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Oral presentation

Submission from Women in Nuclear Canada

In the Matter of the

Canadian Nuclear Laboratories

Application for the renewal of the Nuclear
Research and Test Establishment Operating
Licence for the Chalk River Laboratories

Commission Public Hearing

January 23-25, 2018

Exposé oral

Mémoire de Women in Nuclear Canada

À l'égard des

Les Laboratoires Nucléaires Canadiens

Demande de renouvellement du permis
d'exploitation d'établissement de recherche
et d'essais nucléaires pour les Laboratoires
de Chalk River

Audience publique de la Commission

23-25 janvier 2018



December 11, 2017

Canadian Nuclear Safety Commission
c/o Louise Levert, Secretariat and Doug Wylie, Aboriginal Consultation, Participant Funding
Program, Policy, Aboriginal, and International Relations Division
280 Slater Street, P.O. Box 1046
OTTAWA, ON
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Attention: Canadian Nuclear Safety Commission (CNSC) Tribunal Chair and Commission Members

Re: Women in Nuclear Canada Intervention in Support of the Submission from Canadian Nuclear Laboratories on Application for Licence Renewal for Chalk River Nuclear Laboratories.

PCWatson Engineering and Sustainable Policy Inc. has been retained by WiN-Canada to conduct a technical review of the submission from Canadian Nuclear Laboratories (CNL) on Application for License Renewal for Chalk River Nuclear Laboratories [1] and the submission from CNSC Staff for CRL Licence Renewal (CMD 18-H2), focusing on technical issues as well as real and perceived issues for women workers at CNL.

The objectives of this review by WiN-Canada were to:

- Undertake a technical analysis of the Application for Licence Renewal and Commission Member Document (CMD 18-H2) [2]
- Identify real and perceived risks to female workers at CNL and the adequacy of personnel training, work organization and job design.

About WiN

Women in Nuclear (WiN) Global [3] is a world-wide non-profit association of women working professionally in various fields of nuclear energy and radiation applications, established in 1993. WiN Global currently has approximately 35,000 members, including national chapters' members and individuals from about 100 countries, with over 30 national, regional and international chapters throughout the world.

Women in Nuclear Canada (WiN-Canada) [4], established in 2004, represents over 1,700 women and men across Canada. While many of the members of WiN Canada are employed in the nuclear energy sector (Bruce, Darlington, Pickering and Point Lepreau), WiN-Canada welcomes members from industries who use nuclear and radiation technologies, such as hospitals and medical facilities, mining, academic and research institutions, the wider electricity sector, and the suppliers to all of these industries.



WiN-Canada mission is:

- To develop a dialogue with the public and in particular with other women, to promote awareness around the factual contribution to people and society from nuclear technologies;
- To contribute to knowledge and experience exchange among members and chapters; and
- To promote career interest in nuclear engineering, science, technology, the trades and other nuclear-related professions, especially among women and young people.

In our industry, made up of a little less than 20 percent women, our organization works to showcase the vital contribution women are making as leaders in the nuclear industry. WiN members devote a great deal of their volunteer time working with young women and girls introducing them to non-traditional, but rewarding careers in science, technology and the skilled trades. Chapter events enhance knowledge of the nuclear industry among members. A WiN Speakers Clearinghouse provides this information to the public, especially womens' groups.

WiN-Canada believes that knowledge exchange between our members, about all aspects of the industry, provides them with the information necessary to help educate our family, friends and members of the public. This dialogue provides an opportunity for the public to make an informed decision about whether or not they choose to support the industry.

Women are strong opinion leaders in our country. As a result of its efforts to promote the careers of women, WiN-Canada has become a strong, credible voice in the nuclear industry. It is important for our voice to be heard, including our participation in public hearings in the nuclear industry such as this Chalk River Nuclear Laboratories (CNL) Licence Renewal.

WiN-Eastern Ontario and CNL

Some WiN Canada members are CNL employees and play key roles in the continued safe operation of CNL; they would be directly affected by the outcome of the CNL licence renewal application. These women include members of the WiN Eastern Ontario chapter. CNL is very supportive of our WiN-Eastern Ontario Chapter, our programs and events, the advancement of women, and highlighting the important role women play in the nuclear industry.

We have worked hard to encourage women to pursue careers in STEM, but women are often unaware of the highly skilled, well-paying roles within the nuclear industry; so, although we have made great strides towards increasing the number of women in these roles, we want to see more women enter these careers. There is also a gap in the skilled trades that would benefit from more women entering these careers.

Nuclear Safety Culture

As you are aware, the nuclear industry is one of the most highly regulated industries in Canada. In accordance with CNSC regulatory requirements and guidance and governance at various levels of government and the companies that employ our members, the industry has put in place measures to ensure a very strong nuclear safety culture. Measures include stringent oversight,



regular safety audits, international peer review and our members' own personal accountability for the safety of their coworkers.

WiN-Canada members have a variety of work experiences and education, and are involved at every level of the nuclear industry, from technical roles, such as scientists and engineers, to business professionals, such as lawyers and accountants. We are highly skilled workers, who could work in any industry but choose to work in nuclear, because we know that we are contributing to the societal benefits of nuclear technology.

We understand our responsibility to work safely not only to protect the safety of our colleagues, but to protect the safety of the communities in which our families, our children and our friends reside. We do not take this responsibility lightly and put safety first each and every day at work. This strong culture of safety carries over to our activities outside of work, and in our volunteer activities in the community.

Many of our members have raised their children within close proximity to nuclear facilities such as the Chalk River Nuclear Laboratories. As mothers we worry about many issues facing the safety and well-being of our children on a daily basis. The fact that we live close to a nuclear research facility is not an issue for us as we know that Ontario's nuclear activities have a proven track record of being among the safest in the world. We would not work in this industry, and live in these communities, if we did not believe it was safe to do so.

The safety of our families, friends and communities comes first before our chosen careers. We simply would never put them at risk. We also believe this is the same for future generations. This focus on safety is not just about today, but for those people who will continue to live and work in this community for many years to come.

CNL has a strong safety performance record, safety management systems and safety culture. Stringent oversight and international reviews and audits will ensure the nuclear safety culture does not erode over time and will in fact continue to strengthen through continuous improvement and learning.

Review of Application for Licence Renewal for CRL and Commission Member Document CMD 18-H2

The WiN-Canada findings from the review of the Application for Licence Renewal for CRL [1] and the associated CMD 18-H2 [2] are summarized in the sections below.

1. Management System and Human Performance Safety and Control Areas (SCAs)

The WiN Canada reviewer concurs with the conclusion in CMD 18-H2 that the Management System SCA initiatives planned at CRL will ensure that CNL will continue to maintain a strong safety culture for the women working at these facilities. In particular the WiN Canada reviewer:



- Believes that ongoing improvements to the management system SCA at the CRL facility, particularly Change Management and OPEX, will contribute to CRL remaining a safe workplace for all, including WiN members, during the proposed licence period 2018-2028. The extended period of operation will be one of significant change. Effective change management is especially important.

As WiN represents women working in the nuclear industry, WiN is concerned that the strong nuclear safety culture protecting its members in their places of employment will continue at CRL during the proposed continued operation period. Women have worked for years in the nuclear field partly due to their faith in the nuclear safety culture. Information in the Application for Licence Renewal for CRL [1] and CMD 18-H2 reflects CNL's emphasis on a strong safety culture.

- The WiN-Canada reviewer agrees that self-assessments and effective use of OPEX are important to a strong safety culture.

In the area of the Human Performance SCA, the WiN Canada reviewer:

- Observes that CNL's initiatives at CRL in the area of human performance should positively affect women at the site by reducing the consequences and severity of events, providing on-site training and professional certification opportunities and ensuring a safe workplace through promotion of a strong safety culture.
- Agrees that training and communication are very important to improving human performance; and that tools to track and trend Human Performance are important to monitor effectiveness and drive improvement.

In summary the WiN-Canada reviewer concurs that planned initiatives in the Human Performance and Management area, particularly training, communication and tracking/trending tools, for the period of continued operation of CNL to 2028 should be satisfactory. Training and effective communication are believed to be particularly important for the success of females working in the nuclear industry. In addition, CRL offers excellent career opportunities for women in STEM fields and the WiN-Canada reviewer hopes that CNL's future plans for Human Performance will include programs to effectively utilize female talent.

2. Operating Performance, Safety Analysis, Physical Design, And Fitness-For-Service SCAs

Programs in the areas of operating performance, safety analysis, physical design, and fitness-for-service appear to be adequately managed at CRL, and the WiN-Canada reviewer does not see aspects of particular relevance for females. The shutdown of NRU will remove some hazards that are currently part of the safety analysis.

Operating Performance SCA

In the area of Operating Performance, the WiN-Canada reviewer:

- Agrees that CNL's planned programs and initiatives in the area of Operating Performance are appropriate to ensure safe operating performance from 2018-2028. Engineering Change Control (ECC) is particularly important because of the many changes to operating facilities that are planned.
- Agrees that OPEX is important, as identification of incidents and learning from them is an important contributor to safe operation.
- Notes that with fissile sources on site, criticality safety is important.
- Agrees that planned programs and initiatives in the area of Operating Performance in CMD 18-H2 are adequate for future operation. In particular, the Governing Documents for the nuclear facilities at CRL that give operational limits and conditions for the various facilities are being revised for the new layout of CNL.
- Believes it is important that unplanned events continue to be reported to CNSC, which will ensure that corrective action is taken where necessary.
- Concludes that procedures for the facilities that will remain at CNL will be sufficient to ensure safety to CRL workers including WiN-members. This includes revised operating conditions, reporting and trending of unplanned events, and Severe Accident Management Guidelines (SAMG) modifications to deal with severe accidents such as Fukushima.

Safety Analysis SCA

In the area of Safety Analysis the WiN-Canada reviewer:

- Believes the changes to the facilities during operation out to 2028, discussed under Future Plans in the Application for Licence Renewal [1], will increase safety for the employees, particularly women, working at these facilities.
- Concur that external audits and implementing corrective actions such as physical improvements are important for maintaining effective safety analysis.
- Notes that the shutdown of NRU in 2018 will require changes to the safety analysis, as hazards and risks will be reduced.
- Notes that, with respect to severe accident management (SAM) analysis, women were particularly concerned by the Fukushima accident and, as a result, have been shown to be less supportive of the nuclear industry due to what they see as a higher perceived risk [5]. The adoption of lessons learned from Fukushima should reduce the risk at CNL in the future; the shutdown of NRU will eliminate much of this risk, but the remaining rod bays are still of concern.

Physical Design SCA

In the area of Physical Design, the WiN Canada reviewer:

- Believes that the requirements for design procedures and review are particularly important given site changes planned at CRL. Also, updates and improvements to design engineering and awareness of changes in the external environment are important.
-

- Agrees that these initiatives should improve the areas included in the Physical Design SCA at CNL.
- Concurs with the assessment that the Physical Design SCA will be adequately managed during the proposed operating period, and that there are no special concerns from a female perspective.
- Concludes based on the review of CMD 18-H2 [2] that changes planned to the physical design of the new and modified facilities during the proposed licence renewal period will be safely managed.

Fitness for Service SCA

In the area of Fitness for Service, the WiN-Canada reviewer:

- Agrees that with the recent improvements to the areas included in this SCA, particularly preventive maintenance, ageing management, and periodic inspection and testing, the physical condition of structures and components will be better monitored. Aging management programs in place or planned will help ensure Fitness-for-Service of the major systems, structures and components at CNL for the proposed extended operating period, ensuring safety from ageing related degradation that could adversely affect women workers at CNL or the public.
- Notes the importance of master equipment lists. A technical basis for Preventive Maintenance (PMs) and a System Health (SH) program are new requirements from recent REGDOCS.
- Believes that the integration of Site Maintenance with Work Management will improve the maintenance program. Site Maintenance will be significantly altered by the decommissioning of more than 120 buildings and structures, and construction of new buildings and facilities.
- Believes understanding ageing degradation mechanisms and the technical basis for PMs is important.
- Concludes that the Fitness-for-Service SCA should be satisfactory in future due to technical activities described above; and that there are no unique areas to the female perspective.

3. Radiation Protection, Conventional Health and Safety, Environmental Protection, Emergency Management and Fire Protection SCAs

There are some areas of concern to the WiN-Canada reviewer around radiation protection and conventional health and safety programs due to major site changes, and environmental protection due to legacy contamination. However CNL appears to be taking the appropriate steps to mitigate these concerns.

Radiation Protection SCA

Radiation Protection is an area of heightened interest to WiN members in particular and women in general [5]. In the area of Radiation Protection, the WiN-Canada reviewer:

- Is reassured that dose levels to workers and the public have been well below regulatory levels.
- Agrees that CNLs radiation monitoring should be adequate for future operation.
- Is reassured that the significant sources of radiation have been reduced.
- Notes that buildings planned for decommissioning or repurposing will have their radiological source terms hazards re-evaluated to ensure ALARA during the new licensing period.
- Agrees with the conclusion in CMD 18-H2 that the radiation protection at CNL during the period of extended operation will provide adequate protection for women.
- Notes that in terms of individual and collective dose, no regulatory limits or action levels were exceeded in the review period, and that individual and collective doses remained ALARA.
- Agrees that efforts to improve Contamination control should be satisfactory.
- Is pleased that public dose resulting from CRL's operations has been well below regulatory limits and dose to the public will be reduced after the closure of NRU.
- Notes that the future focus of the CNSC will be on worker protection as buildings and facilities are demolished and repurposed. WiN-Canada's reviewer sees this as very important for CNL workers including WiN members.
- Notes that radiation protection has been documented to be of particular importance to female employees of reproductive age, with concern both for women who are pregnant and men who are attempting to become fathers [6].

The WiN-Canada reviewer agrees with the conclusion in CMD 18-H2 that the radiation protection at CNL during the period of extended operation will provide adequate protection for women.

Conventional Health and Safety SCA

In the area of Conventional Health and Safety, the WiN Canada reviewer:

- Believes that conventional health and safety (H&S) are issues of particular importance to women employees at CNL, particularly the awareness of occupational hazards and prevention of injury [6]. The WiN-Canada reviewer's assessment is that the Conventional Health and Safety SCA should be adequately managed, from a women's perspective, in the future licence period.
- Agrees that the work of Site Health and Safety committees and health and safety policy committees is important for managing H&S.
- Notes that trends showing a reduction in recordable lost time accident frequency and severity indicators are signs of an effective H&S program.
- Agrees that contractor safety is important at CNL, due to large amounts of contract work.

- Believes that ease of reporting of H&S concerns is important.
- Is concerned about construction, operation, decommissioning and demolition activities which involve H&S risks. WiN members may be involved in these activities, and female workers may be particularly at risk.

Environmental Protection SCA

Past studies by WiN-Canada and the Canadian Nuclear Association [5] show that women are particularly concerned with the effects of nuclear power on the environment, so this aspect is important for their support of nuclear technologies. Hazardous releases to the air can affect the respiratory health of their family; releases to the water can affect the health of those drinking it, eating food from it, or crops watered with it. Although these concerns are not unique to women, it has been shown that these risks can more significantly affect women's perspectives of the risks in the nuclear industry.

In the area of Environmental Protection, the WiN-Canada reviewer:

- Is concerned that the environment be protected during the proposed changes to the facilities at the CRL site and during the extended licence period.
- Is also concerned about future protection of the environment as espoused by sustainability objectives.
- Is reassured that CNL is committed to Environmental Programs & Policy and has added sustainability objectives.
- Is reassured that the Environmental Management (EM) program monitors contaminant pathways: effluent, environmental and groundwater.
- Considers groundwater contamination from tritium and Sr-90 downstream of WMA-A and WMA-B to be a significant issues arising from legacy waste.
- Considers monitoring of radiological emissions to be very important.
- Is pleased to learn to hear that exposure to the public from mixed noble gases such as Ar-41, I-131 and tritium has been within regulatory limits and will decrease by 85-90% after the shutdown of NRU and the Mo-99 production facility.
- Considers groundwater contamination from tritium and Sr-90 downstream of WMA-A and WMA-B to be a significant issue arising from legacy waste.
- Considers monitoring of radiological emissions very important and is somewhat concerned that there may be more action level exceedances during demolition of facilities as legacy contamination is disturbed.
- Notes that groundwater contaminant plumes are evaluated every 5-10 years to characterize migration of contaminants, assess environmental impact and evaluate remedial actions, but wonders if this is frequent enough.
- Believes that women consider protection of native species of animals to be important and that CNL is taking effective action in this area.
- Is concerned that the best practices will be used to address the area of the Ottawa River adjacent to the Process Outfall where sediment is contaminated, and notes that natural attenuation and monitoring are considered to be appropriate measures.

- Believes that the planned activities for the proposed Licence Renewal period should ensure that the Environmental Protection SCA will be adequately managed but has concerns over potential action level exceedances during demolition activities, and the groundwater plume with Sr-90 and Tritium.
- Believes that actions taken to reduce the NRX rod bay plume, which CNSC is continuing to monitor, are of particular concern. According to CMD 18-H2 [2], the groundwater contaminants are primarily from legacy waste storage practices: Tritium downgradient of WMA-C, the NRU and NRX rod bay plumes (Tritium and Sr-90), and Tritium near WMA-B.
- Is pleased that there appears to be no unreasonable risk to fish, that potential dose to the chimney swifts is below the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) radiological dose screening benchmark.

4. Conventional Emergency Management and Fire Protection SCA

In the area of Emergency Management and Fire Protection the WiN-Canada reviewer:

- Supports the assessment that the Emergency Management and Fire Protection SCA will be adequately managed, over the proposed licence period. Nuclear Emergency Preparedness and Response has been identified as an area of particular concern to women, but WiN members comfortably continue to live near the CRL facility.
- Notes that there is an impressive list of potential accidents that are covered under annual drills and exercises, such as fire, bomb threat, chemical spill, high radiation alarm, criticality, chlorine, PCB, transportation accident involving radiological materials, site stay-in and site evacuation.
- Notes that after NRU is shutdown in March 2018 there will be no further need for distributing or stockpiling potassium iodide (KI) pills.
- Notes that Cyber-attacks and pandemics are new hazards and their inclusion in this program appropriately reflects a changing world.
- Concludes that fire, nuclear or conventional emergencies at CNL are potentially quite significant, but is reassured by the CNSC assessment in CMD 18-H2 that plans are satisfactory for the proposed extended operational period.

WiN-Canada research shows that women are particularly concerned about the potential effects of a nuclear accident on their families. One of the most significant social impacts of the Chernobyl accident was the increase in thyroid cancers amongst children [7]. Women have been shown to be more concerned about nuclear emergencies [5], agreeing that “When things go wrong, they go very wrong”.

The WiN Canada reviewer:

- Concurs that the emergency management and fire protection program during the period of extended operation will provide reassurance for its female members working at CRL who have families living in the surrounding area.
- Observes that after NRU is shutdown, the need to provide KI pills will be gone, which will be reassuring for the public in general.

5. Waste Management, Security, Safeguards and Non-proliferation, Packaging and Transport

Waste Management SCA

Continued operation at CNL raises issues of particular importance to women including safe long term management of nuclear waste and environmental remediation of the CNL site. In the area of Waste Management, the WiN-Canada reviewer:

- Notes that there is a significant amount of hazardous waste stored at the CRL site, especially NRX and NRU fuel rods. Additional waste will be produced during demolition of existing facilities. However, the WiN-Canada reviewer supports the assessment in CMD 18-H2 that the Waste Management SCA will be adequately managed at CNL during the future licence period.
- Is interested in the issue of legacy waste (NRX core, rods etc.) and the remediation projects that are underway to manage and cleanup legacy waste, and notes that CNL has drafted a waste strategy, forecasted future waste generation, developed interim storage and waste transportation strategies, and looked at waste minimization.
- Notes that the information in CMD 18-H2 supports the observations that the Waste Management SCA involves important issues, but is being satisfactorily managed.
- Concludes that waste management is an issue of great importance to WiN members and women in general, but that CNL appears to have adequate plans for waste management during the proposed extended operating period, and plans for future removal of high level waste.

Security SCA

In the area of security, the WiN-Canada reviewer:

- Observes, based on the review of CMD 18-H2 [2], that security at CRL is extremely important given the current international climate, however, it appears that CNL is making suitable enhancements to physical and cyber security for the proposed extended operating period.

Safeguards and Nonproliferation SCA

The WiN-Canada reviewer believes that the Safeguards and Non-Proliferation SCA will be adequately managed, during the proposed licence period.

- High Enriched Uranium (HEU) repatriation will minimize the number of physical locations of this material.
- As WiN Global is committed to the further development and peaceful use of nuclear science technologies and has an interest in non-proliferation and nuclear security, the WiN-Canada reviewer observes that the measures taken by CNL in the period of continued operation are important to WiN and its members. It appears to the WiN-Canada reviewer that CNL seems to be doing the right things.

Packaging and Transport SCA

The WiN-Canada reviewer has some concerns in the area of packaging and transport, but believes that the Packaging and Transport SCA should be adequately managed during the proposed licence period.

- The issue of packaging and transporting of Highly Enriched Uranium (HEU) during repatriation is of concern to the WiN-Canada reviewer as this is inherently dangerous material that may be a target for terrorists.
- The WiN-Canada reviewer concludes that, based on the review of CMD 18-H2 [2], safety of dangerous goods during packaging and transport will continue to be maintained in the proposed licence period.

6. Other Issues of Concern

Consultation and Public Information Programs

One of WiN's objectives is to provide information on the nuclear industry and communicate it with the public. WiN-Canada appreciates the opportunity to provide input to this CNL licence renewal process, and will seek an opportunity to share information on CNL with its members.

Socio-economic Impact

Socio-economic Considerations is another matter related to the Application for Licence Renewal that is important to WiN-Canada. WiN seeks to promote career interest in nuclear engineering, science, technology, the trades and other nuclear-related professions, especially among women and young people. Increased participation of women in Science, Technology, Engineering and Mathematics (STEM) is a national goal that will allow Canada to utilize more of its human potential to be more competitive internationally. Continued operation of CRL site can provide meaningful job opportunities for women in STEM.

Over the years, CNL has had positive socio-economic effects such as increased employment, income, business activity and municipal revenue in the community. This facility provides jobs for a variety of highly qualified professionals such as engineers and scientists, as well as supporting positions like technical staff and security guards.

We would like to see our community's young people remain in the area for employment. These highly skilled jobs are also well paying jobs, which will provide our families and friends with a high standard of living, while working in a safe environment.

Investing in nuclear research at CNL is an effective way to create many well-paid jobs and to provide opportunities for continued skilled employment of women working in the field of nuclear science and technology.

7. Conclusions

This review of the CNL Application for Licence Renewal [1] and CMD 18-H2 [2] concludes that:

- The Management System and Human Performance SCA initiatives planned at CRL will ensure that CNL will continue to maintain a strong safety culture for the women working at these facilities.
- Programs in the areas of operating performance, safety analysis, physical design, and fitness-for-service appear to be adequately managed, and do not have aspects of particular relevance for females. The shutdown of NRU will remove some hazards inherent to the current facility, as NRU is now over 60 years old and is an aging facility.
- There are some areas of concern that remain around conventional health and safety and radiation protection programs due to major site changes, environmental protection due to legacy contamination, and packaging and transport due to repatriating HEU. However CNL appears to be taking the appropriate steps to mitigate these concerns.
- Planned initiatives in conventional health and safety, emergency management and fire protection should ensure that there are no additional safety risks to women during the proposed extended period of operation.
- Continued operation at CNL raises issues of importance to women in the areas of safe long term management of nuclear waste and environmental remediation of the CNL site.

Continued operation of the CRL facility provides opportunities for continued skilled employment of women working in the field of nuclear science and technology, and Human Performance management programs in future should address this.

WiN-Canada supports the Application for Licence Renewal [1] for the CNL in that the SCAs appear to be satisfactorily addressed for the Licence extension period.

Recommended Follow-up

These above concerns are areas where continuing dialogue with WiN members and the women in the public would be useful. This continuing dialogue could be through WiN chapter meetings and also by providing knowledgeable speakers to womens' groups and to various environmental groups. Some of these groups are supported to a large extent by women who are opposed to the nuclear industry.

It is essential for us to stress that WiN-Canada members are highly skilled workers and would not be working in the nuclear industry if we did not believe in the benefits of nuclear technology to society and its safety. It is important to all of us that when we leave for work in the morning we know that we will return safely at the end of the day and that our families and friends who live in our communities will be safe each and every day.



Due to our day-to-day interaction with the nuclear industry and our strong belief in the expertise of CNL's employees and their proven history of safe operation, WiN-Canada supports the application before the Commission.

Sincerely,

A handwritten signature in black ink that reads "Heather Kleb". The signature is fluid and cursive, with the first letters of each word being capitalized and prominent.

Heather Kleb, MSc, MBA
WiN-Canada President

References

1. E-DOCS-#-5390079-CMD 18-H2.1 - Submission from CNL on Application for Licence Renewal for Chalk River Laboratories
2. E-DOCS-#-5373261-CMD 18-H2 - Submission from CNSC Staff for CRL Licence Renewal January 2018
3. WiN Global <http://www.win-global.org/>
4. WiN Canada <https://canada.womeninnuclear.org/>
5. Innovative Research Group, National Public Opinion Research: 2015 Nuclear Attitudes Survey
6. WiN Canada survey regarding PWMF License Renewal, 2017

**Women in Nuclear (WiN) Canada's Input to
the Review of
E-DOCS-#-5373261-CMD 18-H2 - Submission from CNSC Staff for CRL Licence
Renewal and
E-DOCS-#-5390079-CMD 18-H2.1 - Submission from CNL on Application for
Licence Renewal for Chalk River Laboratories**

Prepared by:

P. C. Watson, P. Eng.

PCWatson Engineering & Sustainable Policy Inc.

December 2017



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1 INTRODUCTION

The Canadian Nuclear Safety Commission (CNSC) has made funding available through its Participant Funding Program (PFP) [1] to assist members of the public, aboriginal groups, and other stakeholders in providing value-added information to the Commission through informed and topic-specific interventions. Funding has been specifically offered in support of the review of the Canadian Nuclear Laboratories (CNL) Application for Nuclear Research and Test Establishment Operating Licence Renewal for Chalk River Laboratories (CRL) [2]. The CNSC has awarded Women in Nuclear (WiN) Canada some of the funding.

PCWatson Engineering and Sustainable Policy Inc. has been retained by WiN-Canada to conduct a technical review of the submission from CNL regarding the Application for Licence Renewal for Chalk River Laboratories [3] and the E-DOCS-#-5373261-CMD 18-H2 - Submission from CNSC Staff for CRL Licence Renewal *Commission Member Document* (CMD) [4], including real and perceived issues for women workers at Chalk River Laboratories during the proposed licence renewal period.

P. Watson is a professional engineer with over 37 years of work experience in the nuclear industry in Ontario, including the areas of condition assessments, ageing management, managed systems, and maintenance integration. This includes 22 years with Ontario Power Generation (OPG), 6 years with Atomic Energy of Canada Limited (AECL) and 9 years with AMEC. While at AECL, P. Watson performed some work for NRU at CRL.

P. Watson has also been involved with the Canadian Nuclear Society as a member of Council and a member of the Nuclear Waste Management Division. P. Watson has been active in WiN Canada since 2004. As such, P. Watson has no conflict of interest with CNL (resume is provided in Appendix A).

2 WOMEN IN NUCLEAR (WiN)

Women in Nuclear (WiN) Global [5] is a world-wide non-profit association of women working professionally in various fields of nuclear energy and radiation applications, established in 1993. WiN Global currently has approximately 35,000 members, including national chapter members and individuals from about 100 countries, with over 30 national, regional and international chapters throughout the world.

Membership in WiN Global includes women and men working in medicine and health care, for regulatory authorities, in industry, and as independent researchers. The members share a common commitment to provide information to, and communicate with the public. WiN Global is also committed to the further development and peaceful use of nuclear science technologies and acknowledges the crucial role of nuclear energy in preserving the earth for future generations.

The WiN Canada chapter [6], established in 2004, adopted its founding goals and objectives based on the goals and objectives of the WiN-Global organization. WiN-Canada is the premier networking organization for Canadian women working in all aspects of nuclear energy, science, trades and technology. As a result of its efforts to promote the careers of women, WiN-Canada has become a strong, credible voice in the nuclear industry.

While many of the members of WiN are employed in the nuclear energy sector, WiN-Canada welcomes members from industries who work with nuclear and radiation technologies and many other related applications. This includes hospitals and medical facilities, mining, academic and research institutions,

the wider electricity sector and the many suppliers to all of these diverse industries. WiN Eastern Ontario is the chapter of WiN Canada that specifically includes women working at the CRL site.

WiN Mandate

WiN was founded in response to the unique perspective that women have been shown to have on nuclear technologies.

WiN-Canada's **Vision** according to its 2014 strategic plan is: *A Canadian public that has the knowledge to make informed decisions about nuclear applications.*

WiN-Canada's **Strategy** is to: *Offer a range of learning opportunities to our members, our partners and the Canadian public - particularly women - to raise the level of knowledge of the nuclear industry.*

WiN-Canada **Mission**:

- *To develop a dialogue with the public, and in particular with other women, to promote awareness around the factual contribution to people and society from nuclear technologies.*
- *To contribute to knowledge and experience exchange among members and chapters.*
- *To promote career interest in nuclear engineering, science, technology, the trades and other nuclear-related professions, especially among women and young people.*

WiN Canada has over 1700 members, mostly women, across the country. Chapter events enhance knowledge of the nuclear industry among members through information exchange and tours of one another's facilities. A WiN Speakers Clearinghouse allows members to share this information with the public, especially women's groups.

3 CNSC MANDATE

WiN Canada's review of the CNL Application for Licence Renewal [3] is intended to support the CNSC's mandate [7] under the *Nuclear Safety and Control Act*, which includes:

- Regulation of the development, production and use of nuclear energy in Canada to protect health, safety and the environment,
- Regulation of the production, possession, use and transport of nuclear substances, and the production, possession and use of prescribed equipment and prescribed information,
- Implementation of measures respecting international control of the development, production, transport and use of nuclear energy and substances, including measures respecting the non-proliferation of nuclear weapons and nuclear explosive devices,
- Dissemination of scientific, technical and regulatory information concerning the activities of the CNSC, and the effects on the environment, on the health and safety of persons, of the development, production, possession, transport and use of nuclear substances.

The CNSC Secretariat, in accordance with the requirements of the *Nuclear Safety and Control Act* and associated Regulations, will review CNL's application for an operating licence for the period from 2018-2028 [3].

4 OVERVIEW OF CHALK RIVER NUCLEAR LABORATORIES FACILITY

Chalk River Nuclear Laboratories was constructed in the 1940's to support Canadian research in the areas of nuclear science and technology. The National Research Experimental (NRX) reactor was the first reactor on the site. An accident with NRX in 1952 caused considerable damage and contamination (the reactor core and calandria were removed and buried), but NRX was repaired and operated for a further 45 years. Radioactive water from the accident¹ had to be dealt with to prevent the water from reaching the Ottawa River. A pipeline was therefore built in a sandy area about 600m away. The contaminated water, containing about 10,000 curies of long-lived fission products, was pumped to the area and allowed to seep out².

The National Research Universal (NRU) Reactor and supporting facilities were constructed in 1957 and used primarily for isotope production for medical purposes, but also for research, training, and development in support of the Canadian CANDU® reactors. Additional facilities were built to study aspects of nuclear science and technology taking advantage of the site's facilities and the highly educated workforce (Table 1).

In 2014 CNL was created as the Site Operating Company under the Government-Owned Contractor-Operated (Go-Co) model. The GOCO model was adopted with the objective of modernizing the CRL research facility. In 2016 October CNL ceased its production of Molybdenum-99 medical isotope and went into standby until the NRU reactor permanent shutdown March 2018.

The current CRL site includes 12 Class I nuclear facilities in an operational state plus an additional five in an extended shutdown state or in storage with surveillance (SWS, Table 2). The Class I facilities include the two research reactors: NRU and Zero Energy Deuterium (ZED-2), processing facilities, Molybdenum Production Facility (MPF), fuel manufacturing facilities, and hot cells. Five additional nuclear Class I facilities are undergoing decommissioning. The site also includes 13 different waste management areas, five in operation and eight in long-term monitoring. Five additional Class I nuclear facilities are undergoing decommissioning. There are four Class II nuclear facilities (accelerators and irradiators), and more than 50 radioisotope laboratories, support facilities and offices. A complete list of the Class I and II facilities is provided in Table 2. Figure 1 shows the current site.

¹¹ The main contaminant of concern associated with the Perch Lake basin continues to be gross beta activity, primarily 90Sr. The most significant sources of 90Sr are from WMA A, the Liquid Dispersal Area, and WMA B. Between 1946 and 1955 Waste Management Area A received solid wastes, wastewaters from the NRX, and waste solutions from fuel reprocessing experiments. http://www.cnl.ca/site/media/Parent/CRL-509243-ASR-2015_Eng.pdf

² <http://www.cns-snc.ca/media/history/nrx.html>



FIGURE 1

TABLE 1 CURRENT CRL FACILITIES

Facility Name	Class	Status	Future Status
1 NRU Reactor	1	Operating	Shutdown March 2018
2 Nuclear Fuel Fabrication Facility	1	Operating	
3 Recycle Fuel Fabrication Laboratories	1	Operating	
4 Zero Energy Deuterium -2 (ZED-2) Reactor	1	Operating	
5 Building 234 Universal Cells	1	Operating	
6 Molybdenum-99 Production Facility	1	Shutdown 2016	
7 Tritium Laboratory	1	Operating	
8 Waste Treatment Centre and Associated Facilities	1	Operating	
9 Fuels and Materials Cells	1	Operating	
10 Waste Management Areas - 5	1	Operating	
11 Nuclear Fuel Fabrication Facility Building 405	1	Operating	
12 Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation (CECEUD) – building 215	1	Operating	
13 Multipurpose Applied Physics Lattice Experimental (Maple) Reactor 1	1	Extended Shutdown	
14 Multipurpose Applied Physics Lattice Experimental (Maple) Reactor 2	1	Extended Shutdown	
15 New Processing Facility	1	Extended Shutdown	
16 NRX Reactor	1	Storage with Surveillance	
17 Active Waste Disposal System	1	Storage with Surveillance	
18 Waste Management Areas - 8		Non-Operating	
19 Plutonium Tower	1	Under Decommissioning	
20 NRX Ancillary Buildings	1	Under Decommissioning	
21 Waste Water Evaporator	1	Under Decommissioning	
22 NRX Fuel Storage Bays Building	1	Under Decommissioning	
23 Plutonium Recovery Laboratory	1	Under Decommissioning	
24 Health Physics Neutron Generator (HPNG)	2	Operating	
25 Gamma Beam Irradiation Facility	2	Operating	
26 Gamma Beam Irradiator	2	Operating	
27 Van de Graaff Electron Accelerator	2	Operating	

The current CRL site licence runs from March 31, 2011-March 31, 2018. During the licence renewal period from 2018 to 2028, CNL plans to shut down and decommission many of the older facilities on site including transitioning NRU to SWS and decommissioning NRX. In line with the GOCO mandate, many new facilities will be constructed enabling the site to become a state of the art nuclear research facility.

Key objectives during the licence renewal period include:

- Permanently shut down the NRU reactor and cease the production of Molybdenum-99 (Mo-99) on March 31, 2018. NRU will transition from operation to a safe shutdown state and then transition to SWS to await decommissioning.
- Decommission or demolish over 120 buildings and structures.
- Build long-term waste management and disposal facilities to process and store legacy waste, remove and process the stored radioactive liquid waste and decommission the associated tanks and structures, as well as remediate some of the affected lands.
- Modernize site infrastructure.
- Construct an Advanced Nuclear Materials Research Center.

The CNL site will be transformed into a campus with centralized facilities (as shown in Figure 2). Some of the new facilities include the Harriet Brooks research laboratory (constructed 2016/17), Advanced Nuclear Materials Research Center, Innovation building, as well as offices and additional upgraded laboratory spaces.



FIGURE 2 WWW.CNL.CA

5 APPLICATION FOR LICENCE RENEWAL

CNL is applying for an operating licence for 2018-2028 to the CNSC Secretariat in accordance with the requirements of the *Nuclear Safety and Control Act* and associated Regulations. To determine if CNL's request for a Nuclear Research and Test Establishment Operating Licence renewal meets the regulatory requirements and standards, CNSC staff assesses the 14 Safety and Control Areas (SCAs) [8] shown in Table 2. Their assessment is documented in CMD 18-H2 - Submission from CNSC Staff for CRL Licence Renewal Commission Member Document [4].

TABLE 2 CNSC SAFETY AND CONTROL AREAS

SCA	Section	Description	2017 rating [4]
Management System	7.1	Covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.	SA
Human Performance	7.2	Covers activities that enable effective human performance through the development and implementation of processes that ensure that Licence staff is sufficient in number in all relevant job areas and that Licence staff have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.	SA
Operating Performance	7.3	Includes an overall review of the conduct of the Licenced activities and the activities that enable effective performance.	SA
Safety Analysis	7.4	Covers the maintenance of the safety analysis that supports that overall safety case for the facility. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards.	SA
Physical Design	7.5	Relates to activities that impact the ability of structures, systems, and components to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.	SA
Fitness for Service	7.6	Covers activities that impact the physical condition of structures, systems, and components to ensure that they remain effective over time.	SA
Radiation Protection	7.7	Covers the implementation of a radiation protection program in accordance with the Radiation Protection Regulations. This program must ensure that contamination levels and radiation doses received are monitored, controlled, and maintained as low as reasonably achievable (ALARA).	SA
Conventional Health and Safety	7.8	Covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.	SA
Environmental Protection	7.9	Covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of Licenced activities.	SA
Emergency and Fire Protection	7.10	Covers emergency plans and emergency preparedness programs which exist for emergencies and for non-routine conditions. This also includes any results of exercise participation.	SA
Waste Management	7.11	Covers internal waste-related programs which form part of a facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. It also covers the planning for decommissioning.	SA

SCA	Section	Description	2017 rating [4]
Security	7.12	Covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity.	SA
Safeguards and Non-proliferation	7.13	Covers the programs and activities required for the successful implementation of the obligations arising from the <i>Canada/IAEA safeguards agreements as well as all other measures arising from the Treaty on the Non- Proliferation of Nuclear Weapons</i> .	SA
Packaging and Transport	7.14	Covers programs that cover the safe packaging and transport of nuclear substances and radiation devices to and from the Licenced facility	SA

Legend: FS = Fully Satisfactory; SA = Satisfactory; BE = Below Expectations

Other matters of regulatory interest that are relevant to CMD 18-H2 [4] were listed and two were considered of particular importance to WiN:

- Other Consultation
- Public Information Program

CMD 18-H2 contains the CNSC assessment of the Application for Licence Renewal [3] against the requirements of the SCAs (Table 2) and an evaluation of whether CNL's past and future performance in each SCA is satisfactory for the proposed continued operation.

6 OBJECTIVE(S)

WiN Canada received participant funding to perform a technical review of the Application for Licence Renewal [3] and Commission Member Documents (CMD 18-H2) [4]. Through this review WiN Canada can add value in line with the CNSCs mandate by identifying any issues of specific concern to females (working in the industry), regarding the continuing operation of CNL.

The two documents: (a) Application for Licence Renewal [3] prepared by CNL [3] and (b) the Commission Member Documents (CMD) from the CNSC [4] were considered from a technical perspective, based on the author's work experience in most of the SCAs. The outcome of this review is summarized in Section 7 below. A survey by the Innovation Research Group [9] was also considered as input on the perspective of female members of the public (see WiN's founding goals, Section 2.0).

7 TECHNICAL REVIEW OF CHALK RIVER NUCLEAR LABORATORIES FACILITY THE APPLICATION FOR LICENCE RENEWAL AND COMMISSION MEMBER DOCUMENT 18-H2

The following sections give specifics of each SCA at CNL, and summarize the assessment by the WiN Canada reviewer based on (a) information from the Application for Licence Renewal [3], and (b) the findings related to the SCA from CMD 18-H2. This is primarily a technical review, but also includes considerations from the viewpoint of females working in the nuclear industry.

7.1 Management System

As per Table 2, the Management System SCA "covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its

performance against these objectives, and fosters a healthy safety culture". It is rated Satisfactory (SA) in the CMD 18-H2 (Table 2). The specific areas related to this SCA at CRL include:

- Management System
- Organization
- Performance Assessment, Improvement and Management Review
- Operating Experience (OPEX)
- Change Management
- Safety Culture
- Configuration Management
- Records Management
- Management of Contractors
- Business Continuity

Applicable regulations from Appendix B in CMD 18-H2 are:

- Class I Nuclear Facilities Regulations,
- General Nuclear Safety and Control Regulations
- CSA N286, Management system requirements for nuclear facilities, CSA N286-05 and CSA N286-12
- CSA N286.0.1, Commentary on N286-12, Management system requirements for nuclear facilities
- CSA N286.10, Configuration management for high energy reactor facilities
- CAN/CSA-ISO 14001, Environmental management systems – Requirements with guidance for use
- CSA Z1000, Occupational health and safety management

The WiN Canada reviewer believes that ongoing improvements to the management system SCA at CNL, particularly Change Management and OPEX, will contribute to CNL remaining a safe workplace for all, including WiN members, during the proposed licence period. As the extended period of operation will be one of significant change, effective change management is especially important.

Management System and Organization

The information in the Application for Licence Renewal [3] supports the above conclusion. Updates to the Management Suite of documents (level 1, 2, and 3) are being made to reflect the new organization, and appropriate change management is being used to implement these documents.

According to CMD 18-H2, CNSC has reviewed samples of level 1 and 2 documents and found that they met regulatory requirements.

CMD 18-H2 also states that the major changes in the CNL organization structure were made according to the CNL Change Management procedures.

Safety Culture and OPEX

As WiN represents women working in the nuclear industry, WiN is concerned that the strong nuclear safety culture protecting its members in their places of employment will continue at CNL during the proposed continued operation period. Women have worked for years in the nuclear field partly due to

their faith in the nuclear safety culture. Information in the Application for Licence Renewal [3] and CMD 18-H2 reflect CNL's emphasis on a strong safety culture.

The CNL Application for Licence Renewal [3] discusses Management of Safety. CNL has, during the current licence period, conducted an Integrated Safety Review resulting in an Integrated Implementation Plan (IIP) and implemented 98 action items from the Voyageur II 2009 program. CNL continues to assess safety culture through annual employee surveys.

Areas of improvement were identified from 2012 self-assessments and improvements were ongoing in 2013 and 2014. Another safety culture assessment was performed in 2015 and areas of improvement were again identified. An employee survey in 2016 led to further action plans. *The WiN Canada reviewer agrees that self-assessments are important to a strong safety culture.*

The CNSC's assessment of CNL's safety culture in CMD 18-H2 [4] also discusses the Voyageur and Voyageur II programs. They have confirmed completion of actions in the Voyageur program. CMD 18-H2 also mentions the CNL safety culture self-assessments (surveys) from 2012-2015. The CNSC state in CMD 18-H2 that the process to gather feedback and response to the survey results were appropriate and they are satisfied with CNL's actions to address findings.

CMD 18-H2 addresses Operating Experience (OPEX) and notes that the program has matured since 2012. CMD 18-H2 states that the CNSC found processes under OPEX were effective and satisfactory. *The WiN Canada reviewer's experience is consistent with the need for effective use of OPEX for a strong safety culture.*

7.2 Human Performance Management

The human performance program SCA (Table 2) "covers activities that enable effective human performance through the development and implementation of processes that ensure a sufficient number of licensee personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties". It is rated SA in the CMD 18-H2 (Table 2). The specific areas of this SCA at CRL include:

- Human Performance Program
- Personnel Training
- Personnel Certification
- Work Organization and Job Design
- Fitness for Duty

Applicable regulations are listed in Appendix B of CMD 18-H2:

- REGDOC-2.2.4, Fitness for Duty: Managing Workers Fatigue
- RD-363, Nuclear Security Officer Medical, Physical, and Psychological Fitness
- G-323, Ensuring Presence of Sufficient Qualified Staff at Class I Nuclear Facilities: Minimum Staff Complement
- REGDOC-2.2.2, Personnel Training, version 2

The WiN Canada reviewer observes that CNL's initiatives at CRL in the area of human performance should positively affect women at the site by reducing the consequences and severity of events, providing on-site training and professional certification opportunities and ensuring a safe workplace through promotion of a strong safety culture.

This is supported by information from the Application for Licence Renewal [3] which says that the main objectives of the Human Performance program at CNL are to:

- Strengthen the safety culture at CNL – discussed above
- Evaluate human performance effectiveness in the work environment.
- Reinforce the use of human performance methodology through training, communication, and observations.
- Assist leaders in promoting and modelling safe work practices and behaviours.
- Assist employees to recognize and avoid error-likely situations.
- Evaluate error-likely situations, assess defences based on evaluations, and ensure defence-in-depth.
- Reduce the error rates through the use of human performance tools.

The WiN Canada reviewer agrees that training and communication are very important to improving human performance; and tools to track and trend Human Performance are important to monitor effectiveness and drive improvement.

The Human Performance program at CNL is said to [3]:

- Focus on a healthy safety culture including the internalization of human performance principles and personal accountability,
- Use Event Free Tools, Event Free Day reset to identify, track and trend human performance indicators, and
- Address fitness for duty through pre-employment medical screening and annual physical testing for firefighters and other specified roles, drug and alcohol testing for post incident response and investigation or in case of a suspected breach, mitigating and recognizing the effects of fatigue in the workplace, disability management and return to work programs.

CMD 18-H2 [4] concludes that “CNL’s human performance, training, and certification programs are satisfactory and that these programs meet applicable regulatory requirements and CNSC expectations”. The WiN Canada reviewer’s conclusions support those of CMD 18-H2.

The WiN Canada reviewer concurs that planned initiatives in the Human Performance and Management area, particularly training, communication and tracking/trending tools, for the period of continued operation of CNL to 2028 should be satisfactory. Training and effective communication are believed to be particularly important for the success of females working in specialized areas such as the nuclear industry. CRL offers excellent career opportunities for women in STEM fields and the WiN Canada reviewer hopes that CNL’s future plans for Human Performance will include programs to effectively utilize female talent.

7.3 Operating Performance

The operating performance SCA includes “an overall review of the conduct of the licensed activities and the activities that enable effective performance” (Table 2). It is rated SA in the CMD 18-H2 (Table 2). The specific areas that makeup this SCA at CRL include:

- Conduct of Licensed Activities
- Procedures
- Reporting and Trending
- Outage Management Performance

- Accident Management and Recovery
- Severe Accident Management and Recovery

Applicable regulations are listed in Appendix B of CMD 18-H2:

- REGDOC-2.3.1, Conduct of Licensed Activities: Construction and Commissioning Programs
- REGDOC-2.3.2, Accident Management, version 2

Conduct of Licensed Activities

The WiN Canada reviewer agrees that CNL's planned programs and initiatives in the area of Operating Performance are appropriate to ensure safe operating performance from 2018-2028. Engineering Change Control (ECC) is particularly important because of the many changes to operating facilities that are planned.

This conclusion is supported by the review of the CNL the Application for Licence Renewal [3]. The Application for Licence Renewal [3] summarizes the planned state of all relevant facilities during the proposed licence period (Table 1). There will be new nuclear facilities such as the Long Term Waste Management and Disposal Facility (LTWM&DF), and the advanced nuclear materials center, and many facilities are or will be shut down and/or decommissioned (Table 1):

- Nuclear facilities in permanent shutdown– CECEUD, HPNG facility with the Texas NG
- Nuclear facilities in extended shutdown, - MAPLE, DIFs
- Nuclear facilities in storage with surveillance – NRU, DEDS
- Nuclear facilities being decommissioned: - Pool Test Reactor, Plutonium Tower, Waste Water Evaporator, NRX Fuel Storage Bays Building, NRX ancillary buildings., Plutonium Recovery Lab, Heavy Water Upgrading Plant, Reactor Bay Deionization System

Engineering Change Control will be used for modifications to existing facilities and processes, and new Operations limits and conditions will be documented.

Reporting and Trending

OPEX is a key component of reporting and trending: incidents are reviewed and analyzed; events, operating experience and lessons learned from internal and external sources are reviewed; and a Corrective Action Program is implemented.

The WiN Canada reviewer agrees that OPEX is important, as identification of incidents and learning from them is an important contributor to safe operation.

CNL maintains a sealed source inventory, reports transfer of sources, leak tests, changes (see RP program). *The WiN Canada reviewer notes that due to the presence of fissile sources on site, criticality safety is important*

Accident Management and Recovery, Severe Accident Management (SAM) and Recovery are important areas, particularly after Fukushima.

Pressure Boundary programs and Fire Protection are standard requirements at a nuclear facility. CNL has installed all required Fukushima required upgrades, maintains a strong pressure boundary program and a strong emergency response plan.

There is a Chemistry Control program that applies to NRU, the Molybdenum production Facility (MPF), and the Fission Solution Storage Tank (FISST).

In the future there will be changes to the operating states for Class 1 nuclear facilities (Table 1):

- NRU reactor will be shutdown March 31, 2018 then governed by a storage with surveillance (SWS) plan and eventually a preliminary decommissioning plan; it will undergo decommissioning in about 40 years.
- Nuclear Fuel Fabrication Facility (consolidated into 1 building from 2, and a SWS plan and detailed decommissioning plan (DDP) will be prepared for the old building,
- Tritium Facility will be transferred to a new building and a SWS plan and DDP will be prepared for the old facility).
- The ZED-2 Reactor, Universal Cells, Fuels and Materials Cells and Recycle Fuel Fabrication laboratory will continue to operate to 2028.

There will also be changes to operating states for Class II nuclear facilities during the proposed licensing period:

- Texas Neutron Generator has been shut down since 2013 and is awaiting removal,
- New neutron generator is awaiting commissioning.
- The Gamma Beam Irradiator Facility has a new irradiator.

The March 2018 shutdown of NRU will affect the extent of Conduct of Licensed Activities and some areas will become less relevant, e.g. Outage Management, SAM.

The WiN Canada reviewer's conclusion that planned programs and initiatives in the area of Operating Performance are adequate for future operation is also supported by the information in CMD 18-H2. The Governing documents for the nuclear facilities at CRL that give operational limits and conditions for the various facilities are being revised for the new format of CRL.

Three radioisotope laboratories are no longer operating, 7 are being renovated, and 3 will be shut down along with NRU. Many labs will be relocated to new buildings and the old buildings will be demolished.

Waste Management Area B has 750 tile holes containing spent fuel rods, many of the older tile holes are degrading and fuel is being retrieved and moved to dry storage. The Fuel Packaging and Storage Facility (FPSF) contains equipment to safely move the fuel to dry storage.

High Enriched Uranium (HEU) fuel used in producing isotopes, that is currently stored in waste management areas will be repatriated to the US to aid in non-proliferation efforts. Liquid containing HEU (HEUNL) has been stored in the Fissile Solutions Storage Tank (FISST)³. The Mo-99 Production Facility

³ Until 2003, liquid inventories containing HEU were stored in a double-walled stainless-steel vessel known as the Fissile Solution Storage Tank (FISST), located at CRL.

Since 2003, when FISST reached its storage capacity, new liquid material generated from medical isotope production has been cemented and is in long-term storage at CRL.

The FISST vessel (now full) is inside a vault shielded by thick concrete. It is monitored for temperature, pressure, and chemical composition. Its content is sampled once a month for detailed chemical analysis.

modifications will facilitate removal of material from the FISST and transfer it to a certified radioactive material transport package, see Packaging and Transport, section 7.14.

All fume hoods were reviewed for compliance with National Fire Code, and approximately 80% have been upgraded.

CMD 18-H2 states that facility specific procedures have been updated and have been reviewed by CNSC.

CMD 18-H2 states that regarding reporting and trending, unplanned situations and events are reported to the CNSC and reviewed for regulatory concerns. The Event reports (Table 5 of CMD 18-H2) include fatalities, and accidental dropping of a fuel rod.

The WiN Canada reviewer believes it is important that unplanned events continue to be reported to CNSC, which will ensure that corrective action is taken where necessary.

CNSC conclusions in CMD 18-H2 are that CNL continues to implement and maintain effective operational programs for the CRL site in accordance with regulatory requirements.

According to CMD 18-H2 [3], the Operating Performance SCA is satisfactory for the new licence period.

The WiN Canada reviewer concludes that procedures for the facilities that will remain at CRL will be sufficient to ensure safety to CRL workers including WiN members. This includes revised operating conditions, reporting and trending of unplanned events, and Severe Accident Management Guidelines (SAMG) modifications to deal with severe accidents such as Fukushima,

7.4 Safety Analysis

According to CMD 18-H2 [4], the safety analysis SCA (Table 2) “covers the maintenance of the safety analyses that supports the overall safety case. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards”. It is rated SA in the CMD 18-H2 (Table 2). The specific areas that are included in this SCA at CRL are:

- Deterministic Safety Analysis
- Hazard Analysis
- Probabilistic Safety Analysis
- Criticality Safety
- Severe Accident Analysis

Applicable Regulations are listed in Appendix D of CMD 18-H2:

- REGDOC-2.4.1, Deterministic Safety Analysis
- REGDOC-2.4.2, Probabilistic Safety Assessment (PSA) for Nuclear Power Plants
- RD-327, Nuclear Criticality Safety
- GD-327, Guidance for Nuclear Criticality Safety

<http://nuclearsafety.gc.ca/eng/reactors/research-reactors/nuclear-facilities/chalk-river/highly-enriched-uranium-in-canada.cfm>

The WiN Canada reviewer believes the changes to the facilities during operation out to 2028, discussed under Future Plans in the Application for Licence Renewal [3], will increase safety for all employees working at these facilities.

As the NRU reactor will shut down in 2018, safety analysis documents for NRU will be revised to reflect the shutdown state. The rod bays will remain operational so Facility Authorizations will be required:

- There will be an update of the suite of documentation under the new facility configuration to guide safety analysis activities. There were audits in 2014/15 on safety analysis by the Nuclear Oversight division and an internal audit in 2017.
- The integrated safety review of NRU resulted in implementing physical improvements and safety analysis as a result of Corrective Actions that were identified.
- Safety Reports and Facility Authorizations for the modified facilities will be updated.

The WiN Canada reviewer concurs that external audits and implementing corrective actions such as physical improvements are important for maintaining effective safety analysis.

WiN Canada's conclusions regarding the Safety Analysis SCA during future operation are also supported by CNSC observations in CMD 18-H2. It is believed that the elements constituting the Safety Analysis SCA will be adequately managed in the future licencing period. The shutdown of NRU will require changes to the safety analysis as hazards will be reduced.

CNL is required to prepare Safety Analysis reports for Class 1 Nuclear Facilities and hazard evaluations. This includes:

- Deterministic Safety Analysis – Safety Analysis Reports (SARs) for Class 1 Nuclear Facilities, Class II nuclear facilities and Class II prescribed equipment will be updated over time and reviewed regularly by CNSC. CNSC found the NRU SAR meets regulatory requirements [4].
- Probabilistic Safety Analysis – performed to support NRU reactor only, which was reviewed and accepted by CNSC [4],
- Criticality Safety – with fissile material on site, a nuclear criticality safety program compliant with RD-327. Criticality Safety Document (CSD) updates according to RD-327 meet regulatory requirements [4],
- Severe Accident Analysis – REGDOC-2.3.2 outlines the response to an accident to prevent escalation, mitigate the consequences, and achieve a long term stable state; this analysis is applicable only to NRU (which will be shutdown in 2018) and has been updated to incorporate lessons learned from Fukushima.

According to CMD 18-H2, the regulatory focus is on revising documents as NRU is shutdown and transitioned to storage with surveillance. Safety analysis will be updated to reflect the current state of all facilities. CNSC staff concludes in CMD 18-H2 that CNL continues to implement and maintain an effective safety analysis program at CRL in accordance with regulatory requirements.

With respect to severe accident management (SAM) analysis, the WiN Canada reviewer notes that women were particularly affected by the Fukushima accident [9] and, as a result, have been shown to be less supportive of the nuclear industry due to what they see as a higher perceived risk [9]. The adoption of lessons learned from Fukushima should reduce the risk at CRL in the future. The shutdown of NRU will

eliminate much of this risk, but as there will be fuel rods in remaining rod bays, cooling of these is still of concern. It is noted that they are well-managed and have back-up cooling.

7.5 Physical Design

According to CMD 18-H2, the physical design SCA (Table 2) “relates to activities that impact the ability of structures, systems and components to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account”. It is rated SA in the CMD 18-H2 (Table 2). The specific areas that are part of this SCA at CRL include:

- Design Governance
- Site Characterization
- Facility Design
- Structure Design
- System Design
- Component Design

Applicable regulations are listed in Appendix B of CMD 18-H2:

- RD-367, Design of Small Reactor Facilities
- RD/GD-352, Design, Testing and Performance of Exposure Devices
- National Building Code of Canada
- REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants
- G-276, Human Factors Engineering Program Plans
- G-278, Human Factors Verification and Validation Plans
- GD-52, Design Guide for Nuclear Substances Laboratories and Nuclear Medicine Rooms
- CSA N285.0/N285.6 Series, General requirements for pressure-retaining system and components in CANDU nuclear power plants / Material standards for reactor components for CANDU nuclear power plants
- CSA B51, Boiler, pressure vessel, and pressure piping code
- CSA N285.0.1, Commentary on CSA N285.0-12, General requirements for pressure-retaining systems and components in CANDU nuclear power plants

The WiN Canada reviewer's conclusions based on the review of CMD 18-H2 [4] are that changes planned to the physical design of the new and modified facilities during the proposed licence renewal period will be safely managed.

The CNL Application for Licence Renewal [3] supports this conclusion. Physical design is managed under the Design Authority and Design Engineering programs and design oversight and change control have been strengthened since 2012. Change Control is managed by the Configuration Management program. The Engineering Change Control Office was established during the past licence period. There are no outstanding regulatory enforcement actions resulting from CNSC compliance inspections of physical design.

Future plans in this area at CNL include creating a formal design review board, redistributing engineering functions, assessments of engineering competence and skills profiles, providing necessary tools, re-establishing engineering field office, improving engagement with the third party supply chain.

The WiN Canada reviewer agrees that these initiatives should improve the areas included in the Physical Design SCA at CNL. WiN Canada would trust that competencies and skills would be judged equally and fairly and in an unbiased way for both male and female employees.

The WiN Canada reviewer's assessment is that the Physical Design SCA will be adequately managed, during the future operating period and that there are no special concerns from a female perspective.

Information in CMD 18-H2 supports this assessment. According to CMD 18-H2, CNL has implemented and maintains a Design Program that ensures safety related Systems, Structures and Components (SSCs) and any modifications to them continue to meet their design basis over time given any new information and changes to the external environment. It is also stated that CNL continues to implement and maintain effective design programs at CRL in accordance with regulatory requirements.

CMD 18-H2 focuses on 3 areas: design governance, site characterization and facility design.

- Design governance – conduct of design engineering document – CNSC has found these documents to be suitable for their intended purpose,
- Site characterization – used as the basis of other documents, including the safety report and in the design of new or modifications to existing facilities; CNSC review finds these up to date and accurate, but notes that site characteristics will change with the new facility layout.
- Facility design – CNSC has reviewed these, focusing on application of appropriate codes and standards for new facilities or design changes, as well as new experimental work, new environmental restoration and site improvement projects (e.g. Shielded Modular Above Ground Storage Building #3, Fuel Packaging and Storage Facility, modifications to Mo-99 Production Facility, Class C radioisotope laboratory complex, and natural gas pipeline.) CNSC has reviewed and confirmed regulatory requirements are met [4].

CMD 18-H2 notes that in future CNL will be updating design engineering procedures and establishing a design review board, restoring the engineering field office, and improving special engineering services. In CMD 18-H2, CNSC staff concludes that CNL continues to implement and maintain effective design programs at CRL in accordance with regulatory requirements.

The WiN Canada reviewer believes that these requirements for design procedures and review are particularly important given site changes planned at CRL. Also updates and improvements to design engineering and awareness of changes in environment are important. There are no aspects unique to the female perspective in this area.

7.6 Fitness for Service

The fitness for service SCA (Table 2) “covers activities that impact the physical condition of structures, systems and components to ensure that they remain effective over time. This area includes programs that verify all equipment is available to perform its intended design function when called upon to do so”. It is rated SA in Table 2. The specific areas that are included in this SCA at CRL include:

- Equipment Fitness for Service / Equipment Performance
- Maintenance
- Aging Management
- Structural Integrity
- Chemistry Control

- Periodic Inspection and Testing

Applicable regulations are listed in Appendix B of CMD 18-H2:

- REGDOC-2.6.3, Aging Management
- CSA N291, Requirements for Safety-Related Structures for CANDU Nuclear Power Plants
- RD/GD-210, Maintenance Programs for Nuclear Power Plants

The WiN Canada reviewer agrees that with the recent improvements to the areas included in this SCA, particularly preventive maintenance, ageing management, and periodic inspection and testing, the physical condition of structures and components will be better monitored. Aging management programs in place or planned will help ensure Fitness for Service of the major SSCs at CNL for the proposed extended operating period, ensuring safety from ageing related degradation that could adversely affect women workers at CNL or the public.

This conclusion is supported by information in the Application for Licence Renewal [3]:

- At NRU the IIP resulted in significant increase in time between reactor trips and forced shutdowns. The preventive maintenance backlog has decreased, master equipment lists have been prepared, spare parts obtained, the technical basis for Preventive Maintenance (PMs) defined, system health program and reporting put in place. In-service inspection and annual fitness-for-service assessments are done on the NRU vessel. The outage schedule for NRU has changed from annually to quarterly to allow for more timely equipment upgrades.
- Ion Chambers (IC) and Cables – 11 replaced, PM/SHR is done, spare ICs tested
- Rod monitoring system – refurbished to increase fleet of spares
- Class I, II, and III power systems have been refurbished, inverters, Emergency Power System (EPS) battery banks, rectifiers, Class I, II, III breakers, etc. have been replaced.
- Non-NRU work included extensive capital projects for domestic water supply, sanitary sewage treatment, storm water management and natural gas supply
- Equipment Reliability Programs have been prepared for 46 safety related systems and 39 BOP systems

The WiN Canada reviewer notes the importance of master equipment lists. A technical basis for Preventive Maintenance (PMs) and a System Health (SH) program are new requirements from recent REGDOCS.

The Application For Licence Renewal [3] notes that CNSC staff has improved the rating of this SCA from BE (below expectation) ranking to S (satisfactory) based on compliance inspections of the areas in the Fitness for Service SCA.

Future plans for maintaining fitness for service at NRU include continued monitoring of equipment performance, preparing System Health Reports (SHRs), and improving maintenance management until NRU is shutdown at the end of March 2018.

Environmental qualification at NRU will ensure critical equipment required to mitigate design basis accidents (DBAs) is qualified under accident conditions, again this will not be applicable after NRU is shutdown.

To improve fitness for service of non-NRU facilities, work includes a focus on structural integrity and chemistry control of FISST. New facilities will be assessed to determine if they require these programs.

Site Maintenance was integrated with Work Management in 2016. *This is, in the WiN Canada reviewer's experience an important integration as facilitates automatic generation of work orders with a rationale for the maintenance.* Site Maintenance will be significantly altered by the decommissioning of more than 120 buildings and structures, and constructing new buildings/facilities.

Information in CMD 18-H2 also supports the WiN Canada reviewer's assessment that the Fitness-for-Service SCA will be adequately managed in the licence renewal period. According to CMD 18-H2, "The SCA rating moved from Below Expectations (BE) in 2016 to Satisfactory (SA) in 2017 due to improvements in the fitness for service program ongoing since 2012. This was done for NRU via the IIP. Fukushima action items were closed and new programs implemented. CNSC has monitored progress with frequent verification activities, and presented status updates at public meetings.

According to CMD 18-H2, challenges since 2012 at CRL have been Equipment Fitness for Service (FFS) and Equipment Performance due to effects of ageing. *The WiN Canada reviewer believes understanding ageing degradation mechanisms and the technical basis for PMs is important.* The IIP improved FFS at NRU through physical and programmatic improvements. Site wide there were also challenges with aging of shared systems e.g. steam/condensate, Class IV power, compressed air, firewater. There are plans to upgrade these, Section 4.0.

There have also been maintenance challenges at CRL due to ageing; maintenance activities are now becoming more effective and proactive as ageing mechanisms are understood. Overdue PMs are being reduced with no carryover of safety significant items; improvements include master equipment lists, critical spares, and SHRs.

Ageing management programs have been revised since 2012 to comply with CNSC requirements; health reports for important NRU systems are now prepared, the status of vessel ageing management is reported annually. Structural Integrity is confirmed by the Periodic Inspection Program (PIP).

With respect to Chemistry Control, Chemistry monitoring and analysis is performed for NRU, FISST, and the diesel stockpile for the emergency generator.

Periodic Inspection (PIP) and testing applied only to NRU reactor, and has been performed in 6 year cycles.

In terms of regulatory focus, the NRU shutdown in March 2018 will mean the focus of FFS will change.

Future plans are that CNL will maintain FFS, structural integrity and chemistry control for the remaining facilities and consider the need for FFS on new facilities. CNL has plans for removing ageing facilities and upgrading shared site wide services.

As stated in CMD 18-H2, CNSC staff concludes that CNL continues to implement and maintain effective fitness for service programs at CRL in accordance with regulatory requirements.

The WiN Canada reviewer's conclusion is that the Fitness for Service SCA should be satisfactory in future due to technical activities described above; and that there are no unique areas to the female perspective.

7.7 Radiation Protection

The radiation protection SCA (Table 2) “covers the implementation of a radiation protection (RP) program in accordance with the Radiation Protection Regulations. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained as low as reasonably achievable (ALARA)”. It is rated SA in Table 2. The specific areas included in this SCA at CRL are:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

Applicable regulations are listed in Appendix B of CMD 18-H2:

- G-129, Revision 1, Keeping Radiation Exposures and Doses “As Low as Reasonably Achievable (ALARA)”
- G-228, Developing and Using Action Levels

Radiation Protection (RP) is an area of heightened interest to WiN members in particular [12] and women in general [9]. The fact that dose levels to workers and the public have been well below regulatory levels is reassuring. The WiN Canada reviewer agrees that CNLs radiation monitoring should be adequate for future operation.

Information on past RP performance in the Application for Licence Renewal [3] supports the WiN Canada assessment. The overall objective of the RP program is to keep the doses as low as reasonably achievable (ALARA), with objectives of limiting doses to less than regulatory limits, limit detrimental stochastic health effects in employees and the public, and prevent detrimental non-stochastic (deterministic) health effects by CNL’s use of radiation. These are areas of particular importance to women.

The Application for Licence Renewal [3] says that the RP program has been monitored and improved since 2011, and includes training, and assessments of the program through audits, peer reviews and self-assessments. Two areas of improvement identified after the 2013 WANO peer review were control of high radiation areas, and contamination control.

The review of past performance in the Application for Licence Renewal [3] shows that in terms of individual and collective dose, no regulatory limits were exceeded in the review period, and that individual and collective doses remained ALARA. Additionally, no dose levels were received that exceeded action levels during the review period. *This is reassuring to the WiN Canada reviewer.*

Improvements in source term reduction and in shielding and containment were also made during the review period. This included cleanup and reduction of Sr-90 in the South Swamp area, a shielding wall around the Mo-99 hot cell active ventilation duct, construction of a cover in WMA C to reduce migration of soluble waste into the water table, and removal of liquid legacy wastes from WMA A. These are all significant sources of radiation that have been reduced, also reassuring to the WiN Canada reviewer. Several other projects have also improved monitoring and radiation protection equipment.

According to the Application for Licence Renewal [3], CNL’s future plans for the RP program are to update documentation to reflect future changes to the facility, reduce the number of high contamination

zones, increase physical barriers and signage for elevated contamination areas, improve monitoring and storage of radioactive materials to provide greater control at the source, review qualification and training of Group 1 RP surveyors. Good industry RP practices will be incorporated into design and construction of new facilities. Buildings planned for decommissioning or repurposing will have their radiological source terms hazards re-evaluated to ensure ALARA during the new licensing period. *This is all reassuring to the WiN Canada reviewer.*

Information in CMD 18-H2 also supports the WiN Canada's reviewer's confidence in CNL's handling of the areas included in the RP SCA in the future licensing period. Control Programs in RP include: management control over work practices, personnel qualification and training, control of occupational and public exposures to radiation, and planning for unusual situations. *In terms of individual and collective dose, no regulatory limits were exceeded in the review period, and individual and collective doses remained ALARA. Additionally, no dose levels were received that exceeded action levels during the review period. This is reassuring to the WiN Canada reviewer.*

As stated in CMD 18-H2, past performance in the RP program can be assessed based on Key Performance Indicators (KPIs). Doses received by workers are assessed by dosimetry. No Nuclear Energy Workers (NEWs) or non-NEWs have exceeded regulatory limits from Jan 2012-June 2017. The average and maximum effective and equivalent doses over this period show that CNL is maintaining control over worker exposure (despite a slight increasing trend in Figure 4 of CMD 18-H2 and an increase in extremity dose, Table 6 of CMD 18-H2). According to CMD 18-H2, CNSC are satisfied. *The WiN Canada reviewer is curious about the reasons for the increasing trends.*

According to CMD 18-H2, the RP program satisfies the Radiation Protection Regulations. Action levels are established at which CNSC must be notified and corrective actions put in place. One action level was exceeded in 2016 and CNSC is satisfied with corrective action taken according to CMD 18-H2.

For contamination control radiological zones are defined, classified and restricted to authorized personnel as well as being monitored. CNSC are satisfied with this according to CMD 18-H2 *and the WiN Canada reviewer agrees.*

CRL has an environmental program to prevent uncontrolled release of contaminants or radiological material from the site and limit dose to the public. According to CMD 18-H2, public dose resulting from CRL's operations has been well below regulatory limits and dose to the public will be significantly reduced after the closure of NRU.

According to CMD 18-H2, the future focus of the CNSC will be on worker protection as buildings and facilities are demolished and repurposed. *WiN Canada's reviewer sees this as very important for CNL workers including potential WiN members. Radiation protection has been documented to be of particular importance to female employees of reproductive age, with concern both for women who are pregnant and men who are attempting to become fathers. The WiN Canada reviewer agrees with the conclusion in CMD 18-H2 that the radiation protection at CNL during the period of extended operation should provide adequate protection for women.*

7.8 Conventional Health and Safety

The conventional health and safety SCA (Table 2) "covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment". It is rated SA in Table 2. The specific areas that make up this SCA at CRL include:

- Practices
- Awareness
- Performance

Applicable regulations are listed in Appendix B of CMD 18-H2:

- CSA Z460, Control of hazardous energy – Lockout and other methods
- CSA Z462, Workplace Electrical Safety

The WiN Canada reviewer believes that conventional health and safety (H&S) are issues of particular importance to women employees at CNL, particularly the awareness of occupational hazards and prevention of injury. The WiN Canada reviewer's assessment is that the Conventional Health and Safety SCA will be adequately managed, from a women's perspective, in the future licence period.

This conclusion is supported by sections of the Application for Licence Renewal [3] which discuss the Occupational Safety and Health (OSH) program at CNL. This program manages health and safety of employees and other persons on CNL site, prevents accidents and injuries in the course of employment, through the work of Site Health and Safety (H&S) committees, and health and safety policy committees. *These are, in the experience of the WiN Canada reviewer, important for managing H&S.*

The Application for Licence Renewal [3] says that there has been an improving trend in recordable lost time accident frequency and severity, and that additional improvement actions are underway. CNSC has conducted assessments and there are no outstanding regulatory enforcement actions. *The WiN Canada reviewer notes that these indicators are signs of an effective H&S program.*

Future plans are to align the Occupational Safety & Health (OSH) program with ISO 45001 and pursue certification, improve competency assessment and validation of qualifications, improve contractor safety performance, support WHMIS via IT software. *The WiN Canada reviewer agrees that contractor safety is important at CNL with large amounts of contract work.*

The WiN Canada reviewer's conclusion regarding the H&S SCA is also supported by information in CMD 18-H2. This document notes that the CNSC has been, and is currently, satisfied with the Conventional Health and Safety SCA at CRL. CNL's activities comply with OHS of Canada Labour Code and Regulations. 200 H&S inspections are conducted annually by CNL and the majority of findings have been minor non-compliances. CNL self-assessments result in actions under the corrective action program. Awareness of H&S is constantly improved by information, training, instruction and supervision. CNL employees report H&S concerns through ImpActs. Recorded Loss Time Incidents (RLTIs) frequency and severity have been trending downward from 2012-2017. *The WiN Canada reviewer believes that ease of reporting concerns is important for H&S.*

According to CMD 18-H2, CNSC regulatory focus will be on planned construction, operation, decommissioning and demolition activities which involve H&S risks. CNL plans improvements to the H&S program over the proposed licensing period. *This is also an area where the WiN Canada reviewer is concerned as WiN members may be involved in these activities, and female workers may be particularly at risk due to these being typically areas where women may have lesser experience. Female specific training may be required.*

7.9 Environmental Protection

The environmental protection SCA (Table 2) “covers programs that identify, control and monitor all releases of nuclear and hazardous substances and effects on the environment from facilities or as the result of licensed activities”. It is rated SA in the CMD 18-H2 (Table 2). The specific areas that makeup this SCA at CRL include:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public
- Environmental Risk Assessment (ERA)

Applicable regulations are listed in Appendix B of CMD 18-H2:

- REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures, version 1.1
- N288.1, Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear
- N288.2, Guidelines for calculating the radiological consequences to the public of a release of airborne radioactive material for nuclear reactor accidents
- N288.3.4, Performance testing of nuclear air-cleaning systems at nuclear facilities
- N288.4, Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills
- N288.5, Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills facilities
- N288.6, Environmental risk assessment at class I nuclear facilities and uranium mines and mills
- N288.7, Groundwater protection programs at Class I nuclear facilities and uranium mines and mills
- N288.8, Establishing and implementing action levels for releases to the environment from nuclear facilities

Surveys commissioned by the Canadian Nuclear Association (CNA) [9] show that women are particularly concerned with the effects of nuclear power on the environment, so this aspect is important for their support of nuclear technologies. Hazardous releases to the air can affect the respiratory health of their families; releases to the water can affect the health of those drinking it, eating food from it, or crops watered with it. Although these concerns are not unique to women, it has been shown that these risks can more significantly affect women’s perspectives of the risks in the nuclear industry. *The WiN Canada reviewer is concerned that the environment be protected during the proposed changes to the facilities at the CRL site and during the extended licence period. The WiN Canada reviewer is also concerned about future protection of the environment as espoused by sustainability objectives.*

Past performance and future plans discussed in the CNL Application for Licence Renewal [3] are reassuring to the WiN Canada reviewer. CNL has committed to protect the environment according to CNL’s environmental program and policy, CNL has also recently added sustainability objectives aligned with the 2016-2019 Federal Sustainable Development Strategy. To this end, the new Harriet Brooks building is certified LEED silver, and natural gas installation will replace propane for heating. The Application for Licence Renewal [3] says that CNL seeks to ‘advance nuclear science and technology for a clean and secure world’. *The WiN Canada reviewer observes that this is a timely sentiment.*

The WiN Canada reviewer finds it reassuring to know that the Environmental Management (EM) program monitors contaminant pathways: effluent, environmental and groundwater. The Environmental Risk Assessment (ERA), which assesses human health and ecological risk, is compliant with CSA N288.6.

The Application for Licence Renewal [3] contains a review of past performance of Effluent and Emissions Control (Releases) at CRL covering: radiological emissions, non-radiological emissions and ground water monitoring. The WiN Canada reviewer is pleased to learn that exposure to the public from mixed noble gases such as Ar-41 (NRU), I-131 and tritium has been within regulatory limits and will decrease by 85-90% after the shutdown of NRU and the Mo-99 production facility.

Groundwater contamination from tritium and Sr-90 downstream of the Waste Management Areas (WMA) WMA-A and WMA-B is considered by the WiN Canada reviewer as significant issues arising from legacy waste. The Application for Licence Renewal [3] says that levels of this contamination have remained stable or decreased since 2011. Groundwater tritium levels have decreased due to projects such as an impermeable cover in WMA-C and the 'pump and treat stations' at West Swamp. A permeable reactive barrier downgradient of WMA-A has reduced Sr-90 contamination discharging from the South Swamp. In the past licence period, these emissions have been well below Derived Release Limits (DRLs).

Monitoring of radiological emissions is considered very important to the WiN Canada reviewer. At CRL this includes measuring ambient gamma radiation, sampling and analysis of drinking water, air, milk, fish, garden produce, and beach/river sediments.

Action levels are well below DRLs, but exceedances indicate a potential problem and there have been numerous recent exceedances: Thirty action level exceedances in 2013 were attributed to vibrations of a fan in the Tritium Facility that released some legacy contamination (gross alpha, beta) and to the subsequent maintenance. There were also I-131 releases mostly from the Molybdenum Production Facility (MPF) stack and building 468 Decontamination Center attributed to the MPF waste can and waste flask during placement in the WMA B tile holes, the tile holes, etc. According to the Application for Licence Renewal [3], corrective action was to return to weekly cleaning of the flasks to avoid buildup of contamination. Fresh charcoal absorbers were also installed in the MPF stack. In 2014 there were 2 action level exceedances, and 2 again in 2016 (gross beta releases at Lower Bass Lake attributable to increased precipitation altering the flow characteristics of the swamp) and gross beta from the MPF. *The WiN Canada reviewer is somewhat concerned that there may be more action level exceedances during demolition of facilities as legacy contamination is disturbed.*

Monitoring is also done for non-radiological (chemical) emissions in liquid effluents from the sewage treatment plant.

According to the Application for Licence Renewal [3], groundwater monitoring assesses the potential effects of CRL operations. Contamination comes mainly from the Waste Management Areas (WMAs) but also from facilities without in-facility monitoring of liquid waste. Groundwater is sampled twice yearly from wells around the site perimeters along the Ottawa River frontage, and known groundwater contaminant plumes are evaluated every 5-10 years to characterize migration of contaminants, assess environmental impact and evaluate remedial actions. *The WiN Canada reviewer wonders if this is frequent enough.*

The WiN Canada reviewer believes that women consider protection of native species of animals to be important and that CNL is taking effective action in this area. The Environmental Management System has several focuses as summarized in the Application for Licence Renewal [3]:

- Fish impingement, entrainment at the water intake well from the Ottawa River is monitored annually,
- Chimney swifts are nesting in the MPF stack; the population of these birds is declining in North America due to the decline in the use of old style chimney stacks. The bird roosts are counted weekly during the appropriate seasons and the radioactive exposure Xe-133 to these birds nesting in the stack has been assessed as satisfactory,
- Barn swallows have been nesting in some of the old facilities since 1944; new nesting habitats are being established before these facilities are demolished,
- There are 4 turtle species on site that are being monitored.

There is a 400 m by 200 m area of the Ottawa River adjacent to the Process Outfall where sediment is contaminated [3]. *This is an issue of particular concern to the WiN Canada reviewer.* According to the Application for Licence Renewal [3], effects on human health and the ecology have been assessed by the Ottawa Riverbed Remediation project as low and acceptable. According to the Application for Licence Renewal [3], no remediation actions are required, but natural attenuation will be monitored.

Four environmental assessments (EAs) were completed at CNL between 2011-2016 related to decommissioning of a plutonium tower, parking area expansion, liquid effluent monitoring stations and the South Swamp groundwater treatment system.

Future plans for the licence renewal period indicated in the Application for Licence Renewal [3] are registration to ISO 14001 2015 and alignment of programs to CSA N288.7 and N288.8.

The WiN Canada reviewer believes that the planned activities for the proposed Licence Renewal period should ensure that the Environmental Protection SCA will be adequately managed but has concerns over potential action level exceedances during demolition activities, and the groundwater plume with Sr-90 and tritium.

The WiN Canada reviewer's position is also supported by information in CMD 18-H2 [4] where the Environmental Protection SCA has been rated satisfactory. Annual liquid and airborne effluent releases have been below CNSC limits since 2012 and CNL monitoring programs have complied with CSA N288.4 and N288.5. The section in CMD 18-H2 on past performance states that radiological and non-radiological releases have been below regulatory limits during the current licence period. Some action level exceedances were reported to CNSC, investigated, and corrective actions taken. CMD 18-H2 says that CNSC is satisfied with CNL's Environmental Management System (EMS). CNL reports the Environmental Monitoring Program (EMP) results annually to CNSC, and in the past the dose level to the public from CNLs operations has been very low.

According to CMD 18-H2, the groundwater contaminants are primarily from legacy waste storage practices: tritium down gradient of WMA-C, the NRU and NRX rod bay plumes (tritium and Sr-90), and tritium near WMA-B. Measurements change as plumes migrate. Actions have been taken to reduce the NRX rod bay plume which CNSC is continuing to monitor. *This is of particular concern to the WiN Canada reviewer as Sr-90 may get into vegetation from the ground water and is harmful if ingested.*

The IEMP program indicates that the public and the environment in the vicinity of CNL are protected.

According to CMD 18-H2, CNSC reviewed the ERA that CNL submitted in 2013, and found it meets the requirements of N288.6. The CNSC has identified 3 areas as discussed above: fish impingement and entrainment at the NRU cooling water intake, chimney swift nesting and roosting, and riverbed sediment

remediation for an area contaminated by releases from NRX. CNSC concluded that there is no unreasonable risk to fish, potential dose to the chimney swifts is below the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) radiological dose screening benchmark, and that natural attenuation and monitoring is an appropriate measure for the contaminated riverbed. *This is reassuring to the WiN Canada reviewer.*

7.10 Emergency Management and Fire Protection

The Emergency Management and Fire Protection SCA (Table 2) “covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions”. It is rated SA in the CMD 18-H2 (Table 2). The specific areas that makeup this SCA at CRL include:

- Conventional Emergency Preparedness and Response
- Nuclear Emergency Preparedness and Response
- Fire Emergency Preparedness and Response

Applicable regulations are listed in Appendix B of CMD 18-H2:

- REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, version 2
- N-1600, General requirements for nuclear emergency management programs
- N393, Fire protection for facilities that process, handle, or store nuclear substances
- National Fire Code of Canada

The WiN Canada reviewer supports the assessment that the Emergency Management and Fire Protection SCA will be adequately managed, over the proposed licence period. Nuclear Emergency Preparedness and Response has been identified as an area of particular concern to women [9], but WiN members comfortably continue to live near the nuclear research center.

This is supported by information in the Application for Licence Renewal [3] which discusses emergency management, fire response and the status of regulatory enforcement actions. During the current licence period the Emergency Management Operations Center (EOC) was activated numerous times: 6 partial or full loss of Class 4 power, 2 highway closures, a false fire alarm, a false criticality alarm, preventative during transfer of NRU rod bay water, and an earthquake. Annual drills and exercises cover events such as fire, bomb threat, chemical spill, high radiation alarm, criticality, chlorine, PCB, transportation accident involving radiological materials, site stay-in and site evacuation. *The WiN Canada reviewer notes that this is an impressive list of potential accidents.*

A severe accident management (SAM) program is in place as a response to the Fukushima accident for beyond design basis events that may occur at NRU prior to permanent shutdown in March 2018. Improvements have been made to the EOC and CRL is aligned with the Ontario Incident Management System. Joint exercises are conducted with external first responders. Potassium Iodide (KI) pills and information have been distributed to residents within the primary zone (9 km) and stockpiles are maintained (secondary zone, 50 km) *The WiN Canada reviewer notes that after NRU is shutdown in March 2018 there will be no further need for distributing or stockpiling KI pills.*

Future plans in EM&FP include developing a risk based emergency management framework, hazard identification for risks to the CRL site, business continuity management that will look at loss of information (IT outage, cyber-attack), loss of building (due to fire, flood, loss of power), and loss of staff (e.g. labour

stoppage, pandemic). *The WiN Canada reviewer notes that Cyber-attacks and pandemics are new hazards and their inclusion appropriately reflects a changing world.*

The Application for Licence Renewal [3] also describes improvements that have been made to fire response capability at CNL.

The WiN Canada reviewer found that CMD 18-H2 also supports the conclusion that the EM&FP SCA will be adequately managed over the proposed licence period. The Nuclear Emergency Preparedness and Response program, and results of exercises, have been assessed in the past by CNSC. CNL has a site emergency response plan, and has made improvements in this area such as to the EOC, command and control structure (Ontario IMS), near boundary radiation monitoring system, Potassium Iodide (KI) distribution, sirens within the primary zone, portable emergency mitigation equipment (water, power), and conduct of major exercises. CNL also has conventional emergency preparedness and response programs.

The WiN Canada reviewer's conclusions are that fire, nuclear or conventional emergencies at CNL are potentially quite significant, but is reassured by the CNSC assessment that plans are satisfactory for the proposed extended operational period.

A recent WiN Canada survey [12] showed that women are particularly concerned about the potential effects of a nuclear accident on their families. One of the most significant social impacts of the Chernobyl accident was the increase in thyroid cancers amongst children. Women have been shown to be more concerned about nuclear emergencies [9], agreeing that "When things go wrong, they go very wrong". *The WiN Canada reviewer believes that the emergency management and fire protection program during the period of extended operation will provide reassurance for its female members working at CRL who have families living in the surrounding area. The WiN Canada reviewer observes that after NRU is shutdown, the need to provide KI pills will be gone, which will be reassuring for the public in general.*

7.11 Waste Management

The Waste Management SCA (Table 2) "covers internal waste-related programs that form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning". It is rated SA in the CMD 18-H2 (Table 2). The specific areas that are part of this SCA at CRL include:

- Waste Characterization
- Waste Minimization
- Waste Management Practices
- Decommissioning Plans

Applicable regulations are listed in Appendix B of CMD 18-H2:

- CSA N292.1, Wet storage of irradiated fuel and other radioactive materials
- CSA N292.2, Interim dry storage of irradiated fuel
- CSA N292.3, Management of low- and intermediate-level radioactive waste
- CSA N292.0, General principles for the management of radioactive waste and irradiated fuel
- CSA N292.5, Guideline for the exemption or clearance from regulatory control of materials that contain, or potentially contain, nuclear substances
- CSA N294, Decommissioning of facilities containing nuclear substances

- G-219, Decommissioning Planning for Licensed Activities
- G-320, Assessing the Long term Safety of Radioactive Waste Management

The WiN Canada reviewer notes that there are significant amounts of hazardous waste stored at the CRL site, especially NRX and NRU fuel rods. Additional waste will be produced during demolition of existing facilities. However, the WiN Canada reviewer supports the assessment that the Waste Management SCA will be adequately managed at CNL during the future licence period.

This conclusion is supported by information from the Application for Licence Renewal [3] which discusses the waste management program that provides oversight, compliance and services (waste processing and storage) for waste management to assure health, safety and security for future generations, including waste currently being generated, legacy waste (going back to 1940) and waste from off-site such as Whiteshell Nuclear Laboratories (WNL) and other CNL sites.

The issue of legacy waste (NRX core, rods etc.) is of particular interest to the WiN Canada reviewer. Remediation projects are underway to manage and cleanup legacy waste and since 2011 CNL has drafted a waste strategy, forecasted future waste generation, developed interim storage and waste transportation strategies, and looked at waste minimization. All waste is sorted by material type. Any waste that is contaminated is being stored on an interim basis until the NSDF is functional.

As of July 2017, 35 structures have been removed, and the building 444 water tower has been demolished, the Heavy Water Upgrading plant and NRX Fuel storage bays have been decommissioned, and degrading structures such as NRX Ventilation Stack Duct, plutonium tower annexes, and upper wooden structures of various buildings have been demolished.

During the proposed licence period, additional facilities will be decommissioned, further reducing or eliminating hazards and liabilities at the CRL site. Decommissioning and environmental restoration will provide sites for new facilities.

Future plans in areas covered by the waste management SCA at CRL include construction of the Near Surface Disposal Facility (NSDF), remediation of Waste Management Areas (WMAs), decommissioning of redundant NRX and NRU buildings, and cleaning and placing NRU in a storage-with-surveillance state.

The Application for Licence Renewal [3] also says that nuclear legacy liabilities are being dealt with, such as decommissioning the Pool Test Reactor and decommissioning the plutonium tower. Stored liquid wastes have been removed, treated, and disposed of from the NRX rod bay complex buildings. Bay water has been treated at the Waste Treatment Center.

The information in CMD 18-H2 also supports the WiN Canada reviewer's observations that the Waste Management SCA involves important issues but is being satisfactorily managed. The CNSC rating for the Waste Management SCA has been satisfactory over the current licence period. CMD 18-H2 looks at past performance, proposed improvements and CNSC regulatory focus. Past work includes segregation and characterization of waste to support minimization, and improved waste management practices including:

- retrieving radioactive liquids from Active Liquid Waste Tanks,
- a permeable reactive barrier to treat the Sr-90 plume from WMA,
- inspection of tile holes at WMA B,
- processing radioactive PCB waste,
- transferring old storage containers from WMA B to Fuel Packaging and Storage Facility,

- treating Sr-90 contaminated water,
- processing compactable waste,
- an engineered cover at WMA C,
- recycling steel at WMA D,
- radiological survey at WMA E,
- Shielded Modular Above Ground Storage (SMAG) storage buildings.

CMD 18-H2 states that “CNSC are satisfied that CNL is effective in their waste management practices”.

With respect to decommissioning and demolition plans, according to the Application for Licence Renewal [3] buildings are first decontaminated in order to allow for general demolition. Waste from decommissioning will be stored on site until a permanent facility is available. Contaminated lands and groundwater, where contamination will have decayed or attenuated to meet the end-state criteria within 300 years, will be managed in-situ, otherwise retrieved and put into disposal facilities (NSDF).

The WiN Canada reviewer’s conclusions are that waste management is an issue of great importance to WiN members and women in general, but that CNL appears to have adequate plans for waste management during the proposed extended operating period, and plans for future removal of high level waste.

7.12 Security

The Security SCA (Table 2) “covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity”. It is rated SA in the CMD 18-H2 (Table 2). The specific areas that make up this SCA at CRL include:

- Facilities and Equipment
- Response Arrangements
- Security Practices
- Drills and Exercises

Appropriate regulations are listed in Appendix B of CMD 18-H2:

- RD-321, Criteria for Physical Protection Systems and Devices at High-Security Sites (document contains prescribed information)
- RD-361, Criteria for Explosive Substance Detection, X-ray Imaging, and Metal Detection Devices at High-Security Sites (document contains prescribed information)
- REGDOC-2.12.1, High-Security Sites: Nuclear Response Force (document contains prescribed information)
- REGDOC-2.12.2, Site Access Security Clearance
- REGDOC-2.12.3, Security of Nuclear Substances: Sealed Sources
- G-208, Transportation Security Plans for Category I, II or III Nuclear Material
- G-274, Security Programs for Category I or II Nuclear Material or Certain Nuclear Facilities
- N290.7, Cyber-security for nuclear power plants and small reactor facilities

The WiN Canada reviewer’s observations based on the review of CMD 18-H2 [3] are that security at CRL is extremely important given the current international climate. However, it appears that CNL is making suitable enhancements to physical and cyber security for the proposed extended operating period.

Information in the Application for Licence Renewal [3] supports the WiN Canada reviewer's observation as it discusses physical security, including the nuclear response force, past performance and status of regulatory enforcement actions. The Nuclear Security Force (NSF) meets the requirements of Nuclear Security regulations SOR/2000-209 and CNSC REGDOC-2.12.1. Improvement opportunities have been identified from CNSC inspections, performance testing, self-assessments and peer reviews. Fitness for duty includes assessing physical, medical and psychological fitness. An important component is regular drills and exercises including force-on-force.

According to the Application for Licence Renewal [3], the physical security program has been found by the CNSC to be satisfactory in the past, and improvements have been made since 2011 such as access control measures, systematic training and physical security system upgrades. Additional improvements are planned.

There is a cyber security program based on NIST SP 800-53 and CSA N290.7-14 that covers all cyber assets owned and operated by CNL. Assessments in the past have led to upgrades and development of a Cyber Security handbook.

CMD 18-H2 also contains information to support the WiN Canada reviewer's observations of the Security SCA at CNL. According to CMD 18-H2, the Security SCA has been assessed in the past as satisfactory. The security program at CNL has been found to meet Nuclear Security Regulations, licence and Licence Conditions Handbook (LCH). There have been security related reportable events since 2012 but they were either addressed by corrective action or were minor events (such as equipment deficiencies). Improvements since 2012 include new X-ray screening equipment, full body detectors at access control, and new vehicle barriers. ZED-2 reactor security has been upgraded. CNSC had findings during security inspections and exercises with respect to Site Access Security Clearance which have been satisfactorily addressed by CNL, according to CMD 18-H2.

CNL has identified 'cyber essential assets' and developed a cyber security program which includes the business network and controlled area computing.

As per Nuclear Security Regulations, CNL has a Nuclear Response Force (NRF). CNSC found issues related to equipment and training documentation which have been addressed to their satisfaction.

Improvements planned include: enhancing security structures, upgrading security lighting and monitoring, continued force-on-force exercises, obtaining new security screening equipment, and new protective barriers.

7.13 Safeguards and Non-Proliferation

The Safeguards and Non-Proliferation SCA (Table 2) "covers the programs and activities required for the successful implementation of the obligations arising from the Government of Canada and the IAEA safeguards agreements as well as other measures arising from the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and bilateral Nuclear Cooperation Agreements". It is rated SA in the CMD 18-H2 (Table 2). The specific areas that are included in this SCA at CRL are:

- Nuclear Material Accountancy and Control
- Access and Assistance to the IAEA
- Operational and Design Information
- Safeguards Equipment, Containment and Surveillance

Applicable regulations are listed in Appendix B of CMD 18-H2:

- RD-336, Accounting and Reporting of Nuclear Material
- GD-336, Guidance for Accounting and Reporting of Nuclear Materials
- REGDOC-2.13.2, Import and Export

The WiN Canada reviewer believes that the Safeguards and Non-Proliferation SCA will be adequately managed, during the proposed licence period. HEU repatriation will minimize the number of physical locations of this material.

Information in the Application for Licence Renewal [3] contains information to support this conclusion. It discusses the Nuclear Materials and Safeguards Management Program (NM&SM) in terms of past performance, status of regulatory actions, and future plans. The NM&SM program covers procurement, receipt, disposition, transfer, accounting, safeguards management, and storage and inventory management of nuclear material. CNL maintains an up to date inventory and location records for all fissionable material on the CRL site meeting requirements of RD-336. Reports are submitted to the CNSC through a Nuclear Materials Accountancy Reporting portal. IAEA inspectors ensure CNL meets international obligations, including safeguards seals, IAEA safeguards monitoring equipment and technical visits.

The Application for Licence Renewal [3] says that in future there will be improvements to International Atomic Energy Agency (IAEA) activities and equipment at CNL. There will be repatriation of some material and additional material from the closure of WNL, Douglas Point (DP) and Gentilly-1 (G-1) waste facilities. The inventory management system will be improved, heavy water inventory management software will be upgraded, and CNL will implement IAEA safeguards changes.

Information in CMD 18-H2 also supports the WiN Canada reviewer's conclusion. To comply with the non-proliferation program (NPT), CNL tracks and reports on nuclear material. In the past CNL has submitted material accounting reports to the CNSC as required, but improvements to accuracy are being pursued. The IAEA inspects, verifies nuclear material transfers (e.g. HEU), and performs equipment maintenance (e.g. remotely monitored equipment in the Target Residue Material processing facility and Fuel Package and Storage Facility), cameras in NRU reactor hall and NRU rod bays). Improvements to nuclear material accounting will be made during the proposed licencing period.

As WiN Global is committed to the further development and peaceful use of nuclear science technologies and has an interest in non-proliferation and nuclear security, the WiN Canada reviewer observes that the measures taken by CNL in the period of continued operation are important to WiN and its members. It appears to the WiN Canada reviewer that CNL seems to be doing the right things.

7.14 Packaging and Transport

The Packaging and Transport SCA (Table 2) "covers programs for the safe packaging and transport of nuclear substances to and from the licensed facility", including:

- Packaging and Transport
- Package Design and Maintenance
- Registration for Use

It is rated SA in the CMD 18-H2 (Table 2). Appropriate regulations are listed in Appendix B of CMD 18-H2:

- RD-364, Joint Canada-United States Guide for Approval of Type B(U) and Fissile Material Transportation Packages
- REGDOC-2.14.1, Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substances Regulations, 2015

The WiN Canada reviewer believes that the Packaging and Transport SCA will be adequately managed during the proposed licence period.

This conclusion is supported by information provided in the Application for Licence Renewal [3]. This document discusses the Transportation of Dangerous Goods (TDG) program which covers the packaging and transportation of dangerous goods to or from any of the CNL sites, by all personnel and all modes of transport.

The program will be updated in future to conform to new IAEA standards and Transport Canada regulations. With future plans for decommissioning of facilities there will be an increase in TDG shipments due to HEU repatriation and acceptance of waste from WNL and other CNL sites, which is of concern to the WiN Canada reviewer.

The issue of packaging and transporting of Highly Enriched Uranium (HEU) during repatriation is of concern to the WiN Canada reviewer as this is inherently dangerous material that may be a target for terrorists.

According to CMD 18-H2, the Packaging and Transport SCA was rated satisfactory by the CNSC over the current licence period. The program covers package design, maintenance and registration. CNSC inspections show compliance with regulations. The process for repatriating waste containing HEU to the US, meets safety and regulatory requirements.

WiN Canada reviewer conclusions based on the review of CMD 18-H2 [3] are that safety of dangerous goods during packaging and transport will continue to be maintained in the proposed licence period.

8 Other

Other matters of regulatory concern included in the Application for Licence Renewal [3] are:

- Aboriginal Consultation
- Other Consultation
- Cost Recovery
- Financial Guarantees
- Public Information Program
- Nuclear Liability Insurance
- Fisheries Act Authorization
- Delegation of Authority

The WiN Canada reviewer suggests that the areas of Consultation and Public Information Programs could be enhanced by including more consultations and information sessions on CNL amongst WiN chapters.

One of WiN's objectives is to provide information on the nuclear industry and communicate it with the public. WiN Canada appreciates the opportunity to provide input to this CNL licence renewal process, and would seek an opportunity to share information on CNL with its members.

Socio Economic Considerations is another matter related to the Application for Licence Renewal [3] that is important to WiN Canada. WiN seeks to promote career interest in nuclear engineering, science, technology, the trades and other nuclear-related professions, especially among women and young people. Increased participation of women in Science, Technology, Engineering and Mathematics (STEM) is a national goal that will allow Canada to utilize more of its human potential to be more competitive internationally. Continued operation of CRL site can provide meaningful job opportunities for women in STEM.

9 DISCUSSION

To determine what areas related to the continued operation of CNL might be of particular concern to women, the results of the National Public Opinion Research 2015 Nuclear Attitudes survey [9] were reviewed. There were 1240 respondents to the 2015 survey, 49% male and 51% female. Some general results that are considered relevant to this review are that:

- The more people feel they know about nuclear as a means of generating electricity, the more likely they are to support it.
- While almost all currently have an opinion on whether or not they support nuclear, additional probing reveals that 68% would like more information before they finally make up their mind.
- The extent to which Canadians understand radiation is directly related to their support for nuclear and younger Canadians have a better grasp on radiation than older Canadians.

Respondents were asked to agree or disagree with statements related to health and safety:

- I am reluctant to take a chance on nuclear energy because when things go wrong, they go very wrong.
- It's wrong to generate 40 or 50 years of electricity for our generation and then leave nuclear waste for generations to come.
- I worry that we don't understand the health impacts of nuclear power plants on surrounding communities.

Four clusters were developed based on the responses [9]: anti-nuclear, health and safety skeptic, pro-nuclear, economic skeptic and ambivalent. The largest cluster was health and safety skeptics, which contained slightly more females.

The survey [9] asked about the ethics on Nuclear Waste: over three-quarters agree it's wrong to leave waste for the future. On "Fear of Disaster": close to three quarters are still reluctant to take a chance on nuclear.

Women respondents to the CNACNA survey were also shown to be most worried about known and unknown health impacts. This is shown also in the WiN survey as more uncertainty about whether there are issues related to women in the area of radiation protection.

Women in the survey [9] thought that they were less familiar with the concept of radiation: as only 15% rated themselves as Very Familiar women, compared to 31% of men.

10 CONCLUSIONS

This review of the Application for Licence Renewal [3] and CMD 18-H2 [4] concludes that:

- The Management System and Human Performance SCA initiatives planned at CRL will ensure that CNL will continue to maintain a strong safety culture for the women working at these facilities.
- Programs in the areas of operating performance, safety analysis, physical design, and fitness-for-service appear to be adequately managed, and do not have aspects of particular relevance for females. The shutdown of NRU will remove some hazards of the current site as NRU is now over 60 years old and is an aging facility.
- There are some areas of concern that remain around conventional health and safety and radiation protection programs (due to major site changes), environmental protection due to legacy contamination, and packaging and transport due to repatriating HEU. CNL appears to be taking the appropriate steps to mitigate these concerns.

Conventional emergency management and fire protection programs should ensure that there are no additional safety risks to women during the proposed extended period of operation.

Continued operation at CNL raises issues of particular importance to women including safe long term management of nuclear waste and environmental remediation of the CNL site.

There are opportunities for continued skilled employment of women working in the field of nuclear science and technology, and Human Performance management programs in future should address this.

WiN Canada supports the Application for Licence Renewal [3] for the CNL in that most SCAs appear to be satisfactorily addressed for the Licence extension period.

11 RECOMMENDED FOLLOW-UP

Continuing dialogue with the public could be enhanced through WiN arranging a session on CNL at WiN chapter meetings, the annual conference and also by providing knowledgeable speakers on this subject to women's groups and to various environmental groups.

12 REFERENCES

1. CNSC Participant Funding Program; <http://nuclearsafety.gc.ca/eng/the-commission/participant-funding-program/pfp-.cfm>, link accessed January 12, 2017
2. Participant Funding Program Agreement with WiN Canada PFP 2017 CRL-01
3. E-DOCS-#-5390079-CMD 18-H2.1 - Submission from CNL on Application for Licence Renewal for Chalk River Laboratories
4. E-DOCS-#-5373261-CMD 18-H2 - Submission from CNSC Staff for CRL Licence Renewal January 2018
5. WiN Global <http://www.win-global.org/>
6. WiN Canada <http://www.wincanada.org/>
7. CNSC Mandate <http://nuclearsafety.gc.ca/eng/about-us/our-mission.cfm>.
8. SCAs <http://nuclearsafety.gc.ca/eng/resources/publications/reports/powerindustry/safety-and-control-areas.cfm>
9. Innovative Research Group, National Public Opinion Research: 2015 Nuclear Attitudes Survey

10. <http://nuclearsafety.gc.ca/eng/resources/publications/reports/powerindustry/safety-and-control-areas.cfm>
11. [WiN Canada survey regarding PWF License Renewal, 2017](#)

APPENDIX A CURRICULUM VITAE FOR P.C. WATSON

Pauline C. Watson, B. Sc., M.A.Sc., M. Eng., P. Eng.

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In 2013 I completed an M. Eng. in Engineering and Public Policy from the School of Engineering Practice at McMaster University, and incorporated a business to provide Engineering and Sustainable Policy consulting. This complements my career as a professional engineer with over 37 years of experience providing engineering services and business support to Ontario's electricity generating stations including 9 years with a consulting engineering company and 22 years at Ontario Power Generation (OPG).

PCWatson Engineering & Sustainable Policy Inc., President August 2013- present

Plenary chair for the Canadian Nuclear Society (CNS) Nuclear Waste Management, Decommissioning, and Environmental Restoration Conference, Ottawa, September 2016 (www.nwmdr.org)

Prepared a technical review, on behalf of Women in Nuclear (WiN), of the Canadian Nuclear Safety Commission (CNSC) Member Document (CMD: 16-H2) for CNL License Renewal, February 2016.

Prepared a technical review, on behalf of Women in Nuclear (WiN), of the Canadian Nuclear Safety Commission (CNSC) Member Document (CMD: 17-H5) for PWMF License Renewal, March 2017.

Conducted Benefit Cost Assessments for nuclear plant refurbishment projects.

Member of QUEST (Quality Urban Energy Systems of Tomorrow) Ontario

Member of Technical Committee for the Climate Change Technology Conference (CCTC 2015), sponsored by Engineers Canada.

Trained as a Climate Reality Leader in 2015 with the Climate Reality Project with former Vice President of the United States Al Gore.

Volunteered unsolicited policy and program input to various government departments including:

- Input comments to the Ontario Environmental Registry on the Long Term Energy Plan (LTEP),
- Input to town planning departments on sustainable neighborhood design,
- Input on energy conservation programs based on a study in an inner city neighborhood on electricity conservation behavior,
- Input on energy labeling and energy efficiency standards,
- Input on Community Energy Programs, and
- Input comments on planning and siting of large energy infrastructure.

Professional Affiliations

- Licensed with Professional Engineers Ontario (PEO) since 1978.
- Member of council of the Canadian Nuclear Society, 2015-present (extended council as of 2017)
- Women in Nuclear Canada – Board of Directors, member at large, 2013-2017.
- Ontario Society of Professional Engineers (OSPE) – member of Women in Engineering Advisory Committee (WEAC)
- Women in Nuclear – Golden Horseshoe West branch –Chair 2011-2013.

Education

M. Eng. (Engineering and Public Policy), McMaster University, Hamilton, Ontario, Canada, Graduated fall 2013

- Final Inquiry: "Policies for Driving Reduced Greenhouse Gas Emissions Behavior in Individuals".
- Courses included: Theory and Practice of Policy Analysis; Systems Engineering and Public Policy; Energy and Public Policy; Emerging Issues in Technology and Public Policy; Environmental Economics; Green Engineering, Sustainability and Public Policy; Design of Sustainable Community Infrastructure; Development of Sustainable Local Communities

Doctoral Candidate, Engineering Physics Department, McMaster University, Hamilton, Ontario, Canada, part-time 1989-1997, did not graduate but withdrew in good standing, thesis not completed

- Thesis: Monitoring and Assessing Thermal Fatigue in CANDU Pressure Boundary Components (not completed).
- Courses completed include: CANDU Heat Transport System Design, Flow Induced Vibration, Elasticity Theory, Analytical Electron Microscopy, Reactor Thermohydraulics
- Successfully passed Comprehensive Examination – Part I and Part II

M.A.Sc. (Mechanical Engineering) (part-time) University of Waterloo, Waterloo, Ontario, Canada, Graduated spring 1981

- Thesis: "Finite Difference Solution to Navier-Stokes Equations".
- Specialized in structural mechanics and numerical methods.
- Courses completed include: Introduction to Finite Element Methods, Reliability of Mechanical Systems, Welding Processes, Fatigue and Fracture Analysis, Topics in Pressure Vessel Design, Fluid Mechanics Design Topics

B.Sc. (Mechanical Engineering) with distinction, University of Alberta, Edmonton, Alberta, Canada, Graduated spring 1976

Graduate courses completed: Aerodynamics, Analytical Dynamics, Turbulent Fluid Dynamics

Additional Selected Training

'Two-Phase Flow and Heat Transfer in the Power and Process Industries', Waterloo Centre for Process Development, University of Waterloo 1981; 'Technical Report Writing', Edutran Services 1985; 'Project Management'; Access; Excel, ISO 9001

Publications and Presentations

- Watson, P., 'How Nuclear Energy is Important in Reducing Climate Change', Win Canada Conference 2014, Saint John, New Brunswick
- Watson, P.C., Dam, R., Nickerson, J., Using the System maintenance Data store to Characterize Lifetime Maintenance for PLiM, 25th Annual CNS Conference, June 2004, Toronto
- Dam, R., Watson, P., Yang, X.J., Nickerson J.H., 'Using Systematic Aging Assessments to Improve Effectiveness of Plant Maintenance Programs', 25th Annual CNS Conference, June 2004, Toronto
- Ontario Hydro Nuclear Plant Life Management Activities, presentation to the sixth meeting of the NEA Expert Group on NPP Life Management, Paris, France April 1997
- Watson, P., Maruska C, Andreeff T, 'CANDU Nuclear Plant Life Assurance Program for Pickering NGS A', PLEX 93, Zurich, Switzerland, November 1993
- Chang Y.F. and Watson P.C., 'Reflux Mode Cooling of Fuel at Decay Power Levels in CANDU Nuclear Generating Stations – Applications and Supporting Experiments', 39th Canadian Chemical Engineering Conference, Hamilton, Ontario, October 1989
- Chang Y.F., Watson P.C., Langan M.D., Sermer P., 'Bruce Nuclear Generating Station B Rapid Cooldown Test and Validation of Simulation Model', Nuclear Technology, Vol 70, September 1985

Employment History

AMEC NSS Ltd., Technical Expert ,Engineering and Life Cycle Management, Engineering Directorate, Toronto, Ontario, September 2004 – August 2013 (now AMEC Foster Wheeler)

Ageing Management

- Technical lead for component Condition Assessments in support of nuclear plant refurbishment.
- Project manager and technical lead for the preparation of life cycle management plans and ageing management studies for major components.

Business Case Assessments

- Technical lead for Business Case Assessments in support of nuclear plant refurbishment.
- Prepared information supporting the new International Financial Reporting System (IFRS).
- Developed a prototype Risk Informed Asset Management model that was used in business case evaluations of proposed plant operational strategies.
- Dealt with regulators in the station response to the Canadian Nuclear Safety Commission (CNSC) on ageing management programs, prepared presentations, and provided support at meetings.

Quality Assurance

- Conducted internal ISO 9001 audits.

Atomic Energy of Canada Ltd (AECL), Senior Engineer, Plant Life Management, Sheridan Park Mississauga, Ontario, August 2002 –September 2004

- Developed methodologies for the aging management program for the Life Extension project for the NRU reactor in Chalk River.
- Performed business case evaluations to integrate technical alternatives.
- Prepared level 1 project execution plans (Microsoft Project).
- Prepared work proposals and product development plans.
- Wrote papers on plant life management for conference presentations.

Ontario Power Generation (OPG), Senior Engineer, Operational Business Planning Department Toronto, Ontario, December 1993 – August 2002 (OPG was created from Ontario Hydro)

Business Planning

- Defined the process and managed the development of Access database for project management.
- Used structured analysis techniques to evaluate processes such as an engineering work management system and make business process improvements.
- Developed economic models (Excel) for the analysis of alternative operating scenarios to maximize facility value and enhance strategic planning; the models included evaluation of future fuel costs, electricity price, and maintenance expenditures.
- Interacted with engineering and financial staff at the nuclear plant sites.
- Prepared Nuclear Business Plans and reports for senior executives.

Nuclear Plant Life Management

- Member of the Nuclear Energy Agency expert groups on Nuclear Plant Life Management and Nuclear Plant Refurbishment; attended meetings and presented papers on Ontario Hydro's Life Cycle Management Activities.

- Member of the Electric Power Research Institute (E.P.R.I.) Nuclear Asset Management working group; presented papers at E.P.R.I. workshops.

Ontario Hydro, Technical Supervisor, Toronto, Ontario, May 1980 – December 1993

Ageing Management

- Performed ageing assessments of major plant mechanical components.
- Presented papers on life cycle management at several conferences (e.g. PLiM/PLEX Berlin 1991).
- Represented Canada on the expert group in Nuclear Plant Life Management for the Nuclear Energy Agency, Organization for Economic Cooperation and Development (OECD).

Fuel & Physics

- Used software models to perform thermohydraulic simulations.
- Provided technical coordination for laboratory research projects.
- Developed station commissioning test procedures.

Human Resource Policies

- Served a term as an executive on the professional collective bargaining unit (Society).
- Served 8 years as a Society delegate.

Atomic Energy of Canada Limited, Design Engineer, Mississauga, Ontario, May 1976- May 1980

- Wrote and modified Assembler language programs for Bruce NGS station control computers.
- Worked on the design of various process systems.
- Modified and documented thermohydraulic software.

Interests and Volunteer Activities

- Board of Directors of Citizens for Clean Air (C4CA) 2009-present
- Director of Joshua Creek Residents Association (JCRA) 2010-2013.
- Represented JCRA on the Suncor Public Liaison Committee 2012-2013
- Active in distance running and triathlons (including coaching), and have organized road races, managed relay teams (Jasper-Banff), and held volunteer administrative positions with running clubs and the Ontario Track and Field Association (1980s).