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EA File: EA1011-001
Via email: pmercredi@reviewboard.ca

Paul Mercredi
Environmental Assessment Officer
Mackenzie Valley Review Board (MVEIRB)
Mackenzie Valley Environmental Impact Review Board
#200 Scotia Centre, 5102-50th Avenue
Yellowknife, NT. X1A 2N7

RE: Lutsel K'e Dene First Nation- Round Information Request for Avalon Rare Metals Inc.'s Thor Lake Rare Earth Element Project (Avalon)

The Lutsel K'e Dene First Nation (Lutsel K'e) is pleased to provide the following Information Request submission to the Mackenzie Valley Environmental Impact Review Board for the Avalon Rare Metals Inc.'s Thor Lake Rare Earth Element Project.

In preparing its Information Requests the Lutsel K'e Dene First Nation became aware that rare metal mining is in its formative stages of development in North America with the Mountain Pass mine the only rare earth element mine ever to be developed in the United States. Therefore, much of the knowledge surrounding rare earth element mining has resulted from operations at Mountain Pass (Hedrick, 2006) as found in (United States Environmental Protection Agency, August 15, 2011).

Given the "newness" of rare metal mining in North America, the Lutsel K'e Dene First Nation encourages the MVEIRB to thoroughly assess the proposed mine. This will serve the interests of the Lutsel K'e Dene First Nation, the NWT, but also the broader public interest well into the future. Undoubtedly, there will be an added burden on Avalon, but with the burden comes the opportunity of becoming a world class rare metal mining company and the competitive advantage of being the first in Canada to develop and operate a rare metal mine.

Lutsel K'e looks forward to working with the Review Board, and other parties in reviewing the project.

Sincerely,

Mike Tollis,

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IR Number: 1
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Employees' Flights to and from the Nechalacho Mine and flotation Plant Sites
DAR Section 4.9.1.1 Nechalacho Mine and flotation Plant Site
ToR Section: N/A

Preamble:

The GNWT in its September 27, 2010 letter to the MVEIRB asked for explicit details on travel and site access policies for local and regional Northern residents and southern hires and, incentives for the company's or contractors employees to live in NWT communities.

Avalon responded by saying that its rotation work schedule is based on fly-in/fly-out transportation, with onsite camp facilities. The planned rotation will include periods of overlap for key personnel to ensure continuity and safe operations. Avalon will provide employees' flights to and from the site. Flights are planned to originate from Edmonton, Yellowknife, Lutsel K'e and Hay River. Page 537, (Avalon Rare Earth Metals Inc, 2010). Further Avalon will attempt to hire 30 per cent of its labour force from its regional study area communities.

According to the Australian Journal, the greatest risk to the economic health of mining towns is the rising tide of fly-in fly-out workers. The more the mining company uses fly-in-fly-out (FIFO) staff, the less likely the local town is to thrive from the presence of a resources operation. Under current Queensland government policies, a mining company is allowed only a proportion of its workforce as FIFO workers; 30 per cent must be local employees (Ryder, 2011).

Request:

Please provide explicit details on incentives for the company's or contractor's employees to live in NWT communities; and, will Avalon Rare Metals Inc. commit to adaptive management policies whereby over the lifetime of its mine at least 50 per cent of its employees reside in the NWT on a full-time basis?

IR Number: 2
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Impacts and Benefits Agreement
DAR Section: Section 7.1.3 Employment Opportunities. Potential Effects
ToR Section: N/A

Preamble:

Avalon Rare Metals Inc. has signed Negotiation Agreements with both the Yellowknives Dene First Nation and the Deninu Ku'e First Nation regarding the development of the Nechalacho rare earth metals deposit at Thor Lake, NWT. Broad principles for co-operation are outlined in the Negotiation Agreement (often referred to as a Memorandum of Understanding), providing the basis for the negotiation towards an Impacts and Benefits or Accommodation Agreement. An Accommodation Agreement typically covers a number of issues including: environmental protection, business and employment opportunities. Page 846, (Avalon Rare Earth Metals Inc, 2010).

Request:

Will Avalon Rare Metals Inc. commit to signed Negotiation Agreements with the Lutsel K'e Dene First Nation regarding the development of the Nechalacho rare earth metals deposit at Thor Lake, NWT? Broad principles for co-operation are outlined in the Negotiation Agreement (often referred to as a Memorandum of Understanding), providing the basis for the negotiation towards an Impacts and Benefits or Accommodation Agreement.

IR Number: 3
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Beryllium
DAR Section: Section 4.2 Property Project History, 4.2.2 Highwood Resources Ltd., Page 445
ToR Section: N/A

Preamble:

The overall metal content of rare earth element ores is another geochemical concern associated with rare earth element production. It is important to note rare earth element mining is hard rock mining, so any of the metal concerns associated with hard rock mining should be a concern with rare earth element mining as well. Metals such as aluminum, arsenic, cadmium, cobalt, copper, gold, iron, lead, manganese, silver, and zinc are often associated with hard rock mining. The dangers of metals in the environment are well documented. Metals of special concern at rare earth element mines include, but are not limited to, aluminum, arsenic, barium, **beryllium** *(emphasis added)*, cadmium, copper, lead, manganese, and zinc (United States Environmental Protection Agency, August 15, 2011).

Beryllium is naturally occurring in rocks and could be found in elevated concentrations at rare earth element mines because beryllium has a 2+ charge like calcium. Calcium is a chemical constituent of carbonate minerals that characterize carbonatites. Beryllium can make its way into air, water, and soil. In air, beryllium exists as very small particles that get carried by wind. Solubility of beryllium in water is dependent on the compound. Some beryllium compounds are soluble while others are not. Weathering processes can change insoluble compounds into soluble (Hurst, 2010) soils, where they can reside for thousands of years without moving into groundwater. Water soluble beryllium compounds pose more of threat to organisms than insoluble forms, however the greatest threat to humans from beryllium is in air. Inhalation of beryllium can harm the lungs of humans and other terrestrial animals. Such damage is similar to pneumonia with reddening and swelling of the lungs. This condition is referred to as "acute beryllium disease." Lung damage stemming from beryllium inhalation can increase a person's risk of lung cancer. The DHHS and IARC have determined beryllium to be a human carcinogen, while EPA believes beryllium is a probable carcinogen (ASTDR, 2002) as found in (United States Environmental Protection Agency, August 15, 2011)**.**

Request:

Please report if beryllium will ever be mined, processed and or created as a by-product; even as a waste, during any part of the mining, milling and refining processes.

IR Number: 4
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc. and the GNWT
Subject: Radon
DAR Section: Section 4.7.3.1 Environmental Characterization of Waste Rock, Tailings, Ore and Concentrate
ToR Section: N/A

Preamble:

One contaminant associated with rare earth element ores are radionuclides. Rare earth element bearing minerals such as monazite, xenotime, and bastnasite can contain low levels of primordial thorium-232, uranium-238, and their decay products. Uranium-235 is also present but in very low quantities. Thorium-232 and uranium-238 are rather benign, but some of the decay products can represent a danger to the environment due to the energetic particles and gamma rays released during radioactive decay. For example in the uranium-238 decay chain, bismuth-214 has a very energetic gamma release and produces radon-222 that can be inhaled and decay in the lungs (Argonne National Laboratory, 2005) as found in (United States Environmental Protection Agency, August 15, 2011).

Mineralization in the Nechalacho deposit includes LREE found principally in allanite, monazite, **bastnaesite** (emphasis added), and synchysite; yttrium, HREE, and tantalum found in fergusonite; niobium in ferro-columbite; HREE and zirconium in zircon; and gallium in biotite, chlorite, and feldspar in albitized feldspathic rocks. This mineralogy has been studied by SGS Minerals Services, XPS Process Services, and McGill University. Page 487 (Avalon Rare Earth Metals Inc, 2010).

SENES (SENES, 2011) on page 1-8 states that radon exposures in underground mining and in enclosed areas can be an issue if appropriate ventilation is not provided. Further on pages 3-1 and 3-2 SENES notes that The NWT Mine Health and Safety Act [*Mine Health and Safety Act*: Consolidation of Mine Health and Safety Regulations R-125-95, MHSA 2011] covers radiation hazards; specifically as follows for exposure to radon progeny:

> ***9.90.*** *The manager shall inform any person in writing of the amount of the exposure of the employee to radon daughters when that exposure reaches*
> *(a) 0.75 WLM in any one month;*
> *(b) 1.5 WLM in any period of three consecutive months; or*
> *(c) 2 WLM in any period of 12 consecutive months.*

SENES adds that although predictions of radon levels can be made, such as in underground locations, **direct measurements are required to confirm the exposures** (emphasis added).

The NWT regulations following the A.E.C.B (now the CNSC) limits for allowable dose and radon progeny levels. Current regulations specify that radon concentrations are multiplied by a dose conversion factor (DCF) of 5 mSv per WLM. Limits on total dose are 50 mSv in any one year and 100 mSv over five years (equivalent to 20 mSv/y) or equivalently, 4 WLM/y.

For protection SENES (SENES, 2011) states that good workplace ventilation is used to control workplace radon decay products levels. As for dust, experience suggests that ventilation provided for diesel and potential non- radiological exposures is often adequate for radiation protection purposes; and further emphasis this point on page 4-6 wherein SENES states that standard mine ventilation practices developed for conventional pollutants, such as diesel exhaust, are expected to control radon and its decay products to acceptable levels.

Request:

1. To Avalon. How will Avalon provide direct measurement of radon exposure for its underground work force?
2. To Avalon. Will the underground workforce have knowledge of the degree of radon exposure they are experiencing and cumulatively?
3. To Avalon. What constitutes “standard mine ventilation”?
4. To Avalon. How will Avalon monitor mine ventilation to ensure unacceptable radon gas accumulation?
5. To the GNWT. Does it have the capacity to effectively monitor work place safety with respect to Radon; and if not, what will the GNWT do to ensure the application of the NWT Mine Health and Safety Act [*Mine Health and Safety Act*: Consolidation of Mine Health and Safety Regulations R-125-95, MHSA 2011 with respect to radon.

IR Number: 5
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Tailings Impoundment
DAR Section: Section 4.7.3.1 Environmental Characterization of Waste Rock, Tailings, Ore and Concentrate
ToR Section: N/A

Preamble:

Rare earth deposits are often associated with elevated levels of thorium and/or uranium, both of which are radioactive elements. Radioactivity is an issue of concern as it relates to worker health in terms of exposure to radiation underground, mineral processing; transportation of radioactive materials; radioactive releases into the natural environment, and disposal of any radioactive product.
Regulations governing radioactivity include:

- Transportation of Dangerous Goods Regulations (TDGR), with limit of 70 Bq/g;
- Health Canada Regulations on Naturally Occurring Radioactive Material (NORM);
- Northwest Territories Mine Health and Safety Act and Regulations which require control on worker exposures where radon decay product levels exceed 0.4 WLM/y (Working Level Months per year); and,
- Canadian Nuclear Safety Commission if uranium and/or thorium materials are produced. Pages 490-491 (Avalon Rare Earth Metals Inc, 2010).

Potential radiation exposures of workers are specifically addressed in the *NWT Mines Act*. The NWT regulations provide limits on allowable radiation dose and exposure to radon gas and its radioactive decay products. The NWT regulations are based on the regulations of the Canadian Nuclear Safety Commission (CNSC), the federal agency that regulates the use of nuclear energy and materials. However, the mandate of the CNSC specifically excludes NORM; the CNSC regulations apply only to radioactive substances used in the nuclear fuel cycle, and to the transport and import/export of radioactive materials. To address situations where the exposure to NORM is not regulated in Canada, the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) were developed in 2000 by a federal-provincial-territorial NORM working group, with the support of Health Canada and the CNSC. Page 542 (Avalon Rare Earth Metals Inc, 2010).

In the United States however, the mining companies such as Rare Element Resources plans to work within the boundaries of Nuclear Regulatory Commission (NRC) rules for construction of a tailing impoundment to properly dispose of their wastes **in case** (emphasis added) thorium and uranium become concentrated enough to warrant regulation by the NRC (Pickarts, 2011) as found in (United States Environmental Protection Agency, August 15, 2011).

Request:

1. Given rare earth deposits are often associated with elevated levels of thorium, can Avalon confirm that there is no thorium at its mine.
2. If there is thorium at its mine or metallurgical plant, is it willing to meet similar standards as Rare Elements Resources just "in case" thorium levels become concentrated enough to warrant more stringent disposal regulation?

(United States Environmental Protection Agency, 1997) (Agency for Toxic Substances and Disease Registry, 2002)

IR Number: 6
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Toxicity of Rare Earth Elements
DAR Section: Section 9.1.3 Environmental Effects of Concentrate in Great Slave Lake
ToR Section: N/A

Preamble:

The United States Environmental Protection Agency (US EPA) states that the toxicity of rare earth elements in the environment are not completely understood but are considered metals at their elemental level (United States Environmental Protection Agency, August 15, 2011).

Avalon (Avalon Rare Earth Metals Inc, 2010) concludes that the anticipated environmental effects of any residual rare metal concentrates remaining on the bottom of Great Slave Lake in the vicinity of such a most unlikely incident would be expected to be of a negligible and insignificant nature with no significant residual impacts expected to occur.

Request:

1. Does Avalon agree with the US EPA that the toxicity of rare earth elements in the environment is not completely understood?
2. Will Avalon commit to increasing the public understanding of the toxicity of rare earth elements so that pre-emptive action can be taken to mitigate unforeseen environmental impacts?
3. If Avalon is open to increasing the public understanding of the toxicity of rare earth elements, will it commit to funding independent research into the subject over the lifetime of the Avalon Rare Earth Metals Inc. project?

IR Number: 7
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Carbonate mineral dissolution
DAR Section: Section 4.7.3.1 Environmental Characterization of Waste Rock, Tailings, Ore and Concentrate
ToR Section: N/A

Preamble:

Modified acid base accounting (ABA) test results reported by SGS (2011) for the Basal Zone ore composites (*Master Comp 1* and *Master Comp 2*), concentrates (*F-29 Gravity Conc*, *F-30 Gravity Conc* and *F-3 Conc*), low grade sample (*SW-SAG Reject*) and Basal Zone sample (*S-BZ-A SAG Reject*) indicated that these samples are potentially acid neutralizing (PAN). Similarly, although ABA test results for the upper ore sample (*S-UZ-A SAG Reject*) and the tails samples (*Test F-29 Tls* and *Test F-30 Tls*) suggested some minor uncertainty, the very low sulphide concentrations reported, coupled with the **significant carbonate (CO3) neutralization** (emphasis added) potential ratios (NP/AP), indicate that these samples are highly unlikely to generate acidity. The alkaline final pH values reported after **aggressive oxidation** (emphasis added) of these samples during net acid generation (NAG) testing, confirmed the highly unlikely acid generation potential of these samples (Avanlon Rare Earth Metals Inc., 2010).

It is important to note the natural buffer of carbonate minerals in rare earth element ores can cause potential environmental concerns as well. Too much carbonate mineral dissolution represents just as much danger as sulfide mineral dissolution. Carbonate mineral dissolution introduces alkaline materials into water, where they can raise the pH of water to elevated levels. The dissolution of carbonate minerals can also introduce possible contaminants into the environment similar to how sulfide mineral dissolution can. Bastnasite is one of the carbonate minerals that can undergo dissolution. The dissolution of this carbonate mineral is what would release the rare earth elements into the environment. Another contaminant to be concerned about in carbonate mineral dissolution is fluorine. Fluorine is also a constituent of rare earth element bearing bastnasite (United States Environmental Protection Agency, August 15, 2011).

Request:

As the mineralization in the Nechalacho deposit includes LREE found principally in allanite, monazite, **bastnaesite** (emphasis added), has Avalon reported the likelihood and possible impact that the dissolution of this carbonate mineral could release rare earth elements into the environment?

IR Number: 8
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Radiation Protection Program in Support of the Thor Lake Project
DAR Section: (SENES, 2011) Section 5.0 SUMMARY AND DISCUSSION
ToR Section: N/A

Preamble:

Modern mines are required to comprehensively evaluate environmental concerns at the earliest stages of mine planning and design. Environmental controls are now considered as an integral part of overall mine management (EPA, 1997). *However, mining and refining of rare earth elements, if not carefully monitored, can pose threats to human health and the environment (emphasis Added)*. Nowhere is this more apparent than in the nation dominating rare earth element production today (United States Environmental Protection Agency, August 15, 2011).

SENES (SENES, 2011) notes that due to the **absence of laboratory results on Hydrometallurgical concentrate samples, projections of radiological constituents of concern were conducted** (emphasis added) by SENES. SENES concludes that **"the radiation dose to some workers when exposed to average ore grades was estimated to be above 1 mSv per year, the dose limit for incidentally exposed workers recommended in the Canadian NORM Guidelines** (emphasis added). The dose limit for incidentally exposed workers is the same as that of general members of the public. Should such exposures occur, a radiation protection program (RPP) would be indicated."

Request:

1. Can Avalon please provide information as to how it will monitor worker exposure to radiological constituents of concern?
2. Will workers at the hydrometallurgical plant know their level of exposure to radiological constituents of concern?
3. Will Avalon have a radiation protection program at its hydrometallurgical plant?

IR Number: 9
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Hydrometallurgical Plant Process Flow Outputs
DAR Section: (SENES, 2011) 2.2.3 Hydrometallurgical Plant Process Flow
ToR Section: N/A

Preamble:

According to the Chinese Society of Rare Earths, every ton of rare earth elements produced generates approximately 8.5 kilograms of fluorine and 13 kilograms of flue dust. Additionally, sulfuric acid refining techniques used to produce one ton of rare earth elements generates 9,600 to 12,000 cubic meters of gas laden with flue dust concentrate, hydrofluoric acid, sulfur dioxide, and sulfuric acid. Not only are large quantities of harmful gas produced, alarming amounts of liquid and solid waste also resulted from Chinese refining processes. They estimate at the completion of refining one ton of rare earth elements, approximately 75 cubic meters of acidic waste water and about one ton of radioactive waste residue are produced.

China produced over 130,000 metric tons of rare earth elements in 2008 alone (IAGS, 2010). Extrapolation of the waste generation estimates over total production yields extreme amounts of waste. With little environmental regulation, stories of environmental pollution and human sickness remain frequent in areas near Chinese rare earth element production facilities. United States government agencies, including EPA, can learn a lot from China's environmental issues related to rare earth element production (United States Environmental Protection Agency, August 15, 2011).

SENES (SENES, 2011) describes the Hydrometallurgical Plant Process Flow. The process flow includes an Acid Bake wherein Concentrate will be mixed with concentrated sulphuric acid, heated to a temperature of about 200ºC, quenched with water and the resulting slurry will be pumped to automatic filter presses. The washed and blow-dried acid bake residue will be repulped and refiltered then conveyed to the acid bake residue handling system.

Request:

1. Will the Avalon Rare Metals Inc. project generate fluorine, gas laden flue dust and/or sulfur dioxide?
2. If the answer to any of the above is yes, please explain how much will be produced and potential impacts on human and animal health.

IR Number: 10
Source: Lutsel K'e Dene First Nation
To: Avalon Rare Metals Inc.
Subject: Water Treatment from the Tailings Basin if Required
DAR Section: Section 4.7.4.1 Environmental Characterization of Waste Rock, Tailings, Ore and Concentrate; and, 6.4.2.6 Assessment
ToR Section: N/A

Preamble:

The tailings and water management strategy for the Nechalacho Mine and Flotation Plant site consists of a closed loop system to minimize effects on the natural hydrologic flows within the Thor Lake watershed area. All tailings solids and fluids, as well as, process effluent from the Flotation Plant will report to the tailings basin. The TMF design currently includes a polishing pond. Excess water from the tailings basin **will be treated (if necessary)** and discharged from the polishing pond to Drizzle Lake. Ultimately, all water from the TMF will return to Thor Lake via Drizzle and Murky lakes. Page 499 (Avalon Rare Earth Metals Inc, 2010).

Based on the foregoing, water quality in Thor Lake and further downstream is not anticipated to be adversely affected by mining activities and discharges of decant water from the TMF. No adverse residual effects are therefore predicted. Water quality and biological monitoring will be carried out according to requirements of the Water License and the MMER. Monitoring results will be used to confirm that water quality downstream of the TMF discharge remains within allowable limits. Page 693 (Avalon Rare Earth Metals Inc, 2010)

Request:

How will Avalon provide assurance there will be no downstream impacts on Thor Lake or Great Slave Lake if it has no means of treating water from the tailings basin should such a need arise. If water treatment is found to be necessary, how will the water be treated? Using a water treatment plant or some other method?

IR Number:
Source: Lutsel K'e Dene First Nation
To: Department of Fisheries and Oceans Canada
Subject: Fisheries Authorization Permitting the harmful alteration, disruption or destruction of fish habitat (HADD)
DAR Section: 6.6 Fish and Fish Habitat
ToR Section: N/A

Preamble:

Section 35 of the *Fisheries Act* provides for the protection of fish and fish habitat. Under the Act, no one may carry out any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat (HADD) unless authorized by the Minister of Fisheries and Oceans Canada.

> **35.** (1) No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.
>
> Alteration, etc., authorized
>
> (2) No person contravenes subsection (1) by causing the alteration, disruption or destruction of fish habitat by any means or under any conditions authorized by the Minister or under regulations made by the Governor in Council under this Act (*Fisheries Act. R.S.C., 1985, c. F-14*).

Request:

1. What means and/or conditions are being considered by DFO and how will they satisfy DFO's No Net Loss and Fish Compensation policy?
2. Will DFO provide the MVEIRB a draft of its proposed Fisheries Authorization before the conclusion of the environmental assessment?

Bibliography

Agency for Toxic Substances and Disease Registry. (2002, September). *Agency for Toxic Substances and Disease Registry*. Retrieved 2011, from http://www.atsdr.cdc.gov/ToxProfiles/tp4-c1-b.pdf

Avanlon Rare Earth Metals Inc. (2010). *Developer's Assessment Report prepared for the Mackenize Valley Environmental Impact Review Board.* Avalon Rare Earth Metals.

Avanlon Rare Earth Metals Inc. . (2010). *Developer's Assessment Report prepared for the Mackenize Valley Environmental Impact Review Board.* Avalon Rare Earth Metals.

Hedrick, J. a. (2006). Rare Earth Elements. *Industrial Minerals Volume 7*, 769-792.

Hurst, C. (2010). *China's Rare Earth Elements Industry: What can the West learn?* Hurst, C.: Analysis of Global Security.

Pickarts, J. (June 22, 2011). *Bear Lodge Project Overview.* N.A: N.A.

Ryder, T. (2011, July 28). *Forget carbon tax, fly-in fly-out raises a red flag over mining hubs as investment destinations*. Retrieved January 2, 2012, from The Austraian Newspaper: http://www.theaustralian.com.au/business/property/forget-carbon-tax-fly-in-fly-out-raises-a-red-flag-over-mining-hubs-as-investment-destinations/story-fn9656lz-1226102792814

SENES. (2011). *Radiation Protection Program in Support of the Thor Lake Project.* N.A: SENES.

United States Environmental Protection Agency. (1997). *Hardrock Mining Framework.* N.A: United States Environmental Protection Agency.

United States Environmental Protection Agency. (August 15, 2011). *Investigating Rare Earth Element Mine Development in EPA Region 8 and Potential Environmental Impacts.* US EPA, EPA Document-908R1103.