

Independent Expert Advisory Committee (IEAC) Oversight Committee (OC)

BRIEFING PACKAGE

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IEC Opinion and Update on the draft report “Muskrat Falls – Soil and Vegetation Removal from the Future Reservoir Area”

On December 22, 2017, the IEC received the draft report “Muskrat Falls – Soil and Vegetation Removal from the Future Reservoir Area”, prepared by SNC Lavalin for Nalcor in response to Recommendation #1 made by the IEAC and accepted by the Minister of Municipal Affairs and Environment on September 25, 2017: *“The IEAC recommends that a feasibility study be undertaken by December 20, 2017, for the removal of soil and vegetation from the future reservoir area.”* The Executive Summary of the draft report is provided on page 5.

The report was presented to us very much in draft format, with some noticeable oversights, incorrect figures, basic errors and unqualified statements. Overall, the tone of the report is dismissive, and in its current form is not a useful tool for assessing the feasibility of mitigation through soil removal. Some requirements of the Statement of Work were not fulfilled, such as the assessment of targeted soil removal. It was expected that with the work completed by Nalcor in 2017 (Amec and Azimuth) on total organic carbon (TOC) and labile carbon content of soils in the future reservoir, a speculative targeted-removal scenario could have been assessed in this report. It is recognized that it would have been advantageous for the IEC to provide more input into targeted scenarios before the Dec 20th deadline, however an opinion based on the best available science and traditional knowledge was not possible within that timeline (ie. we awaited results of soil flux experiments, and were seeking convergence of the Harvard and Nalcor predictive models).

Moving forward, the IEC is working with Nalcor/SNC Lavalin to seek clarity and gain a better understanding of the assumptions made and conclusions drawn in the draft feasibility study, and moreover, to achieve a more complete study that fully addresses the Statement of Work. Concurrently, we are running scenarios through the Harvard and Nalcor models, and will soon be receiving results from the soil flux experiments (January 29).

The IEC has not discounted the benefits of targeted soil removal as a mitigation option for the protection of health of the local and indigenous population. We know that there is a relationship between organic carbon in the newly flooded area of reservoirs and environmental methylmercury concentrations. We will continue to examine the results of the work we have commissioned in order to help better define this relationship for Muskrat Falls. We acknowledge that Nalcor has presented the draft feasibility study as a draft for discussion, and we will continue to work with them by quantifying a recommendation for targeted removal that can be added to the study.

Muskrat Falls – Soil and Vegetation Removal from the Future Reservoir Area – Executive Summary

The following is the Executive Summary of the draft report “Muskrat Falls – Soil and Vegetation Removal from the Future Reservoir Area”.

IMPORTANT POINTS TO NOTE:

- The Scope of Work included an analysis of two scenarios of soil and vegetation removal: a) complete removal, and b) targeted removal. Scenario b) was not addressed in the current draft. The draft report in its current form examines the technical and economic factors associated with the removal of all soil and vegetation from the entire future reservoir area, up to the 42m asl (above sea level) elevation (3m above the full impoundment level).
- There is a considerable amount of uncertainty in the cost estimate stated in the Executive Summary, as the range of costs provided in the report is between \$1.2 billion to \$2.3 billion, for complete removal of soil and vegetation to 42m asl. Targeted soil removal options that, for example, consider accessibility (ie. areas that are already cleared of trees and that are accessible by road) would result in a lower cost estimate.

Muskrat Falls – Soil and Vegetation Removal from the Future Reservoir Area



Executive Summary

This report presents the preliminary construction assessment carried out by SNC-Lavalin Inc. for the Muskrat Falls Hydroelectric Project reservoir (Site) located in the Lower Churchill Project (LCP) area. The constructability assessment considered technical and economic factors associated with the overburden soil and vegetation removal from the future reservoir area.

This report addresses the removal of all organic soil and vegetation, as requested by the Independent Expert Advisory Committee (IEAC). The purpose of the removal is to mitigate the potential for the transmission of methyl mercury into the water courses.

The analysis includes a review of current physical characteristics of the Muskrat Falls reservoir and its surrounding area using available GIS data and compilation of data from various reports and surveys. The analysis is focused on engineering requirements and constructability based on soil types, volumes and depths of the organic soil layer that can be removed safely in this new phase.

The schedule is short (6-7 months) and mobilisation will significantly reduce available time. Allowing 2 months for mobilisation is necessary but probably unrealistic. The volumes to be excavated are very large, even for just the organic materials they are large. The volumes of material estimated for excavation vary greatly if it is assumed that winter operation requires greater depths of excavations. This is probable and the rate of production makes it difficult to be limited in the removal and separation of frozen and other material.

The estimate of required equipment (Table 11.2) is very high. It will be a challenge to locate sufficient equipment to complete the work, the numbers represent a substantial proportion of the equipment available in Eastern Canada. Increasing the size of haul trucks and associated vehicles could increase productivity and reduce numbers of plant and operators. However, larger equipment requires longer mobilisation times and specialist support. For a short construction program it is likely that mobilisation time would be very high and an even higher premium on rates demanded for equipment.

Contractually the project may require a number of large contractors to be able to complete the work. Rates are likely to be high as there will be very little competition particularly if it is all to be completed in a short period of time. There is no incentive for longer term work and investment in additional plant and equipment if it sits idle after the project.

Environmentally the project faces a number challenges. Exposing large areas of the footprint is likely to result in environmental concerns stakeholder consultations, and issues related to obtaining necessary permit and clearances.

The clearance of all organics (trees, brush and organic soils) from the footprint of the reservoir to FSL is extremely costly and unlikely to be achievable within the schedule to allow impoundment for first power in July 2019. Increasing the reliability of delivery in that time period, without triggering a major landslide, is difficult. The act of removing organics (all trees, brush and organic soils) from the footprint may in itself cause instability of the slopes while construction proceeds.

Muskrat Falls – Soil and Vegetation Removal from the Future Reservoir Area



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The overall program of organic soil and vegetation removal should be considered a major civil engineering activity in its own right. The clearing project should be considered in the context, it is on the scale of a large mine development conducted in less than one year rather than the more typical 5 to 10 years to first ore production from breaking ground. The short schedule drives the costs and the generation of extraordinary premiums for the work.

The program of works to remove all organics (soils, trees and brush) from the footprint of the FSL is very challenging and the cost extreme at up to \$2.3 billion. The project constitutes an extreme civil engineering project (in short duration and cost) and would be perhaps unique in attempting to conduct such a large project of this nature amongst significant geohazards in so short a period of time.

The project may be achievable in one year with sufficient lead time for planning, engineering, procurement and regulatory requirements (consultation and approval). However, it should be considered a challenging and difficult project with a high risk of not delivering on schedule.

Update on the IEC work on Health Aspects of Methylmercury and Muskrat Falls.

January 14, 2018

NOTE: The following is a draft report from the IEC Human Health Subcommittee and not a final document for public release. The IEC is currently reviewing the work being submitted by our commissioned biomonitoring expert, and we wish to share some preliminary results with the OC to have it reviewed concurrently by both committees. We welcome any feedback or questions that you might have, which will be considered in our review process. Any public messaging with regards to human health issues will undergo full review by all committees and experts involved before it is finalized.

Introduction

The purpose of this report is to provide the Oversight Committee with an update on the ongoing work of the IEC on the human health aspects of methylmercury (MeHg) and Muskrat Falls.

Background

Health effects of Methylmercury:

A google search of methylmercury results in phrases such as “*Methylmercury* is a very poisonous form of mercury” or “*Methylmercury* poisoning”. A search also results in references to incidents of high dose exposure related to contamination of fish or grain with methylmercury that led to serious and alarming health effects in exposed people. Some members of the public and local media have used these terms and phrases when discussing the Muskrat Falls Project. This creates the perception that the risk related to MeHg and Muskrat Falls is higher than it is. The situation in Labrador is very different and shouldn't be confused with high dose exposure.

Most people in Canada and the US are exposed to low levels of MeHg, often through food. In Labrador, country food is an important source of exposure. There are many factors that determine whether health effects will occur as a result of this low level exposure including the age or developmental stage of the individual, the amount to which a person is exposed, the time period over which exposure occurs and the overall diet.

It is known that low levels of MeHg exposure over time may have health effects. Unborn babies, infants and children are the most susceptible to this exposure. These effects are very subtle and can only be detected by very specialized testing. These subtle effects may or may not be clinically significant for infants and young children. The evidence for health effects in adults is not conclusive.

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There is ongoing research in this area including among Inuit in northern Quebec where a group of children exposed to MeHg in utero are being followed. The research shows subtle effects especially related to exposure of the fetus and young children. See Appendix A “Mercury and Human Health” for more detailed information.

MeHg is not the only exposure of concern for the fetus. Alcohol and smoking are well known to cause adverse pregnancy outcomes and clinically significant effects on the fetus. (low birth weight, prematurity, fetal alcohol spectrum disorder).

Methylmercury and Country Food:

Country food is one (but not the only) source of exposure to MeHg. Given the natural desire to protect the fetus, infants, children and all family members from any effects related to MeHg, it would seem sensible to limit exposure to MeHg by decreasing consumption of country food. However, it is not as simple as that.

Public discourse around increased MeHg in country food as a result of Muskrat Falls has focused on the possible health effects of MeHg without taking into account the benefits of country food. Country foods are the source of many very important nutrients that promote health such as omega-3 fatty acids and Vitamin D. Some of nutrients in country food may in fact counteract the effects of MeHg. In addition, not all country foods have the same amount of MeHg. It depends on the type of country food and its habitat. For example, salmon spend very little time in Lake Melville and normally don't feed during this part of their life cycle, so they will continue to be a very healthy food. Country foods also provide positive cultural and social benefits and contribute to food security in an area where the availability of a sufficient supply of good quality, healthy and affordable store-bought food is an important issue. There needs to be a balance between exposure to MeHg and the benefits of country food.

Provincial officials have indicated in the past that consumption advisories would be considered in the future if levels of MeHg in country food increased as a result of the Muskrat Falls project. This approach does not take into account the health benefits of country food, or issues related to food security as noted above. Limiting exposure to MeHg by advising against consuming country foods i.e. consumption advisories is not the only or the best approach.

Other approaches include:

- Upstream mitigation to decrease the amount of MeHg that is available for bioaccumulation in fish, sea mammals and wildfowl by decreasing where feasible the amount that enters the foodweb.
- Providing more specific information for consumers of country food on:
 - which species are more likely to bioaccumulate MeHg and which will have lower levels.
 - the positive health benefits of country foods by species.
 - which parts of fish or sea mammals etc. should be eaten as opposed to other parts.
- Seeking out information on who in the population is more vulnerable due to consumption patterns, stage of development etc. and providing them with the appropriate information.
- Taking personal preference into account.

Progress of the IEC on health aspects

While all of the work of the IEC is directed towards protecting the health of people in the affected communities, this report focuses on human exposure as opposed to the upstream considerations for decreasing the amount of MeHg that is available for bioaccumulation or on monitoring levels of MeHg in country food.

The IEC has developed a work plan for the human health related work. One of the key elements on the work plan is to review and consolidate the information in two reports on human exposure through diet and the measurement of actual levels of mercury in the body (biomonitoring using human hair samples). One of these reports is the Human Health Risk Assessment commissioned by Nalcor as part of the Environmental Assessment process (Golder Associates, 2015). The other is the research done by Calder and colleagues on Inuit in the Upper Lake Melville area and Rigolet. A toxicologist/environmental health scientist was contracted to review and analyze the relevant documents (Dr. Chris Ollson). The committee is scheduled to receive his report and to participate in a webinar on this topic before the end of January. However, he has provided the points below) for consideration:

Initial Findings pertaining to baseline conditions and predictive assessments for methylmercury (MeHg) for the Muskrat Falls Project:

1. *There are two datasets that provide information on the current day level of MeHg in hair for the communities in the area - Calder 2016 and Golder 2015.*
 - a. *Both of these studies used appropriate recruitment, sampling and analytical techniques.*
 - b. *They are complementary datasets, with Calder focused on the Inuit communities and Golder on the remaining communities (including some Inuit participation). These datasets can be combined, and I believe taken as a whole, can be used to make meaningful assessment for all communities in the area harvesting country food.*
 - c. *The combined results indicate that MeHg levels are typically well below any Canadian benchmark concern levels and that the current community practices of harvesting country foods is safe.*
2. *There have also been two sets of dietary surveys completed. Again, they appear to be complementary and can be used in the future to target species of highest consumption for the various communities.*
3. *In all cases the prospective (in the future) risk assessments have predicted a potential increase of MeHg in some harvested species. All of these assessments align around a potential 4-10 fold increase, only in certain species, with a level of uncertainty. I note that risk assessments use conservative assumptions in risk prediction and should over-estimate the potential for an increase in dietary intake of MeHg. I understand that there is an EEM program underway and*

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that it should provide an effective monitoring tool to catch any increasing trend of MeHg in species over time, prior to it ever becoming cause for community concern.

4. *At this point it is unclear the extent to which an increase in MeHg in country foods may result in an actual health risk to their consumption. The notion that one could simply implement a consumption advisory is far too simplistic and potentially drastic measure. From McAuley and Knopper, 2011 "consumption advisories can lead to cultural loss and have been linked to a certain amount of social, psychological, nutritional, economic and lifestyle disruption." I believe that additional work could be undertaken to better understand this issue, for example:*

a) better interpret the dietary studies for species most harvested and seasonal patterns,

b) working with communities to understand the abundance of these species for harvest, the existing food security issues for the communities and species of particular cultural importance.

c) Involvement of community members in developing a pre-established community-based solution/program that could then be implemented in the event that the EEM program indicates that action is warranted for one or more species.

Christopher Ollson, PhD
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Ollson Environmental Health Management

IEC is also reviewing and developing background papers on the benefits of country food, the risks and benefits of consumption advisories and best practices around communicating this type of information to communities.

IEC notes with interest that NunatuKavut included biomonitoring and dietary studies as part of their agreement with Nalcor.

The IEC is aware of and is following other relevant initiatives. Harvard researchers have looked at the nutritional benefits and risks of replacing country food with store bought food using data from the previous biomonitoring and dietary survey work in Rigolet and the Upper Lake Melville communities. The scientific paper prepared as a result of this work has been submitted for publication and is not publicly available at this time. However, the authors provided IEC with a summary of the manuscript in which they state that country food is an important source of key nutrients. While replacing country food with store bought food may decrease health risks related to MeHg, it would increase nutrient deficits and may exacerbate rather than mitigate some health risks in communities experiencing food insecurity. Choosing country foods that are high in nutrients and low in methylmercury, such as salmon, will maximize health benefits.

References:

Calder RSD, Schartup AT, Li, M et al. 2016. Future Impacts of Hydroelectric Power Development on Methylmercury Exposures of Canadian Indigenous Communities. Environ. Sci. Technol., DOI: 10.1021/acs.est.6b04447

Calder RSD, Bromage S, Sunderland EM., 2017. Potential Impacts of Food Consumption Advisories on Inuit Health in the Lake Melville Region. Executive Summary of Manuscript “Countervailing Health Risks of Food Consumption Advisories for Labrador Inuit” for Community Comment. Undated. Provided to IEC by EM Sunderland.

Golder and Associates, 2015. Report on the Baseline Dietary Survey and Human Biomonitoring Program, Nalcor Energy Lower Churchill Project. Available at <https://muskratfalls.nalcorenergy.com/environment/generation/>

Ollson C. Initial findings. Email to K. Reimer, IEAC. Jan 10, 2018

Appendix A: Mercury and Human Health

How are people exposed to methylmercury?

Most people in Canada and the US are exposed to low levels of methylmercury, often through food. There are many factors that determine whether health effects will occur as a result of this exposure including the age or developmental stage, the amount to which a person is exposed, the time period over which exposure occurs.

In Labrador people are exposed to low doses of methylmercury through both store bought and country food over their lifetime. Unborn babies, infants and children are the most susceptible to this exposure.

What are the health effects of low dose methylmercury over a long time?

The health effects of low doses of methylmercury over a long period of time are difficult to detect as there are no obvious signs and symptoms. A considerable amount of research has been done and continues in this area.

The developing nervous system in unborn babies (fetus), infants and young children is the most susceptible to adverse health effects of methylmercury. Large studies have been done in the Faroe Islands, New Zealand and Nunavik (northern Quebec), where the consumption of country food and the way of life most closely resembles that of the Labrador Inuit. Exposure of the unborn baby via the diet of the mother may result in effects on several different aspects of child development including intellectual ability, memory, attention, language, and fine motor and visual and spatial skills. Postnatal exposure may also result in some subtle neurological effects. Further research is needed to see if the effects are persistent.

Exposure during pregnancy may also result in earlier delivery by a few days and reduced fetal growth.

Unlike for children, the evidence for the health effects of long term low dose exposure of adults to methylmercury is limited. There may be some neurological effects and effects on the cardiovascular system but the studies are not consistent or conclusive.

Are the health effects of exposure to high levels methylmercury different from exposure to low levels over time?

The health effects of exposure to high levels of methylmercury are much more overt and serious than exposure to low levels over time. Much of what is known about the health effects of methylmercury comes from exposure of people to high doses of mercury either through their occupation or from specific situations such as in Japan and Iraq. In Japan, discharges from a chemical plant into a bay contaminated fish and seafood, leading to high concentrations of mercury in hair of the people who ate the seafood. In Iraq, people were exposed through local bread products made from contaminated flour. These high dose exposures resulted in overt clinical effects such as sensory impairment of the

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extremities, changes to visual fields, loss of balance and co-ordination, hearing and vision loss, muscle weakness, tremor, decline in memory and thinking skills and death.

Exposure to high doses of methylmercury may also be non-specific, hard to detect and vary between individuals. An assessment by an expert such as a neurologist is required particularly as there are other causes of this clinical picture.

The situation in Labrador is very different from what happened in Japan and Iraq. Exposure from food is much lower, occurs over a long period of time and may not result in readily observable symptoms.

How long does mercury stay in the human body?

Mercury is eliminated from the body through natural processes. About half of the mercury in the body present at a certain time will be eliminated in 50 to 70 days.

Is there an effective treatment available to remove mercury from the human body?

There is no specific treatment that removes mercury from the human body. However, it is important to note that the human body eliminates mercury on its own. About half of the mercury in the body present at a certain time will be eliminated in 50 to 70 days.