2008 Report of the NWMO Independent Technical Review Group

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Summary

The overall finding of this review is that the NWMO Technical Programme reflects a good awareness of the issues and challenges associated with the current stage of implementation of the APM approach. Although work needs to be intensified in some areas as identified below, with a concomitant build-up of staffing resource, there are no major omissions of topics from the planned programme.

1. Introduction

The Independent Technical Review Group (ITRG) met for the first time at NWMO Offices on 15-16 September 2008. Brief biographies of the ITRG members are given in Annex 1.The meeting was conducted according to the agenda proposed by NWMO (Annex 2). Derek Martin was able to attend only on 15 September but confirmed that he had made all the contributions that he considered necessary prior to departure. ITRG members had received the briefing material listed in Annex 3 in good time before the meeting

This is the report of the ITRG on its findings from the review of the NWMO Technical programme that it was able to undertake on this basis. Naturally this first review did not involve detailed technical evaluations. Nonetheless the ITRG wishes to confirm that the information provided in the briefing documents, presentations and oral responses to questions was sufficient to enable it to form a view on the Technical Programme in the context of NWMO's overall planning. Furthermore the ITRG wishes to confirm that it was able to conduct its business with the required level of independence and would like to thank the NWMO team for their clear and comprehensive answers to the many questions posed by its members.

NWMO staff members have checked the final report for factual accuracy but, subject only to a small number of resulting factual corrections, the report presents the independent findings of the ITRG.

2. Terms of Reference

The Terms of Reference (TOR) dated October 25, 2007 were reviewed and discussed. It was agreed that they provide a sound basis for the ITRG to provide the NWMO Board with the advice that it requires on the Technical Programme.

The ITRG discussed its current membership in relation to the technical content of the current programme and confirms that it has available the range of knowledge and skills necessary to

comment meaningfully on all aspects. This will be kept under review and the ITRG will advise NWMO if it believes any further specialist should be added to its membership in the future.

The ITRG believes that the wording of one part of the Mandate and Scope (Part 2 of the TOR) may be misleading. This concerns the adequate basis for "Assembling robust and credible safety cases for both crystalline and sedimentary formations."
The ITRG recommends that "robust and credible safety cases" should 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.

3. Review Findings on the Technical Programme

The ITRG presents its findings in this report on the basis of the evaluation factors that are derived from the TOR.

3.1 Based on appropriate scientific and technical approaches and methodologies:

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. Examples included:

- Work on the integrity of used fuel, where the issue concerns its handling and encapsulation and the proposed work will provide a valuable input to the design of encapsulation facilities for example.
- Seismic hazard assessment, where it is not clear what barrier function might be compromised, thus making it difficult to judge the appropriateness of the approach. The ITRG noted that the public concern aspects of this topic are mentioned and agrees that it is important to address those, but believe that for the technical programme this needs to be done in a structured manner. This should include a methodology for siting related to seismic impacts at depth, in particular the impact on shear displacement along existing geological features and engineered barriers. Subsequent to receiving these comments, NWMO informed the ITRG of its involvement with SKB, Sweden, in work related to this topic.

b) 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.

c) 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.

d) In all other respects the ITRG was impressed with the scientific and technical approaches and methodologies. For example, following clarification with the NWMO team, we commend the approach to the important topic of the effects of future glaciations. Here NWMO is assembling evidence on the relevant processes from past glaciations and will use this to develop appropriate future glaciation scenarios for its long-term safety analysis.

3.2 Addresses range of technical issues and challenges associated with design and development of used fuel storage, transportation and placement in a deep geological repository in either crystalline rock or sedimentary rock:

a) The ITRG was impressed that NWMO has identified all the relevant issues and challenges and proposes a comprehensive programme of work to address these. The remaining findings in this section represent recommendations on how work might be enhanced or prioritised in key areas identified by the ITRG.

b) Concerning used fuel storage, NWMO clearly recognises the importance of fuel bundle structural integrity and quite appropriately is planning to perform additional studies in this area. This appears prudent given the potentially long duration of interim wet and dry storage of the used fuel.

c) 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.

d) 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).

e) 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.

f) NWMO is clearly aware of the depth of experience on crystalline rock available from the previous AECL programme and internationally (e.g. Sweden and Finland). The ITRG felt that this depth of experience was not conveyed in the presentation material made available to it. Nonetheless the work programme on crystalline rock is judged to be well-matched to the requirements of the overall programme.

g) 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.

h) 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.

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.

3.3 Able to initiate technical site evaluation and characterisation at potential candidate sites:

a) 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.

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.

3.4 Able to develop illustrative safety assessments:

a) NWMO clearly has well-developed capabilities for developing the required illustrative safety assessments. However, it recognises the highly demanding nature of its work programme in this area with the production of assessments for crystalline and sedimentary formations in successive years and the requirement for substantial progress on the understanding and modelling of key, safety-related phenomena by 2013.

b) 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.

3.5 Consistent with international practice:

a) 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.

b) 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&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.

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.

3.6 Broaden and advance NWMO's technical knowledge to adequately support implementation of APM:

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).

b) The co-funding of Ph.D. studentships is an excellent initiative both in terms of advancing technical knowledge and in bringing young people into contact with the challenges of such a long-term project.

c) The ITRG also commends NWMO's initiative in establishing specialised chairs such as the one at the University of Western Ontario and encourages the commitment to long-term continuity of such arrangements.

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.

3.7 Has sufficient technical resources:

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.

b) 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.

c) 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.

Verification

We, the members of the NWMO Independent Technical Review Group, agree this report as a true and accurate record of the 2008 ITRG review of the NWMO Technical Programme.

Signed 

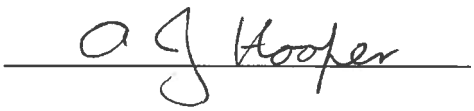
Kaj Ahlbom (SKB, Sweden)

Signed 

Lawrence Johnson (Nagra, Switzerland)

Signed 

Derek Martin (University of Alberta, Canada)

Signed 

Chairman, Alan Hooper (Alan Hooper Consulting Limited, UK)

Annex 1

Brief Biographies of the ITRG Members

Alan Hooper is the Chair of the ITRG. Since 2007 he has been an independent consultant who specializes in the safe, long-term management of radioactive waste for the UK and other national programmes. He also currently acts as the Chief Scientific Advisor to the UK Nuclear Decommissioning Authority Radioactive Waste Management Directorate.

On joining the electricity supply industry, Hooper researched the operational safety of advanced reactor designs before transferring into early research on decommissioning nuclear power stations and radioactive waste management. He joined Nirex, the UK radioactive waste management agency in 1988, holding a number of senior management positions including Director for Science. Dr. Hooper holds a Bachelor of Science and Ph.D. in Chemistry from Nottingham University, UK.

Kaj Ahlbom has 30 years of experience in the Swedish radioactive waste programme concerning site selection, site characterisation and interaction with stakeholders. Since 2002, he has been the Site Manager for SKB's (Swedish Nuclear Fuel and Waste Management Company) site investigation for a repository for spent nuclear fuel at Forsmark, Sweden. He has been involved in all aspects of site selection from formulating site selection critera to participating in the site selection process and investigating candidate municipalities and sites. All phases of this process have involved interactions with stakeholders such as government agencies, municipal officers, the geoscientific community, nearby residents, landowners, general public and media.

Mr. Ahlbom received his bachelor's degree in Precambrian Geology from the University of Gothenburg, Sweden, and master's degree in Applied Geophysics from Imperial College, UK.

Lawrence Johnson is a senior scientist and research and development coordinator at Nagra (Swiss National Cooperative for the Disposal of Radioactive Waste), where he has worked since 1999 on various aspects of engineered barriers performance.

Mr. Johnson received a bachelor's degree in Chemistry with Great Distinction from the University of Lethbridge, Alberta, in 1977. He joined the Atomic Energy of Canada Limited (AECL) at Whiteshell Laboratories in 1978, where he studied the dissolution of spent fuel and vitrified high-level waste for several years before becoming Manager of Engineered Barrier Studies in the Canadian Nuclear Fuel Waste Management Program. He also managed the technical studies of durability of spent fuel in interim wet and dry storage.

He is the author of over 110 reports and journal papers covering many areas related to materials performance aspects of engineered barrier systems, as well as a number of studies dealing with long-term safety assessment. A member of the International Scientific Advisory Board of the CEA PRECCI Programme, Mr. Johnson conducts research on the long-term evolution of spent fuel packages.

Derek Martin is a professor in the Department of Civil and Environmental Engineering at the University of Alberta, Edmonton, since 2000. He started his career as Engineering Geologist for I.D. Engineering Company, Winnipeg; then moved as Geotechnical Engineer for B.C. Hydro, Vancouver; and later became Senior Geotechnical Engineer for EBA Engineering Consultants, Edmonton.

Dr. Martin was also Senior Advisor to the Director of the Canadian Nuclear Fuel Waste Management Program, as well as head of the Geotechnical Research Section of AECL's Whiteshell Underground Research Laboratory. He then assumed the roles of Associate Director of the Geomechanics Research Centre and Professor in the School of Engineering at Laurentian University, Sudbury.

Martin holds a bachelor's degree in Geology from Memorial University, St. John's. He obtained both his master's degree and doctorate in Civil/Geotechnical Engineering from the University of Alberta, Edmonton, and the University of Manitoba, Winnipeg, respectively. He has reviewed nuclear waste programs for countries around the world. He is a scientific advisor to the Swedish nuclear fuel and waste management program, as well as member of the Geoscience Review Group for Ontario Power Generation's Deep Geologic Repository project for Low and Intermediate Level Waste.

Annex 2

Agenda for the September 2008 Meeting of the Independent Technical Review Group

Date:	September 15-16, 2008
Location:	NWMO Board Room, 22 St. Clair Ave. East, 6th Floor, Toronto CANADA
Attendees:	**ITRG:** Alan Hooper, Kaj Ahlbom, Lawrence Johnson and Derek Martin **NWMO:** Frank King, Ben Belfadhel, Paul Gierszewski, Atika Khan and Sean Russell
Contact:	Sean Russell – Ph: 647-259-3022. Cell: 647-272-6442. E-mail: srussell@nwmo.ca

DAY 1 – Monday September 15, 2008		
Time	**Item**	**Lead**
08:30	Refreshments [NWMO office]	
09:00	Welcome & Introductions	All
09:15	Review & Discussion of Terms of Reference - Questions & Discussion	F. King
09:45	Overview of NWMO Implementation Plan & Technical R&D Program - Questions & Discussion	F. King
10:15	Break	
10:30	Engineering - Questions & Discussion	S. Russell
12:00	Lunch & Brief DGR Presentations [NWMO office]	M. Jensen R. Heystee
12:45	Geoscience - Questions & Discussion	M. Ben Belfadhel

DAY 1 – Monday September 15, 2008		
Time	**Item**	**Lead**
14:15	Break	
14:30	Safety Assessment - Questions & Discussion	P. Gierszewski
16:00	ITRG Discussion of Technical R&D Program (*in camera*) Example items for discussion: - Appropriateness of scientific & technical approaches and methodologies - Consistency with international practice & state of knowledge - Ability to support siting process & conduct feasibility studies - Ability to develop conceptual designs & cost estimates - Ability to develop robust & credible safety cases	ITRG
17:00	Adjourn	
19:00	Dinner	

DAY 2 – Tuesday September 16, 2008		
Time	**Item**	**Lead**
08:30	Refreshments [NWMO office]	
09:00	ITRG Discussion of Technical R&D Program (*in camera*) (NWMO staff available for discussion, as required)	ITRG
09:45	Break	
10:00	ITRG Feedback on Technical R&D Program - Comments, Questions & Discussion of R&D Issues	A. Hooper ITRG
11:30	Next Steps - Preparation of ITRG Report to NWMO Board - Presentation to NWMO Board on November 13, 2008	F. King

DAY 2 – Tuesday September 16, 2008		
Time	**Item**	**Lead**
	- Presentation to Advisory Committee on November 14, 2008	
12:00	Lunch [NWMO office]	
13:00	Adjourn	

Annex 3

Documents Sent for Review by the Independent Technical Review Group

No.	Item	Date Available
1	Draft Agenda	July 2008
2	Implementing Adaptive Phased Management 2008 to 2012, Revised June 2008	July 2008
3	Technical Research and Development Program for Long-Term Management of Canada's Used Nuclear Fuel – Annual Report 2007. NWMO TR-2008-01	June 2008
4	NWMO Technical Program Activities for the Period 2009 to 2013, Revision 0	June 2008
5	NWMO – Who are we?	July 2008
6	NWMO Project Description	July 2008
7	Moving Forward Together: Designing the Process for Selecting a Site	August 2008
8	Technical Research and Development Program, Quarterly Progress Report, April to June 2008	July 2008