2012 Report of the NWMO Independent Technical Review Group

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Lawrence Johnson (Nagra, Switzerland),
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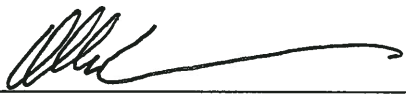
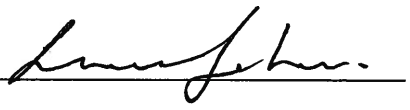
November 2012

Signed 

Olle Olsson (SKB, Sweden)

Signed 

Lawrence Johnson (Nagra, Switzerland)

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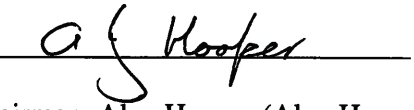
Derek Martin (University of Alberta, Canada)

Signed 

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

2012 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 Construction Licence Application in 2021. The scientific research that has been carried out to date or that is planned will provide strong support for what is recognised by the NWMO to be an ambitious set of planning assumptions for siting an APM facility. Appropriately for the current stage of the programme, considerable attention is being given to optimised design solutions for the transport of used fuel to the repository, its encapsulation in repository containers and the emplacement of these containers as part of the overall engineered barrier system in the repository. The ITRG considers that the planned activities in the engineering design area of the Technical Programme may well lead to improvements in design solutions, but it questions whether sufficient scientific and technical underpinning could be developed for such solutions on the timescales implied by the current overall planning assumptions. 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 may be required.

1. Introduction

The Independent Technical Review Group (ITRG) met at NWMO Offices on 11-12 September 2012. Since its last Annual Report in 2011, there has been a change of ITRG membership, with Kaj Ahlbom being replaced by an SKB colleague, Olle Olsson. Brief biographies of the current ITRG members are given in Annex 1. The meeting was conducted according to the agenda proposed by the NWMO (Annex 2). 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'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 documents, 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 sought clarification on its role and the role of the recently established Geoscientific Review Group in respect of geoscientific screening and preliminary assessment of communities for a prospective APM repository. The clarification received is that the ITRG should review the preparedness of the NWMO to undertake the relevant technical site evaluation and characterisation activities but is not expected to review the characterisation programme itself or its results.

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. The ITRG was asked to comment specifically on two questions raised by the NWMO; these questions are identified and commented upon under the relevant evaluation factor.

3.1 Based on appropriate scientific and technical approaches and methodologies:

a) The Technical Programme Objectives remain clear and comprehensive in defining what should be achieved. As noted in its 2011 Report, the ITRG continues to consider that the objective to develop and demonstrate the full range of components for transferring used fuel from reactor site storage into the deep geological repository by 2018 appears ambitious despite some progress in this area. Nonetheless the ITRG recognises that this represents a logical objective in the context of the current illustrative implementation schedule.

b) The ITRG identified some seeming inconsistencies in the timings of certain objectives where integration of engineering designs, geoscientific information and safety analyses would be required. For example, one objective is to submit an optimised conceptual design and safety assessment of a site-specific repository to the Canadian Nuclear Safety Commission (CNSC) for pre-project review by 2016 (shown as 2015 in reference 2, see annex 3). It seems unlikely that sufficient information would be available about site characteristics to develop a site-specific repository design and carry out a safety assessment when detailed characterisation is planned only to commence in 2016. The ITRG emphasised the role of safety assessment as a process of integrating the required strands of scientific and technological information. The ITRG is satisfied that the NWMO intends to adopt such an approach and recommends that the timing of objectives that rely upon multi-disciplinary inputs should be reviewed carefully in the light of its comments.

c) In general, the ITRG continues to be impressed 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 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. At the time of finalising this report, twenty-two communities have expressed an interest in learning more about the NWMO site selection process and requested an initial screening against the criteria that have been established. The communities that have passed, or are undergoing initial screening, offer the potential of eventually siting the repository in either crystalline or sedimentary rock. The NWMO programme currently supports both eventualities, although in a few areas it implies commonalities between design solutions for crystalline and sedimentary host rocks that may not be appropriate. In particular the ITRG questions whether one design solution currently being considered, involving the use of a bentonite-block overpack for the used fuel container, will be suitable for a repository in crystalline rock (as discussed in more detail in (b) below). The findings in the remainder of this section represent recommendations on how work might be planned in key areas identified by the ITRG.

b) One of the specific questions on which the ITRG was asked to comment was:
Is the NWMO developing sufficient technical capability and is the APM technical program sufficiently well planned? In particular can the NWMO Board of Directors be confident that the program will result in a well developed repository, packaging plant design and safety case, and that proof testing of major components will have been carried out to allow a quality regulatory submission to be made by 2021(assuming the short site selection timeline materializes)?

The ITRG received some detailed presentational material concerning work that is underway or planned in the repository engineering programme, which provides the main basis for responding to this question. In particular, the NWMO has initiated development of a potentially improved "Mark II" design that incorporates new technologies and innovative concepts. This requires development in each of the areas of: used fuel characteristics, transportation, repository container, used fuel packaging plant, buffer and backfill, repository container transfer and repository design. Possible Mark II concepts will be short-listed in 2013 and a decision taken in 2014 on which to incorporate. The NWMO's current plan is to continue to refine the existing Mark I design in parallel with development of the Mark II design, and to make a decision on whether to adopt the Mark I or Mark II design in advance of the licence submission.

As noted in its 2011 report, the ITRG sees the merit of looking to achieve some standardisation, particularly of transport containers, and optimisation of fuel handling operations and container design. Potentially such work could reduce the number of handling operations required, and therefore the radiological doses to workers involved in each of those operations, as well as potentially leading to a cost-effective solution and overall efficiency. Noting that the NWMO will retain the option of adopting the Mark I design, the ITRG considers the timetable for sufficiently developing the Mark II design to provide the basis for the planned regulatory submission in 2021 to be highly ambitious, as outlined below.

Based on precedents from other countries, which are available to the CNSC, the ITRG believes that the NWMO will need to have developed a fully verified, specific design as the basis for its regulatory submission for a construction licence. The ITRG considers that this will require the same level of substantiation of the engineered barrier design as has been provided for the geosphere barrier in the recently submitted licence application for a low- and intermediate-level waste (L&ILW) deep geological repository (DGR) for Ontario Power Generation (OPG). Again from international precedent, this implies a need for the fabrication, testing and demonstration of many prototypes for components such as repository containers or buffer and backfill systems. Despite the efficiency with which the NWMO implements its Technical Programme, the ITRG doubts that sufficient research, development and demonstration (RD&D) can be conducted in the time available to fully substantiate a design that is markedly different from the current Mark I design. If correct, the ITRG recommends that the NWMO will need to balance the risks of going ahead with the level of substantiation available for the Mark II design as the basis for a regulatory submission against such benefits as will be afforded by this design. The ITRG therefore emphasises that there is merit in continuing to develop the current Mark I design in parallel with development of the Mark II design as risk mitigation. The ITRG's analysis was made for the planning assumption case of the short site selection timeline; clearly a more relaxed timescale would allow a greater level of design substantiation. The ITRG is also aware of the constructive dialogue established between the NWMO and the CNSC, which would to some extent identify regulatory expectations in this area.

Current work on the development of a Mark II design envisages the emplacement of used fuel repository containers within an overpack of pre-fabricated bentonite blocks. These overpacks are envisaged to be stacked within an emplacement room. For the purpose of future Mark II design development it would be sensible to consider operational constraints associated with successfully emplacing such bentonite-block overpacks routinely in a "wet" sub-surface environment. The ITRG believes that this is a potentially suitable concept for emplacement of used fuel in a repository in a sedimentary host rock where there are no localised or seeping inflows of groundwater to the emplacement positions and the humidity is fairly uniform. However, experience from international projects (e.g. FEBEX[1]) on engineered barrier design

[1] Fuentes-Cantillana, J.L. and J.L. Garcia-Sineriz (1998): Full-scale engineered barriers experiment in crystalline host rock, final design and installation of the "in situ" test at Grimsel, Enresa Publicacion Tecnica Num. 12/98.

has shown that such bentonite block overpacks are prone to damage in the event of localised contact with water and changes in humidity. Therefore the ITRG is doubtful that the current version of the Mark II design could be applied to a crystalline host rock where localised or seeping inflows may occur. Design modifications may be required. The ITRG notes that the NWMO is planning to test and demonstrate the Mark II design in a surface-based prototype test facility. Whereas the ITRG would agree that conditions in the emplacement area of a repository in low-permeability sedimentary rock might be reasonably well simulated in such a facility, it is doubtful that this would be the case for a crystalline rock repository. The ITRG recommends that the NWMO should consider whether, in the light of published information, the proposed Mark II design and testing are suitable for a repository in crystalline rock.

As part of its continuing development work on the Mark I design, the NWMO is conducting studies to improve the thermal conductivity of the buffer material surrounding the used fuel container, for example by mixing graphite or copper into the bentonite clay, to prevent the bentonite from experiencing an excessively high temperature. The ITRG drew attention to a considerable amount of work carried out on graphite-doped bentonite in support of an earlier ONDRAF/NIRAS (Belgium) concept for the emplacement of used fuel[2], which the NWMO should take account of. However, the ITRG also recommends that the safety-related requirements of the bentonite buffer should be reviewed for the case of a repository in sedimentary rock to ensure that those requirements, which are thought to be driving the current buffer design and protection measures, are indeed relevant to that case. If not, a simpler and more cost-effective design might be developed and further complex issues, such as the interaction between highly saline groundwater and bentonite, might not require detailed investigation.

The ITRG also questioned what requirements had been established by the NWMO for retrievability and recommends that it should document how the proposed Mark II design matches up to these.

c) The second specific question on which the ITRG was requested to comment is best dealt with in this section of the report. The question was:
Is the program as planned being conducted in an efficient and effective way? In particular, is the NWMO focusing only on essential work, using resources available in a cost-efficient way and taking advantage of international experience?

The ITRG believes that the NWMO is correctly identifying the main technical challenges and prioritising its work programme accordingly. Elements of the Technical Programme that were scrutinised by the ITRG in the context of this question all passed the test of providing information that it is necessary for the NWMO to obtain in order to answer questions both internally and externally on important aspects of repository design and safety analysis.

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[2] Verstricht, J., Demarche, M. and Gatabin, C. (2001): Development of a backfill material within the Belgian concept for geological disposal of high-level radioactive waste: an example of successful international cooperation, Waste Management 01, Proceedings of the International Conference, Tucson, AZ (USA), 25 Feb.–01 March 2001.

Most areas of the Technical Programme fall in the category of applied research where a specific application can be identified for the work in the future implementation of the APM repository. As noted previously by the ITRG, this is particularly evident for the geoscience programme where the work done to date will be used to support geoscientific characterisation of prospective repository sites. The ITRG commends the recently conducted Geoscience Work Program Evaluation which clearly shows the status of the NWMO's work program in this area and enables any gaps to be identified, as well as confirming the adequacy of information in a number of the technical areas. The ITRG recommends that this type of evaluation should be considered for other parts of the Technical Programme. This will build confidence in the focus of the programme and provide a valuable basis for shared understanding both within the NWMO and with interested parties external to the organisation, in particular the broader scientific community.

The NWMO has responded appropriately to filling an identified gap in knowledge concerning the vapour phase corrosion of copper in partially saturated conditions, such as might persist in low-permeability host rock formations. This knowledge gap has been identified in other waste management programmes where copper container material may be used and the NMWO is already aware of the possibility of international co-operation in this area. The ITRG recommends that the NWMO should also consider whether a more focussed work programme is required on the interaction of container corrosion products and bentonite buffer, where again international cooperation may be possible.

The ITRG raised with the NWMO team the adequacy of its work on thermal-hydraulic-mechanical coupling in respect of a sedimentary host rock, which is typically seen as an important aspect of the design and safety analysis in this case. The response was reassuring both scientifically and in respect of efficient planning. The NWMO believes it has sufficient information coming forward from existing work on coupled processes, for example through its development work on the FRAC3DVS-OPG thermal-hydraulic-mechanical model or will rely on interpolation from work carried out on thermo-mechanical coupling in crystalline rock given the relatively high strength of Canadian sedimentary rocks likely to be of interest in the siting programme. The adequacy of this approach will be reviewed at an appropriate stage in the future.

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

a) As noted in the two 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. As a further response to the question posed to the ITRG concerning cost-efficient use of resources available, we repeat our finding from the 2011 report that this approach should ensure the successful transfer of knowledge and experience, particularly when it comes to integrating multi-disciplinary field data as required to develop a safety case. Furthermore, this is likely to represent a highly cost-effective strategy since there will not be an initial

"learning-curve" period. We additionally commend the development of networks of specialist researches in important areas of geosciences, such as environmental tracers (providing natural evidence of long-term solute transport characteristics of the groundwater system), which was a highly effective approach adopted by SKB in its site characterisation programme.

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 is currently finalising a "4th Case Study" for a used fuel repository in crystalline rock for submission to the CNSC as part of the pre-project review material. In its 2011 report, the ITRG questioned an aspect of the approach that was being used for the selection of geosphere parameters to represent the large-scale permeability of the crystalline rock surrounding the repository. The interim geosphere parameters chosen in 2011 were sufficiently low that any solute transport in the groundwater system surrounding the repository would be governed by diffusive processes. Particularly in the context of having interested communities in areas underlain by crystalline rock, the ITRG considered it would be prudent to show that long-term management of used fuel in a deep geological repository can be safely achieved in crystalline rocks containing fractures that carry advective flow, as has been done in SKB's recently published licence application for a used fuel repository in Sweden. The NWMO has responded to the ITRG's recommendations by extending the range of rock mass hydraulic conductivities that are used in the safety assessment to include situations where advective flow would control solute transport in close proximity to the repository. Certain transport characteristics (concerning diffusion and dispersion) in the fracture network system are implied by the numerical treatment that has been used, which may be somewhat different to those that would be found at a specific site but, provided that the conditional nature of the numerical results is recognised in setting the context for the 4th Case Study, this change to the modelling approach responds to the concerns raised by the ITRG previously.

b) The NWMO has increasingly turned its attention in this work area to the "5th Case Study" for a repository in sedimentary rock. In line with previous ITRG comments and recommendations, an initial study has been carried out to better understand the issues concerning gas generation and migration in a tight sedimentary formation. Although the gas modelling studies completed to date do not consider all the gas-transport relevant features (e.g., excavation disturbed zone) suggested by the ITRG in its 2011 report, the preliminary findings indicate a likelihood that high gas pressures will 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. Various engineering design measures are possible to dissipate the gas pressure, for example the use of relatively high permeability seals for emplacement rooms and shafts, but these may have adverse consequences for the long-term isolation and containment of the radionuclides in the used fuel and are likely to require complex assessments of the range of possible transport pathways that may result. Further modelling work is planned to explore these issues and this will be valuable in informing NWMO decisions on, for example, the selection of the corrosion barrier material for used fuel containers for a repository in sedimentary rock.

c) The current objectives in this area of the Technical Programme include the submission to the CNSC for pre-project review of a 5th Case Study illustrative safety assessment for a repository in sedimentary rock using steel used fuel containers followed by a further illustrative safety assessment for a repository in sedimentary rock using copper containers. The ITRG sees considerable merit in presenting an illustrative safety assessment for a repository in sedimentary rock given that communities underlain by such rocks have now expressed an interest in the site selection process. However, the ITRG questions whether the CNSC will be able to give the desired feedback to the NWMO on a timely basis when requested to review and comment on three illustrative safety assessments in as many years (4th Case Study to be submitted by December 2012 and potentially two 5th Case Studies in 2013 and 2014, respectively). When the NWMO is clearly faced with some complex technical questions over the use of steel containers because of their gas generation potential, the ITRG recommends that consideration should be given to submitting a single illustrative safety assessment for a repository in sedimentary rock. If both container corrosion barrier materials, steel and copper, are still under consideration at the time of submission, the safety assessment could treat these as alternatives. This would facilitate an understanding of the consequences of making a choice between the two corrosion barrier materials at a later stage.

3.5 **Consistent with international practice:**

a) The NWMO continues to have an appropriate level of involvement with relevant international activities to ensure a good awareness of the latest developments in repository science and technology. It is 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. The NWMO is also selectively involved in the most relevant activities of international organisations, in particular the Nuclear Energy Agency (NEA). The ITRG welcomes the information that the NWMO will participate in the updating of the NEA "Clay Club" database of features, events and processes relevant to sedimentary rocks (known as FEPCAT); the compilation and subsequent use of this database was previously found highly beneficial by waste management organisations such as Nagra (Switzerland).

b) To date the NWMO has adapted reference case repository concepts, which have been developed in other countries, to make them appropriate for the emplacement of CANDU used fuel bundles. Innovations such as copper coating technology have already attracted interest in other countries and the NWMO has the prospect of fruitful co-operation in such areas where it might be seen as improving on aspects of international practice. The current proposals for a Mark II design, in particular the use of an overpack fabricated from pre-formed bentonite blocks and the stacking arrangements for over-packed used fuel containers, are somewhat different to the designs under consideration in other countries. However, as already noted in Section 3.2, there is a considerable body of information from international RD&D activities in this area, particularly from large-scale demonstration experiments. The ITRG

recommends that the NWMO should take full account of this information at an early stage of developing its Mark II design.

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

a) 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 2011 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. Generally, the ITRG is 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. The ITRG also commends the appropriate commissioning by the NWMO of alternative approaches in some specialised areas, thereby building confidence in the underpinning of the technical programme.

3.7 Has sufficient technical resources:

a) The ITRG welcomes that the controlled build up of in-house capability in terms both of numbers, and of qualifications and experience has continued. It welcomes the strengthening of the in-house repository design team, in line with its previous recommendations in this area. The ITRG repeats the finding in its 2011 report that, given the current scope of the Technical Programme, the in-house technical staff numbers are such that the staff will have to work efficiently if they are to continue to control and manage the programme to sustain the quality of outputs achieved to date. The ITRG also repeats its previous finding that planned additions to the in-house staff in future years look to be the bare minimum that will be adequate for the delivery of the planned scope of the Technical Programme. However, the ITRG recognises that the resources required will be strongly dependent upon the number and nature of potential sites undergoing evaluation and investigation and notes that the NWMO intends to review its resource plans when the position is known in this regard.

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.

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 2012 Meeting of the Independent Technical Review Group

Independent Technical Review Group **September 2012 Meeting** **AGENDA**	
Date:	September 11-12, 2012
Location:	NWMO Board Room, 22 St. Clair Avenue East, 6th Floor, Toronto CANADA
Attendees:	**ITRG:** Alan Hooper, Olle Olsson, Derek Martin and Lawrence Johnson **NWMO:** Ken Nash[3], Ben Belfadhel, Paul Gierszewski, Chris Hatton, Mark Jensen, Atika Khan, Sean Russell, Derek Wilson and Monique Hobbs
Contact:	Mark Jensen → Ph: 647-259-3031 Cell: 416-592-7773. E-mail: mjensen@nwmo.ca

DAY 1 – Tuesday September 11, 2012		
Time	**Item**	**Lead**
08:30	Refreshments [NWMO office]	
09:00	Welcome & Introductions	All
09:15	Overview of APM Technical Program & Status - objectives, assumptions and schedule - budget, staffing	M. Jensen
09:40	APM DGR Illustrative Safety Assessments - Illustrative Case Studies Objectives/Schedule/Approach - Geologic Settings (Crystalline/Sedimentary) - Reference DGR Engineering Design - Safety Assessment Approach and Analyses - CNSC pre-project review - status	S. Russell / M. Hobbs P. Gierszewski/ A. Khan
10:15	Break	
10:30	DGR Engineered Systems and Designs - Reactor Site Transfer Systems - Used Fuel Repository Container - Design/Sizing/Proto-type - Repository Systems/Proto-type Facility	C. Hatton/ D. Wilson
12:00	Lunch [NWMO office]	All

[3] Part time

DAY 1 – Tuesday September 11, 2012		
Time	**Item**	**Lead**
12:30	L&ILW DGR Project Update (*lunch time presentation*)	F. King
13:00	Confidence Building & Process Understanding - Geoscientific Characterisation/Geosynthesis/Case Studies - Safety Assessment Methodologies - International Projects (Äspö, Mont Terri)	P. Gierszewski / M. Hobbs/ S. Russell/ C. Hatton
14:30	Break	
14:45	APM DGR Site Selection Activities - Status of Screening and Preliminary Site Assessments - Planned activities for 2013/14	M. Ben Belfadhel
16:00	ITRG Discussion of APM Technical Program (*in camera*)	ITRG
17:00	Adjourn	
19:00	Dinner [TBD]	All

DAY 2 – Wednesday September 12, 2012		
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 - Comments, Questions & Discussion of Issues	A. Hooper ITRG
13:45	Closing Comments	K. Nash
14:00	Next Steps	M. Jensen

DAY 2 – Wednesday September 12, 2012		
Time	**Item**	**Lead**
	- Preparation of ITRG Report to NWMO Board - Presentation to Advisory Council on November 28, 2012 - Presentation to NWMO Board on November 29, 2012	
14:30	Adjourn	M. Jensen

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

No.	Item
1	Draft Agenda for September 2012 Meeting
2	APM Technical Program Activities for the Period 2013 to 2019, Revision 1. June 2012
3	Technical Program for the Long-Term Management of Canada's Used Nuclear Fuel-Annual Report 2011, NWMO Report TR-2012-01. April 2012