

**NWMO Response to the  
2008 Report of the Independent Technical Review Group**

**February 2009**

## **NWMO Response to the 2008 Report of the Independent Technical Review Group**

### **Summary**

The Board of Directors of the Nuclear Waste Management Organization (NWMO) established the Independent Technical Review Group (ITRG) to provide an independent review and assessment of the NWMO's technical research and development (R&D) program.

In September 2008, the ITRG held its inaugural meeting at the NWMO offices in Toronto and in November 2008, the ITRG presented its findings to the NWMO Board and Advisory Council.

The majority of the ITRG recommendations are related to the initiation of additional items of work in several program areas and the need to build up the level of NWMO staffing resources to implement Adaptive Phased Management. While the ITRG recognized the co-operative work of the NWMO with other national and international radioactive waste management organizations, it strongly recommended expanded in-house resources in core capability functions.

NWMO have reviewed and considered the recommendations of the 2008 ITRG report.

NWMO accepts the ITRG recommendations and has prepared a response and action plan which is outlined below. In all cases, work has been initiated or plans have been defined to initiate work to address these recommendations. In particular, NWMO will be assessing the staffing needs to support its expanding program as part of Business Planning and will report results by October 2009. As well, NWMO will continuously re-assess its target resources and adjust its action plan over time.

## Specific ITRG Recommendations and NWMO Response

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2.	Regarding the Independent Technical Review Group (ITRG) Terms of Reference, the ITRG recommends that “robust and credible safety cases” be replaced by “illustrative safety assessments” to reflect the current state of the implementation of the Adaptive Phased Management (APM) approach. In the absence of site-specific information it is possible only to show how a robust and credible safety case could be made in the future if a combination of suitable geological characteristics pertained at a candidate site.	<p><b>Recommendation accepted.</b></p> <p>NWMO will update the Independent Technical Review Group Terms of Reference (ToR) to refer to “illustrative safety assessments”.</p> <p><b>Due Date - Updated Terms of Reference:</b> February 2009.</p>
3.1 a)	The reasons for proposed items of work are not clear in all cases. The ITRG recommends that the issue to be addressed by each item of work should be explained clearly and welcomes the information provided at its meeting that NWMO proposes to develop a document that explains the Technical Programme in this way.	<p><b>Recommendation accepted.</b></p> <p>In all cases NWMO work scope sheets and contracts clearly define the purpose of work. The Annual Summary Technical Program document provides an update of the research activities but does not address the purpose of each item of work.</p> <p>To facilitate external communication and to provide clarity of the planned research activities, NWMO is preparing a comprehensive technical research, development and demonstration (RD&amp;D) program report by December 2010 that will document the status of the research and provide the rationale for conducting research in each area of study.</p> <p>The first draft of the RD&amp;D program report will be available for review by the ITRG in June 2009.</p> <p><b>Due Date - 1<sup>st</sup> Draft RD&amp;D Report:</b> June 2009.</p> <p><b>Due Date – Final RD&amp;D 2010 Report:</b> December 2010.</p>

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3.1 b)	<p>The ITRG recommends that NWMO should develop networking arrangements with the oil and mining industries in relation to its work on limestones and claystones in order to utilise the existing knowledge and experience of key characteristics of comparable rocks, for example concerning the effects of heat on such rock masses.</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO staff held an initial meeting with the Alberta Research Council in October 2008.</p> <p>In 2009, NWMO will hold further meetings and establish contacts with representatives from the oil and mining industry in Canada.</p> <p><b>Due Date – Establish Oil &amp; Mining Contacts:</b> April 2009.</p>
3.1 c)	<p>Greater clarity is required concerning the scientific and technical process for selecting the final depth of a repository. The depth assumed for costing purposes is entirely reasonable but it needs to be clearer that this is not a design proposal.</p>	<p><b>Recommendation accepted.</b></p> <p>Historically, NWMO has used the original AECL assumption of a planned repository depth from 500 m to 1,000 m below surface for the purpose of developing conceptual designs and illustrative safety assessments.</p> <p>In future external communication statements of repository depth, e.g., draft Project Description, the NWMO will be less definitive and will refer to the scientific and technical process for selecting the final depth of the repository.</p> <p><b>Due Date – External Communications on Repository Depth:</b> May 2009.</p>
3.2 c)	<p>It was difficult to evaluate the adequacy of work on transportation. Clearly there is a great deal of relevant experience from existing nuclear transportation in Canada and NWMO will need to assess what, if any, specific additional issues or challenges will require attention.</p>	<p><b>Recommendation accepted.</b></p> <p>Conceptual designs, transportation logistics and safety analyses have been prepared and documented for used fuel transportation via road, rail and water in Canada.</p> <p>Additional work will begin in 2009 on a review of the transportation modes, infrastructure, designs and logistics for transporting nuclear fuel from reactor storage sites to a hypothetical central facility in each of the four nuclear provinces.</p> <p><b>Due Date – Transportation Work Initiated:</b> June 2009.</p>

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3.2 d)	<p>The ITRG recommends that NWMO establishes a specific technology assessment capability in order to assess what technology options are available and what technological developments are required and on what timescale. Given the likelihood that disposal facility operation may be decades away, it is important to take maximum advantage of technological developments occurring elsewhere. It is thus recommended that options remain open, for example with respect to canister material selection and engineered barrier design, both to increase flexibility and to address the increasing emphasis that is being put on adequate consideration of alternatives (for example the requirement in some programmes for Best Available Technology).</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO technical program staff will be reviewing the status of technology and document the findings in its RD&amp;D program report as well as its future plans over the next 5 years. This is in addition to the NWMO's recent assessments of container material, container size, placement methods and sealing technologies that have occurred over the past few years.</p> <p>NWMO will continue to hire additional technical staff (see 3.7 (a)) in engineering, geoscience and safety assessment to support Adaptive Phased Management and will continue to actively monitor the developments in site characterization methods, repository technology and safety assessments in other national waste management organizations with similar concepts and geologies.</p> <p>NWMO will be assessing the staffing needs to support an expanding program as part of Business Planning and report results by October 2009.</p> <p>NWMO is keeping a number of repository options available (e.g., in-floor borehole concept for crystalline rock vs horizontal tunnel concept for sedimentary rock; copper used fuel containers vs steel used fuel containers; electron beam welding vs friction stir welding) and is preparing updated conceptual designs and illustrative safety assessments in the 2010 to 2011 timeframe.</p> <p><b>Due Date - 1<sup>st</sup> Draft RD&amp;D Report:</b> June 2009.</p> <p><b>Due Date – NWMO Staffing Needs:</b> October 2009.</p> <p><b>Due Date – Final RD&amp;D 2010 Report:</b> December 2010.</p>

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3.2 e)	<p>The ITRG recommends that NWMO should assess what options exist for rock support technologies in the geological formations of interest and what implications these have for the design and safety of the repository. This should be part of a systematic approach to developing design, for example using a requirements management approach as is being developed in a number of other programmes.</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO is developing a design for the rock support system for application in the L&amp;ILW DGR in sedimentary rock. The preliminary design for a L&amp;ILW repository, including rock support technology, will be updated by 2010.</p> <p>NWMO will also review rock support technologies as part of its 2010 update to the conceptual design of a deep geological repository for used fuel in crystalline rock and its 2011 update to the conceptual design of a deep geological repository for used fuel in sedimentary rock.</p> <p>The NWMO does maintain a set of System Requirements documents to support repository design. These will be provided to the ITRG for their 2009 review.</p> <p><b>Due Date – System Requirements:</b> June 2009.</p> <p><b>Due Date – Rock Support Work Completed:</b> December 2011.</p>

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3.2 g)	<p>Particularly given some of the unique characteristics of the deep shales and limestones comprising the sedimentary formations of Southern Ontario compared with those evaluated in other countries, NWMO needs to make a considerable effort to build up its understanding of such formations in relation to spent fuel disposal. This would build on the good understanding of the geological characteristics that has been obtained from the investigations in support of the siting of the ILW/LLW repository. Key areas identified by the ITRG were thermal effects, changes in pore pressures, the effects of gas pressurisation and the effects of very high salinity on the performance of engineered barrier systems. The latter is unique in the context of the sedimentary formations being considered world-wide for radioactive waste disposal, thus there will be little prospect of sharing experience with other organisations examining disposal in sedimentary rocks. In turn attention is required on how these phenomena will be integrated into the relevant safety assessments.</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO recognizes the need to improve its understanding of deep saline shales and limestones in the context of hosting a repository for used nuclear fuel. As noted, current site characterization, design and safety assessment studies for OPG's Deep Geologic Repository (DGR) for low and intermediate level waste (L&amp;ILW) at the Bruce nuclear site has led to much greater understanding of these rock types and this improved understanding will continue as this project advances.</p> <p>Program of work currently underway or in planning includes:</p> <ul style="list-style-type: none"> <li>- thermal properties of sedimentary rocks,</li> <li>- microbial analysis of sedimentary rocks,</li> <li>- review of effects of salinity on repository system processes,</li> <li>- development of reference saline groundwaters to guide experimental work,</li> <li>- development of reference thermo-chemical dataset and solubilities,</li> <li>- measurement of sorption under saline sedimentary rock conditions,</li> <li>- measurement of diffusive properties in sedimentary rock,</li> <li>- development of porewater extraction and characterization techniques in sedimentary rock,</li> <li>- assessment of effects of gas pressurization on sedimentary rocks, and</li> <li>- application of current THM models to repository in sedimentary rock.</li> </ul> <p><b>Due Date – All Program Elements Initiated:</b> June 2010.</p>
3.2 h)	<p>The ITRG sees considerable merit in the development of a database of features, events and processes that are specifically relevant to the sedimentary rocks that are found in Canada and commends the OECD-NEA FEPCAT as a general model</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO will initiate a systematic review the NEA FEP (features, events and processes) catalogue for argillaceous media and develop an NWMO FEP list that is specific to the Canadian program.</p> <p><b>Due Date – NEA FEP Review Completed:</b> December 2009.</p>

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3.2 i)	The ITRG noted an emphasis on external perturbations in the analysis of perturbed repository conditions, whereas internal perturbations, such as those given in (g), are potentially more important for sedimentary rocks.	<p>NWMO recognizes that internal perturbations for a repository in sedimentary rock may be important and has augmented its 2009 technical work program to address internal perturbations such as thermal effects, gas pressures and microbial impacts in sedimentary rock, as previously noted in response to 3.1 (g).</p> <p><b>Due Date – Work on Internal Perturbations Initiated:</b> December 2009.</p>
3.3 a)	<p>NWMO demonstrates a good knowledge base and understanding of what will be required to initiate site evaluation and characterisation. The experience from the work by OPG on the ILW/LLW Geological Repository is invaluable in this respect. However, the in-house resources are too small in number if a site came forward in the near future and further comment on this is made under 3.7.</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO is taking steps to expand the number of in-house staff to provide support to the NWMO's future siting activities.</p> <p>The considerable internal and external resources currently occupied by characterization of the Bruce nuclear site for OPG's L&amp;ILW DGR should be available for the NWMO's Adaptive Phased Management deep geological repository site characterization activities should Adaptive Phased Management siting proceed in a timely manner.</p> <p>The NWMO's review of staffing requirements to support siting will draw from the early siting experience in Finland and Sweden and will provide a revised staff level projection as part of the Business Planning process by October 2009.</p> <p><b>Due Date – NWMO Staffing Needs:</b> October 2009.</p>
3.3 b)	At this early stage of implementation of APM, NWMO combines siting studies and research on geoscientific phenomena that are related to safety, in contrast with most other programmes where there is a separation of these activities. Respecting the current management arrangements, there is a need to put greater effort into the geological phenomena such as radionuclide sorption and diffusion that will control the safety functions provided by the sedimentary formation.	<p><b>Recommendation accepted.</b></p> <p>NWMO completed a state-of-knowledge review of sorption under highly saline conditions in 2008. The results have been used to develop a significant 2009 work program which will investigate sorption properties and their measurements in sedimentary rocks.</p> <p><b>Due Date – Work on Diffusion and Sorption Initiated:</b> October 2009.</p>



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3.4 b)	<p>The ITRG strongly advises that the illustrative safety assessments should be developed in such a way that by the time potential candidate sites are identified NWMO can make credible statements why such sites may be suitable and use the safety assessments to provide the focus for the design of the site evaluation and characterisation. The ITRG further advises caution in presenting dose or risk calculations at an early stage, when sites are first identified, as these would be misleading since they would necessarily be based on too many uncertain assumptions. However, the ITRG recognises the merit of presenting such calculations for entirely hypothetical sites in order to illustrate the types of results that would be obtained once site-specific information is available.</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO will prepare illustrative safety assessments for a hypothetical deep geological repository in crystalline rock by 2010 and in sedimentary rock by 2011, in order to help focus the site evaluation effort and to illustrate the types of results.</p> <p><b>Due Date – Illustrative Safety Assessment Completed:</b> December 2011.</p>
3.5 a)	<p>NWMO has established good networking arrangements internationally, having selective involvement with programmes and initiatives that are clearly relevant to implementation of the APM approach. The ITRG sees this as highly beneficial to NWMO's programme but notes that resources should be kept under close review to ensure that these remain adequate for active participation and thus a strengthening of capabilities rather than simply maintaining a watching brief.</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO will maintain its international program for co-operative research and development based on NWMO's ability for active participation and will provide a revised staff level projection as part of the Business Planning process by October 2009.</p> <p><b>Due Date – NWMO Staffing Needs:</b> October 2009.</p>
3.5 b)	<p>A number of programmes in other countries periodically issue a report to clarify the objectives and scope of the technical programme (e.g. the RD&amp;D report issued triennially by SKB in Sweden). The current absence of an equivalent NWMO report is noted under 3.1 but the ITRG welcomes the proposal that such a report will be developed.</p>	<p><b>Recommendation accepted.</b></p> <p>As also noted in Response to 3.1(a), NWMO is preparing a comprehensive technical research, development and demonstration (RD&amp;D 2010) program report associated with the NWMO's technical program for implementing APM.</p> <p>The first draft of the RD&amp;D program report will be available for review by the ITRG in 2009.</p> <p><b>Due Date - 1<sup>st</sup> Draft RD&amp;D Report:</b> June 2009.</p> <p><b>Due Date – Final RD&amp;D 2010 Report:</b> December 2010.</p>

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3.5 c)	A number of programmes ensure that counterparts in other countries, stakeholders and the public have good access to their technical programmes through the ready availability of technical reports on websites. The ITRG notes that it is difficult to find technical reports on the NWMO website and recommends that their accessibility should be improved.	<p><b>Recommendation accepted.</b></p> <p>NWMO is presently redesigning its website. One objective is to improve the ease of locating technical reports on the NWMO website.</p> <p><b>Due Date – Website Improvements:</b> April 2009.</p>
3.6 a)	The ITRG commends NWMO on the level of outreach to universities as a key technical contribution to its programme. Given the contribution that this makes to ensuring the technical quality of the programme, as well as the benefits accruing from building awareness and support at the universities, we recommend that more is made of this strategy in key NWMO documents (both public and technical).	<p><b>Recommendation accepted.</b></p> <p>NWMO will include more explicit reporting of its involvement in Canadian universities in the NWMO's annual report and in its presentation material to the public and other interested stakeholders.</p> <p><b>Due Date – Reporting of Involvement in Universities:</b> April 2009.</p>
3.6 d)	Monitoring and retrievability are central to the APM approach. While recognising the challenges faced by all national programmes in developing a technical programme to address monitoring and retrievability, the ITRG did not see a clear commitment to developing a coherent technical work programme in this area and recommends that this should be given greater attention.	<p><b>Recommendation accepted.</b></p> <p>As of December 2008, NWMO is supporting the international Underground Research Laboratory Closure Enhanced Sealing and Monitoring Project along with partners from Sweden, Finland and France, as well as the NEA Reversibility &amp; Retrievability Project.</p> <p>NWMO will include further explicit work on monitoring and retrievability in its 2009 to 2013 technical R&amp;D program plan.</p> <p><b>Due Date – Monitoring and Retrievability Plan:</b> November 2009</p>
3.7 a)	The ITRG believes that the NWMO technical programme is under-staffed to deliver the current demanding work programme. If the ITRG's recommendations on enhancing the programme were to be accepted this would add further demands. In particular we believe that significant strengthening is required in sedimentary rock studies.	<p><b>Recommendation accepted.</b></p> <p>NWMO has had an aggressive hiring program for the last year which resulted in a number of new staff. The program will continue in 2009. NWMO staff numbers for future years will be reviewed during 2009 and revised projections provided by October 2009 as part of the Business Planning process.</p> <p><b>Due Date – NWMO Staffing Needs:</b> October 2009.</p>

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3.7 b)	<p>ITRG members have considerable collective experience of compiling resource plans and recognise the difficulties of conveying a full story through tabulated data as were available for this review, particularly when the specialised contractor sector has an important role to play in implementation. Nevertheless, we believe that the planned increases in NWMO staff in the siting studies area are not sufficient to support the necessary site evaluation and characterisation activities that would start in 2013 according to the reference plan. Further, given the specialised nature of work in this field, we believe the team should be built up earlier than is currently proposed.</p>	<p><b>Recommendation accepted.</b></p> <p>See response to 3.7 a).</p> <p>NWMO will be assessing the staffing needs to support an expanding program as part of Business Planning and report results by October 2009.</p> <p><b>Due Date – NWMO Staffing Needs:</b> October 2009.</p>
3.7 c)	<p>In all waste management organisations, both safety strategy and repository design strategy are core in-house activities. We thus strongly recommend that NWMO adjusts the current extent of use of external resources to support repository development and increases its in-house resources in the area of repository design. It is very important that NWMO controls, and is seen by stakeholders and the public to control, the basis on which the repository will provide safety.</p>	<p><b>Recommendation accepted.</b></p> <p>NWMO also controls safety strategy and repository design strategy using in-house resources.</p> <p>However, NWMO acknowledges that it needs to increase its in-house repository design capability and NWMO has been actively recruiting in this area.</p> <p>NWMO will be assessing the staffing needs to support an expanding program as part of Business Planning and report results by October 2009.</p> <p><b>Due Date – NWMO Staffing Needs:</b> October 2009.</p>