2013 Report of the NWMO Independent Technical Review Group

Alan Hooper (Alan Hooper Consulting Limited, UK),
Lawrence Johnson (Nagra, Switzerland),
Derek Martin (University of Alberta, Canada),
Olle Olsson (SKB, Sweden)

November 2013

Signed _____

Lawrence Johnson (Nagra, Switzerland)

Signed _____

Derek Martin (University of Alberta, Canada)

Signed _____

Olle Olsson (SKB, Sweden)

Signed _____

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

2013 Report of the NWMO Independent Technical Review Group

Summary

The planning and implementation of activities within the Nuclear Waste Management Organization's (NWMO's) Adaptive Phased Management (APM) Technical Programme has continued over the past year with a clear focus on the prospective geoscientific characterisation and selection of a preferred site for an APM facility, to be followed by the submission of an Environmental Impact Statement (EIS) and supporting documents for a Site Preparation and Construction Licence in 2023. The scientific research that has been carried out to date or that is planned will provide the necessary level of support for what is recognised by the NWMO to be an ambitious set of planning assumptions for siting an APM facility, with 2023 being the earliest possible date by which the necessary submissions could be envisaged. The NWMO is currently placing considerable emphasis on the proof testing and optimisation of the engineered barrier system that will be used in the repository, including its adaptation to a realistic repository design suited to the geological setting that ultimately will be chosen. Given the good progress that has been made over the past year, the ITRG considers that the planned activities in the engineering design area of the Technical Programme may well lead to improvements in design solutions. Previously the ITRG questioned whether sufficient scientific and technical underpinning could be developed for such solutions on the required timescales. Although still ambitious, there has been a helpful relaxation of the relevant timescales within the overall planning assumptions, and the NWMO proposes to commission a more detailed expert peer review in 2014 to test its plans in this key area. Recommendations made previously by the ITRG have either been implemented or their implementation is underway, although in some cases the ITRG has emphasised where more work or a change of approach may be required.

1. Introduction

The Independent Technical Review Group (ITRG) met at NWMO Offices on 17-18 September 2013. Brief biographies of the current ITRG members are given in Annex 1. The meeting was conducted according to the agenda agreed with the NWMO (Annex 2). The written agenda covers all the areas relevant to the ITRG in general terms; in agreeing to the agenda the ITRG requested that, under the relevant agenda items, specific attention would be given to the topics of gas evolution and migration in a repository in sedimentary rock and of corrosion of copper under the range of possible repository conditions. ITRG members had received the briefing material that is 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's APM Technical Programme that it was able to undertake on this basis. Whereas the review did not involve detailed technical evaluations the ITRG wishes to confirm that the information provided in the briefing material, presentations and oral responses to questions was sufficient to enable it to form a view on the Technical Programme in

the context of the NWMO's overall planning. Furthermore the ITRG wishes to confirm that it was able to conduct its business with the required level of independence. It would also 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 to those factual corrections, the report presents the independent findings of the ITRG.

2. Terms of Reference

The ITRG agreed that the revised Terms of Reference distributed in February 2009 continue to provide a sound basis for it to give the NWMO Board of Directors the advice that it requires on the APM Technical Programme.

The ITRG reaffirmed that its current membership covers the range of knowledge and skills necessary to comment meaningfully on all aspects of the current Technical Programme. In coming to this position, the ITRG noted that the NWMO proposes to commission an international peer review group to conduct a detailed review of its design development and proof testing plans in early 2014. The ITRG does not have a remit to conduct the necessary detailed review; therefore it welcomes this proposal as an appropriate response to the relevant comments in its 2012 Report on this area.

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 Terms of Reference.

3.1 Based on appropriate scientific and technical approaches and methodologies:

a) The Technical Programme Objectives and associated milestones remain clear and comprehensive in defining what should be achieved. As in previous reviews, the ITRG has focused much attention on the programme for development and demonstration of key components of the overall engineered design, in particular with respect to the proof testing and optimisation of the engineered barrier system (EBS) that will be used in the repository. There has been impressive scientific and technological progress in the past year to support the imminent selection of the Mark I and Mark II container and buffer designs that are to be carried into the next stage of proof testing. In parallel, the plans and programmes for the progression of the engineered design have undergone significant development. Nonetheless, the objectives related to this area of the Technical Programme remain ambitious in terms of delivery of substantiated designs and prototypes, and there is little scope for reversals if the overall planned timescales are to be met. Therefore, the ITRG welcomes the NWMO proposal to commission a detailed review of its plans in this area in early 2014 and to follow this up with a review of the finalised plans by the Canadian Nuclear Safety Commission (CNSC).

b) The ITRG sought to understand the approach to proof testing in more detail and in particular to understand the basis that would be used to define the testing programme. The basis for proof tests appears to be appropriately founded on formally documented

design requirements: these in turn are supported by documented quantitative criteria. The ITRG understands that the design requirements are established through a formal process of inputs from, and iteration with, safety assessments. It welcomes the information received at the review meeting that the engineering design programme is developing documentation of the basis for its design decisions, that will make clear this important relationship between design and safety assessment, noting that design requirements and quantitative criteria for individual components of the engineered system in the as-built condition must be related to the anticipated long-term evolution of the component and of the repository system as a whole. This linkage between engineering design and safety assessment appears to be in place for the work on containers and near-field systems. The ITRG understands that further development of repository sealing systems is planned: it recommends clarity on the integration of work between engineering design, safety assessment and geoscience in this area, where geoscience is important in relation to the disturbance of the rock caused by excavation and to the design and geometry of repository seals in order to minimise any pathway for inflows or releases afforded by an excavation disturbed zone (EDZ).

c) More generally the geoscience programme continues to appear well-focused on ensuring that the methods are in place to support the characterisation of deep rock-water systems in either crystalline or sedimentary rock formations, providing the necessary information to support engineering design and providing the data and models that will be required to underpin a robust repository safety case.

d) The ITRG questioned the proposal for an "underground demonstration facility" to be developed in 2016. This terminology has specific connotations for scientists and engineers working in the field, in particular in relation to demonstrating the adaptation of conceptual engineering designs to the conditions found in a natural geological setting having the potential to host a repository. The NWMO clarified that the purpose would be to develop a facility at or near the ground surface in which various operational procedures could be tested and optimised. The ITRG recognises that this approach has considerable potential value in helping the NWMO to manage its project risk. It recommends that the scope of demonstration and testing to be carried out in such a facility should be explained very carefully to interested parties in order to constrain expectations and that the use of a term such as "facility to demonstrate underground operations" would be preferable.

e) The ITRG supports the approach adopted in the engineered design programme for the Mark II container whereby the use of existing or proven technology is being maximised and a number of recognised specialist technological organisations are involved in the current stage of the testing and mock-up programme in this area.

f) In general, the ITRG is in agreement with the scientific and technical approaches and methodologies that the NWMO is using in its Technical Programme. There were rare exceptions to this overall finding, which will be covered in the more detailed comments in the relevant sections below.

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 remains of the view expressed in its previous reports that the NWMO has identified all the relevant issues and challenges and proposes a comprehensive programme of work to address these. There is a good balance in the programme to cover the possible outcomes from the siting process while taking account of the existing knowledge that has been obtained in Canada and other countries. In particular, where the NWMO is maintaining the development of Mark I and Mark II container designs in parallel and is leveraging scientific and technical information from relevant international programmes it shows a good awareness of specific issues and challenges that it should address through additional work of its own. The findings in the remainder of this section represent recommendations on how work might be planned in key areas identified by the ITRG.

b) As noted in the 2012 ITRG Report, work on the development of a Mark II design envisages the emplacement of a used fuel repository container within an overpack of pre-fabricated bentonite blocks, now referred to as a "buffer box". In that report, the ITRG suggested that the bentonite blocks might be prone to damage in the event of localised contact with water and changes in humidity. The ITRG is impressed by the response of the NWMO to this potential problem, where a surrounding shell is now envisaged to prevent the bentonite blocks from developing such damage at the surface. Approaches using super container designs have already undergone some prototype testing in other international used-fuel management programmes: the SKB/ Posiva development work on the KBS-3H design of super container has led to the selection of a perforated titanium shell to surround the bentonite blocks[1]. The ITRG agrees with the NWMO's evaluation that the manufacture of the buffer box is not a straightforward challenge, in particular when it comes to ensuring that the requirements for properties such as the dry density of the compacted blocks can be met reliably. Therefore the ITRG welcomes the proposals for manufacturing trials that will be initiated once a preferred design for the EBS has been selected.

c) The NWMO's Mark II container design is based on the use of a corrosion-resistant copper coating over a steel container. The NWMO has recognised the importance of substantiating the corrosion performance of the copper coating under the range of possible conditions that will pertain during the evolution of the repository from the time of waste emplacement into the far future. The importance of this substantiation has been accentuated by the challenges to the scientific understanding of copper corrosion presented by SKB (Sweden) in its licence application for the construction of a used fuel repository[2]. The work that the NWMO has carried out over the past year represents an important advancement of copper corrosion science and has been guided by independent peer review findings from some of the leading experts in the field of copper corrosion. Highly demanding experiments have been conducted that confirm the low corrosion rates consistent with the safety function of the copper coating. Furthermore the NWMO's continuing work in this area promises to contribute to the

[1] SKB, 2012, KBS-3H Complementary Studies 2008-2010, SKB Report TR-12-01.
[2] Johansson, A. J. and Brinck, T., 2012, Mechanisms and energetics of surface reactions at the copper-water interface: A critical literature review with implications for the debate on corrosion of copper in anoxic water, SKB Report TR-12-07.

understanding of the relevant corrosion processes, which ideally would underpin this position. The ITRG welcomes the collaboration with other research groups, such as that from SKB, working in this field whereby comparisons can be made of results from different experimental designs and approaches.

d) The ITRG was impressed by the advances made in trial manufacturing of copper-coated steel test pieces, and by the involvement of recognised specialist technology organisations in the industrialised production of these. On the basis of the information presented to the ITRG, it appears that the NWMO will be in a position to make a selection of the preferred copper coating and welding processes for the Mark II container design later in 2013 as planned. The NWMO showed a good awareness of the need to be able to inspect the coating, in particular in the area of the sealing welds in the steel container, and of the limitations in terms of detection limits of the non-destructive testing techniques that will be used. The ITRG concluded that the work that has been conducted to date affords the NWMO the flexibility to choose the thickness of the copper coating within a range where it is shown to retain its required properties, in order to provide a contingency against non-detection of small flaws in the coating.

e) Over a period covered by a number of its annual reviews, the ITRG has emphasised the importance of the NWMO's planned objective of developing a thermodynamic database to define the chemical behaviour of radionuclides and other dissolved materials of interest in highly saline groundwaters such as are found in deep sedimentary rocks in Canada. The ITRG has supported initiatives to explore the utility of existing databases, although unfortunately none to date has met the NWMO's requirements. The ITRG sees merit in the latest such initiative to explore the utility of the THEREDA (THErmodynamic Reference Database) database that is being developed in Germany[3]. In the event that the NWMO evaluates that this will not fully meet its needs for supporting the thermodynamic modelling of solubilities and chemical speciation in highly saline groundwaters, the ITRG strongly recommends the NWMO should determine the radionuclides that are most significant to its emerging safety assessments of such systems. This would enable the NWMO to identify the gaps in existing thermodynamic databases, and to put in place the necessary work to fill those gaps on a suitable timescale to ensure the availability of a database that will support its safety assessment programme in this area.

f) Noting the interest shown by the CNSC in its review of the 4th Case Study Pre-Project Report in Crystalline Rock on software quality assurance and classification of computer codes, in line with similar stances from regulators in other countries, the ITRG questioned how the NWMO would qualify highly specialised codes developed for example by university research departments. It was reassured to learn that the NWMO is considering the implications of achieving the appropriate nuclear grade for such codes and that it plans to develop internal guidance to support the appropriate classification of codes.

[3] www.thereda.de accessed 28 October 2013

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

a) As noted in previous ITRG reports, the NWMO is in a good state of readiness for the forthcoming site identification and site selection phases of its implementation programme, greatly helped by the transfer of in-house geoscience staff and expertise from the L&ILW DGR Project to the APM project and the strategy of maintaining historical relationships with academic institutions, specialists and consultants from the L&ILW DGR Project. The knowledge and experience available to the NWMO as a result of this strategy enables it to determine with confidence the likely scope and associated resource requirements of the planned Phase 2 Preliminary Field Investigations at a small number of sites within the site selection process.

3.4 Able to develop illustrative safety assessments:

a) As noted in previous ITRG reports, the NWMO is building on well-established capabilities in the area of safety assessments. It has maintained its modelling capabilities and safety assessment methods at an appropriate level for the purposes of undertaking illustrative safety assessments and seeking reviews of its approach by the CNSC. The ITRG is in broad agreement with the NWMO's identification of areas for further development in the future, namely an assessment model to treat the coupling of hydraulic and mechanical processes in tight sedimentary rocks and an expansion of the disruptive scenarios or calculation cases that might be covered in connection with assessments of a repository at a real site.

b) The NWMO is currently finalising a "5th Case Study" for a used fuel repository in sedimentary rock for submission to the CNSC as part of the pre-project review material. In its 2012 report, the ITRG recommended that a proposal to present two separate 5th Case Study safety assessments for respectively a copper and a steel used fuel container should be reconsidered and that a single safety assessment treating the different container materials as alternatives would be more instructive. NWMO accepted this recommendation and ultimately is proposing to treat the option of a steel container through the presentation of a descriptive appendix in the safety assessment. This will leverage on the large amounts of work on the use of steel used fuel containers that has been conducted in other countries, in particular France and Switzerland. The ITRG agrees that this represents an appropriate response to its 2012 recommendation.

c) The NWMO has constructed the geosphere model for its 5th Case Study on the basis of a hypothetical site in Southern Ontario, with the repository located at a notional depth of 500m below ground surface in the Cobourg Formation. Given that all the communities in the siting process that are underlain by sedimentary rocks at depth are in Southern Ontario, this is a supportable approach. The ITRG recommends that the NWMO should establish a clear context for its use of this model and for the geological and hydrogeological parameters that have been assigned to it. Given the continuity observed in the rock formations from investigations of the Paleozoic sedimentary rocks of Southern Ontario in support of the L&ILW DGR Project, in line with historical observations at the regional scale, the assigned properties appear to be reasonable. The ITRG welcomes the information that the NWMO has acknowledged

in the 5th Case Study that ultimately these properties would need to be tested at any site that might be investigated.

d) In line with previous ITRG comments and recommendations, the 5th Case Study includes analyses that have been carried out to better understand the issues concerning the generation of gas, as a result of steel corrosion, and its migration in a tight sedimentary formation. For the case of a copper used fuel container, these analyses relate to a significantly disrupted situation in which the copper corrosion barrier fails unexpectedly quickly on all containers to expose the underlying steel to groundwater. These analyses appear to confirm the preliminary findings, as considered by the ITRG in its 2012 Report, indicating that under this disruptive scenario there is the potential for high gas pressures to develop within the emplacement areas as a result of gas generation from the corrosion of steel containers and the inability of gas to disperse into the surrounding low- permeability host rock. With the current models of the repository system, the gas pressure is relieved before it equals the lithostatic confining stresses in the rocks by the escape of gas through the modelled sealing system in the access shaft. This outcome implies some requirements in terms of the permeability of the sealing system in relation to gas and water movement and exemplifies the importance of the relationship between design and safety assessment, as discussed in 3.1 (b).

e) The preliminary results from the current stage of the 5th Case Study show essentially zero or very low calculated radiological doses from the groundwater mediated transfer of radionuclides to the biosphere, even for quite pessimistic calculation cases. The 5th Case Study has also explored the consequences of potential releases of non-radioactive contaminants, including copper dissolved from copper used-fuel containers into groundwater. The ITRG recommends that the NWMO should reconsider its modelling approach in this area. The modelling of dissolved copper concentrations in groundwater assumes that copper instantly dissolves up to its solubility limit rather than its dissolution being controlled by corrosion kinetics. This is almost certainly a highly pessimistic approach. While it shows the resilience of the repository system to such an extreme calculation case, it would be better to present a more realistic model when the objective of the Case Study is to exemplify the approach that will be adopted in the future. The ITRG welcomes the treatment of non-radioactive contaminants in the NWMO's safety assessments and notes the potential difficulty of selecting appropriate environmental protection standards in relation to potential releases from a deep radioactive waste repository. The ITRG notes that some useful work has been carried out both by SKB, presented as a supporting reference in the Environmental Impact Statement[4] forming part of SKB's recent licence application, and in connection with the environmental permitting of the UK national low-level waste repository[5], albeit under different European and UK legislative frameworks.

[4] SKB, 2011, Section 10.1.7, Environmental Impact Statement: Interim storage, encapsulation and final disposal of spent nuclear fuel, ISBN 978-91-978702-5-2.
[5] LLW Repository Ltd., 2011, The Environmental Safety Case: Assessment of Non-radiological Impacts, Report LLWR/ESC/R(11)10029.

3.5 Consistent with international practice:

a) The NWMO continues to have a well-focused involvement with relevant international activities to ensure a good awareness of the latest developments in repository science and technology. It continues to be actively involved in highly relevant projects at the Äspö Rock Laboratory in Sweden (crystalline rock) and at the Mont Terri Underground Rock Laboratory in Switzerland (sedimentary rock), and is a partner with SKB and Posiva Oy in the Greenland Analogue Project concerning the effects of glacial cycles on deep rock-water systems and repository engineered barrier systems. In the light of observations made by the ITRG in 3.4 (d), concerning the requirements from sealing systems in relation to gas and water movement, the ITRG particularly welcomes the NWMO's involvement in a new international project GAST, Gas Permeable Seal Test, at the Grimsel Test Site in Switzerland, having the objective of demonstrating the effective functioning of gas permeable seals at repository scales, and in the HG-A Experiment at Mont Terri, exploring the gas path along a sedimentary host rock and through seals.

b) As noted previously by the ITRG, the NWMO's Mark II design, in particular the use of the buffer box overpack, fabricated from pre-formed bentonite blocks, and the stacking arrangements in the repository for the resulting over-packed used fuel containers, are somewhat different to the designs under consideration in other countries. However, as the NWMO approaches design development and proof testing of EBS components at full scale, there is much useful information becoming available from international projects such as the European Commission supported LUCOEX, Large Underground Concept Experiments, Project, and the ITRG recommends that the NWMO should ensure that it benefits from all the lessons learned during this project[6].

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

a) The ITRG repeats its observation made in previous reports that the NWMO Technical Programme has continued to involve departments in Canadian universities recognised for their specialist knowledge and scientific excellence. The reporting of the NWMO's involvement with Canadian universities in the 2012 Annual Report represents a sustained response to the ITRG's previous recommendations in this respect. The NWMO is also working with a number of recognised scientific and engineering consultancies, many of which bring a wealth of knowledge and experience from their involvement in equivalent programmes in other countries. Increasingly there is evidence of the involvement of specialist technology organisations with the capability of testing engineering concepts for development at full industrialised scale. Generally, the ITRG remains impressed with the ability of the NWMO to identify and engage with the individuals and organisations that can provide the required technical knowledge to advance the programme.

b) The ITRG commends the NWMO for its systematic approach to testing the adequacy of its technical knowledge to support implementation. Over the period covered by the operation of the ITRG, there has been increasing visibility of objective

[6] www.lucoex.eu/deliverables.html accessed 28 October 2013

internal reviews by the NWMO, supported by independent expert peer review when appropriate, of the status of technical knowledge in each of the disciplinary areas relevant to implementation.

3.7 Has sufficient technical resources:

a) The ITRG notes that the controlled build up of in-house capability in terms both of numbers, and of qualifications and experience has continued and that this build-up is leading to an appropriate, almost steady-state, complement in the next year or so. The continued strengthening of the in-house repository design/ engineering team is in line with its previous recommendations in this area and marks the progress of the planned approach to design development and proof testing. The sufficiency of internal technical resources will depend crucially on the ability of the NWMO to achieve a complementary level of support from the supply chain of external contractors, especially in highly specialised areas where direct recruitment would not be appropriate. The ITRG welcomes the NWMO initiative of preparing a preliminary design development contract strategy to inform its position later in 2013. In particular this will be valuable in testing the assumptions on the balance between in-house staff and contractor effort that underpins the current resource plan in this area. The ITRG understands that in effect an equivalent exercise has been possible in the geosciences area related to siting, based on the experience from the L&ILW DGR Project.

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. In 2008 he was appointed Visiting Professor of Repository Science and Engineering in the Department of Earth Science and Engineering at Imperial College London.

On joining the electricity supply industry, Alan 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. Professor Hooper holds a Bachelor of Science and Ph.D. in Chemistry from Nottingham University, 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 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.

Mr. Johnson 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. He is a member of the International Scientific Advisory Board of the CEA PRECCI Programme and has acted as advisor and reviewer for nuclear waste management programs in Finland, Sweden, Japan and the U.S.

Derek Martin is a professor in the Department of Civil and Environmental Engineering at the University of Alberta, Edmonton, since 2000. Prior to joining the University of Alberta, Dr. Martin served as 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.

Professor Martin holds a BSc in Geology from Memorial University, a Masters of Engineering from the University of Alberta and a PhD from the University of Manitoba in Civil/Geotechnical Engineering. He has reviewed nuclear waste programs for various countries. 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. Professor Martin has published over 150 articles related to geotechnical engineering and deep geological repositories and underground excavations. He is a Fellow of the Engineering Institute of Canada and a Fellow of the Canadian Academy of Engineering.

Olle Olsson has 30 years of experience working within the Swedish nuclear waste management program, primarily associated with geoscientific issues related to the final disposal of spent nuclear fuel within a Deep Geologic Repository. From 1983 to 1992, he was Principal Investigator for development of integrated site characterization and numerical techniques within the International Stripa Project. In 1995, he became Director of the SKB's (Swedish Nuclear Fuel and Waste Management Co.) underground research facility, the Äspö Hard Rock Laboratory. Starting in 2002, he managed the recently completed investigations of two potential Swedish repository sites, and was responsible for preparation of the license application – submitted to the Swedish government in March 2011 – for the selected Forsmark site. Dr. Olsson now holds the position of Vice President Strategy and Programmes at SKB.

Olle Olsson received his Ph.D. in Applied Geophysics from the University of Luleå, Sweden, in 1978. He has been a member of the Royal Swedish Academy of Engineering Sciences since 2003.

Annex 2

Agenda for the September 2013 Meeting of the Independent Technical Review Group

Independent Technical Review Group **September 2013 Meeting** **AGENDA**	
Date:	September 17-18, 2013
Location:	NWMO Board Room, 22 St. Clair Avenue East, 6th Floor, Toronto CANADA
Attendees:	**ITRG:** Alan Hooper, Lawrence Johnson, Derek Martin and Olle Olsson **NWMO:** Ken Nash[7], Ben Belfadhel, Chris Hatton, Lisa Lang, Sean Russell, Monique Hobbs, Neale Hunt, Alan Murchison[1], Ken Birch[1], Mark Mielcarek[1] Dave Doyle[1], Chris Boyle[1], Peter Keech[1] and Eric Kremer[1]
Contact:	Monique Hobbs → Ph: 647-259-3712. E-mail: mhobbs@nwmo.ca

DAY 1 – Tuesday September 17, 2013		
Time	**Item**	**Lead**
08:30	Refreshments [NWMO office]	
09:00	Welcome & Introductions	Chris
09:15	Overview of APM Technical Program & Status - Objectives, Assumptions and Schedule - Budget, Staffing	Chris
09:45	APM DGR Illustrative 5th Case Study (Sedimentary) - Objectives/Schedule/Approach - Geologic Setting - Reference DGR Engineering Design - Safety Assessment Approach and Analyses - CNSC pre-project review(s) – Status 4th/5th Case Studies	Neale/Monique /Lisa
10:15	Break	
10:30	Repository Engineering - Design and Proof Testing - Mark 1 and Mark 2 design selection - Mark 1 - general features/Crystalline/Sedimentary - Mark 2 - Corrosion barrier/Structural design/NDE/Buffer box	Chris

[7] Part time

DAY 1 – Tuesday September 17, 2013		
Time	**Item**	**Lead**
	- Next Steps	
12:00	Lunch [NWMO office]	
12:30	OPG Kincardine L&ILW DGR Project Update (*lunch time presentation*)	Monique
13:00	Confidence Building & Process Understanding - Geoscientific Characterisation/Geosynthesis/Case Studies - Repository Safety - International Projects (Äspö, Mont Terri, Grimsel)	Neale/Monique
14:30	Break	
14:45	APM DGR Site Selection Activities - Status of Screening and Preliminary Site Assessments	Ben
16:00	ITRG Discussion of APM Technical Program (*in camera*)	
17:00	Adjourn	
19:00	Dinner [La Maquette; 111 King St. East; 416-366-8191]	

DAY 2 – Wednesday September 18, 2013		
Time	**Item**	**Lead**
08:30	Refreshments [NWMO office]	
09:00	ITRG Discussion of APM Technical Program (*in camera*) (NWMO staff available for discussion, as required)	ITRG
10:00	Break	
10:15	ITRG Discussion of APM Technical Program (*in camera*) (NWMO staff available for discussion, as required)	ITRG
12:00	Lunch [NWMO office]	
13:00	ITRG Feedback on APM Technical Program	A. Hooper
	- Comments, Questions & Discussion of Issues	ITRG
13:45	Closing Comments	K. Nash
14:00	Next Steps	Chris

DAY 2 – Wednesday September 18, 2013		
Time	**Item**	**Lead**
	- Preparation of ITRG Report to NWMO Board - Presentation to Advisory Council on November 27, 2013 - Presentation to NWMO Board on December 4, 2013	
14:30	Adjourn	

Annex 3
Documents Sent for Review by the Independent Technical Review Group

No.	Item
1	Draft Agenda for September 2013 Meeting
2	APM Technical Program Activities for the Period 2014 to 2020, Revision 0. June 2013 (DRAFT)