nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

March 4, 2011

Mayor Mike Natomagan
Northern Village of Pinehouse
Box 130
Pinehouse Lake, SK S0J 2B0

Re: **Adaptive Phased Management Initial Screening –Northern Village of Pinehouse**

Dear Mayor Natomagan,

Further to your request to Learn More about the Adaptive Phased Management program and request for an initial screening, I am pleased to attach a report outlining the findings from the initial screening, as described in the *Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel* (May, 2010). As you know, the purpose of the initial screening in Step 2 of the process is to determine whether, based on readily-available information and five screening criteria, there are any obvious conditions that would exclude the Northern Village of Pinehouse from further consideration in the site selection process.

As the report indicates, the review of readily-available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Northern Village of Pinehouse from further consideration in the NWMO site selection process for the deep geological repository for Canada's used nuclear fuel. Should your community choose to continue to explore its potential interest in the project, your area would be the subject of progressively more detailed assessments against both technical and social factors to confirm the suitability of your community. Several years of studies would be required to confirm whether a site within your area could be demonstrated to safely contain and isolate used nuclear fuel.

The process for identifying an informed and willing host community for a deep geological repository for the long-term management of Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future. The NWMO expects that the selection of a preferred site would take between seven to ten years. It is important that any community which decides to host this project base its decisions on an understanding of the best scientific and social research available and its own aspirations. Should the Northern Village of Pinehouse continue to be interested in exploring the project, over this period there would be ongoing engagement of your community, surrounding communities and others who may be affected. By the end of this process, the Northern Village of Pinehouse as a whole community would need to clearly demonstrate that it is willing to host the repository in order for this project to proceed.

The next evaluation step would be to conduct a feasibility study as described in Step 3 of the site selection process. This feasibility study would focus on areas selected in collaboration with the community. As your community considers whether it is interested in advancing to the feasibility study phase, the NWMO encourages you to continue community discussion and further learning

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about the project. Your community has already begun the process of visioning and considering whether this project is consistent with achieving that vision and you are currently engaging your community in learning more about this project through programs and resources available through the Learn More Program.

Once again, I thank you for taking the time to learn about Canada's plan for the safe, secure management of Canada's used nuclear fuel.

Sincerely,

Kathryn Shaver

Kathryn Shaver,
Vice President, APM Public Engagement and Site Selection

February 2011

SUMMARY REPORT
INITIAL SCREENING FOR SITING A DEEP GEOLOGICAL REPOSITORY FOR CANADA'S USED NUCLEAR FUEL

Northern Village of Pinehouse, Saskatchewan

Submitted to:
Nuclear Waste Management Organization
22 St. Clair Avenue East, 6th Floor
Toronto, Ontario
M4T 2S3

REPORT

A world of capabilities delivered locally

Report Number: 10-1152-0110 (3000B)

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EXECUTIVE SUMMARY

On August 17, 2010, the Northern Village of Pinehouse, Saskatchewan and the Kineepik Métis Local expressed interest in learning more about the Nuclear Waste Management Organization (NWMO) site selection process to find an informed and willing community to host a deep geological repository for Canada's used nuclear fuel (NWMO 2010). This report summarizes the findings of an initial screening, conducted by Golder Associates Ltd., to evaluate the potential suitability of the Pinehouse area against five screening criteria using readily available information. The purpose of the initial screening is to identify whether there are any obvious conditions that would exclude the Pinehouse area from further consideration in the site selection process. The five initial screening criteria are defined in the site selection process document (NWMO, 2010) and relate to: having sufficient space to accommodate surface and underground facilities, being outside protected areas and heritage features, absence of known groundwater resources at repository depth, absence of known natural resources and avoiding known hydrogeologic and geologic conditions that would make an area or site unsuitable for hosting a deep geological repository.

The surface area within the boundaries of the Northern Village of Pinehouse would not be sufficient to accommodate the repository surface facilities. Therefore, as per discussions between NWMO and the community, the initial screening was conducted to assess whether there are areas at the periphery of the Northern Village that would meet the initial screening criteria. In the following, the periphery of the Northern Village of Pinehouse is also referred to as the "Pinehouse area".

The review of readily available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Northern Village of Pinehouse from being further considered in the NWMO site selection process. There are areas at the periphery of the Northern Village of Pinehouse that are potentially suitable for hosting a deep geological repository. However, the areas to the southwest of Pinehouse are excluded from further consideration as the potentially suitable rock is covered by about 100 m of sedimentary rocks of the Western Canada Sedimentary Basin, which would greatly reduce the ability to characterize it. Potential suitability of the areas not excluded would need to be further assessed during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

It is important to note that the intent of this initial screening is not to confirm the suitability of the Northern Village of Pinehouse to host a deep geological repository, but rather to provide early feedback on whether there are known reasons to exclude it from further consideration. Should the community of Pinehouse remain interested in continuing with the site selection process, more detailed studies would be required to confirm and demonstrate whether the Pinehouse area contains sites that can safely contain and isolate used nuclear fuel. The process for identifying an informed and willing host community for a deep geological repository for Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future.

1.0 INTRODUCTION

In May 2010, the NWMO published and initiated a nine-step site selection process to find an informed and willing community to host a deep geological repository for Canada's used nuclear fuel (NWMO, 2010). The site selection process is designed to address a broad range of technical and social, economic and cultural factors as identified through dialogue with Canadians and Aboriginal peoples, and draws from experiences and lessons learned from past work and processes developed in Canada to site facilities for the management of other hazardous material. It also draws from similar projects in other countries pursuing the development of deep geological repositories for used nuclear fuel. The suitability of potential candidate sites will ultimately be assessed against a number of site evaluation factors, both technical and social in nature.

The site evaluation process includes three main phases over a period of several years, with each step designed to evaluate the site in progressively greater detail upon request of the community. These are: Initial Screenings (Step 2) to evaluate the potential suitability of the community against a list of initial screening criteria; Feasibility Studies (Step 3) to determine if candidate sites within the proposed areas may be potentially suitable for developing a safe used nuclear fuel repository; and Detailed Site Evaluations (Step 4), at one or more selected sites, to confirm suitability based on detailed site evaluation criteria. It is up to the communities to decide whether they wish to continue to participate in these steps in the process.

2.0 OBJECTIVE OF THE INITIAL SCREENING

The overall objective of the initial screening is to evaluate proposed geographic areas against a list of screening criteria, using readily available information. Initial Screening criteria require that:

1) The site must have enough available land of sufficient size to accommodate the surface and underground facilities.

2) This available land must be outside of protected areas, heritage sites, provincial parks and national parks.

3) This available land must not contain known groundwater resources at the repository depth, so that the repository site is unlikely to be disturbed by future generations.

4) This available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations.

5) This available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the safety factors outlined in Section 6 of the Site Selection Document (NWMO, 2010).

For cases where readily available information is limited and where assessment of some of the criteria is not possible at the initial screening stage, the area would be advanced to the feasibility study stage for more detailed evaluation, if the community remains interested in participating in the siting process.

3.0 INITIAL SCREENING ASSESSMENT

This section provides a summary evaluation of each of the five initial screening criteria for the Pinehouse area, based on readily available information. The intent of this evaluation is not to conduct a detailed analysis of all

available information or identify specific potentially suitable sites, but rather to identify any obvious conditions that would exclude the Pinehouse area from further consideration in the site selection process.

The Northern Village of Pinehouse is situated in north-central Saskatchewan, on the western shore of Pinehouse Lake. Pinehouse is located 80 km northeast of Beauval, 93 km northwest of La Ronge, and 250 km north of Prince Albert, Saskatchewan. The municipal extent of the Northern Village of Pinehouse itself is approximately 1 km^2 in size.

Screening Criterion 1: The site must have enough available land of sufficient size to accommodate the surface and underground facilities.

The review of publicly available information shows that the periphery of the Northern Village of Pinehouse contains sufficient land to accommodate the repository surface and underground facilities. Surface facilities will require a land parcel of about 1 km by 1 km (100 ha) in size, although some additional space may be required to satisfy regulatory requirements. The underground footprint of the repository is about 1.5 km by 2.5 km (375 ha) at a typical depth of about 500 m.

As mentioned above, the surface area within the boundaries of the Northern Village of Pinehouse is only 1 km^2 and would not be sufficient to accommodate the repository surface facilities. Review of available mapping and satellite imagery showed that there are areas in the periphery of the Northern Village that have no constraints that would prevent the development of the repository surface facilities. The domestic and industrial infrastructure of the Northern Village of Pinehouse covers only a small area. The land in the periphery of Pinehouse is largely undeveloped, with no major infrastructure present. Despite the presence of major lakes and permanent water bodies such as Pinehouse Lake, there are large portions of land well in excess of the surface area needed for the development of the facilities associated with a deep geological repository.

Although topographic relief is variable across the area, there are no obvious topographic features that would prevent construction and site characterization activities. Also, as discussed later, the review of available geological information suggests that the Pinehouse area contains a number of geological formations with potentially sufficient volumes of rock at depth to accommodate the repository underground facilities.

Screening Criterion 2: Available land must be outside of protected areas, heritage sites, provincial parks and national parks.

The review of publicly available information shows that the Pinehouse area contains sufficient land outside of protected areas, heritage sites, provincial parks and national parks to accommodate the repository's facilities.

There are two recreational areas within the Pinehouse area: the Gordon Lake Recreation Site and the Besnard Lake Recreational Site, located approximately 27 km north and 35 km southeast of the Northern Village of Pinehouse respectively. These recreational sites are small and cover less that 4 km^2 each. In addition to these recreation sites, several heritage sites were identified near the Northern Village of Pinehouse. These sites are small and generally concentrated along the Churchill River and along Provincial Road 914 north of Pinehouse. There are no known wildlife or nature reserves in the area.

The absence of locally protected areas would need to be confirmed in discussion with the community and Aboriginal peoples in the area during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

Screening Criterion 3: Available land must not contain known groundwater resources at the repository depth, so that the repository site is unlikely to be disturbed by future generations.

The review of available information did not identify any known groundwater resources at repository depth in the Pinehouse area. The Saskatchewan Watershed Authority (SWA) Water Well Record (WWR) database shows that the water wells in the area obtain water from the overburden, at depths ranging from 10 m to 20 m. The geology in the Pinehouse area at typical repository depth is dominated by the crystalline bedrock from the Canadian Shield, including the southwestern portion of the area that is covered by a relatively thin layer of sedimentary rocks of the Western Canada Sedimentary Basin.

Experience from other areas in the Canadian Shield has shown that active groundwater flow is generally confined to localized shallow fractured systems, in the upper 300 m. At greater depth, permeability tends to decrease as fractures become less common and interconnected. Groundwater at such depths is also generally saline. The absence of groundwater resources at repository depth will, however, need to be confirmed during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

Screening Criterion 4: Available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations.

Based on the review of available information, the Pinehouse area contains sufficient areas, free of known economically exploitable natural resources, to accommodate the required repository's facilities.

The Pinehouse area has a generally low potential for oil and gas resources and economic minerals. There are currently no operating or past producing mines within the Pinehouse area. A few mineral occurrences have been identified at specific locations. Although some of them are currently being explored some 30 km east of Pinehouse, their economic viability is yet to be proven. Coal is currently being explored for in the sedimentary rocks of the Western Canada Sedimentary Basin south of Pinehouse, but no economically exploitable reserves have been identified to date.

No record of non-metallic mineral resources exploitation was found within the Pinehouse area. Potential for limestone has been recognized in the sedimentary rocks, approximately 20 km south of Pinehouse. As well, sand and gravel resources are abundant throughout Saskatchewan and are expected to be present near Pinehouse. Commercial potential for peat exists in some low-lying areas, but no peat extraction has occurred in the Pinehouse area. The risk that these resources pose for future human intrusion is negligible, as operations to extract non-metallic minerals would be limited to very shallow depths.

Screening Criterion 5: Available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the safety factors outlined in Section 6 of the Site Selection Document.

Based on the review of available geological and hydrogeological information, the Pinehouse area comprises areas of lands that do not contain obvious known geological and hydrogeological conditions that would make the area unsuitable for hosting a deep geological repository. These include the felsic gneiss that dominates the geology of the Pinehouse area. However, the southwestern potions of the Pinehouse area were excluded from further consideration as the potentially suitable rock at repository depth would not be amenable to site

characterization and data interpretation activities. These areas are composed of crystalline rocks that are covered by about 100m of sedimentary rocks of the Western Canada Sedimentary Basin. One of the key criteria in assessing the suitability of a site relate to having a host rock that is amenable to site characterization in order to develop a good understanding of the geoscientific characteristics of the site and a robust safety case. Because of the nature of the structural characteristics of crystalline rock (e.g. fractures geometry and frequency), the presence of a thick sedimentary cover would greatly reduce the ability to adequately characterize the crystalline rock at repository depth.

The evaluation of this screening criterion will focus on the remaining areas where the crystalline rocks are not covered by sedimentary rocks from the Western Canada Sedimentary Basin. The safety-related geoscientific factors outlined in Section 6 of the Site Selection Document (NWMO, 2010) relate to: safe containment and isolation of used nuclear fuel; long-term resilience to future geological processes and climate change; safe construction, operation and closure of the repository; isolation from future human activities; and amenability to site characterization and data interpretation activities. At this early stage of the site evaluation process, where limited data at repository depth exist, these factors are assessed using readily available information, with the objective of identifying any obvious unfavourable hydrogeological and geological conditions that would exclude the northern portion of the Pinehouse area from further consideration. These factors would be gradually assessed in more detail as the site evaluation process progresses and more site specific data is collected during subsequent site evaluation phases, provided the community remains interested in continuing in the site selection process.

Safe Containment and Isolation

The geological and hydrogeological conditions of a suitable site should promote long-term isolation and containment of used nuclear fuel and retard the movement of any potentially released radioactive material. This requires that the repository be located at a sufficient depth, around 500 m, in a sufficient rock volume with characteristics that limit groundwater movement. The review of readily available information indicates that the Pinehouse area contains areas that are expected to have geological and hydrogeological conditions that can potentially meet the containment and isolation requirements.

The geology of the Pinehouse area is dominated by felsic gneiss, with the presence of narrow bands of metasedimentary rocks. Given their granitic composition, their lateral extent and depth, the felsic gneiss rocks might be considered as potential host rock for a deep geological repository.

Faulting in the Pinehouse area has been inferred on a frequency of 10 km to 20 km and is in a predominantly northwest (and secondary northeast) direction. Sufficient volumes of rock to potentially host the repository exist between these faults. There is no readily available information that suggests fracturing in the rock at depth between the inferred faults. This would need to be assessed in subsequent site evaluation stages.

From a hydrogeologic perspective, the review of readily available information did not reveal the existence of known deep fracture systems or deep aquifers in the crystalline rock within the Pinehouse area. Crystalline rocks, such as those found in the area, generally have hydraulic properties that would limit groundwater flow except where extensive fracturing is present. The presence of active deep groundwater flow systems in crystalline formations is controlled by the frequency and interconnectivity of fractures at depth. Experience from other areas in the Canadian Shield indicate that active groundwater flow tends to be generally limited to shallow fractured systems, typically less than 300 m depth.

Long-term Stability

A suitable site for hosting a repository is a site that would remain stable over the very long term in a manner that will ensure that the performance of the repository will not be substantially altered by geological and climate change processes, such as earthquakes or glaciation. A full assessment of this geoscientific factor requires detailed site specific data that would be typically collected and analyzed through detailed field investigations.

At this early stage of the site evaluation process, the long-term stability factor is evaluated by assessing whether there is any evidence that would raise concerns about the hydrogeological and geological long-term stability of the Pinehouse area. The review of readily available information did not reveal any obvious characteristics that would suggest this.

Pinehouse is located in the Hearne Province of the Canadian Shield, where large portions of land have remained tectonically stable for the last 1.8 billion years. No earthquakes have been recorded near Pinehouse from 1985 through 2010 and there is no evidence of historical earthquakes prior to 1985. There is no evidence that the Needle Falls Shear Zone (located approximately 30 km east of Pinehouse) or the smaller scale faults in the Pinehouse area have been significantly active in the last 1.8 billion years.

The geology of the Pinehouse area is typical of many areas of the Canadian Shield, which has been subjected to numerous glacial cycles during the last million years. This is a significant past perturbation that will likely occur in the future. However, findings from studies conducted in areas of the Canadian Shield suggest that deep crystalline formations, particularly plutonic intrusions, have remained largely unaffected by past perturbations such as glaciations.

Potential for Human Intrusion

The site should not be located in areas where the containment and isolation functions of the repository are likely to be disrupted by future human activities such as exploration or mining. This factor has already been addressed in previous sections, which concluded that the potential for deep groundwater resources at repository depths and known economically exploitable natural resources is low throughout the Pinehouse area.

Amenability to Construction and Site Characterization

The characteristics of a suitable site should be favourable for the safe construction, operation, closure and long-term performance of the repository. This requires that the strength of the host rock and in-situ stress at repository depth are such that the repository could be safely excavated, operated and closed without unacceptable rock instabilities; and that the soil cover depth over the host rock should not adversely impact repository construction and site investigation activities. Similarly, the host rock geometry and structure should be predictable and amenable to site characterization and interpretation activities.

From a constructability perspective, limited site specific information is available on the local rock strength characteristics and in-situ stresses for the Pinehouse area. However, there is abundant information at other locations of the Canadian Shield that could provide insight into what should be expected for the Pinehouse area in general. Available information suggests that crystalline rock formations within the Shield such as the felsic gneiss generally possess geomechanical characteristics that are good to very good and amenable to the type of excavation activities involved in the development of a deep geological repository for used nuclear fuel.

In terms of predictability of the geological formations and amenability to site characterization activities, the review of readily available information on the bedrock geology and Quaternary geology for the Pinehouse area indicate conditions which could make the rock mass more difficult to characterize and predict may be present in localized

areas. Examples of such conditions are overburden thicknesses of up to 20 m at specific locations and low lying areas in the Pinehouse area that are extensively covered by muskeg. The degree to which these factors might affect the characterization and data interpretation activities would require further assessment during subsequent stages of the site selection process.

4.0 INITIAL SCREENING FINDINGS

This summary report presents the results of an initial screening to assess the suitability of the Pinehouse area against five initial screening criteria using readily available information. As outlined in NWMO's site selection process (NWMO, 2010), the five initial screening criteria relate to: having sufficient space to accommodate surface facilities, being outside protected areas and heritage features, absence of groundwater resources at repository depth, absence of known natural resources and avoiding known hydrogeologic and geologic conditions that would make an area or site unsuitable for hosting a deep geological repository.

The surface area within the boundaries of the Northern Village of Pinehouse is only 1 km^2 and would not be sufficient to accommodate the repository surface facilities. Therefore, as per discussions between NWMO and the community, the initial screening was conducted to assess whether there are areas within the periphery of the Northern Village (the Pinehouse area) that would meet the initial screening criteria.

The review of available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Northern Village of Pinehouse from further consideration in the NWMO site selection process. There are areas at the periphery of the Northern Village of Pinehouse that are potentially suitable for hosting a deep geological repository. These areas include the felsic gneiss rocks that dominate the geology of the Pinehouse area. Potential suitability of these areas would need to be further assessed during subsequent evaluation stages, if the community remains interested in continuing with the site selection process.

The southwestern portion of the Pinehouse area was excluded from further consideration because the potentially suitable host rock formation, the felsic gneiss, lies under about 100 m of sedimentary rocks of the Western Canada Sedimentary Basin. Because of the nature of the structural characteristics of crystalline rock (e.g., fractures geometry and frequency), the presence of the sedimentary cover would greatly reduce the ability to adequately characterize the host rock.

It is important to note that at this early stage of the site evaluation process, the intent of the initial screening was not to confirm the suitability of the Pinehouse area, but rather to identify whether there are any obvious conditions that would exclude it from further consideration in the site selection process. Should the community of Pinehouse remain interested in continuing with the site selection process, more detailed studies would be required to confirm and demonstrate whether the Pinehouse area contains sites that can safely contain and isolate used nuclear fuel.

The process for identifying an informed and willing host community for a deep geological repository for Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future.

5.0 REFERENCES

Golder Associates Ltd., 2011. Initial Screening for Siting a Deep Geologic Repository for Canada's Used Nuclear Fuel – Northern Village of Pinehouse, Saskatchewan. Golder Report Number 10-1152-0110 (3000)

NWMO, 2010. Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel, Nuclear Waste Management Organization. (Available at www.nwmo.ca)

6.0 REPORT SIGNATURE PAGE

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