we had noted that last time we talked about improvements to the radiation protection program and what we would consider to be good practice and necessary practice now is this annual review of the radiation protection program and how they are working.

And I think this is one of the benefits of this one. You look at all your sources of doses, your sources of where the hazards are and the licensee looks at this and says, do I need this, can I do this, what can I do to reduce it.

And so this is evidence that McMaster's radiation protection program is actually working as designed.

MEMBER HARVEY: Last question. It is about the "reactor physics code suite", it's on page 17. First, could you just explain, I am not familiar with that, because after that:

> "CNSC staff are satisfied with the progress made by McMaster University with respect to the deterministic safety analysis improvement

> and will follow the ongoing code validation work as part of baseline compliance activities."

So could you explain briefly what it is and what is the importance of that?

MR. TANGUAY: Pierre Tanguay, for the record. After McMaster changed the core from HEU to LEU in 2007 they were requested to revisit the safety analysis to ensure that all the facts from the safety analysis were still valid, given that the core was essentially different.

So over the licence period McMaster provided every six months updates to the safety analysis being revisited. They have done modellizations and a lot of theoretical work to ensure that the trip coverage of the reactor maintains adequate for the new core.

MR. ELDER: Peter Elder, just to add to that. So these are all based on computer code calculations and this is, again, when we get into what's the expectation for a power reactor versus a research reactor; in a power reactor we would want these codes to be validated so that you have experimental data that says they can actually predict the conditions.

Obviously it's how you grade that expectation to a research reactor where you can get away with more simplistic calculations, but I'll be frank, being universities, they tend to do more complex ones than is absolutely necessary. So what is the appropriate level of validation of those codes?

So we don't have any concerns about the safety case, but the way they're approaching this one saying, if you want to use a sophisticated code you really should do some validation to give us some degree of how much confidence there is in the results.

That said, there is a lot of evidence and experimental evidence that there aren't any safety concerns around these reactors. How can I put this, very severe experiments were done in the early nuclear period, in the 50s and 60s with this type of reactors that form our basis of some of the understandings and they were very severe, in fact they did essentially not simulate it, they did really severe accidents with these types of cores, blew them out of the water, took the fuel out, dump it in a hot cell and see what happens, and things you wouldn't, actually as a regulator we wouldn't want anybody to do today. These were actually done.

So this is a case of saying, well, if you're going to do a modelling, you need to have some idea of how good your modelling is. But, again, it's really confirmation work, we have no real concerns -- not real concerns, no concerns about the safety case of the facility.

MEMBER HARVEY: But it seems to be quite complex you mentioned because that started in 2007 and it's always in progress.

MR. ELDER: I guess I'll let McMaster talk about this one. And, again, this is confirmation work, this is not that they're expected, this is please confirm there isn't a gap.

And so, we looked at the timelines for the work in that context as well and also recognizing, again, they're a small organization, it's not critical work to be have been done quickly, but over the period of time it does add to the knowledge if you can do this type of work.

MEMBER HARVEY: Thank you. Do you want to add something?

MR. HEYSEL: Chris Heysel, McMaster University. The reactor parameters we used to formulate our safety case were based on the experiments that Mr. Elder spoke about.

So we took experimental data from those experiments, we made conservative estimates of parameters for MNR and we used those to develop our safety case. So we took very conservative estimates from real data to build our safety case.

What we're looking at now is trying to understand exact parameters for our exact core. Some of those parameters can only be measured at start-up of the reactor or initial start-up of the reactor or loading the reactor.

So we're developing models to better understand very conservative numbers we've used in our safety case. Our safety case is extremely conservative. What we're trying to do is just better understand our machine.

MEMBER HARVEY: Merci.

THE PRESIDENT: Thank you. Anybody...? Any other questions?

I am interested, maybe it's a bit the long term. I saw your research program which is pretty impressive and, as you know, we are --

at least I'm personally very supportive of research as a whole.

You mentioned that you are putting this new positron beam and you believe that the NPP will actually use it. I'm trying to understand, are the NPP using your facilities and are they giving you some financial support, or are you expecting some more financial support?

Let me really load the question here, and are you planning for the unknown in 2016, which is, we don't know what the future of the NRU is; right?

MR. HEYSEL: Chris Heysel, for the record. We work with a lot of different companies, nuclear power plants are one of them. We support geologists, mining companies, aircraft manufacturers, all kinds of environmentalists looking for analysis, so we do lots of things.

We do things like validate flux detectors that are used in power plants. So we do a number of different services and, yes, nuclear power plants do come and they're willing to pay well and that helps our researchers who are not always in the position to pay normal fees for some of our services that would come at a cost.

So we've got an important future and, yes, nuclear power plants are part of it.

As far as 2016 goes, we really look forward to the resurrection of AECL as a focused research laboratory. It's right in our ballpark. We're all about research at McMaster and we look forward to working with them.

I see lots of opportunities for our facility and AECL's NRU to work together and I do hope that they pursue relicensing past 2016.

THE PRESIDENT: You used to, years ago I'm told, to actually be in the technetium production also; were you not? And so, hypothetically there is, I don't know, shortages in 2016; are you guys able to gear up to meet such supply?

MR. HEYSEL: We produced isotopes in the 70s and technically we can produce technetium. There's a number of hurdles, we don't have processing facilities or that sort of stuff that's required in the supply chain of that isotope.

THE PRESIDENT: Thank you. Anybody, final question...? All right. Thank you very much.

THE SECRETARY: So just to be clear, the Commission will confer with regard to information that it has considered today and then will determine if further information is needed or if it is ready to proceed with a decision and we will advise accordingly.

Sorry I was not faster on the button.

--- Laughter / Rires

THE SECRETARY: Bye-bye.

THE PRESIDENT: We will reconvene at --

THE SECRETARY: One o'clock.

THE PRESIDENT: -- one o'clock. We will be back at one o'clock.

--- Upon recessing at 12:02 p.m. /
Suspension à 12 h 02