2019 Report of the
NWMO Adaptive Phased Management
Geoscientific Review Group (GRG)

- Preliminary Geoscientific Assessments -

December 2019

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Table of contents

Executive summary

This report summarizes the work completed in 2019 by the Adaptive Phased Management Geoscientific Review Group (APM-GRG; abbreviated to GRG). This year the GRG met two times by teleconference call and once face-to-face in Toronto.

The GRG reviews approaches, methods, criteria and findings related to broad geoscientific issues addressed by the NWMO. Focus during 2019 was on crystalline rock in the northern part of the Revell Batholith, Ignace area. The GRG also reviewed an updated NWMO glossary of geoscientific terms for use in all project work initiated by the NWMO. As far as the Ignace area is concerned, the GRG reviewed: (1) the Work Plan concerned with hydraulic conductivity and helium porosity tests for core from boreholes 1 to 3 (IG_BH1 to BH3); (2) separate Work Plans for the development of a 3D Geological Model (3DGM) and a 3D geophysical model for the Revell Batholith and its surroundings; (3) the Work Plan to illustrate groundwater system behaviour for the potential repository area in the Revell Batholith, through the creation of a sub-regional scale conceptual hydrogeological model and preliminary groundwater systems numerical simulations; (4) a plan for Geoscientific Site Characterization of the potential site in the Revell Batholith as a basis for development of a Descriptive Geoscientific Site Model (DGSM); and (5) findings resulting from the integration of geoscientific data acquired from borehole IG_BH1.

As in previous years, the GRG made various contributions to geoscientific aspects and these are briefly described in this report. The NWMO documented all suggestions, questions and comments in disposition tables, and subsequently addressed them. The NWMO continues to provide high-quality responses to all points raised by the GRG in a timely, transparent and professional manner. In the GRG members' opinion, the adopted approach continues to follow or exceed international practices in this phase of assessment.

The GRG's overall assessment of the progress during 2019 is again very positive. A systematic approach was executed by the NWMO, and the GRG feels that good progress was made in the integration of data from Borehole 1 and in the preparation for forthcoming 3D modelling work. The NWMO team and its consultants have undertaken many tasks and this work is presented in high-quality documents. The review group also appreciates the careful and timely planning by the NWMO geoscientific team to support our review work. This allowed the GRG to fulfil its mandate and carefully assess approaches, methods and findings.

Technical and scientific aspects are described in the main body of this report. A few high-level aspects are highlighted here:

- The GRG identified several opportunities to meet the challenging timelines: (1) streamline the production of the 'Single Borehole Data Integration Report' by splitting the release of the final report into two parts; (2) establish a work-flow strategy in which lineament interpretation, surface geology mapping, 3D geophysical modelling and Discrete Fracture Network modelling all precede the establishment of the 3D Geological Model; (3) consider the creation of two subgroups within NWMO´s Geoscience team, one focussing on data acquisition and the other on data interpretation and modelling; and (4) facilitate at least one iteration in the DGSM development prior to 2023.
- With respect to the point (4) above, the GRG pointed out that it is essential to demonstrate credibility of offered solutions throughout the data collection and interpretation process. For this purpose, an iterative work flow needs to demonstrate a steady reduction of uncertainties in key inputs and model outputs. There is therefore a need for an iterative modelling strategy to verify the justification of the proposed drilling programme.
- A fully updated NWMO APM Project Glossary of Terms has been completed and is warmly welcomed by the GRG. It is vital that this document is now used in all projects and complemented with new terms when a need arises. The GRG has identified some possible

additions.

- Since the 3DGM will form the base for many tasks, the GRG strongly recommends completion of a first version of the regional- and site-scale geological models (3DGM v.1.0) after the acquisition of data from Boreholes 1 to 3 at the Ignace potential site. The GRG would also very much welcome a coordination of the next GRG face-to-face visit with a workshop discussing the first version of the 3DGM, preferably before this version is released for use by other disciplines.
- A key input to the 3DGM will be the results of 3D geophysical modelling. The GRG sought clarity on the relationships between the proposed 3D geophysical and geological modelling activities. The GRG also recommended that 3D geophysical modelling should be used not only as input to the 3DGM but also as a quantitative approach to reduce uncertainty in the 3DGM. NWMO responded positively to these suggestions.
- GRG's questions concerning the treatment of fracture zones in the groundwater system analyses and the use of 2D elements (e.g. for fracture zones, dykes) in the groundwater modelling were satisfactorily addressed by NWMO.
- The NWMO modified an earlier version of the Geoscientific Site Characterization Plan, originally delivered to the GRG at the end of 2018 and reviewed during 2018-2019. In particular, changes to the fundamental structure of the plan were identified in the review and have been completed by the NWMO. The GRG is pleased that the revised Geoscientific Site Characterization Plan reflects a more generic rather than site-specific perspective, which is favourable at this stage in the process.
- The review of the 'Single Borehole Data Integration Report' for borehole IG_BH1 is currently ongoing and conclusions will be included in future reports of the GRG.

It is evident to and very much welcomed by the GRG that the NMWO geoscientific team has developed work plans for the execution of various aspects of the forthcoming 3D geoscientific modelling work in the Ignace area, and documented integrated geoscientific information from the first borehole at this potential site. The GRG is looking forward to further information from Boreholes 2 and 3 at Ignace, to the first regional- and site-scale 3D Geological Model (3DGM) and, eventually, to an integrated Descriptive Geoscientific Site Model (DGSM) for this potential site.

1 Introduction

The Adaptive Phased Management Geoscientific Review Group (APM-GRG; abbreviated to GRG) was established by NWMO in 2012. It aims to provide independent review comments and advice on the preliminary geoscientific assessments being conducted as part of NWMO's evaluations to identify a suitable deep geological repository site for Canada's used nuclear fuel in an informed and willing host community. More specifically, the GRG provides comments on the approach, methods and criteria used, the data interpretation, and the adequacy of proposed preliminary field investigation and drilling programs to advance the understanding of the geology and increase confidence in the potential suitability of the various siting areas being considered by NWMO.

This report covers the activities of the GRG during the year 2019. Previous GRG reports were issued in December 2013, 2014, 2016, 2017 and 2018, and are publicly available on NWMO's website (APM-GRG 2013, 2014, 2016, 2017, 2018 www.nwmo.ca). Brief biographies of the GRG members for the 2019 term are attached to this report.

2 Objectives of NWMO's geoscientific preliminary assessments

The suitability of communities is assessed using a staged approach including 'Initial Screenings', 'Preliminary Assessments' and 'Detailed Site Characterization', and considers both technical and community well-being factors (NWMO 2010).

The overall preliminary assessment is conducted through a series of technical, socio-economic and cultural studies conducted in two phases over several years. Technical studies involve geoscience, engineering, transportation, environment and safety. The objective of the geoscientific suitability preliminary assessment is to assess whether candidate areas have the potential to meet NWMO's site evaluation factors (geoscientific suitability). The two phases are:

- *Phase 1 - Desktop Study:* Undertaken for all communities electing to be the focus of a preliminary assessment. This phase involves desktop studies using available geoscientific information, and a set of key geoscientific characteristics and factors that can be realistically assessed at the desktop phase of the preliminary assessment. Desktop studies for all 22 communities are completed.
- *Phase 2 - Preliminary Field Investigations:* Undertaken to further assess the potential suitability of a subset of communities selected by the NWMO. Depending on the geological setting, Phase 2 field investigations can include high resolution airborne surveys, geological mapping and initial borehole drilling.

The subset of communities advanced to Phase 2 preliminary assessment were selected based on the findings from the desktop study during Phase 1, considering technical, socio-economic and cultural considerations. It is important to note that the mandate of the GRG is exclusively focussed on the approach, methods, criteria and findings associated with the geoscientific suitability assessments. The GRG is not involved in matters pertaining to transportation and environment, and is not consulted when narrowing down the number of communities.

The status of involvement by different communities in NWMO's site selection process as of December 2019 is illustrated in Figure 1. There are currently three communities remaining in the site selection process. They are all in Phase 2 of the preliminary assessment, and include Ignace on crystalline rock, and Huron-Kinloss and South Bruce on sedimentary rock. During 2019, the GRG reviewed geoscience reports related to the Ignace community. No review activities bearing on the two sedimentary rock sites were assigned to the GRG this year.

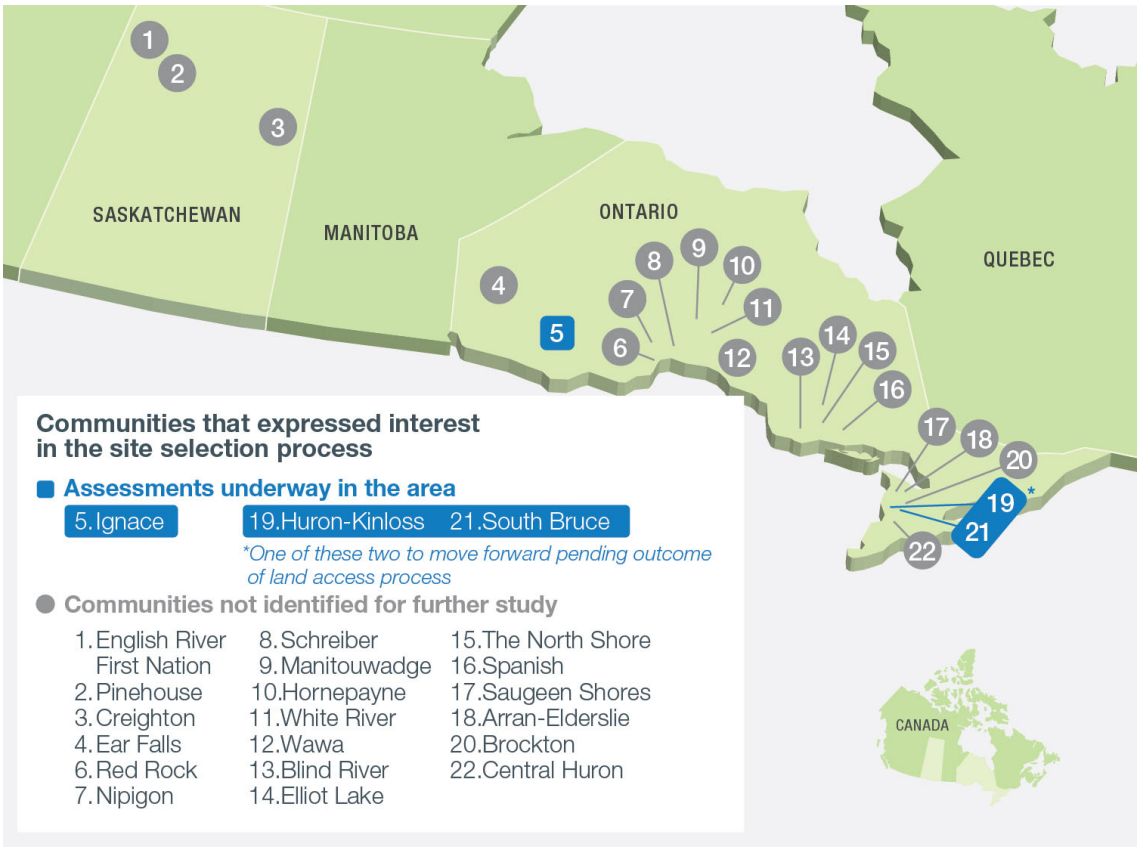

Figure 1. Communities that expressed interest in the site selection process (as of December 2019). Communities 1 to 16 are located on crystalline rock, and communities 17 to 22 on sedimentary rock.

3 GRG review activities in 2019

As the following list of activities illustrates, 2019 was another active period for the GRG with an in-person meeting in Toronto, two teleconferences, reviews of seven documents [one currently ongoing], and advisory functions on forthcoming work tasks.

3.1 Meetings between GRG and NWMO

In 2019, the GRG has been involved in reviewing NWMO's geoscientific activities in the communities of Wabigoon Lake Ojibway Nation and Ignace, Ontario, referred to here as the 'Ignace area', remaining in Phase 2 of the preliminary assessments. The meetings included:

- Teleconference call on February 28, 2019.
  Focus: Status of Revell Geoscientific Site Characterization Plan; Borehole 1 'Single Borehole Data Integration Report'; Revell 2D geological map update.
- In-Person meeting in Toronto October 8th and 9th, 2019 (Figure 2).
  Focus: Borehole drilling data acquisition, interpretation and modelling; fracture characterization/parameterization.
- Teleconference call on December 9, 2019.
  Focus: Timelines and geoscience/safety assessment interface (to be included in future reports).

Feedback from the GRG for consideration by the NWMO was shared following the discussions during the in-person meeting. The GRG pointed out that many suggestions presented in last year's feedback have been addressed or are in the process of being tackled. The GRG is pleased to see that resourcing

has been improved, and that the team is being restructured and focussed to take on an aggressive timeline.

Beyond some general observations, the feedback included comments relating to opportunities to achieve a tight time schedule of site selection fieldwork, human resource requirements, data reporting and integration including forthcoming 3D Geological Model (3DGM), and work packages for the geoscientific characterization of the Ignace potential site in the Descriptive Geoscientific Site Model (DGSM).

By comparison to the Swedish program, the GRG identified the following opportunities: (1) streamline the production of the 'Single Borehole Data Integration Report' (work package WP10) by splitting the release of the final integrated report production into two parts – geological interpretation results and interpretations in other geoscientific disciplines relying on the geological interpretation results; (2) establish a clear work-flow strategy and timelines with lineament interpretation (completed), surface geology mapping (in progress), 3D geophysical modelling (in progress) and Discrete Fracture Network (DFN) modelling all preceding the establishment of the 3D Geological Model (3DGM); (3) consider the creation of two subgroups in NWMO´s Geoscience team, one focussing on data acquisition and the other focussing on data analysis and modelling; and (4) facilitate at least one iteration in the DGSM development prior to 2023.

The GRG pointed out that it is essential to demonstrate credibility of offered solutions throughout the data collection and interpretation process. For this purpose, an iterative work flow needs to demonstrate a steady reduction of uncertainties in key inputs and model outputs. There is a need for an iterative modelling strategy to verify the justification of the proposed drilling programme.

The GRG also offered comments and suggestions with respect to several technical/scientific aspects of the 'Single Borehole Data Integration Report', as presented during the in-person meeting. These included aspects of the interpretation of joint sets, identification of discrete structures including fracture zones and ductile shear zones, use of rock mass ratings, in-situ stresses, strategic decisions concerning hydraulic testing and water sampling, fluid flow electric conductivity logging, and investigating the provision of data for modelling matrix diffusion in radionuclide transport models.

Figure 2. APM-GRG members at October 2019 in-person meeting; from left to right:
Peter Kaiser (Chairman), Michael Stephens, Sandy Cruden, Andreas Gautschi and Anders Ström.

3.2 Specific studies reviewed by the GRG

The GRG systematically reviewed approaches, methods and some findings related to the following geoscientific activities, and summarizes some comments on them in later sections of this report. Most of these activities specifically address the potential site in the Ignace area.

- Review of updated NWMO APM Project Glossary (Section 5.1).
- Review of Work Plan (University of Alberta) concerned with hydraulic conductivity and helium porosity tests for core from boreholes 1 to 3 in the Ignace area (Section 5.2).
- Review of Work Plan to Develop a 3D Geological Model (3DGM) for the Revell Batholith and Surroundings, Ignace area (Section 5.3).
- Review of Work Plan for 3D Geophysical Forward and Inverse Modelling of the Revell Batholith granitoid bedrock and surrounding Greenstone Belt Bedrock, Ignace area (Section 5.4).
- Review of Work Plan for Groundwater System Analyses for the Revell Batholith, Ignace area (Section 5.5).
- Review of a Geoscientific Site Characterization Plan for the Revell Site, Ignace area (Section 5.6).
- Review of 'Single Borehole Data Integration Report' for IG_BH01 (Section 5.7) [currently ongoing].

4 Overall assessment of progress during 2019

The GRG's review process followed the same approach as in previous years:

- Prior to meetings, NWMO shared draft work plans and initial findings in technical reports, as they became available, in order to solicit review comments;
- The in-person meeting, teleconferences and email exchanges with NWMO were held to discuss the GRG's review comments;
- GRG comments were documented and tracked in disposition tables, which, together with NWMO responses and in several cases final dispositions (see below), were returned to the GRG to ensure that the approach to address the review comments was appropriate.

The GRG's overall contributions in 2019 focussed on the tasks listed in Section 3.2, the results of which were presented to the GRG in the form of technical documents or oral presentations at the meetings.

The GRG is again satisfied with the approach and methods adopted by the NWMO and is impressed by the progress made to-date. In particular, the GRG notes that NWMO has advanced in the process of preparing a plan for the geoscientific characterization of the Revell potential site in the Ignace area and the underlying 3D modelling work. The NWMO has also completed the drilling of two more boreholes in the Phase 2 Preliminary Field Investigations of the Ignace area. All this work has been carried out in parallel with the preparation of data reports from the first borehole at Ignace (IG_BH01) and a detailed interpretation process of the results of this drilling. The systematic, iterative process developed and adopted by NWMO allowed the GRG to review findings and progress in detail.

The NWMO team and its consultants have again undertaken high-quality work that facilitated a carefully reviewed approach. The GRG was able to provide timely input for consideration by NWMO. Suggestions by the GRG for process improvements were considered and implemented by NWMO in a rapid, transparent and professional manner. As a consequence, NWMO continues to maintain a high standard of quality work and is making steady progress in the site evaluation process. In the GRG members' opinion, the adopted approach continues to follow or exceed international practices.

5 GRG review comments

5.1 Review of NWMO APM Project Glossary

A glossary of geoscientific terms is a vital component for use in all the different NWMO APM geoscientific projects executed by personnel at the NWMO and their external consultants. Clarification of terminology and consistency of use are essential. The GRG has noted in previous annual reports some inconsistencies in the terminology used in technical reports and pointed out the need for and use of a fully updated glossary. The GRG is pleased that the draft of such a glossary was presented to and reviewed by the GRG during the early part of 2019. A satisfactory updated glossary was subsequently delivered. It is vital that this document be now used in all projects and complemented with new terms when they arise. The GRG has already detected two new terms that should be added to the glossary when reviewing the work plan for Groundwater System Analyses for the Revell Batholith (rock matrix and fracture zone).

5.2 Review of Work Plan WP4a-1 (University of Alberta) concerned with hydraulic conductivity and helium porosity tests for core from boreholes 1 to 3 in the Ignace area

The GRG provided some comments and questions concerning details of the testing procedure (hydraulic conductivity measurements under different confining stress) and has received satisfying replies from NWMO. As per GRG comment, a section has been added to the work plan to compare the methods used to characterize porosity (total, water-loss and helium porosity). NWMO will also conduct a review and compile experiences from other national programs as per GRG recommendation.

5.3 Review of Work Plan to Develop a 3D Geological Model (3DGM) for the Revell Batholith and Surroundings, Ignace area

The NWMO geoscience team presented to the GRG a work plan to develop a 3D Geological Model (3DGM) for the Revell Batholith and Surroundings in the Ignace area. Following a review of this work plan, the GRG requested inspection of a revised version, which was subsequently viewed by the GRG. In the same manner as in other tasks, NWMO provided a clear documentation of their responses to the comments by the GRG in the first review, thereby motivating the content of the final, revised document. In addition to the points highlighted below, the GRG recommended several other changes to help improve the quality of the work plan report.

The GRG advised the NWMO geoscience team to address in the work plan the question of data freezes and coupled model versions, and to modify the structure of the plan so as to match better the objectives of the 3D geological modelling work. Such changes were completed by NWMO in the final version of the work plan.

The GRG also recommended the inclusion of some additional data sets in the 3D geological modelling work. For example, data bearing on the internal structure of faults or fault zones are needed. This information will provide a basis for a better understanding of variable transmissivity along such structures, which the GRG anticipates will emerge during the investigations at this potential site. A second recommendation concerned the need for mineralogical and whole-rock geochemical data in order to constrain more firmly the character of the lithology at the Ignace potential site. The NWMO geoscience team agreed with the GRG that these data sets are important but lie outside the scope of the first version of the 3DGM (3DGM v. 1.0). They will be addressed as more borehole information is acquired and later versions of the 3DGM are developed.

The GRG was concerned that the 3DGM work plan places too much emphasis on lithology and lithological boundaries, and insufficient focus on the identification of fracture zones including the interpretation of lineaments. Most geo-models (geo-mechanical, hydro-geological, etc.) rely on the structural part of the 3DGM more so than the lithological part. In their response, the NWMO geoscience team pointed out that the updated interpretation of lineaments, completed during 2018,

will be integrated with the geological mapping data (e.g. structural points) in the 2D integrated geological mapping report, which will be delivered later to the GRG for review. Furthermore, fracture surfaces contributing to the DFN model will be incorporated into the 3DGM as an input, in the same manner as the 3D geophysical model of the Revell batholith and surrounding rock in the Ignace area (see below) will be handled. At that stage, the DFN will then be evaluated in relation to all other spatial geoscientific data in the 3DGM model.

Since the 3DGM will form the base for so many other tasks, the GRG strongly recommends completion of the 3DGM v. 1.0 (regional- and site-scale) after the acquisition of approved data from the first three boreholes at the Ignace site. Such a task will provide an important stage in a learning-by-doing process. The GRG would also very much welcome coordination of the next GRG face-to-face visit with a workshop discussing the 3DGM v.1.0, preferably before this version is released for use by other disciplines.

5.4 Review of Work Plan For 3D Geophysical Forward and Inverse Modelling of the Revell Batholith granitoid bedrock and surrounding Greenstone Belt Bedrock, Ignace area

The GRG's feedback on this work plan sought clarity on the relationships between the proposed 3D forward and inverse geophysical modelling and the activities around building the 3D Geological Model (3DGM) for the Revell Batholith and Surroundings in the Ignace area. The GRG also suggested that NWMO should consider the underlying purposes of 3D geophysical and 3D geological model development. Namely, that 3D geophysical modelling provides not only input for the 3DGM but also opportunities for testing and validating uncertain aspects of the 3DGM.

The NWMO clarified the complementarity of both the 3D geophysical and geological modelling activities. Specifically, 1) that the geophysical forward and inverse models will largely focus on defining the geometries of geological units at the scale covering the Revell batholith and surrounding greenstone belts; 2) the resulting geophysical models will provide a key input into the development of the regional geological understanding in the 3DGM; 3) 3D geophysical modelling will continuously be refined as new data (e.g., seismic reflection surveys, results from borehole drilling, etc.) becomes available; and 4) that results of 3D geophysical modelling will be used to reduce uncertainty in the 3DGM. The GRG is supportive of this approach.

5.5 Review of Work Plan for Groundwater System Analyses for the Revell Batholith, Ignace area

In response to GRG's questions concerning the treatment of fracture zones in the Groundwater System Analyses, NWMO clarified that fracture zones will be directly linked to interpreted lineaments at surface as they are included in the groundwater model based on the DFN modelling performed by MIRARCO.

The GRG was concerned that 2D elements (e.g. fracture zones, dykes) in the groundwater model can only be modelled as conduits along a fault or dyke, but not as a barrier for flow perpendicular to the transmissive element, even though there are observations that this does happen in nature. NWMO replied that, in such cases, 2D permeable elements can surround a much lower permeability 'core' that will act as a barrier to flow, thereby implementing high permeability parallel to the fault and low permeability normal to the fault. The GRG noted similarities with examples from the Swiss program and was satisfied with the reply.

The GRG highlighted that site-specific chemistry (total dissolved solids, specific components) of matrix pore waters is not mentioned in the Groundwater System Analyses Work Plan, although corresponding data are collected in the Ignace boreholes. NWMO informed the GRG that these aspects are being addressed as a part of a complementary R&D study, where information on the variation in the concentration of solutes between fracture zones and their rock matrix will be used as a proxy for rates of mass transport. Site-specific chemistry data will be included in a future phase once it is possible to define a site-specific reference salinity profile.

5.6 Review of Geoscientific Site Characterization Plan for the Revell Site, Ignace area

In a review of the Geoscientific Site Characterization Plan for the Revell Site, the GRG noted that the approach came across as a generic plan aimed at crystalline rock rather than as a site-specific plan for the Revell Batholith, as suggested in the title. The GRG identified serious difficulties with the general structure of the plan, which was presented to the GRG initially at two teleconferences and in manuscript form at the end of 2018 (see also APM-GRG, 2018). The GRG was also not satisfied with the order of presentation of different parts of the Geological Characterization Plan component and recommended significant changes so as to emphasize better the necessary work flow. The need to include a plan for the characterization of transport properties at the potential site and some terminological issues with the Geomechanics component were also presented to the NWMO. In addition, the GRG recommended many specific changes to help improve the quality of the report. A request by the GRG to read a revised version was made.

The NWMO delivered responses to the extensive list of remarks carried out in the first review and a revised version of the Geoscientific Site Characterization Plan for a second review in June 2019. The GRG consider that the revised June 2019 version is a major improvement on the earlier version, not least concerning its fundamental structure and generic perspective. The GRG appreciates very much that the earlier review work was handled so thoroughly by the NWMO. The GRG expressed concern around the possibility to include newly-acquired geoscientific information into modelling activities shortly after a specific data freeze has been passed. The GRG pointed out that, if NWMO allows this procedure to take place, there have to be strict rules and full transparency around the inclusion of newly-acquired data. The NWMO responded that the introduction of new geoscientific data following a formal data freeze needs to be limited, emphasizing also that such a step will only be taken following substantive discussions with safety assessment and engineering.

5.7 Review of Single-Borehole Data Integration Report (WP10) for IG_BH01

This review is currently ongoing and will be included in future reports of the GRG.

6 Concluding remarks

As indicated in previous reports, the GRG is satisfied with the progress made, and continues to be impressed by the systematic and consistent approach adopted by NWMO to conduct geoscientific site evaluation. NWMO has developed sound work flows for the various field and interpretation studies to ensure consistency between the many consultants involved and between different communities, which allowed the GRG to carefully assess approaches, interpretations and conclusions. On this basis, the GRG supports the overall outcomes from these studies at this stage of investigation.

The GRG has made many suggestions for data interpretation process improvements and is pleased to report that the NWMO at all times is responding to all identified issues in a timely, highly transparent, technically sound and professional manner.

Based on the experience of its members and as indicated previously, the GRG feels that the adopted approach and the quality of the studies by the NWMO team and its consultants continue to follow or exceed international practices at this phase of site evaluation.

7 References – Documents available from www.nwmo.ca

NWMO, 2010. Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel, Nuclear Waste Management Organization.

APM-GRG, 2013. 2012-2013 Report of the NWMO Adaptive Phased Management Geoscientific Review Group (GRG).

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APM-GRG, 2016. 2015-2016 Report of the NWMO Adaptive Phased Management Geoscientific Review Group (GRG).

APM-GRG, 2017. 2017 Report of the NWMO Adaptive Phased Management Geoscientific Review Group (GRG).

APM-GRG, 2018. 2018 Report of the NWMO Adaptive Phased Management Geoscientific Review Group (GRG).

8 Attachment - Brief biographies of the APM-GRG members

The APM-GRG is composed of five internationally recognized experts from Canada, Sweden, Switzerland, and Australia. They combine extensive multidisciplinary experience in areas relevant to the siting of deep geological repositories in both crystalline rock and sedimentary rock formations.

Dr. Peter Kaiser

Dr. Peter Kaiser, Chairman of the APM-GRG, is Professor Emeritus of Mining Engineering at Laurentian University, former Chair for Rock Engineering and Ground Control, former Director of the Rio Tinto Centre for Underground Mine Construction, and former Founding Director of the Centre for Excellence in Mining Innovation. His interests lie in geomechanics, underground excavation stability, mine design, mechanized excavation, and the applications of other emerging technologies that increase mining safety and productivity. Dr. Kaiser is a Fellow of the Canadian Academy of Engineers and a Fellow of the Engineering Institute of Canada. He is the author of more than 350 technical publications.

Dr. Sandy (Alexander) Cruden

Dr. Sandy (Alexander) Cruden is Professor of Tectonics and Geodynamics in the School of Earth, Atmosphere and Environment at Monash University (Australia). Dr. Cruden has more than 25 years of geoscience experience related to structural geology, analysis and characterization in both crystalline and sedimentary rock settings. Dr. Cruden completed a fault reactivation analysis and structural characterization of southwestern Ontario as part of site characterization activities for Ontario Power Generation's proposed Low- and Intermediate-Level Waste Deep Geologic Repository at the Bruce site.

Dr. Andreas Gautschi

Dr. Andreas Gautschi was Chief Geoscientific Advisor at the Swiss National Cooperative for the Disposal of Radioactive Waste. Since his retirement he works as an international geoscientific consultant. Dr. Gautschi has more than 30 years of geoscience experience related to the planning, co-ordination and implementation of site evaluation programs for deep geological repositories in both crystalline and sedimentary rocks. He coordinated successful geoscience activities that contributed to the selection of the Opalinus Clay formation as the preferred geologic setting for the long-term management of high-level waste in Switzerland. He still has a lectureship at ETH Zurich on Deep Geological Disposal of Radioactive Waste

Dr. Michael Stephens

Dr. Michael Stephens is a retired Senior State Geologist with the Geological Survey of Sweden in Uppsala. Dr. Stephens has been actively involved in the Swedish site evaluation process, including country-wide reconnaissance studies conducted in Sweden to identify potentially suitable regions for hosting a deep geological repository, geoscientific feasibility studies, and the detailed site characterization of the Forsmark site which was selected by SKB (the Swedish Nuclear Fuel and Waste Management Company) as the site for the deep geological repository for used nuclear fuel in Sweden.

Mr. Anders Ström

Mr. Anders Ström is Senior Program Manager at SKB (the Swedish Nuclear Fuel and Waste Management Company) and head of the Asset Development unit for the Spent Fuel Repository. Mr. Ström has been actively involved in SKB's siting program since the early 1990s, among other things, in charge of the development of requirements on the rock for the spent fuel repository and criteria for site evaluation. During the site characterization project, he was Chief Project Manager for the multidisciplinary site descriptive modelling conducted for the two candidate sites at Forsmark and Laxemar-Simpevarp (Oskarshamn).