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Nuclear Waste Management Organization

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The NWMO Pioneers New Design in Used Fuel Containers

The NWMO recently built its first container designed specifically for the used CANDU fuel produced by Canadian nuclear power reactors. The used fuel container is one of the principal engineered barriers in a multi-barrier deep geological repository. The completion of a full-sized engineered barrier system marks a major step forward in demonstrating that used fuel can be safely and securely contained and isolated over the long term.

"When we began working on our container design, we started from basic principles and took advantage of the latest in current manufacturing

technologies," explains Chris Hatton, the NWMO's Director of Nuclear Design and Transportation. "The NWMO's copper-coating program has attracted a lot of interest from other countries that are developing their own used nuclear fuel containers, and it's a really great feeling to know that Canada is a world-leader in this technology."

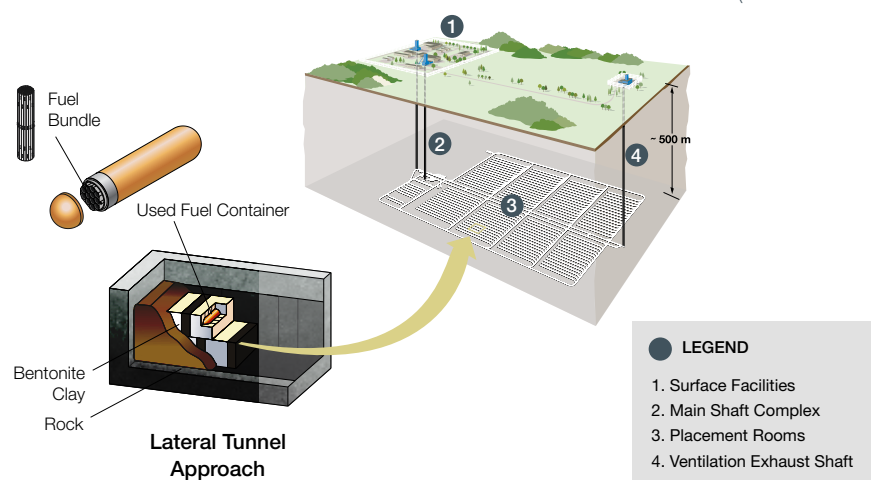
The NWMO's container, in conjunction with the buffer system, will keep used nuclear fuel completely isolated from its surroundings until its radioactivity has decreased to the same levels as natural uranium. It is designed to withstand

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Selecting a Site for the Long-Term Management of Canada's Used Nuclear Fuel

In May 2010, the NWMO launched a nine-step, community-driven process to identify a site where Canada's used nuclear fuel can be safely contained and isolated in a deep geological repository. Confirming a safe site with an informed and willing host will take several years of progressively more detailed technical, environmental, social, economic and cultural studies. The project will only proceed with the interested community, First Nation and Métis communities in the area, and surrounding municipalities working together to implement it.

At present, land within the vicinity of Blind River, Elliot Lake, Hornepayne, Ignace, Manitouwadge and White River is being studied as part of the site selection process. As well, land within the municipalities of Central Huron, Huron-Kinloss and South Bruce is a focus of work.



An engineered barrier system is the primary protection for the used nuclear fuel that is contained and isolated in a deep geological repository. It consists of the used fuel container, buffer box, sealing materials and emplacement system.

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mechanical and hydraulic pressures up to 45 megapascals (MPa), which includes the load from multiple glaciers with up to three kilometres of ice, hydrostatic loads at a 500 metre depth, and swelling pressure of the bentonite clay buffer surrounding the container.

Used fuel containers commonly use steel for strength and copper for corrosion resistance. In the NWMO's design, corrosion-resistant copper is directly applied to the steel inner vessel. This innovation eliminates the gap between the copper and steel, thus avoiding the problems of copper creep (gradual deformation of the copper) while also providing a much safer design.

Because the coating is a continuous layer, there is no need to weld the copper. This approach avoids the metallurgical difficulties associated with copper welds.

The container's spherical heads take advantage of this shape's natural ability to withstand the high loads that might bear down on the container.

Another feature of the NWMO's container is its comparatively small size (approximately 2.5 by 0.6 metres). The result is a container whose size and weight make it easier to emplace in a deep geological repository. The smaller size of the container means that readily available materials can be used in its manufacture.

As well, manufacturing of this smaller container can be performed entirely in Canadian manufacturing facilities, generating new jobs in the regions where they are eventually located.

The new container is one element in the engineered barrier system design the NWMO completed in 2014.

The next step is to implement a proof test plan to prove the engineered barrier system's safety performance. In the case of the used fuel container, this includes tests of its ability to withstand repository loads and resist corrosion throughout the life of the repository.

"Overall, the approach that [the NWMO] developed for canister design is an elegant solution to a challenging problem which has attracted a lot of international interest."

—Lawrence Johnson, RD&D Coordinator,
National Cooperative for the Disposal
of Radioactive Waste (Switzerland)

"The beauty of [the NWMO's] innovative design is in the realization that the unique structure of the CANDU fuel bundle allows one to take advantage of available proven technology and avoids the need for specialized fabrication facilities, and adds the advantage that the container can meet key ASME code requirements."

—Professor David Shoesmith, Department
of Chemistry, Western University



The NWMO's Chris Hatton Receives Innovation Achievement Award from the Canadian Nuclear Society

Chris Hatton, the NWMO's Director of Nuclear Design and Transportation, has received the Canadian Nuclear Society's Innovative Achievement Award for his leading-edge work in developing an engineered barrier system for safely containing and isolating used CANDU fuel over the long term.

The award was presented by the Canadian Nuclear Society at its annual conference in June.

In making the award, the Honours and Awards Committee cited two major innovations in the engineered barrier system designed by Mr. Hatton.

The first is the direct application of copper onto the steel container, a process pioneered by the NWMO and Canadian research centres.

The second innovation is pre-packaging the used fuel container and buffer into a buffer box. This approach ensures high quality control of buffer density, and also simplifies handling operations in a repository.

The NWMO Co-Sponsors a New Industrial Research Chair at Western University



Dr. Clara Wren (fourth from right, front) with her lab group at Western University.

Dr. J. Clara Wren, a Professor in Western University's Department of Chemistry, has been awarded a senior Industrial Research Chair (IRC) in Radiation-Induced Corrosion. Her work will be jointly funded by the NWMO, the Natural Sciences and Engineering Research Council of Canada (NSERC), and the University Network of Excellence in Nuclear Engineering.

Dr. Wren's work will focus on the effect of radiation on the weld used to close used fuel containers. By minimizing the amount of time containers are open before being welded shut, her work can be used to improve efficiency in the used fuel packaging plant where the NWMO will receive and repackage used nuclear fuel into long-lived corrosion-resistant containers.

"The NWMO is committed to continuously improving technical knowledge," explains Dr. Peter Keech, the NWMO's Senior Corrosion and Coatings Scientist/Engineer. "By drawing on the expertise of leading researchers in the field, we're helping to ensure our work is scientifically rigorous."

We're very excited about Professor Wren's work because it can be applied to our operations in a used fuel packaging plant. The plant is designed to handle containers in the safest manner possible, and this project will make a major contribution toward achieving that goal."

Professor Wren's IRC, which is renewable, will be for five years. It will help fund related research conducted by graduate students, research associates and postdoctoral fellows.

"The work to be funded under the IRC program is a natural extension of the previous work our lab has done with the NWMO on radiolysis-induced corrosion," says Dr. Wren. "It takes us into even more complex and interesting environments. It is frontier research in corrosion and radiation chemistry areas. The IRC research addresses not only practical issues that are pertinent to the NWMO and the nuclear power industry, but also is expected to provide new insights and advance our knowledge of corrosion processes."

Professor David Shoesmith, of Western University's Electrochemistry and Corrosion Studies program, also holds an NSERC/NWMO IRC.

The NWMO Co-Sponsors International Conference About Using Clays in Deep Geological Repositories



In March, the NWMO joined with the nuclear waste management organizations of Belgium, Sweden, France, the Netherlands, Switzerland and Finland to sponsor the sixth international conference of Clays in Natural and Engineered Barriers for Radioactive Waste Confinement. The four-day conference was held in Brussels, and was attended by nearly 500 people.

Nuclear waste management organizations are interested in clays because they have characteristics that make them high-quality barriers to the migration of radionuclides and chemical contaminants.

Clays have several possible uses in deep geological repositories. They can be used within the excavated repository openings as buffers. They can also be used as backfills to protect and enclose the used nuclear fuel container, acting as effective natural barriers that can survive over millions of years.

“As natural barriers, clays have been shown to be very stable over long periods of time,” says Mark Jensen, the NWMO’s Director of Deep Geological Repository Geoscience and Research. “Many of the clay bedrock formations you see today in North America were formed hundreds of millions of years ago.”

“The low permeability of clay materials can provide a significant barrier to radionuclide mobility,” said Mr. Jensen.

NWMO Staff and Graduate Students Make Presentations at the 2015 Clay Conference

NWMO staff and graduate students were among the presenters at the sixth international conference of Clays in Natural and Engineered Barriers for Radioactive Waste Confinement.

In the opening session, the NWMO’s Mark Jensen provided an overview of nuclear waste management advances in Canada. He also co-chaired a session about large-scale heater tests in underground research laboratories. (Heater tests are used to test a rock surface’s ability to withstand the range of temperatures likely to occur in a deep geological repository).

As well, two graduate students supported by the NWMO presented the results of their research.

Magda Celejewski, a PhD student in the Department of Earth Sciences at the University of New Brunswick, presented a paper on a new way to extract and measure porewater chemistry in sedimentary rocks that contain only trace amounts of porewater.

Cornelia Wigger, a PhD student at Switzerland’s Paul Scherrer Institute, presented a poster on clay rocks’



Magda Celejewski, a PhD student whose research is funded by the NWMO, discusses the challenges of extracting and measuring porewater in low-permeability rocks.

potential to reduce the diffusion of radionuclides. Her work is jointly funded by the NWMO and the Paul Scherrer Institute, with additional support from the University of Bern, the University of New Brunswick, and

Nagra (Switzerland’s radioactive waste management organization).

For more information about the presentations, please visit the conference’s website at: www.ClayConferenceBrussels2015.com.

The NWMO's Advisory Council Welcomes Three New Members

The NWMO recently announced the appointment of three new members to its Advisory Council: Linda Thompson, Diane Kelly, and Dr. Dean Jacobs.

The NWMO Board of Directors established the Advisory Council in 2002, as mandated by the *Nuclear Fuel Waste Act (NFWA)*. The Council meets regularly with NWMO senior management, closely follows the development of the organization's plans and activities, and provides ongoing counsel and advice. Appointments to the Council are guided by the type of work the NWMO will be engaged in over the next four years, the expertise that work will require, and the specific provisions of the *NFWA*.

"Each of the new members brings a wealth of experience and knowledge directly relevant to the sorts of work we will be engaged in as the site selection process moves forward," said Ken Nash, the NWMO's President and CEO.

Linda Thompson has extensive experience in nuclear community relations

and public affairs, government relations, and is the former mayor of Port Hope.

Diane Kelly is a lawyer and former Grand Chief of Grand Council Treaty 3. She has extensive knowledge in traditional law, Indigenous Traditional Knowledge, and perspectives from Northwestern Ontario.

Dr. Dean Jacobs is a former Chief of the Walpole Island First Nation and founding director of the Walpole Island Heritage Centre. He has more than 40 years of experience in public service.

The Honourable David Crombie has agreed to continue as the Advisory Council Chair, while David Cameron has accepted the newly-created position of Vice-Chair. The NWMO looks forward to the continuing contributions of members Eva Ligeti, Derek Lister, Dougal McCreath and Donald Obonsawin.

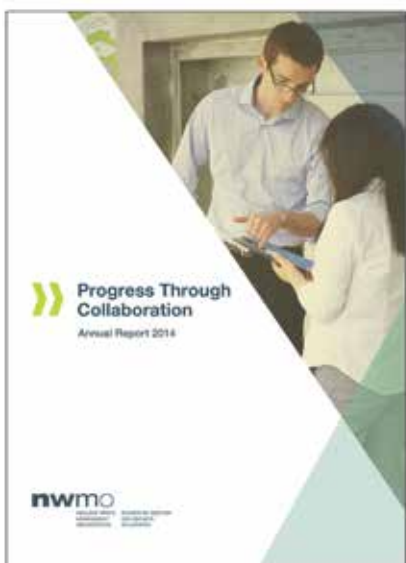
The NWMO gratefully acknowledges the important contributions of the members of the Advisory Council who have now completed their terms: Marlyn Cook, Wesley Cragg, Fred Gilbert and Michel Rhéaume.

The NWMO's Advisory Council

The NWMO's Advisory Council is made up of individuals knowledgeable in nuclear waste management issues, and experienced in working with citizens and communities on a range of public policy issues. The current members are:

- » David Crombie—Chair
- » David R. Cameron—Vice-Chair
- » Dean Jacobs
- » Diane Kelly
- » Eva Ligeti
- » Derek Lister
- » Dougal McCreath
- » Donald Obonsawin
- » Linda Thompson

For more about the Advisory Council, please go to: www.nwmo.ca/advisory.



The NWMO Publishes its Annual Report for 2014 and its Implementation Plan for 2015 to 2019

In March, the NWMO submitted its annual report for 2014 (*Progress Through Collaboration*) to the Honourable Greg Rickford, Minister of Natural Resources Canada. At the same time, it released its strategic plan for the next five years: *Implementing Adaptive Phased Management 2015 to 2019*.

Every year, the NWMO assesses its five-year implementation plan to strengthen and redirect it as appropriate in light of new information, advances in technology and science, evolving public policy, and comments we receive through our engagement initiatives. A draft of the newest plan was released for public comment in October 2014. The published plan has been revised to reflect the input received.

"The NWMO invites all Canadians and Aboriginal peoples of Canada to stay involved in the implementation of Adaptive Phased Management for Canada's used nuclear fuel," said Kathryn Shaver, Vice President of Adaptive Phased Management Engagement and Site Selection.

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The NWMO reports its progress to the Minister of Natural Resources Canada on an annual basis, as required by the *Nuclear Fuel Waste Act*. Its annual report is tabled by the Minister in both Houses of Parliament, and the Minister issues a statement on it.

The 2014 annual report is available online at: www.nwmo.ca/annualreport.

The Implementation Plan for 2015 to 2019 is available online at: www.nwmo.ca/implementationplan.



Check Out the NWMO's Newest Publications!

The NWMO recently updated its transportation brochure, Q&A booklet about transportation, and backgrounder about funding Canada's plan for the long-term management of used nuclear fuel. All three documents are meant to share information with people interested in Canada's plan.

The 2015 transportation brochure (*Safe and Secure Transportation of Canada's Used Nuclear Fuel*) provides updated information on a range of topics members of the public have raised about the future transportation of used nuclear fuel.

The Q&A booklet (*Safe and Secure Transportation of Canada's Used Nuclear Fuel: Questions and Answers*) provides answers to frequently asked questions about transportation-related topics.

The 2015 financial backgrounder (*Funding Canada's Plan for the Safe, Long-Term Management of Used Nuclear Fuel*) was released at the same time as the NWMO's most recent annual report. It is based on the NWMO's latest cost estimates and answers frequently asked questions about the cost of the project, funding for the NWMO's work, and the trust funds that will be used to finance the project.

All three documents are available online at: www.nwmo.ca.



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NUCLEAR WASTE
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ORGANIZATION

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