



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Record of Proceedings, Including Reasons for Decision

In the Matter of

Applicant McMaster University

Subject Application to Renew the McMaster Nuclear
Reactor Operating Licence

Public Hearing
Date May 8, 2014

RECORD OF PROCEEDINGS

Applicant: McMaster University

Address/Location: 1280 Main Street West, Hamilton, Ontario, L8S 4K1

Purpose: Application by McMaster University to Renew the McMaster Nuclear Reactor Operating Licence

Application received: September 6, 2013

Date of public hearing: May 8, 2014

Location: Canadian Nuclear Safety Commission (CNSC) Public Hearing Room, 280 Slater St., 14th. Floor, Ottawa, Ontario

Members present: M. Binder, Chair
A. Harvey D. D. Tolgyesi
S. McEwan R. Velshi

Secretary: M.A. Leblanc
Recording Secretary: D. Carrière
General Counsel: L. Thiele

Applicant Represented By	Document Number
<ul style="list-style-type: none">• M. Elbestawi, Vice President, Research and International Affairs• D. Tucker, University Senior Health Physicist• C. Heysel, Director, Nuclear Operations and Facilities	CMD 14-H4.1 CMD 14-H4.1A
CNSC staff	Document Number
<ul style="list-style-type: none">• P. Elder• P. Tanguay• R. Jammal	CMD 14-H4 CMD 14-H4.A
Intervenors	Document Number
<ul style="list-style-type: none">• Hamilton Fire Department	CMD 14-H4.2
<ul style="list-style-type: none">• Siegfried (Ziggy) Kleinau	CMD 14-H4.3 CMD 14-H4.3A
<ul style="list-style-type: none">• Steve Staniek	CMD 14-H4.4

Licence: Renewed

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1.0 INTRODUCTION

1. McMaster University has applied to the Canadian Nuclear Safety Commission¹ for the renewal of the Non-Power Reactor Operating Licence for the McMaster Nuclear Reactor (MNR) located on the university campus in Hamilton, Ontario. The current operating licence, NPROL-01.01/2014, expires on June 30, 2014. McMaster University has requested a renewal of the licence for a period of 10 years.
2. The MNR is a small pool-type research reactor that uses demineralised water as moderator and coolant. It is fueled with Materials Test Reactor (MTR) Low Enriched Uranium (LEU) fuel assemblies. The MNR is currently licensed to operate up to 5 megawatt (MW) thermal power. The reactor is confined within a concrete containment building located on the university's main campus.
3. The MNR began operation in 1959 and is used for a variety of purposes including research and education, commercial applications, and medical radioisotope production.

Issue

4. In considering the application, the Commission was required to decide, pursuant to subsection 24(4) of the *Nuclear Safety and Control Act*² (NSCA):
 - a) if McMaster University is qualified to carry on the activity that the licence would authorize; and
 - b) if, in carrying on that activity, McMaster University would make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

Public Hearing

5. The Commission, in making its decision, considered information presented for a public hearing held on May 8, 2014 in Ottawa, Ontario. The public hearing was conducted in accordance with the *Canadian Nuclear Safety Commission Rules of Procedure*³. During the public hearing, the Commission considered written submissions and heard oral presentations from CNSC staff (CMD 14-H4, CMD14-H4.A) and McMaster University (CMD 14-H4.1, CMD 14-H4.1A). The Commission also considered written submissions from three intervenors. The hearing was webcasted live via the CNSC website and video archives are available for a three-month period after the hearing.

¹ The *Canadian Nuclear Safety Commission* is referred to as the "CNSC" when referring to the organization and its staff in general, and as the "Commission" when referring to the tribunal component.

² Statutes of Canada (S.C.) 1997, chapter (c.) 9.

³ Statutory Orders and Regulations (SOR)/2000-211.

2.0 DECISION

6. Based on its consideration of the matter, as described in more detail in the following sections of this *Record of Proceedings*, the Commission concludes that McMaster University is qualified to carry on the activity that the licence will authorize. The Commission is of the opinion that McMaster University, in carrying on that activity, will make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed. Therefore,

the Commission, pursuant to section 24 of the *Nuclear Safety and Control Act*, renews the Non-Power Reactor Operating Licence issued to McMaster University for the McMaster Nuclear Reactor located on the university campus in Hamilton, Ontario. The renewed licence, NPROL-01.00/2024, is valid from July 1, 2014 until June 30, 2024, unless suspended, amended, revoked, replaced or transferred.

7. The Commission includes in the licence the conditions as recommended by CNSC staff in CMD 14-H4.
8. With this decision, the Commission directs CNSC staff to provide annual reports on the performance of the McMaster Nuclear Reactor, as part of the annual safety performance reports on nuclear research facilities in Canada. CNSC staff shall present these reports at public proceedings of the Commission.
9. The Commission also accepts CNSC staff's recommendation regarding the delegation of authority in the Licence Conditions Handbook (LCH). The Commission notes that CNSC staff can bring any matter to the Commission as applicable. The Commission directs CNSC staff to inform the Commission on an annual basis of any changes made to the LCH.
10. The Commission also accepts the revised financial guarantee for decommissioning of the MNR.

3.0 ISSUES AND COMMISSION FINDINGS

11. In making its licensing decision, the Commission considered a number of issues relating to McMaster University's qualification to carry out the proposed activities and the adequacy of the proposed measures for protecting the environment, the health and safety of persons, national security and international obligations to which Canada has agreed.

3.1 Management System

12. The Commission examined McMaster University's management system, which covers the framework that establishes the processes and programs required to ensure that the MNR achieves its safety objectives and continuously monitors its performance against these objectives, and fosters a healthy safety culture.

3.1.1 Quality Management

13. McMaster University reported that its quality management (QM) program activities enable facility management to plan activities, manage safe operation, and generate the necessary records and documentation related to the operation of the facility. This program ensures that adequate resources are provided and maintained to carry out licensed activities. The QM program activities were conducted with the intent of improving performance over the current licence period and in accordance with approved documented procedures.
14. McMaster University also reported that several regulatory and compliance audits of the MNR Management System and Training Program were conducted over the current licence period and all resulting action notices were subsequently closed.
15. McMaster University noted several improvements to its QM program over the current licence period, and informed the Commission of its intention to expand its databases into other quality management areas on a priority basis.
16. CNSC staff reported that improvements in the areas of the QM program described by McMaster University were completed to CNSC staff satisfaction. A follow-up inspection was conducted in 2013 confirming the closure of all the items raised during the 2009 inspection to CNSC staff satisfaction.
17. CNSC staff reported that it had reviewed the management system performance for the MNR and rated McMaster University's performance within this safety and control area (SCA) as satisfactory. McMaster University has developed and implemented a QM program for MNR that complies with CNSC expectations and meets the required improvements noted during the licence renewal hearing in 2007. CNSC staff also reported having reviewed McMaster University's revisions to its management system program documents and found them to meet expectations.

3.1.2 Organization

18. CNSC staff reported that, during the current licence period, it made recommendations to McMaster University regarding the appropriate definition and description of roles and responsibilities within the organization. These mostly related to discrepancies between documents and organizational changes that were not appropriately represented. CNSC staff stated that it reviewed the revised MNR Organizational Structure document and found it to be satisfactory.

19. In response to a question from the Commission, a McMaster University representative explained that the University is the licensee and the President and Vice Chancellor of McMaster University is the licence holder. Authority to operate the facility according to the licence has been delegated to operations staff who are responsible for periodically informing the licence holder and the board of directors of all activities at the MNR. The Commission asked with whom lies the authority to shut down the facility in emergency situations. A McMaster University representative stated that the licence holder will support any decision by operations staff to shut down the reactor if there is a safety concern or compliance issue.

3.1.3 Conclusion on Management System

20. Based on its consideration of the presented information, the Commission concludes that McMaster University has appropriate organization and management structures in place and that the operating performance at MNR provides a positive indication of the applicant's ability to adequately carry out the activities under the proposed licence.

3.2 Human Performance Management

21. Human performance management encompasses activities that enable effective human performance through the development and implementation of processes that ensure licensee staff is sufficient in number in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.
22. CNSC staff reported that McMaster University has an effective training program in place to ensure proper training of the MNR operational staff. CNSC staff rated this SCA as satisfactory.

3.2.1 Personnel Training

23. McMaster University reported that conditions in the current licence required MNR to transform its training method from the traditional on-the-job training approach to the Systematic Approach to Training (SAT) methodology. CNSC staff explained that SAT is the framework endorsed by the CNSC for establishing and maintaining training for persons working in a nuclear facility or at any place where nuclear substances or prescribed equipment are produced, used, possessed, packaged, transported or disposed.
24. CNSC staff reported having reviewed MNR's new training program. A Type II compliance inspection of MNR's training program was conducted in March 2013, and resulted in two action notices pertaining to SAT-based training documentation for the Reactor Supervisor position requiring an update in order to meet the requirements of the current operating licence. CNSC staff stated that McMaster University satisfactorily addressed these two action notices in a timely manner and in accordance with corrective action plans that had been reviewed and accepted by CNSC staff. All action notices have been closed.

25. McMaster University listed the training program activities it completed during the licence period. McMaster University stated that, during the proposed licence period, it will finalize training material for the Reactor Supervisor Training Program and it will complete evaluations of the Reactor Operator and Reactor Supervisor training programs, as required.
26. CNSC staff stated that it is satisfied with MNR's training program and that it will continue to monitor the implementation and maintenance of the training program through its regulatory compliance activities.

3.2.2 Personnel Certification

27. McMaster University provided information on employee certifications completed during the current licence period. Four candidates received their Reactor Operator certifications from the CNSC in November 2013. McMaster University noted that it will continue to re-certify Reactor Operators and maintain the qualifications of Reactor Supervisors, as required. CNSC staff reported that McMaster University currently has seven certified Reactor Operators and one certified Reactor Supervisor. One additional MNR staff is undergoing the qualification program to become Reactor Supervisor.
28. CNSC staff described the certification requirements and processes for Reactor Operator and Reactor Supervisor positions. CNSC staff reported that McMaster University updated their training documents in 2013 to satisfy and reflect the training requirements under a SAT-based training program.
29. With regards to the certification program requirements, McMaster University expressed concerns regarding its ability to meet CNSC staff's expectations on requirements designed for larger nuclear organizations. McMaster University stated that it will continue to work with CNSC staff to meet the requirements.
30. The Commission enquired about the certification of visitors and researchers at the MNR facility. A McMaster University representative explained that any person requiring unescorted access to the facility is declared a nuclear energy worker (NEW) and is required to complete radiation safety training. Training is not required for those not conducting radiological work at the facility and those being escorted through the facility.

3.2.3 Conclusion on Human Performance Management

31. Based on its consideration of the presented information, the Commission concludes that McMaster University has appropriate programs in place and that the current efforts related to human performance management provide a positive indication of McMaster University's ability to adequately carry out the activities under the proposed licence.

32. The Commission requests that progress on training and certification be part of the annual reports to the Commission.

3.3 Operating Performance

33. Operating performance includes an overall review of the conduct of the licensed activities and the activities that enable effective performance as well as improvement plans and significant future activities at the MNR.

3.3.1 Safe Operating Envelope

34. McMaster University reported having operated in accordance with the conditions prescribed in its governing documents over the current licence period. CNSC staff confirmed that McMaster University has operated the reactor in full compliance of its Operating Limits and Conditions (OLCs) over the licence period. CNSC staff stated that McMaster University has operated the facility safely during the licence period, in compliance with the CNSC regulatory requirements, and is performing satisfactorily with respect to this SCA.
35. CNSC staff reported that, through routine compliance inspections and desktop reviews, it found McMaster University's programs related to operation and maintenance of the MNR to be adequate.

3.3.2 Reporting and Trending

36. CNSC staff reported that it had reviewed McMaster University's Annual Compliance Reports filed, as required by the licence, and that no issue with safe operations had been identified.
37. With regards to unplanned events, CNSC staff stated that McMaster University reported two events where action levels had been exceeded during the current licence period. One event was related to a finger puncture with a contaminated wire in August 2011, and the other event was related to a worker's thyroid burden increase due to an intake of I-125 in December 2007. CNSC staff stated that it has followed up on these two events, discussed further in the section on Radiation Protection of this *Record of Proceedings*, and found that McMaster University took appropriate corrective actions. The event has not reoccurred and adverse trends have not been observed.

3.3.3 Operating Experience

38. McMaster University reported that there were no major unplanned outages during the current licence period.

39. In its submission, an intervenor made reference to a significant incident that occurred at the facility 20 years ago. The Commission enquired about this incident and its outcome. A McMaster University representative explained the incident that occurred during a reactor fueling activity and resulted in an unexpected critical power excursion⁴ exceeding the licence power requirement. The representative from McMaster University stated that the intervenor incorrectly described the incident as a near meltdown of the reactor. The safety systems performed as intended, the fuel was not damaged and there were no releases of radioactivity to the environment or radiological dose received by workers or the public as a result of this incident. The McMaster University representative reported that the root cause analysis indicated several procedural and administrative violations. Corrective actions were immediately addressed through increased validation and verification during the refueling processes. Although the corrective actions deal with human performance as opposed to installing physical barriers that could prevent reoccurrence, they are resource-intensive and focused on ensuring that the reactor is constantly monitored during these operations. The Commission asked if physical barriers could be added to further reduce the possibility of reoccurrence of this type of event. CNSC staff explained that it did investigate this possibility but that normal physical barriers cannot be relied upon during fuel changes other than the shutdown system that remains poised and available.
40. The Commission enquired about the International Nuclear Events Scale (INES) rating of two for the event mentioned in above. CNSC staff explained that any event requiring the activation of a safety system is automatically considered a level two on the INES, even if there are no releases or impacts to the public or the environment.
41. In response to a statement by an intervenor that there is a lack of regulatory oversight at the MNR facility, the Commission enquired about the periodicity of CNSC staff inspections. CNSC staff stated that it follows a compliance inspection plan to evaluate every SCA on an ongoing basis. This amounts to two to three inspections per year.

3.3.4 Conclusion on Operating Performance

42. Based on the above information, the Commission concludes that the operating performance at the facility during the current licence period provides a positive indication of McMaster's ability to carry out the activities under the proposed licence.

3.4 Safety Analysis

43. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or the operation of a facility, and considers the effectiveness of preventive measures and strategies in reducing the effects of such hazards. It supports the overall safety case for the facility. CNSC staff rated this SCA as satisfactory.

⁴ Critical power excursion: an unexpected rise in reactor power due to an unplanned insertion of reactivity.

3.4.1 *Deterministic Safety Analysis*

44. CNSC staff reported that McMaster University's deterministic safety analysis is documented in the MNR Safety Analysis Report (SAR). McMaster University stated that all proposed changes to the facility are subject to the MNR change control program, which requires that the impact of any change be assessed against the requirements of the MNR SAR. CNSC staff further stated that McMaster University committed to update and reconfirm the safety analysis results of the MNR SAR following the conversion of the core from high enriched uranium (HEU) to low enriched uranium (LEU) fuel in 2007. The additional analysis provides better information on a wider range of events and validates the conclusions of the MNR SAR following the conversion. CNSC staff was informed twice per year on the progress of improvements to the safety analysis by McMaster University. CNSC staff reported that it is satisfied with McMaster University's progress on the deterministic safety analysis improvements and that it will follow the ongoing code validation work as part of baseline compliance activities.
45. With regards to the deterministic safety analysis improvement, the Commission requested further information regarding the ongoing code validation work, including the importance of this work. CNSC staff explained that McMaster University was requested to revisit the safety analysis following their core conversion from HEU to LEU fuel in order to ensure that all aspects of the safety analysis remained valid given the different core. A McMaster University representative and CNSC staff provided information regarding the updates and work completed by McMaster University. CNSC staff stated that there are no concerns regarding the safety case of the facility and that this work is for validation purposes. The McMaster University representative added that it is currently trying to understand exact parameters for the MNR core, some of which can only be measured at start-up of the reactor or loading of the reactor. McMaster University is developing models to better understand the very conservative estimates it currently has in its safety case.
46. CNSC staff discussed the reliability and the safety features of the MNR design, explaining that the reactor is inherently safe and that shutdown safety systems are not required to provide and maintain a safe shutdown state. The Commission enquired about the requirement for safety systems if the reactor has an inherently safe design. CNSC staff explained that, although the reactor can shut down without any intervention, this mode of operation is not preferred. The safety systems are to provide faster means to shut down the reactor. With regards to the incident referenced by one intervenor that occurred over 20 years ago, the Commission asked if there is certainty that natural processes would have shut down the reactor if the safety systems failed. CNSC staff responded that analyses, including the safety assessment, demonstrated that the natural processes would have performed as anticipated. CNSC staff noted that it is assumed that the heat generated by the fuel within the MNR is low enough for air cooling to be sufficient to prevent fuel from melting. Although this is the case, CNSC staff stated that it is not relying on that assumption and requires means for water cooling at all times.

47. The Commission enquired further on analyses completed on air cooling of MNR fuel. A McMaster University representative explained that experiments have been conducted where MNR-type fuel removed from a reactor core into a hot cell with air cooling only did not reach melting temperatures. Further analysis is required to understand the exact characteristics of the fuel used in that experiment to ensure MNR fuel is similar and to determine if it can be air-cooled. McMaster's current calculations and analyses show that the heat being generated per area of MNR fuel shortly after shutdown is low, but more verification is required to determine if air-cooling is sufficient to keep the fuel from melting. The Commission asked if the core conversion from HEU to LEU fuel affects the analysis and literature review results. The McMaster University representative responded that the core conversion does change them slightly, which is one of the items McMaster University is verifying in the research it is doing.

3.4.2 Hazards Analysis

48. McMaster University reported that it had commissioned third party experts to perform a Fire Safe Shutdown Analysis (FSSA) in 2010, followed by a Fire Hazards Analysis (FHA) for the MNR subsequent to the introduction of the regulatory document NFPA-801, *Standard for Fire Protection for Facilities Handling Radioactive Material*⁵, in the current licence in 2007. The FSSA assessed the ability of the MNR facility to achieve and maintain a safe shutdown state in the event of a fire. McMaster University reported that the assessment had not identified any deficiency in MNR's capability to place and maintain the reactor in a safe shutdown state in the event of a fire.
49. McMaster University reported that the FHA identified a number of minor deficiencies relating to changes to code of design and fire protection approaches since the construction of the facility. All recommendations in the FHA have since been addressed.
50. CNSC staff reported having reviewed both the FSSA and FHA and found them and the remedial actions performed by McMaster University to be acceptable.

3.4.3 Criticality Safety

51. CNSC staff reported that McMaster University developed a Nuclear Criticality Safety Program (NCSP) that complies with modern standards, as required by the current licence. CNSC staff stated that it reviewed the NCSP and found it acceptable. CNSC staff also stated that it performed an inspection in 2009, which confirmed that the NCSP was implemented satisfactorily.

⁵ National Fire Protection Association (NFPA) Standard NFPA-801, 2014

3.4.4 Fukushima Follow-up Actions

52. McMaster University reported that, in response to the Fukushima-Daiichi accident in 2011, a Defence-in-Depth (DID) assessment of the MNR was performed, and that no significant gaps were found. CNSC staff noted that opportunities for improvement in the area of Severe Accident Management were identified. CNSC staff stated that McMaster University is developing emergency procedures to use fire water to cool the reactor core as an additional safety measure. This also addresses one intervenor's concern that the MNR does not have a dedicated emergency cooling system. CNSC staff reported that it is following up on this and other initiatives, which are expected to be completed within the first year of the proposed licence period.
53. Further to the considerations of lessons learned from the Fukushima-Daiichi accident, CNSC staff reported that McMaster University chose to install an additional connection for an external electrical power supply source on the outside of the reactor building in case the University's diesel generators become unavailable.
54. The Commission enquired about the power required during an event or accident and asked if this additional connection for external electrical power was required. CNSC staff responded that the MNR does not require power to remain safe and that this additional connection is to ensure monitoring capability during an event.

3.4.5 Revision of the SAR

55. McMaster University discussed a licence amendment approved by the Commission in 2012 to change the backup electrical power supply source to the Reactor Building from the original stand-alone 25 kW generator to the University's modern set of four 1 MW diesel generators with their associate switchgear, transformers and distribution panels. CNSC staff reported that the SAR was revised and the licence amendment was issued to reflect this minor change.

3.4.6 Conclusion on Safety Analysis

56. On the basis of the information presented, the Commission concludes that the systematic evaluation of the potential hazards and the preparedness for reducing the effects of such hazards is adequate for the operation of the facility and the activities under the proposed licence.

3.5 Physical Design

57. Physical design includes activities to design the systems, structures and components to meet and maintain the design basis of the facility. The design basis is the range of conditions, according to established criteria, that the facility must withstand without exceeding authorized limits for the planned operation of safety systems. CNSC staff rated this SCA as satisfactory.

3.5.1 Design Governance

58. McMaster University noted that the design basis for the MNR is documented in the *McMaster Nuclear Reactor Safety Analysis Report*. McMaster University reported that there had been no changes to the facility or operations over the current licence period that might have affected the design basis. CNSC staff concurred with McMaster University and explained that upgrades to existing systems were completed as part of MNR's aging management and maintenance program in accordance with the facility's engineering change control process.
59. McMaster University stated that it will continue to improve infrastructure to ensure safe, secure and compliant operation of the MNR.

3.5.2 Facility Design

60. McMaster University reported that it conducted a Defence-in-Depth (DID) review of the MNR design following international standards in response to the Fukushima-Daiichi accident of March 2011. A report of the review, which validated the design basis of the facility, was submitted to the CNSC in 2012. The DID review showed that the MNR has strong provisions for protecting workers, the public and the environment against internal and external hazards. CNSC staff confirmed that McMaster University's DID assessment of the MNR facility confirmed the robustness of MNR's design.
61. McMaster University stated that the DID review identified a number of opportunities for improvement to facilitate response to severe accidents at the facility. MNR is in the process of implementing those opportunities with completion expected during the next licensing period.
62. McMaster University also provided a description of the core cooling process, noting that electricity and other services are not required to place or maintain the reactor in a safe shutdown state. CNSC staff described the improvements made following the Fukushima-Daiichi accident, as detailed in section 3.4.4.

3.5.3 Conclusion on Physical Design

63. On the basis of the information presented, the Commission concludes that the design of the MNR is adequate for the operation period included in the proposed licence.

3.6 Fitness for Service

64. Fitness for Service covers activities that are performed to ensure the systems, components and structures at the MNR continue to effectively fulfill their intended purpose.

3.6.1 Equipment Fitness for Service

65. McMaster University reported that non-destructive evaluation (NDE) had been completed on the primary water system piping and the main heat exchanger tube bundles by an independent contractor in January 2010. The results of the inspection indicated that the primary water system piping was in excellent condition, but showed limited signs of incipient degradation of the main heat exchanger tubes. The affected tubes were removed from service. A follow-up NDE inspection of the main heat exchanger tubes and primary water piping, completed in 2012, found no significant changes to the component integrity since the initial inspection in 2010. McMaster University stated that the NDE contractor recommended on-going periodic inspections every three years to monitor system health.
66. McMaster University also reported that testing of safety-related systems had been carried out successfully, as scheduled and in accordance with the MNR document AP-1111, *Operating Limits and Conditions*. McMaster University provided a description of the MNR annual containment air leak test, the quarterly shim-safety rods drop test and the bi-monthly high-power trip test, all of which concluded no changes in system performance during the current licence period. CNSC staff reported that it reviews the results of these tests on a continual basis.
67. CNSC staff stated that McMaster University has performed the surveillance necessary to ensure that the facility's systems and components remain effective over time. CNSC staff also stated that its review of the MNR Annual Compliance Reports and results from CNSC routine compliance inspections confirm the fitness for service of the MNR's systems and components.

3.6.2 Maintenance

68. McMaster University reported that all maintenance activities at MNR were successfully completed as scheduled and in accordance with the Operating Limits and Conditions and relevant procedures. CNSC staff confirmed that McMaster University has a well-established maintenance program and that all maintenance activities necessary to demonstrate the performance and reliability of MNR systems and components were successfully carried out during the current licence period.

3.6.3 Aging Management

69. McMaster University reported that, in 2010, it issued the technical report MNR TN 2010-04, *Status of McMaster Nuclear Reactor Structures, Systems and Components*, following the guidelines presented in the IAEA safety standard, *Ageing Management for Research Reactors*⁶. The report itemizes the safety-critical systems, structures and components (SSCs), provides the relevant inspection and maintenance activities and

⁶ IAEA Specific Safety Guide No. SSG-10, 2010

performance testing for safety-critical systems, and details completed and scheduled or planned refurbishment and replacement activities. CNSC staff stated that the condition of all systems was assessed as either good or very good and that it is satisfied that periodic inspections and performance testing are being conducted regularly.

70. McMaster University noted that aging management activities comprised of on-going maintenance, scheduled inspections and equipment refurbishment or replacement activities continue to be effective. It will continue to execute its safety system testing and maintenance programs to ensure fitness for service.
71. CNSC staff reported that McMaster University maintains the MNR facility in accordance with its maintenance program and aging management program to ensure that the facility remains fit for service throughout its lifecycle. CNSC staff also reported that MNR has proactively upgraded several equipment components over the current licence period as part of its aging management program. CNSC staff stated that McMaster University maintains the facility adequately, ensuring the equipment performs and remains fit for service, and that it proactively manages the aging of safety-critical SSCs.
72. The Commission enquired about the life of the facility. A McMaster University representative responded that, due to the simplicity of its design, the facility can be repaired and maintained to allow for continued safe operations for an indeterminate time.
73. The Commission enquired about tests conducted to confirm the integrity of MNR's concrete containment structure and asked if core samples of the concrete structure have been analyzed. McMaster University responded that they have not analyzed core samples of the concrete containment structure. CNSC staff considers that, even though MNR's containment structure does not have to withstand the same types of high design pressure nuclear power reactors would since its actual design pressure is much lower, McMaster University should be looking at these types of opportunities as part of its aging management program. The Commission requests that McMaster University examine the integrity of MNR's concrete containment structure as part of its aging management program.
74. The Commission also enquired about the physical state of the concrete structure. A McMaster University representative explained that the concrete containment structure leak tests and maintenance are periodically performed. The outside of the building was resurfaced in 2006, and the seals of the access points to the facility are routinely maintained. Other concrete structures are also routinely inspected and maintained to ensure continued safe operation.

3.6.4 Conclusion on Fitness for Service

75. The Commission is satisfied with McMaster's programs for the inspection and life-cycle management of key safety systems. The Commission requests that the verification of the integrity of MNR's concrete containment structure be included as part of the McMaster University aging management program. Based on the above information, the Commission concludes that the equipment as installed at the MNR is fit for service.

3.7 Radiation Protection

76. As part of its evaluation of the adequacy of providing for the protection of the health and safety of persons, the Commission considered the past performance of McMaster in the area of radiation protection. The Commission also considered the radiation program at the MNR to ensure that both radiation doses to persons and contamination are monitored, controlled and kept as low as reasonably achievable (ALARA), with social and economic factors taken into consideration.
77. CNSC staff reported that, during the current licence period, McMaster University has continued to maintain and implement a comprehensive Radiation Protection (RP) program at its facility. CNSC staff rated this SCA as satisfactory, and stated that it will continue to monitor the effectiveness of the RP Program to ensure it meets CNSC expectations.

3.7.1 Application of ALARA

78. McMaster University described the overall objectives of the MNR RP program that it states continued to be met throughout the licence period. CNSC staff confirmed that McMaster University has demonstrated a commitment to the implementation of the ALARA principle and continued to apply measures to keep doses received by workers ALARA.
79. CNSC staff reported that McMaster University has an effective program in place to ensure that doses to workers are maintained ALARA.

3.7.2 Radiation Protection Program Performance

80. McMaster University stated that the MNR RP program is documented in its document HP-9000, *MNR Radiation Protection Program*, which specifies the requirements in the following areas:
- responsibilities, training and qualification requirements;
 - external and internal exposure limits;
 - personnel monitoring and dosimetry requirements;

- facility internal surveillance and posting requirements;
 - conduct of radiological work requirements;
 - facility boundary surveillance requirements;
 - radioactive waste disposal requirements;
 - instrumentation and calibration requirements;
 - incidents and emergency procedures; and
 - program assessment requirements.
81. McMaster University reported that its RP program performance has been strong throughout the licence period and noted that continuous improvements are being made in several areas of the program. McMaster University also reported that detailed annual RP program assessments are completed by MNR and Health Physics Department management that are presented to the Health Physics Advisory Committee and Nuclear Facilities Control Committee.
82. CNSC staff reported that it evaluated MNR's RP program elements for effective implementation through various compliance and verification activities. Compliance inspections were conducted by CNSC staff during the current licence period and several action items were identified during these inspections, none having a potential increased risk to the health and safety of workers or members of the public. CNSC staff stated that it continues to verify the effective implementation of the corrective actions for items identified during inspections through the baseline compliance plan.
83. McMaster University stated that it performed extensive annual RP program reviews and that a significant expansion of, and update to, the RP program documentation were completed during the current licence period.
84. CNSC staff also reported that McMaster University performed an in-depth review of the RP program, as committed in 2007. CNSC staff noted changes made to the program, including update of organizational structure, responsibilities and associated procedures/instructions to reflect current practices, and addition of specific requirements. CNSC staff stated that it reviewed the revised program and found it to be acceptable.
85. McMaster University reported that its facility radiation safety training programs were significantly expanded and updated, and that a formal continuing radiation safety training program was implemented. All workers completed the new initial training program.
86. CNSC staff reported that, in 2010, following an alpha radiation contamination event at Bruce Power, the CNSC requested a detailed assessment by MNR of the potential for hazards arising from alpha-emitting contamination within their facility. McMaster University stated that it completed a detailed assessment of the potential for hazards from alpha-emitting contamination within the facility during the current licence period. McMaster University reported that no significant source term of alpha-emitting contamination currently exists within the facility, and that the likelihood of a source

term developing is low given the extensive and sufficient monitoring routinely performed within the MNR RP program. McMaster University and CNSC staff described enhancements that were implemented to the MNR RP program, including routine trending and reporting of alpha-emitting radionuclide concentrations and enhancements to the initial and continuing training of workers. CNSC staff stated that it reviewed the assessment and monitoring program for alpha emitting radionuclides and determined that appropriate measures are taken by MNR.

87. In response to a question from the Commission, a representative from McMaster University described the oversight and reporting structure within the university's RP program. The Commission further asked if there is clear guidance from the CNSC that identifies the reporting structure within a university framework. CNSC staff responded that the regulations do not specify a reporting structure, but that CNSC staff evaluates the RP program as a whole. CNSC staff stated that the licensee is responsible for ensuring that their RP program meets the RP requirements established by the CNSC. CNSC staff explained that the university is required to establish its own radiation safety committee with the responsible radiation safety officer reporting to that committee in order to be able to harmonize and evaluate the RP program. CNSC regulation of radiation protection is performance-based and requires institutions to ensure that there is a holistic approach and oversight across the organization.

3.7.3 Worker Dose Control

88. McMaster University described the RP program at the MNR and provided a summary of the doses to workers over the licence period. McMaster University stated that, over the licence period, extensive facility air and surface contamination monitoring and personnel contamination monitoring have not indicated any significant internal exposures to operations personnel, iodine production personnel or neutron radiographers. Also, doses to workers within the MNR have not exceeded Administrative Control Levels (ACLs) or regulatory limits in 2013. No trends of concern were identified. The average, maximum and collective effective doses were well within the recent operating experience for the facility.
89. With regards to its radiation safety performance during the licence period, McMaster University stated that all radiation doses associated with the MNR were less than regulatory dose limits at all times. McMaster University described two events that led to ACL exceedances. CNSC staff confirmed that the regulatory dose limit was not exceeded. CNSC staff stated that McMaster University has reported the action level exceedances to the CNSC within the period specified in the licence, and conducted investigations to establish the causes of the events. Corrective actions were undertaken by MNR to prevent reoccurrence, and CNSC staff stated that it is satisfied with the result of the investigations and compliance verification.

90. McMaster University reported that the annual collective dose to the most significantly exposed workers at the facility had decreased by 41% since the beginning of the licence period in 2007. Higher collective doses were received during 2010 and 2011 due to extensive refurbishment activities and the campaign of stored waste removal. However, ALARA improvements and improvements to facility shielding have led to the overall decrease in collective doses during the licence period.
91. CNSC staff confirmed that there were no radiation exposures exceeding regulatory limits. CNSC staff stated that variations in the average effective and extremity doses from year to year are due primarily to the scope and duration of the activities, the number of workers involved and the dose rates associated with the radiological work activities.

3.7.4 Radiological Hazard Monitoring and Control

92. McMaster University noted that upgrades were made to its portable and installed radiation safety instrumentation program, including an expanded and more rigorous instrumentation quality assurance and calibration program and update and expansion of the instrument inventory.
93. McMaster University reported that airborne gross beta-emitting contaminants, airborne Iodine-125 concentrations, Argon-41 levels, and ambient radiation fields did not pose a significant radiological risk to personnel at the facility during the current licence period. No trend of concern was evident. McMaster University noted that ambient radiation fields at the facility are generally stable or gradually improving year-to-year.
94. McMaster University also reported that reactor water systems were monitored for radioactivity and that there was no indication that the gross beta-emitting activity and gross alpha-emitting activity in the primary water constitute a significant risk to facility personnel. No trend of concern was evident. Similarly, the activity at the outlet of the demineralizer system was assessed and no trends of concern were evident in the total and long-lived components of the gross beta-emitting activity.
95. McMaster University stated that its contamination control program at MNR remained highly effective throughout the licence period.
96. CNSC staff reported that the radiological hazard survey results over the licence period have not demonstrated any radiological hazard or trend that could be a safety concern for MNR workers. CNSC staff stated that adequate measures are in place to control radiological hazards in the workplace at MNR.

3.7.5 *Estimated Dose to the Public*

97. With regards to radiation doses to the public, CNSC staff reported that maximum possible doses are orders of magnitude (1,000 times) lower than the regulatory public dose limit of 1 mSv.

3.7.6 *Conclusion on Radiation Protection*

98. The Commission is of the opinion that, given the mitigation measures and safety programs that are in place to control radiation hazards, McMaster provides adequate protection to the health and safety of persons and the environment.

3.8 Conventional Health and Safety

99. Conventional health and safety covers the implementation of a program to manage workplace safety hazards. This program is mandatory for all employers and employees in order to reduce the risks associated with conventional (non-radiological) hazards in the workplace. This program includes compliance with Part II of the *Canada Labour Code*⁷ and conventional safety training.
100. McMaster University reported that it has a comprehensive Health and Safety Program, administered by the University's Employee Occupational Health and Support Services, that is in full compliance with federal and provincial regulations. The MNR is part of the McMaster Institute of Applied Radiation Sciences local safety committee, who perform periodic safety inspections. Various building safety inspections are also routinely conducted by MNR management. All deficiencies or findings noted during facility inspections conducted over the current licence period were reviewed and appropriate corrective actions were identified and implemented. CNSC staff confirmed that McMaster University has in place a Health and Safety program comprised of a central Health and Safety Committee and several local committees formed of workers and managers within the organization who ensure and promote a safe work environment. CNSC staff also confirmed that appropriate corrective actions were taken to address the minor deficiencies identified during the periodic safety inspections of the workplace.
101. McMaster University stated that it provides many safety training courses, and that it highlights and promotes the priority of safety on campus by imbedding explicit safety goals in all members of the management team's annual performance appraisals. Safety goals were met or exceeded during the current licence period.
102. McMaster University also reported that there were no lost time injuries, near misses or major safety findings during the current licence period. McMaster University stated that it will continue to promote, foster and implement a safe work environment at the reactor in accordance with Provincial, University and facility-specific programs.

⁷ Revised Statutes of Canada (R.S.C.), 1985, c. L-2

103. CNSC staff reported that McMaster University is performing satisfactorily with respect to this SCA.
104. Based on the information presented, the Commission is of the opinion that the health and safety of workers was adequately protected during the operation of the facility for the current licence period, and that the health and safety of persons will also be adequately protected during the continued operation of the facility.

3.9 Environmental Protection

105. Environmental Protection covers McMaster's programs that identify, control and monitor all releases of radioactive and hazardous substances, and to minimize the effects on the environment which may result from the licensed activities. It includes effluent and emissions control, environmental monitoring and estimated doses to the public.
106. McMaster University described its environmental protection program, which has a key objective to "protect the public and the environment by ensuring that releases of radioactive material are maintained ALARA". McMaster University reported that its performance in environmental protection has been strong throughout the licence period, that releases have remained below the ACLs and Derived Release Limits (DRLs), and there have been no events involving releases of radioactivity.
107. CNSC staff reported that McMaster University has in place environmental protection measures and practices that comply with CNSC requirements and that it is performing satisfactorily with respect to the SCA.

3.9.1 Effluent and Emissions Control and Monitoring

108. McMaster University reported that air effluent DRL calculations have been updated to reflect recent weather data and to ensure consistency with the most recent version of CSA-N288.1, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*.
109. McMaster University reported that air effluents from the Reactor Building are continuously sampled for beta-emitting particulates and Iodine-125. None of the measurements exceeded the ACLs and DRLs. McMaster University also reported that Argon-41 concentrations in the exhaust were also monitored weekly and found to be below ACLs and DRLs. CNSC staff confirmed that controls are in place to ensure that airborne releases of nuclear substances to the environment are minimized.
110. Regarding the Derived Release Limits, CNSC staff explained that they have been established for airborne releases of Iodine-125 and Argon-41 and calculated using the most recent CSA Standard N288.1-08 methodology.

111. McMaster University explained how the dose to a hypothetical person at the point of maximum ground level concentration is calculated and reported that the annual boundary dose from Argon-41 and Iodine-125 were well below the regulatory public dose limit of 1 mSv per year. CNSC staff confirmed that effluent/emission monitoring has demonstrated that releases are a fraction of the DRLs, and are orders of magnitude (at least 1,000 times) lower than the regulatory public dose limit. CNSC staff reported that there were no exceedances of any environmental action level or regulatory limit at MNR over the licence period.
112. McMaster University explained that weekly sampling of water showed no leakage of radioactive water from the heat exchanger. Also, there have been no liquid releases to the municipal sewer system since 1988; all active liquid waste is captured and conditioned for re-use in the reactor water system or evaporated. CNSC staff stated that appropriate procedures to sample liquid effluents before any releases are in place in the event that a voluntary pump out from the sump is required. Effluents would only be released at very low levels under the regulatory limits to ensure the health and safety of the public and the environment is protected.
113. An intervenor expressed concerns regarding an increase in the release of Iodine-125 from the facility. McMaster University reported that there are no trends of concern evident in any of the effluent monitoring data and there is no indication that releases from the facility pose a significant hazard to members of the public.

3.9.2 Assessment and Monitoring

114. McMaster University reported that several air monitoring stations that sample air for particulates and Iodine-125 are operated at locations surrounding the Reactor Building. There were no radiologically significant concentrations detected during the licence period from air monitoring. CNSC staff confirmed that, during the licence period, the effluent and environmental monitoring results did not indicate any radiological releases from MNR that were at levels not protective of the health and safety of persons and the environment.

3.9.3 Conclusion on Environmental Protection

115. Based on the above information, the Commission is satisfied that, given the mitigation measures and safety programs that are in place to control hazards, McMaster will provide adequate protection to the health and safety of persons and the environment.

3.10 Emergency Management and Fire Protection

116. Emergency Management and Fire Protection cover McMaster's provisions for preparedness and response capabilities that exist for emergencies and for non-routine conditions at the MNR. This includes nuclear emergency management, conventional emergency response, and fire protection and response.

3.10.1 Nuclear Emergency Preparedness and Response

117. CNSC staff reported that McMaster University has a well-developed emergency preparedness program in place to ensure that direction is available should an incident occur, responders are trained, responsibilities are defined and resources are available. CNSC staff stated that MNR's emergency risk is considered as low.
118. McMaster University described the various activities it completed relating to this SCA during the current licence period. These included training on the emergency procedures, installation of a campus-wide public address and alerting system, implementation of an automated notification system to activate emergency response, and working with local emergency responders on various levels of emergency response to nuclear emergencies at the MNR.
119. McMaster University reported that it continued to cooperate closely with the City of Hamilton emergency responders and hospitals throughout the current licence period and that it provided extensive refresher training on radiological incident response to the Hamilton Fire Department's Hazmat response teams in 2010 and 2012. McMaster University also provided ongoing support in instrument selection, maintenance and calibration, and continued to fulfill its ongoing agreement to provide radiological assistance for any City response. McMaster University discussed its involvement in a public health exercise focused on lost nuclear substances in the city, in the planning of a city-wide radiological response exercise, and in the installation of city hospitals' emergency portal monitors. McMaster University also discussed a meeting it hosted with City emergency responders to discuss the concept of establishing community reception centres for radiological and other public health emergencies.
120. With regards to McMaster University's full-scale emergency exercise in 2010, CNSC staff stated that the results of its compliance inspection showed that McMaster University had an acceptable emergency preparedness response capability and adequate interaction with responders to deal with credible nuclear emergency situations. The minor findings and three action notices issued were adequately addressed by McMaster University. CNSC staff reported having verified the emergency preparedness measures in place at McMaster following the 2010 inspection, stating that it did not note any non-compliance. New equipment was available and ready for service. A demonstration of McMaster's notification system was made.
121. CNSC staff stated that McMaster University is planning to conduct another full-scale emergency exercise in the fall of 2014. CNSC staff will attend and assess the exercise.
122. The Commission asked if there is a credible event that could lead to radioactive emissions requiring McMaster University to take actions in the surrounding area. Specifically, the Commission asked if McMaster has planned for a scenario which would require the distribution of potassium iodide (KI) pills. A McMaster University representative responded that its emergency plan is based on beyond-design basis and that none of the accidents assessed in its safety analysis report could trigger the

requirements for implementation of its emergency plan. Nonetheless, the MNR has an emergency planning zone that goes considerably beyond the international standards for reactors its size or larger. McMaster University has supplies of KI maintained as part of its emergency supplies intended for use by emergency workers if they had to enter the facility or controlled areas. There is no credible accident scenario that would require administration of KI to members of the public.

123. With regards to MNR's plan to water the core using a fire hose in the event of a significant loss of reactor coolant, an intervenor expressed concerns with sending responders into an area with high radiation fields to perform this task. McMaster University representatives explained that fire water as makeup water has always been part of its emergency plan, but that a responder would not be required to hold the hose to spray the core. An emergency responder would be tasked with manually connecting the hose from the hose station within the building to the spray system, opening the valve and abandoning the building if the reactor could not be isolated from the leak location. The Commission enquired further about what would occur if this connection could not be made due to a break in the fire water line coming to the building. A McMaster University representative explained its procedure to connect a mobile pumper to the building to supplement in the event the fire water line coming to the building could not supply cooling water to the reactor core.
124. The Commission enquired about dispersion of contaminated water to the environment from overflowing the core in an emergency situation. A McMaster University representative responded the MNR containment building is leak tight and large enough to contain any overspill or leak that may occur in an emergency situation, and to provide the time required to mitigate the leak.

3.10.2 Fire Protection Program

125. McMaster University reported having developed the MNR document EP-7400, *MNR Fire Protection Program*, to ensure a low level of fire risk within the building. McMaster University conducted routine inspections and audits of the fire protection program throughout the current licence period. McMaster University also reported that internal and external audits of the fire protection program were carried out during the current licence period to ensure compliance with and to recommend improvements to the fire safety program at MNR. All recommendations have been implemented. CNSC staff confirmed that McMaster University has developed a comprehensive fire protection program, and that recommendations from routine inspections and internal and external audits performed during the current licence period have been implemented.
126. McMaster University reported that a Fire Hazards Analysis (FHA) was completed for MNR during the current licence period which concluded that all life and radiological safety objectives were met and no credible fire could cause a significant release of hazardous substances from the reactor building to the environment. CNSC staff made

recommendations to improve fire safety at MNR which have been implemented. These included improvement modifications to the Fire Protection System, reduction of the combustible load within the facility, installation of a fire retardant barrier over the shielding at Beam Port #3, and improvements to egress lighting throughout the building. CNSC staff reported having reviewed the MNR FHA, which concluded that existing provisions are effective to provide and maintain the safe shutdown of the reactor in the event of a fire, and found the report and methodology to be acceptable.

127. An intervention from the Hamilton Fire Department stated that it is confident that McMaster will continue to make improvements to the MNR emergency planning and response and recovery to support safe operations. The Commission enquired about the improvements required. A McMaster University representative responded that the intervenor was referring to continual improvement of MNR's program. There is no specific action or demand from the fire department that has not yet been met by McMaster University.
128. The Commission enquired about the frequency of joint training, exercises and meetings between McMaster and the Hamilton Fire Department. A McMaster University representative explained that it participates in an annual emergency planning conference with the University and the City emergency response community. It has periodic ad hoc meetings (at least quarterly) and annual training sessions with the Hamilton Fire Department personnel.
129. CNSC staff stated that, during the 2007 licence renewal hearing, it had expressed concerns regarding the large fire loads within the MNR facility. CNSC staff reported that McMaster University has since taken measures to reduce combustibles within the facility, and that CNSC staff will continue to monitor McMaster University's progress.

3.10.3 Conclusion on Emergency Management and Fire Protection

130. Based on the above information, the Commission concludes that the fire protection measures and emergency management preparedness programs in place and that will be in place at the MNR are adequate to protect the health and safety of persons and the environment.

3.11 Waste Management

131. Waste management covers the licensee's site-wide waste management program. CNSC staff evaluated McMaster's performance with regards to waste minimization, segregation, characterization, and storage.
132. McMaster University reported that it led an extensive active waste inventory reduction campaign in 2010/2011, resulting in a significant reduction of active waste stored at the MNR. McMaster University and CNSC staff reported that all remaining used HEU fuel assemblies from the reactor core conversion to LEU fuel were returned to the United States Department of Energy Savannah River facility in 2008.

133. CNSC staff reported that it conducted routine inspections during the current licence period covering waste management practices at MNR and that McMaster University was found to be compliant. CNSC staff stated that McMaster University adequately stores, labels, manages and performs surveys of disposable waste.
134. The Commission enquired about the fuel cycle at the MNR. A McMaster University representative responded that fuel assemblies are changed every three months and that used fuel is stored in the reactor pool until there are sufficient assemblies accumulated to fill a transportation container. Used fuel is shipped from the facility every seven to ten years, depending on historical operating power and time at power.
135. The Commission asked if the fuel is required to be kept in the pool for a period of seven to ten years, as is done for CANDU nuclear reactor fuel. CNSC staff responded that the requirements are different for MNR fuel because it contains less activity. Used fuel from the MNR requires only a few weeks of cooling in the pool before it can be transferred to transportation containers.
136. The Commission enquired about the location of the used fuel storage pool within the MNR facility. A McMaster University representative responded that used fuel is stored in the same pool as the reactor, and therefore in the same containment building.
137. The Commission also enquired about the current inventory of waste at the MNR, and asked how this low level of active waste will be maintained going forward. A McMaster University representative responded that the active waste has been maintained at low levels since undertaking this waste reduction initiative, but that waste shipments are made taking into consideration radiation fields and the ALARA⁸ principle. Therefore, the active waste inventory can fluctuate. Long-term historic waste has not been accumulated since undertaking this initiative. CNSC staff stated that it is satisfied with the current waste management practices.
138. Based on the above information and considerations, the Commission is satisfied that McMaster University is safely managing waste at the MNR.

3.12 Security

139. Security covers the programs required to implement and support the security requirements stipulated in the relevant regulations, licence, orders, or expectations for the facility or activity. This includes compliance with the applicable provisions of the *General Nuclear Safety and Control Regulations*⁹ and the *Nuclear Security Regulations*¹⁰.

⁸ CNSC Regulatory Guide G-129, *Keeping Radiation Exposures and Doses "As Low as Reasonably Achievable (ALARA)*, October 2004

⁹ SOR/2000-202

¹⁰ SOR/2000-209

140. McMaster University reported that security incidents did not occur at the facility during the current licence period. CNSC staff stated that it found through security inspections it conducted during the current licence period that McMaster University is implementing and maintaining a security program that fully meets the requirements set out in Part 2 of the *Nuclear Security Regulations*. McMaster University also maintains a site Security Report, the most recent submitted in January 2014 and assessed by CNSC staff as satisfactory.
141. McMaster University described the extensive refurbishment and modernization of the University's Security Monitoring Room, which resulted in improved security monitoring capabilities for the MNR. CNSC staff concurred with McMaster University and stated that McMaster University provides adequate infrastructure, physical barriers, procedures, systems and devices, and security personnel to meet its Security Program requirements.
142. McMaster University reported that a number of key university staff members received Top Secret security clearances to allow enhanced communications with the CNSC and other security groups. CNSC staff reported that McMaster maintains a strong security culture and provides an effective program to control access to facilities, nuclear material, and prescribed/classified information. CNSC staff also reported that McMaster University maintains a fully satisfactory facility-access security clearance program to control access to the facility, and a robust supervisory awareness program to recognize behavioral changes in personnel that could pose a risk to security at the MNR.
143. CNSC staff reported that McMaster validates its security procedures, regulatory compliance and identifies areas for improvement in security operation through various exercises and drills, some of which involve the Hamilton Police Services.
144. CNSC staff stated that McMaster employs its own security guard service that operates 24 hours per day, 365 days per year. McMaster also has a Memorandum of Understanding with the Hamilton Police Services.
145. CNSC staff reported that it conducted its most recent security inspection in October 2013, which did not result in negative findings. CNSC staff also reported that the MNR did not have reportable security-related events over the current licence period.
146. The Commission is satisfied that McMaster's performance with respect to maintaining security at the facility has been acceptable.
147. The Commission concludes that McMaster has made adequate provision for ensuring the physical security of the facility, and is of the opinion that McMaster will continue to make adequate provision during the proposed licence period.

3.13 Safeguards

148. The CNSC's regulatory mandate includes ensuring conformity with measures required to implement Canada's international obligations under the Treaty on the Non-Proliferation of Nuclear Weapons. Pursuant to the Treaty, Canada has entered into safeguard agreements with the International Atomic Energy Agency (IAEA). The objective of these agreements is for the IAEA to provide credible assurance on an annual basis to Canada and to the international community that all declared nuclear material is in peaceful, non-explosive uses and that there is no undeclared nuclear material or activities in this country.
149. CNSC staff stated that the scope of the Non-Proliferation program for the MNR is limited to the tracking and reporting of foreign obligations and origins of nuclear material. The import and export of controlled nuclear substances, equipment and information identified in the *Nuclear Non-proliferation Import and Export Control Regulations*¹¹ require separate authorization from the CNSC.
150. McMaster University reported that it met all safeguards requirements during the current licence period to ensure Canada's compliance with all applicable safeguards agreements are met at the MNR. Several IAEA and CNSC inspections, including physical inventory takings and design verification inspections, were conducted during the current licence period. No issues were raised and all safeguards obligations were satisfied. CNSC staff reported that MNR has an effective safeguards program that conforms to measures required by the CNSC to meet Canada's international safeguards obligations as well as other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*. CNSC staff stated that MNR maintains a Safeguards program to comply with its current licence and CNSC regulatory document RD-336, *Accounting and Reporting of Nuclear Material*.
151. CNSC staff reported that, during the current licence period, MNR provided the CNSC and the IAEA with all the reports and information necessary to comply with the safeguards regulatory requirements, including those related to nuclear material accounting and reporting. For IAEA inspections and CNSC evaluations, MNR provided the necessary access and assistance to perform the activities, and complied with all regulatory requirements. There were no reportable events or action notices issued as a result of these inspections. CNSC staff found that MNR has an acceptable Safeguards program and is performing satisfactorily with respect to this SCA.
152. McMaster University noted that, in 2008, a Category III spent fuel shipment was completed at the MNR following all Canadian and international safeguards regulations. This resulted in the removal of all HEU fuel from the reactor building.
153. McMaster University stated that it will continue to work with the CNSC and the IAEA to ensure Canada's compliance with all applicable safeguards agreements.

¹¹ SOR/2000-210

154. Based on the above information, the Commission is satisfied that McMaster University has made and will continue to make adequate provision in the areas of safeguards and non-proliferation at the MNR that are necessary for maintaining national security and measures necessary for implementing international agreements to which Canada has agreed, and will continue to do so.

3.14 Packaging and Transport

155. Packaging and transport covers the safe packaging and transport of nuclear substances and radiation devices to and from the licensed facility. The licensee must adhere to the *Packaging and Transport of Nuclear Substances Regulations*¹² and Transport Canada's *Transportation of Dangerous Goods Regulations*¹³ for all shipments leaving the facility.
156. McMaster University reported that its shipments and receipts of radioactive material are made in accordance with the *Packaging and Transport of Nuclear Substances Regulations* and the *Transportation of Dangerous Goods Regulations*. McMaster University reported that no transportation or packaging incidents occurred during the current licence period and that all expectations were met. CNSC staff concurred with McMaster University.
157. McMaster University reported that it made approximately 2000 radioactive shipments consisting mainly of medical isotopes and research samples. CNSC staff reported that regular inspections throughout the licence period confirmed that McMaster University was in compliance with applicable regulations.
158. McMaster University also reported that individuals involved in radioactive shipments at MNR successfully completed third party training on the Transportation of Dangerous Goods, with an emphasis on radioactive shipments (Class 7). The training was provided by an external contractor.
159. The Commission further enquired about the shipments of used HEU fuel from the MNR, and asked if these generated a public reaction. A McMaster University representative responded that there was no public response as the transportation activities were not publicly advertised. Security restrictions regarding routes and material were in place. CNSC staff confirmed that all shipping requirements for this type of package were met.
160. Based on the above information, the Commission is satisfied that McMaster University is meeting regulatory requirements regarding packaging and transport.

¹² SOR/2000-208

¹³ SOR/2001-286

3.15 Aboriginal Engagement and Public Information

3.15.1 Aboriginal Engagement

161. The common law Duty to Consult with Aboriginal communities and organizations applies when the Crown contemplates actions that may adversely affect established or potential Aboriginal or treaty rights.
162. The proposed renewed licence would authorize the continued operation of the MNR within an existing, contained area located on the McMaster University campus. CNSC staff determined that the activities to be conducted under this decision will not cause an adverse impact on potential or established Aboriginal or treaty rights. The Commission agrees with this conclusion.

3.15.2 Public Information

163. A public information program is a regulatory requirement for licence applicants and licensed operators of Class I nuclear facilities. Paragraph 3(j) of the *Class I Nuclear Facilities Regulations*¹⁴ requires that licence applications include “the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed.”
164. McMaster University described its extensive public information program which supports one of its key missions to support its local and broader communities. McMaster University reported that it posts its annual reports to the Board of Governors on its website for public access and makes them available to persons living within the vicinity of the MNR. MNR also plays an important role in educating the public on nuclear technology by providing outreach to the local community and by allowing public visits of its facility to observe the reactor while it is operating. McMaster University reported that over 15,000 people visited the MNR during the current licence period. MNR staff members, the Health Physics group and the University faculty members continue to provide information to the public upon request, through media interviews and through public information sessions.
165. McMaster University also reported that it operates a website as part of its outreach program to engage the public. It hosts a webserver, which provides an internet based forum for the discussion and information sharing of nuclear-based science and technology topics, and it hosts three email list servers for discussions amongst radiation safety practitioners.
166. McMaster University stated that it plans to continue to support its proactive and comprehensive Public Information Policies and Community Outreach programs to inform the public. It is also currently preparing a Public Disclosure Protocol.

¹⁴ SOR/2000-204

167. From its review of the licence application and material referenced therein, CNSC staff reported that MNR appears to be engaged with the local communities and committed to keeping the public informed of its activities and any event that may be perceived to have an impact on the health and safety of the people and the environment. CNSC staff stated that Regulatory Document RD/GD-99.3, *Public Information and Disclosure*, requires that all Class I facilities produce a disclosure protocol. MNR does not have a disclosure protocol at this time, although it has been disclosing events on an ad hoc basis. CNSC staff stated that it is following up to ensure that MNR meets the intent of RD/GD-99.3, including a disclosure protocol, through a condition in the proposed LCH. This disclosure protocol is expected to be submitted to CNSC staff within the first year of the proposed licence period.
168. CNSC staff reported that it is satisfied that McMaster University has a Public Information Program and it will follow up on the additional requirements of RD/GD-99 through compliance criteria in the LCH.
169. With regards to a statement made by an intervenor that there is a lack of CNSC oversight at the MNR, the Commission requests that information regarding CNSC inspections conducted at the facility be included in the MNR's disclosure protocol to inform the public of the CNSC's involvement in the oversight of the MNR facility.

3.15.3 Conclusion on Aboriginal Engagement and Public Information

170. Based on this information, the Commission is satisfied that McMaster University's public information program is effective in keeping Aboriginal communities and the public informed of facility plans and operations. The Commission encourages McMaster University to continue to create, maintain and improve its dialogue with the neighbouring communities. The Commission directs McMaster University to complete the disclosure protocol by June 2015.

3.16 Decommissioning Plans and Financial Guarantee

171. The Commission requires that licensees have operational plans for decommissioning of facilities and long-term management of waste produced during the life-span of the facility. In order to ensure that adequate resources are available for safe and secure future decommissioning of the MNR site, the Commission requires that an adequate financial guarantee for realization of planned activities is put in place and maintained in a form acceptable to the Commission throughout the licence period.
172. McMaster University reported that its most recent Preliminary Decommissioning Plan (PDP) for MNR is documented in MNR document TN 2002-08 Rev 2, *McMaster Nuclear Reactor Preliminary Decommissioning Plan*. This revised PDP was submitted to CNSC staff for review in April 2011. CNSC staff stated that it reviewed the PDP as part of McMaster University's application for a licence renewal and made a number of

comments. One comment was about the estimated cost of decommissioning that may be underestimated due to McMaster University crediting its own workforce for some aspects of decommissioning activities, whereas CNSC Guidance Document G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*, recommends planning for third-party labour costs. The decommissioning cost, estimated by McMaster University at \$12.5M, could be significantly higher if external labour was utilized for the entire decommissioning project. CNSC staff stated that McMaster University maintains that, as a public academic institution with a long, stable history, it is reasonable to credit McMaster's own work force for the purpose of establishing an equitable Financial Guarantee. CNSC staff stated that it will continue to ensure McMaster University is making adequate provision for maintaining the internal work force and the adequate knowledge required for decommissioning.

173. The Commission enquired about CNSC's requirements for decommissioning costs to be estimated taking into account that all decommissioning work would be performed by external contractors and not university staff. CNSC staff explained that current requirements ensure that costs are estimated to provide for the event that an operator disappears prior to decommissioning. Sufficient funds would be available for contractors to be hired to do the work, which typically costs more than if the work was to be performed in-house. However, CNSC staff stated that they agree with the validity of McMaster University's PDP, saying that universities do not disappear overnight. CNSC staff stated that McMaster University has demonstrated that it will maintain its capabilities by ensuring that essential knowledgeable staff remains available if MNR was to be permanently shut down.
174. The current operating licence requires McMaster University to maintain a Financial Guarantee for the future decommissioning of its facility that is acceptable to the Commission. CNSC staff reported that McMaster University is required to contribute a minimum of \$100,000 annually, and an average of \$350,000 on a five-year average, to a trust fund as per an agreed schedule described in Appendix A of the CNSC Financial Security and Access Agreement. McMaster University has exceeded this minimum contribution and the required five-year average over the current licence period. The amount currently invested in the fund can fully cover the high-importance decommissioning activities, such as disposing of the irradiated fuel, the core and other high activity items. McMaster University stated that its Nuclear Reactor Restricted Reserve to fund the eventual decommissioning of MNR has shown steady growth over the licence period, and it expects the restricted reserve to be fully funded during the upcoming licence period. CNSC staff reported that McMaster University could achieve its \$12.5M financial guarantee in 11 years; however, it expects the financial guarantee to be achieved in less than 10 years given McMaster University's current average rate of contribution.
175. CNSC staff reported that McMaster University maintains the required Financial Guarantee for decommissioning and is in compliance with the current licence condition pertaining with Financial Guarantee and consistent with the criteria set out in Regulatory Guide G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*.

176. McMaster University expressed some concerns regarding financial strains the CNSC's requirements for financial guarantees place on its operating budget. McMaster University stated that the CNSC's position on financial guarantees at Canadian universities continue to place McMaster University at a competitive disadvantage for research and commercial undertakings and medical isotope production. The Commission enquired about McMaster's concerns. A McMaster University representative stated that a written commitment by the University that it assumes full financial responsibility for the eventual decommissioning of the facility should be sufficient to justify continued operation without building a fund. CNSC staff explained that facilities are required to have a certain amount in trust to ensure that they can quickly put the facility into a safe state. CNSC staff stated that it will be revising its regulatory documents regarding financial guarantees, which will provide universities and other public institutions an opportunity to voice their opinions on current requirements.
177. Based on this information, the Commission considers that the preliminary decommissioning plans and related financial guarantee are acceptable for the purpose of the current application for licence renewal.

3.17 Nuclear Liability Insurance and Cost Recovery

178. McMaster University is required to have Nuclear Liability Insurance under the *Nuclear Liability Act*¹⁵. McMaster University stated that it has a commercial coverage insurance policy totalling \$1,500,000 for the MNR, as required under the *Nuclear Liability Act*. CNSC staff stated that it is satisfied with McMaster University's provision to fulfill its liability obligation with respect to the MNR under the *Nuclear Liability Act*.
179. As an educational institution, McMaster University is not subject to the *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*¹⁶ for the MNR facility.

3.18 Licence Length and Conditions

180. McMaster University requested the renewal of the current operating licence for a period of 10 years. CNSC staff recommended the renewal of the licence for a period of 10 years, stating that McMaster University is qualified to carry on the licensed activities authorized by the licence. CNSC staff also recommended that annual reports on the facility would be provided for consideration by the Commission at public meetings to be held annually.

¹⁵ R.S.C., 1985, c. N-28

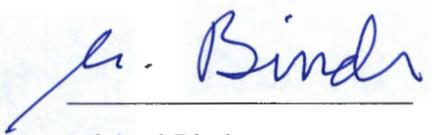
¹⁶ SOR/2003-212

181. The Commission enquired about the size and complexity of the Licence Condition Handbook (LCH). A McMaster University representative responded that it is actively working with CNSC staff to better understand the LCH and how it will be applied at the facility. The representative from McMaster University stated that it supports the philosophy behind the LCH, but that the application of this document will be challenging. CNSC staff confirmed that it is working with McMaster University on the application of the LCH. CNSC staff explained that they are producing a regulatory document that will define how standards developed for nuclear power plants are to be applied to research reactors. In absence of this document, the LCH provides the necessary information to prevent interpretation errors of licence conditions.
182. Based on the above information received during the course of this hearing, the Commission is satisfied that a 10-year licence is appropriate. The Commission accepts the licence conditions as recommended by CNSC staff. The Commission also accepts CNSC staff's recommendation regarding the delegation of authority, and notes that it can bring any matter to the Commission as applicable.

4.0 CONCLUSION

183. The Commission has considered the information and submissions of CNSC staff, the applicant and all other participants as set out in the material available for reference on the record, as well as the written submissions provided by the participants at the hearing.
184. The Commission is satisfied that McMaster University meets the requirements of subsection 24(4) of the *Nuclear Safety and Control Act*. That is, the Commission is of the opinion that McMaster University is qualified to carry on the activity that the proposed licence will authorize and that the applicant will make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.
185. Therefore, the Commission, pursuant to section 24 of the *Nuclear Safety and Control Act*, renews McMaster University's Non-Power Reactor Operating Licence NPROL-01.01/2014 for the McMaster Nuclear Reactor located on the university campus in Hamilton, Ontario. The renewed licence NPROL-01.00/2024 will be valid from July 1, 2014 until June 30, 2024, unless suspended, amended, revoked, replaced or transferred.
186. The Commission includes in the licence the conditions as recommended by CNSC staff in CMD 14-H4.
187. The Commission also accepts CNSC staff's recommendation regarding the delegation of authority in the Licence Conditions Handbook (LCH). The Commission notes that CNSC staff can bring any matter to the Commission as applicable. The Commission directs CNSC staff to inform the Commission on an annual basis of any changes made to the LCH.

188. With this decision, the Commission directs CNSC staff to provide annual reports on the performance of the McMaster Nuclear Reactor, as part of the annual safety performance reports on nuclear research facilities in Canada. CNSC staff shall present these reports at public proceedings of the Commission.

A handwritten signature in blue ink that reads "M. Binder". The signature is written in a cursive style and is positioned above a horizontal line.

Michael Binder
President,
Canadian Nuclear Safety Commission

JUN 26 2014

Date