Kiggavik Project

Environmental Impact Statement

Tier 3 Technical Appendix 4F

Noise Abatement Plan

December 2011

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1 INTRODUCTION

The AREVA Resources Canada Inc. (AREVA) Noise Abatement Plan (Plan) will be in effect for the duration of the Kiggavik Project. The Plan applies to the Kiggavik Project (Project) located approximately 80 km west of Baker Lake, points located between the Project and Baker Lake, and marine transport routes. The implementation of noise abatement practices is derived from the assessment of potential noise and vibration and applicable standards to develop effective mitigating practices. The following Plan outlines noise control methods, noise reduction through design, noise attenuation and minimization, and occupational noise management and monitoring programs.

1.1 PURPOSE AND SCOPE

AREVA developed the following management plan for the Kiggavik Project (Project) to mitigate effects identified within the noise and vibration assessments pursuant to the Nunavut Impact Review Board (NIRB) guidelines. The Plan provides guidance on management of noise and vibration effects from the Project as they relate to human health, the terrestrial environment, and aquatic/marine environments. The Plan includes actions to prevent, control, and mitigate noise and vibration hazards imposing a potential nuisance to surrounding populations. The Plan intends to conform to applicable standards, guidelines and regulations to minimize and mitigate noise effects.

The Project footprint consists of three components; Kiggavik and Sissons Mine Sites, the Kiggavik-Sissons Access Road, the Baker Lake-Kiggavik Winter Road, and the Dock and Storage Facility. The Plan will be in effect during construction, operation, and decommissioning of the Project. The Plan will undergo regular review and be updated as indicated by incident investigation, regulatory change, management review, and when otherwise required.

2 NOISE AND VIBRATION

High amounts of unwanted or undesirable sound defined as noise is characterized by small air pressure fluctuations above and below atmospheric pressure. Typical noise sources may include road traffic, air traffic, marine traffic, impact equipment, stationary equipment, blasting, material handling, earth movers, and facilities. Ground-borne vibration can be defined as the regular repeated motion of a physical object about a fixed point. The most perceptible indoor vibration is caused by sources within buildings including movement of individuals and operation of mechanical equipment within the building. Potential impacts from outdoor sources of ground-borne vibration are construction equipment, blasting, and road traffic. Disturbance effects from noise and vibration are regulated by various levels of government and shall meet the defined guidelines.

3 GUIDELINES

3.1 TERRITORIAL

The Nunavut Department of Environment (Environmental Protection Service) regulates activities that have the potential to affect noise and vibration via the *Nunavut Environmental Protection Act.* The Act regulates contaminant discharges into the environment and includes emissions of noise and vibration. Currently, no environmental noise regulations, guidelines or criteria have been established in Nunavut. Considering the absence of ground-borne noise or vibration regulations, guidelines or criteria at the Territorial and Federal Level, provincial guidelines were utilized to provide comparative regulatory context. The *Nunavut Wildlife Act,* under the Nunavut Land Claims Agreement and the Department of Environment Wildlife Management division regulate the Project effects on terrestrial and aquatic wildlife.

3.2 FEDERAL

The Fisheries Act and Species at Risk Act regulate the Project to ensure noise and vibration levels are below limits for protection of marine species and habitat. The National Guidelines for Environmental Noise Control (Health Canada 1989) provide techniques for noise measurement and outline the roles of each level of government in environmental noise control. The Guidelines outline the concepts and procedures for developing a noise control program and include information on land-use planning, examples of noise control legislation, technical reference material, instrument specifications and measurement practices, as well as prediction and noise reduction techniques. As shown in Table 3.2-1 Health Canada Recommended Point of Reception Sound Level Limits, the Guidelines also provide recommended general sound level limits for application at a point of reception.

Table 3.2-1 Health Canada Recommended Point of Reception Sound Level Limits

Location	Time Period	Sound Level Limit at Point of Reception (Leq, dBA)
Suburban Outdoor Recreational Area	7 a.m. to 11 p.m. (16-hr)	55
Suburban Outdoor Area[a]	11 p.m. to 7 a.m. (8-hr)	50

Source: (Health Canada 1989)
Note:
[a]applied at the plane of window for night time hours

The Department of Fisheries and Oceans Canada (DFO) produced *Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters* for protection of marine wildlife from vibrations (DFO, 1998). When guidelines cannot be met, a mitigation plan will be developed to outline procedures for protection of fish and their habitat. The DFO guidelines are as follows:

- No explosive may be used that produces or is likely to produce, a peak particle velocity greater than 13 mm/s in a spawning bed during egg incubation. Ground vibration levels are anticipated to fall below the DFO guideline limit of 13 mm/s beyond a distance of approximately 70 m from blasting operations.

- No explosive is to be knowingly detonated within 500 m of any marine mammal (or no visual contact from an observer using 7 x 35 power binocular).

- Although no blasting is expected to occur in any body of water on or around the Kiggavik Project site, AREVA will adhere to the following recommendation should the need arise. No explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e., overpressure) greater than 100 kPa in the swim bladder of a fish. DFO later determined a 50 kPa limit would be more sufficient for protection of fish.

4 NOISE SOURCES AND MITIGATION

Although there are no predicted significant effects resulting from the Project, the following general mitigation measures will be implemented to reduce construction, operation, and decommissioning noise and vibration at the source. No vibration monitoring is currently recommended relative to the protection of human health. A noise monitoring program will be established at the Kiggavik and Sissons Sites and Baker Lake dock facility that considers baseline noise prior to the Project and following implementation of the Project. AREVA is committed to fulfilling the following mitigation measures and noise control methods to ensure noise abatement on the Kiggavik Project.

4.1 CONSTRUCTION AND DECOMMISSIONING

The greatest noise effects from the Project are predicted to occur during construction and decommissioning. The short term residual noise effect is expected to be moderate or slightly above the existing noise levels in Baker Lake during the construction of the Dock and Storage Facility. This is primarily due to movement and use of heavy equipment at the Dock and Storage Facility area. Environmental noise associated with construction would consist of continuous noise produced by construction activities, as well as occasional noise produced by road, marine, and air traffic.

Construction activities will include in-water and on-land activities, including, but not limited to, tug and barge traffic, site grading, excavation, concrete production and pouring, pile driving, rock crushing and screening, power generation and building construction. Noise from the propulsion systems of the 4500 BHP tugs will also be produced by articulated tug and barge (ATB) operations during marine transport. Barges do not influence marine noise levels substantially as they are not self propelled. Other ocean vessels contributing to noise levels include fuel tankers, geared cargo ships and containerships. During construction, operation, and decommissioning, the Baker Lake dock site will not interact with marine vegetation or wildlife as the dock is situated within the Baker Lake freshwater habitat. Marine mammals and fish are not expected to undergo substantial effects from noise and vibration associated with routine activities however monitoring will ensure marine wildlife remains unaffected by marine vessels.

Potential effects from tug and barge noise depends upon sound propagation and proximity to riverbanks or islets in river channels. The ATB noise levels are largest offshore where conditions allow greater propagation, and alternatively smaller in closer proximity to shorelines. As referenced in the Technical Appendix 7B (Underwater Acousting Modelling of Tug and Barge Noise for Estimating Effects on Marine Animals), behavioral noise responses may occur from 90 to 150 dB in beluga whales and seals however low exposure levels of less than 150 dB greater

than 100 m are unlikely to injure marine wildlife. ATB sound levels during transit are likely audible to all species of the assessment, but are not expected to incur injury or hearing loss.

Vibration would consist of blasting and other operations of construction equipment, including pile driving. Some semi-continuous vibrations would occur from site preparation equipment (front-end loaders, dozers) and truck traffic. The maximum noise and vibration impact of the Project from construction and decommissioning occurs during the period where work activities are scheduled that require the greatest number of pieces of equipment to be operated simultaneously.

Removal of site infrastructure during decommissioning involves activities similar to construction. Some noise sources during construction such as blasting and pile driving would not occur during decommissioning. Work activities will occur in up to three primary areas (Kiggavik Mine Site, Sissons Mine Site and Dock and Storage Facility), each with its own maximum equipment usage requirements.

Construction activities at the Kiggavik and Sissons Mine Sites and during the South Winter Road construction are not expected to generate any perceptible residual noise effects, and there would be no cumulative noise and vibration effects.

4.2 OPERATIONS

As with the construction and decommissioning, operational noise effects would be local. Operations will occur at the Kiggavik and Sissons mine sites, dock and storage facility, marine transport routes, and south winter road. The mine infrastructure is designed to concentrate activities within a small footprint, which effectively reduces noise sources.

Activities during operation include open pit mining, underground mining, waste rock and ore stockpiling, mill operations (ore processing, power generation), tailings management, road transportation of ore, fuel, reagents and supplies, air transportation of yellowcake and personnel and exploration activities.

Environmental noise will consist of continuous noise produced by the excavation and processing activities at the Project. Vibration from blasting and intermittent operations of heavy equipment, including site preparation equipment (front end loaders, dozers) and truck traffic will occur. Intermittent noise will be produced by access/haul road traffic and air traffic, exploration activities within the lease boundary, and the 4500 BHP tugs during marine transport.

Residual effects would primarily be associated with the Pointer Lake Airstrip and mining activities close to the accommodations. The predominant source of noise and vibration from the Project will be heavy equipment and mill operations, for which the associated effects would decrease with increasing distance from the activity. The greatest amount of noise from the Kiggavik and Sisson mine sites will be concentrated within a small area.

4.3 MITIGATION

The following Table 4.3-1 Noise Sources and Mitigation Measures will be adopted during the construction, operation, and decommissioning of the mine:

Table 4.3-1 Noise Sources and Mitigation Measures

Noise Source	Mitigation
Heavy equipment (pile drivers, excavator/large dozer/caisson, small bulldozer, crane, loaded trucks)	Ensuring site equipment is located as far away as possible from noise and vibration sensitive receptors
	Turning off equipment with potential to generate excessive noise and vibration when not in use, where feasible;
	Where more than one type/model of equipment or technique can be used to complete a particular job with similar efficiency, using equipment with the lowest overall sound/vibration potential;
	To the extent possible, selecting ventilation intake/exhaust equipment with low sound levels and/or pre-packaged mitigation measures;
	Ensure newer, efficient machinery is utilized, and carry out regular maintenance on all equipment, including lubrication and replacement of worn parts, especially exhaust systems;
	To the extent possible, considering phasing the operation of equipment with the highest noise and vibration potential;
	Implement proper operating practice according to best practices
Stationary Equipment (rock breakers, compressors, generators, pumps)	All equipment will be maintained regularly
	Position equipment in a sheltered location or behind a barrier
Blasting	Implement design modifications such as borehole diameter reduction with drill pattern reduction. Reduction in drill pattern if water conditions permit. Introduce decked charges within each borehole. Reduce the borehole length (depth) by reducing bench height.
	Complete blasting when the environment is least sensitive during the day to avoid night time disturbance
	Significant blasting activities will not occur in the vicinity of caribou migrations to avoid unnecessary disturbance.
	Use delays and appropriate blast schedule
	Restrict the maximum amount of explosives (kg) to be used in any single blast either above or below ground.
	Blasting near the pit crests may exceed the 13 mm/s vibration limit, and would thus require modifications to blast designs. If blasting approaches the Andrew Lake ultimate pit crest, an increased collar an/or decking may be required to maintain vibrations below DFO limits for the Andrew Lake Dewatering Structure and any active spawning beds which may occur near the shores of Andrew Lake closest to the dike.

	Limiting vehicle speeds on access, haul and intermediate roads
Road Traffic	Avoid truck operation during the night when achievable
	Traffic will not interfere with caribou migrations, and must cease haul traffic in the presence of caribou migrations
	Restricting vehicle traffic to approved access routes to and from the site, and ensure continuous traffic flow to avoid excessive idling
	Maintaining project road surfaces to reduce tire noise/vibration and truck bed/gate banging
	To the extent possible, routing heavily-loaded trucks away from residential areas
	Fitting all gas or diesel-powered equipment with intake (if appropriate) and exhaust silencers (mufflers) meeting manufacturer's recommendations, and maintaining these silencers (mufflers) in effective working condition
	Select vehicles with minimum noise output (tire noise, exhaust)
	Limit low altitude flights and restrict air traffic to daytime hours when feasible by scheduling take off and landing times.
Air Traffic	For long-range flights greater than 25 km, a minimum altitude of 610 m above ground is required except when low-level ceiling conditions, high winds, or other risk to flight safety exist.
	For short-range flights between 4 to 25 km, aircraft must fly a minimum of 300 m above ground. Exceptions may exist during high winds, movement of equipment through slinging activity, flight distances insufficient to reach desired altitude, or other risks to flight safety.
	In the presence of 50 or more caribou the herd will be avoided by approximately 610 m above or around the herd. Helicopters will not land within 1 km of the herd.
	Known raptor nests will be avoided by a 1.5 km buffer when achievable.
	Aircraft will not fly over the Beverly caribou calving grounds 70 km northwest of the project area.
	Avoidance of concentrated marine life through planning of routes and schedules.
Marine Traffic	Minimize propulsion noise through utilizing low-cavitation propeller shapes such as “high skew” while ensuring regular monitoring and maintenance.
	Vessels maintain constant speed and course whenever possible. Speed reduction or engine power reduction through sensitive areas. Vessels will not exceed 12 knots along established shipping routes in western Hudson Bay and Hudson Strait. Vessels will travel a maximum speed of 8 to 10 knots surrounding Churchill during the open-water season unless otherwise required for safe navigation
	Minimize Idling at the Dock and Storage Facility

	Vessels will halt if the Marine Mammal Observer (MMO) determines mammals are disturbed within the vicinity of Chesterfield Inlet unless conditions are unsafe to do so. The vessel captain will implement operating protocols as advised by the MMO when individual or groupings of marine mammals are observed within specific radii of the vessel
	When pile driving is required, activities will be halted if a marine mammal is observed within or approaching the area of construction
	Restrict type of equipment to those compliant with applicable standards
Mine Facilities (blowers, motors, crushers, screeners, power plant, mill)	Recommend noise attenuations to manufacturer for incorporation into design (e.g., noise absorbing walls and roves minimum 22 gauge steel)
	Enclose moving parts to reduce noise output where necessary
	Shielding with the planned development of stock piles and buildings to aid in noise minimization

5 MONITORING AND ABATEMENT

5.1 MONITORING

The following noise monitoring program for the Kiggavik and Sissons Sites and Baker Lake was developed to coincide with the construction, decomissioning, and operation scenarios. No vibration monitoring is currently recommended relative to the protection of human health. This monitoring program considers baseline noise prior to construction, during operations, and during decomissioning of the Project, and the monitoring data is utilized to validate the predicted noise assessment results. Blast-induced noise, marine, air, and road traffic will continually be monitored to ensure levels are below limits. In addition, community complaints are documented through a complaints/response procedure to address noise and vibration concerns.

Noise monitoring stations are located around the airstrip, the Project Site, and the dock and storage facility. Noise monitoring surveys will run for 24 hours at each location to best represent variabilities between day and night. During the life of the Project, noise monitoring is conducted twice annually to compare to predicted noise levels and implement noise abatement where necessary. Noise monitoring identifies noise sources and where exceedances of baseline noise levels may occur. Monitoring results will be reported to aid evaluation and review of the Noise Abatement Plan, and submitted to appropriate regulatory agencies. The results of noise surveys will be provided to the Occupational Health Committee (OHC) and made available to the mine inspector.

Blast-induced vibrations specifically around the Andrew Lake Dewatering Structure must be monitored to avoid exceedances of the DFO limit of 13 mm/s peak particle velocity if active spawning beds occur in the water bodies nearest the pit crest. Mitigation measures in Table 4.3-1 will be utilized in the event an exceedance occurs.

Marine noise monitoring will be conducted to ensure noise mitigation is in place. Beluga whales and ringed seals will be monitored specifically to avoid any disturbances to migration routes. Monitoring for marine traffic will consist of Inuit Advisors/Monitors onboard a select collection of vessels for observing marine mammals. The marine mammal observers (MMO) will collect observation data for wildlife reactions to shipping operations, distribution of mammals on shipping routes, verification of baseline data, and assessment of mitigation effectiveness. The MMO will observe and record near-misses, vessel strikes, and marine mammal sightings. In the absence of the MMO, the designated crew will document incidents and near-misses.

The type of noise monitoring will range from advisors and monitors to sound level meters and noise dosimeters. As an example the Quest 2400 sound level meter and Quest Noise Pro DL noise dosimeter are effective tools for noise monitoring as they are currently used to monitor

northern Saskatchewan mine sites. In addition, the integrated sound level meter and octave band analyzer provide sound levels and individual frequency analysis. When personal noise dosimeters are utilized, they must have a noise measurement exchange rate of 3 dB, a threshold of 75 dBA, and if measured in a percentage, a reading of 100% when exposure averages to 85 dBA for eight hours (see Table 5.1-1). AREVA ensures that no worker is exposed to steady state noise over 109 dBA, a maximum equivavalent noise level great than 85 dBA for an eight hour shift, or impact noise at a peak pressure level greater than 140 dBC. The manager shall create and implement a hearing conservation program that includes education of employees, noise survey of worksite and equipment, engineering and adminstrative controls, hearing protection for employees, audiometric testing, and consultation with employees. Where workers are subjected to noise levels of 80 dBA or greater, AREVA will provide audiometric tests for hearing acuity on commencement of employment, annually, or when required by the chief inspector.

Table 5.1-1 Exposure Limits Equivalent to 85 dBA / 8 Hour Shift

Length of Exposure	Average Noise Level (dBA)
16 hours	82
12 hours	83
10 hours	84
8 hours	85
4 hours	88
2 hours	91
1 hour	94
½ hour	97
¼ hour	100

Source: Occupational Health and Safety Regulations (OHS)

5.2 ABATEMENT

Noise monitoring identifies the sources of excessive noise levels, and aids in determining if the exceedance originates from a single noise source. If noise levels exceed 50 dBA daytime or 45 dBA night time, 6.5%Ha mitigation as described in Table 4.3-1 will be considered. The environmental team and responsible party will address the noise occurrence by developing an action plan to eliminate or reduce the noise source by applying best practices available within the industry. Where the noise is constant and measurements show noise levels in excess of 85 dBA, the area shall be clearly marked by sign indicating that hearing protection is required. The manager shall ensure that effective procedures are provided to protect employees from any harmful effects of the noise and copies of the procedures are sent to the chief inspector and the OHC. Continued noise monitoring will conclude when noise levels are at a satisfactory level that the responsible party is capable of maintaining.

6 SUMMARY

The Kiggavik Project is dedicated to fulfilling the Noise Abatement Plan directives during the construction, operation, and decommissioning of the mine. AREVA is responsible for annual noise monitoring to aid in mitigation, annual review, and comparison to baseline levels. During construction, decommissioning and operations, vibration effects are not expected to be perceptible and negligible residual effects are predicted. AREVA recognizes variations associated with noise and vibration are dependant upon the activity, equipment, duration, distance between activity and receptors, and shielding. Measures and technologies summarized within this Plan will be in place to minimize these noise effects on wildlife and humans. Potential exceedances will be identified prior to installation or use of equipment to ensure best practices and mitigation are in place. AREVA is confident in the design, noise control methods, noise management programs, and monitoring in place, and ensures the Plan provides effective noise abatement and management.

7 REFERENCES

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8 GLOSSARY AND TERMS

Glossary

Acoustics	The science of sound. Its production, transmission and effects.
Amplitude	The maximum extent of a vibration or oscillation, measured from a position of equilibrium
Attenuation	The reduction of sound energy as a function of distance traveled.
Decibel (dB)	Unit of level when the base of the logarithm is the 10th root of 10 and the quantities concerned are proportional to power.
Decibel, A-Weighted (dBA)	Unit representing the sound level measured with the A-weighting network on a sound level meter
Energy Equivalent Sound Level (Leq)	The constant sound level which would result in exposure to the same total A-weighted energy as would the specified time-varying sound, if the constant sound level persisted over an equal time interval
Frequency	Sound is a fluctuation of air pressure. The number of times the fluctuation occurs in one second is called its frequency. In acoustics, frequency is quantified in cycles per second, or Hertz (abbreviated Hz).
Ground-borne vibration	The regular repeated motion of a physical object about a fixed point.
%Ha	Percent highly annoyed
Impact Noise	Noise in which variations of peak pressure levels occur at intervals greater than one second apart.
Noise	See Sound
Receptor	A building or land use that may be impacted by emissions from a facility (air, noise, vibration). A receptor is generally a place where people live, or conduct educational or recreational or religious activities.
Sound	Vibrations transmitted through an elastic solid or a liquid or gas, with frequencies in the approximate range of 20 to 20,000 hertz, capable of being detected by human organs of hearing.

Sound level	A measure of sound expressed in decibels as a comparison corresponding to familiar sounds experienced in a variety of situations
Sound Power Level (Lw)	A measure of the total airborne acoustic power generated by a noise source, expressed on a decibel scale referenced to a reference standard (usually 10-12 watts).
Sound Pressure Level (Lp)	A measure of the air pressure change caused by a sound wave, expressed on a decibel scale referenced to 20µPa
Sound level meter	A device that converts sound pressure variations in air into corresponding electronic signals. The signals are filtered to exclude signals outside frequencies desired.
Source	Any place or object from which noise and vibration are released. Sources that are fixed in space are stationary sources and sources that move are mobile sources.
Spectrum	The description of a sound wave's components of frequency and amplitude.
Stationary Sources	Non-mobile sources such as power plants, refineries, and manufacturing facilities which emit noise. (See also mobile sources).
Steady State Noise	Noise in which variations of peak pressure levels occur in one second or less.
Tonal Noise	Noise with a narrow sound frequency composition (i.e., the sound level at a certain frequency, or several adjacent frequencies, dominates over all other frequencies).

Terms

dB	decibel
dBA	A-weighted decibel
DNL	day-night sound level
%Ha	Percent highly annoyed
km	kilometer
LAA	local assessment area
L_{eq}	energy equivalent sound level
L_P	sound pressure level
L_W	Sound Power Level
m	Metre
PPV	peak particle velocity (mm/s)
RAA	regional assessment area
SPL	sound pressure level