Kugaaruk New Diesel Power Plant

Project Summary

Entrusted with supplying safe, reliable and efficient power to customers in all 25 communities across Nunavut through both traditional and alternative sources, Qulliq Energy Corporation (QEC) is the sole electricity provider in the territory. We currently operate 25 stand-alone diesel power generation facilities and distribution systems across the territory.

The Hamlet of Kugaaruk is located in the Kitikmeot Region of Nunavut. In this community, QEC's power plant was built in 1974 and is obsolete. We are proposing to construct and operate a new diesel-fired power plant, in order to replace it. This multi-year project will include a new four-engine power generation facility (proposed total generating capacity of approximately 2,500 kilowatts) designed for a life expectancy of more than 40 years. This new plant will also incorporate new technology in order to improve efficiency, reliability, safety, operational ergonomics, and to reduce environmental impacts. For all of these reasons, this new plant will be superior to the obsolete plant that it will be replacing.

To ensure a reliable fuel supply, the installation will include a fuel storage system consisting of two 90,000 litre double-walled, 110% contained horizontal fuel tanks, appropriate fuel pumping facilities, Quonset garage, transformer storage, pole racks, oil and glycol drum storage and waste disposal area (with secondary containment berm). Space will also be provided for a transient staff accommodation unit, sea cans for storage, and a back-up emergency generator. Upgrades to the existing distribution system will also be required to connect to the new power plant. A fuel pipeline, of approximate length 75 metres, will be built in order to connect to the Government of Nunavut's Petroleum Products Division (PPD) bulk fuel storage facility, which is located adjacent to the property. The pipeline will be of aboveground construction. The new power plant will be capable of integrating renewable energy sources, including wind, geothermal, and solar. This will enable us to have hybrid power at a future date.

Proponent Background Information

Qulliq Energy Corporation (QEC) is a Government of Nunavut (GN) territorial corporation. Through the operation of 25 stand-alone diesel-fueled reciprocating-engine-based power plants with a total installed capacity of approximately 76,000 kilowatts, QEC is the sole provider of electricity to approximately 15,000 metered accounts in the territory. QEC provides mechanical, electrical, and line maintenance services from three regional centers: Iqaluit, Rankin Inlet and Cambridge Bay. QEC's administrative activities are carried out at the

Head Administrative Office in Baker Lake and the Corporate Office in Iqaluit.

QEC is committed to planning and developing cost-effective and efficient ways to provide a safe, reliable, long-lasting, stable energy supply for all Nunavummiut. This includes a commitment to investigating and (where technically feasible and where funds are available) integrating renewable energy sources.

Project Background and Rationale

Kugaaruk is an Inuit hamlet located on the western shore of Hudson Bay in the Kitikmeot Region of Nunavut, Canada. Access to the community is limited to air and sea traffic travel only. The community fuel supply, which is overseen and administered by PPD, is replenished annually in the summer/fall via marine fuel-supply tanker.

Kugaaruk is gradually growing and thus is experiencing an increasing demand for electricity. Anticipated population is projected to be roughly 1200 individuals in 2036. The community includes a health centre, as well as various commercial and institutional buildings. Each building exerts its demands on the power supply.

Figure 1: Physical location of Kugaaruk.

The existing Kugaaruk power plant was constructed by the Northern Canada Power Commission (NCPC) in 1974. At 48 years old, the plant has exceeded its 40-year design life. The installed firm capacity (defined as the power available with the largest unit out of service) of the existing vintage power plant is inadequate to meet the community's projected required firm capacity. Without changes to the power-generation infrastructure, the capacity shortfall will steadily increase with increased electricity demand in the community, thereby resulting in reduced plant reliability and therefore blackouts or rolling blackouts.

The building structure, foundation, and ancillary equipment are in poor condition, having started to deteriorate, primarily as a result of melting permafrost. Some of the generators are nearing the end of their rated lifespans. The existing switchgear is obsolete and is not arc-flash resistant, and there is no automatic fire-suppression system. This increases the fire and employee-safety risk of the facility. As the systems continue to age and become even more outdated, and as replacement parts become increasingly difficult to obtain, it will become more difficult to maintain the facility, and plant reliability will become an issue. Without reliable equipment, QEC's customers are at risk of partial or total system

failure.

A new power plant equipped with fuel-efficient generators, and plant automation will increase fuel efficiency and overall plant reliability. A study into the topic of impact on customer utility costs found that the increase would be less than a half-cent per kilowatt-hour. This very small impact is due to the combination of savings due to improved efficiency (i.e. less fuel usage) and reliability (i.e. reduction in costly emergency repairs), as well as the primary funding from the federal Arctic Energy Fund.

Given that the new plant will be more efficient and cleaner than the existing one, the reduction in airborne emissions demonstrates respect for the environment. This fulfils the Inuit Societal value of *Kamatsiarniq.*

Replacing the existing power plant will enable QEC to provide a safe and reliable electricity supply to the community. This demonstrates QEC's respect for the valued relationship and care it has for its customers, *Inuuqatigiitsiarniq.*

Alternatives Considered

QEC recognizes the need for a long-term approach to prioritize and maximize the benefit of capital expenditures while providing safe and reliable electricity service. The existing plant's deficiencies mean that the "Do Nothing" option is not a viable option. Operating assets beyond their service life also places a larger burden on QEC's maintenance and operations personnel by trying to maintain and operate assets that should be replaced.

The following two alternatives were evaluated and are described further below.

- Major plant upgrade
- Construct a new plant at a new location

Upgrading of existing vintage power plant

A major plant upgrade would include replacement of major components and systems within the existing facility, including the generators, switchgear and fuel system. This option was determined to be not technically feasible for the following reasons:

- The powerhouse building has deteriorated due to age. Multiple building systems have already exceeded their design life expectancies. It is simply not upgradeable.
- The existing powerhouse foundation is crumbling, primarily due to permafrost melting and the resulting differential settlement. This cannot be repaired. The building structure is literally on its last legs.

- The existing plant footprint is exceedingly cramped and is too small to accommodate the space required for the new generator sets. It is important to note that all newer generators are physically bulkier due to the emissions standards that they must meet.
- Because it is located directly within the community, the existing plant site does not have sufficient land space to accommodate any type of plant expansion.
- The existing facility's two fuel tanks are single-walled and do not comply with federal storage-tank system regulations nor with current codes of practice. The secondary-containment gravel berm is also unsatisfactory. Upgrading the fuel storage at the existing facility is not possible without taking the entire plant out of service for an extended period of time. This would plunge Kugaaruk into darkness, or it would require an extremely expensive leasing of portable generators for use in a temporary cobbled-together network.

The existing power plant is located in an area defined by the Hamlet of Kugaaruk for heavy industrial use. It is understood that the Hamlet of Kugaaruk prefers to have industrial land located outside of the community, and the proposed location of our new (replacement) power plant is in accordance with this preference.

Construction of a new plant at a new location

Considering the space issues associated with upgrading the existing facility, QEC explored constructing an entirely new power plant at a suitable location in the community. QEC preliminarily reviewed four different location options in different locations near the PPD tank farm, and examined a number of criteria that are of key importance in determining a suitable location for a new power plant. These include the following:

- Proximity to Petroleum Products Division (PPD) Tank Farm: If the power plant is located near the PPD Tank Farm, then QEC can easily have a direct pipeline connection for fuel transfers. This reduces the environmental, health and safety risks associated with trucking fuel across roadways dozens or hundreds of times per year.
- Sufficient space: QEC requires at least 6,000 m^2 to accommodate the power plant building, fuel system, pole storage, transient unit, Quonset garage, and waste oil containment area.
- Current land-use zoning: If an area is not currently zoned for industrial development, then additional time might be needed for obtaining re-zoning applications prior to securing land for the power plant.
- Flat and level (or amenable to easy levelling): If an area is flat and level (or if it can easily be made so), then this reduces the cost and time associated with earthworks

that would be required to prepare the site for construction.

- Airport Restrictions: Transport Canada Airport Zoning Regulations apply to areas within 4 kilometres of an airport. Due to the small physical extent of the hamlets in Nunavut, and given that nearly all communities have their airports located in close proximity to the developed areas, effectively these regulations translate into additional approval procedures for all types of construction.
- Previous Disturbance/Development: Our preference is to avoid impacts to native tundra areas. We note that additional cost and construction-scheduling implications arise if an area has not been previously disturbed or developed (e.g., survey, site investigations, earthworks).
- Proximity to Migratory Bird or Wildlife Areas or Cultural Sites: Close proximity to a migratory bird sanctuary, wildlife area or cultural site may increase environmental permitting requirements and the need for environmental monitoring during construction and operation. Buffering distances may also be required.
- Evidence of Groundwater or Surface Drainages: Developments requiring in-stream works (such as bridges or culverts) may require permits or environmental monitoring during construction/operations. We therefore avoid sites where evidence of watercourses is present.
- Prevailing wind: We note that the wind direction affects noise, odour and drifting of snow. These considerations depend on the direction of the prevailing wind and the relative locations of the power plant and the community it will serve. Therefore, we look for sites that are located at least one kilometre from the edge of the primary developed zone of the community.
- Known Contamination: Pre-existing subsurface contamination could impact the type and extent of site investigation required and could increase environmental risk. Additional permitting may be required if the power plant is located close to a waste disposal site. For these reasons, we avoid sites located near waste sites or contaminated (brownfield) sites.

In 2020, a team of representatives from QEC met with Kugaaruk Hamlet Council in order to present the proposed location options for the new (replacement) power plant, as well as to outline the benefits and drawbacks of each location. Following these discussions, the Hamlet issued a letter of acceptance of herein described location in 2021. Site investigations were completed in the summer of 2020 and included a Phase 1 and limited Phase 2 environmental site assessment as well as a geotechnical assessment. An archaeological assessment was completed in the summer of 2021. This study confirmed that there are no

archaeological conflicts pertaining to our chosen site.

Project Location and Components

The results of the site investigations provided QEC with sufficient site-specific information to confirm that Option 4, as shown in Figure 2, would be technically best suited to for construction and operation of the power plant. A preliminary site layout was prepared and a land application was submitted to the Hamlet of Kugaaruk in 2021.

After having submitted the application, QEC worked collaboratively with representatives of the Government of Nunavut (GN) Department of Community and Government Services (CGS) Planning and Lands Division to further refine the location. The resulting proposed location for the power plant considers the future plans of the Hamlet to establish a formal road easement for the existing road to the PPD bulk fuel facility as well as establish additional lots on the east side of the road for industrial land use.

The proposed lot is approximately 8,000 square metres located on unsurveyed, untitled Commissioner's land, south of the PPD bulk fuel facility. QEC's land application was presented to and approved by the Hamlet of Kugaaruk in 2021.

Figure 2: Kugaaruk Proposed Sites of New Power Plant.

The power plant will include a four-engine generation facility, with a proposed total generating capacity of 2,500 kilowatts and an installed firm capacity (i.e. capacity with largest unit out of service) of 1,900 kilowatts. The facility will be designed for a life expectancy exceeding 40 years. Construction will include a fuel storage system consisting of two 90-cubic-metre double-walled, 110% contained horizontal fuel tanks with continuous monitoring of the interstitial vacuum. Also present will be appropriate fuel pumping facilities, transformer storage, pole racks, oil and glycol drum storage and a waste disposal area that includes a secondary containment berm.

Space at the site will also be provided for a transient staff accommodation unit, sea cans for storage, and a back-up emergency generator. Upgrades to the existing distribution system will also be required to connect to the new power plant. An above-ground fuel pipeline of approximately 75 metres in length will be constructed to connect to the Petroleum Products Division (PPD) bulk fuel storage facility located to the north. This pipeline will be made of welded steel with a corrosion-inhibiting coating, and will be equipped with other anti-spillage features including multiple anti-backflow valves. Also, this pipeline will be operated only for fuel transfers, and therefore it will not have fuel continuously flowing through its length.

Detailed design of the new plant will include exhaust particulate filters as well as high-attenuation mufflers (also known as silencers). As an additional feature, the new plant will also be capable of integrating renewable energy sources, including wind and solar.

A preliminary site layout of the power plant is provided separately. This is a schematic drawing only, given that it is possible that the new plant will be built as a design-bid-build (DBB) process, according to our detailed specifications.

As envisioned, the main power plant building (40 by 23 metres) will include an electrical control room, mechanical room, garage, workshop, a fully accessible office with washroom, and the power generation hall itself. The specific location and orientation of these components within the area selected will be determined through detailed engineering.

Geotechnically, the powerhouse foundation will be built either as steel-reinforced-concrete that is keyed directly into bedrock, or with rock-socketed steel piles. Both designs very effectively bypass the typical permafrost-related geotechnical concerns of heaving, displacement, and destabilization. Both designs are also suitable for handling the weight and vibration of a power plant.

Schedule

The project schedule is shown in Table 1.

Table 1: Potential Schedule for the New Kugaaruk Power Plant Project

Task	Anticipated Milestone
Selected Land and Completed Archaeological Impact Assessment	March 2021 to March 2022 (already completed)
Contracting and Procurement	October 2024 to January 2025
Detailed engineering design	February 2025 to March 2026
Construction	May 2026 to November 2029 (climatically seasonal)
Testing and Commissioning	December 2029 to March 2030
Plant Handover to QEC Staff	March/April 2030
Operations (power production)	2030 to 2070 and beyond

Construction Labour

Based on previous project statistics, the anticipated total number of workers during construction is shown in Table 2. The contractor who is awarded the construction tender will ultimately determine their required labour force to meet project requirements. Also, during construction, certain tasks of certain phases may overlap in time and staffing.

Table 2: Estimated Number of Construction Workers Required During Construction

Construction Phase	Estimated Number of Workers	Estimated Time On-Site (Days)
Foundation and Land Development	15	90
Civil Works, Building Structure, Fuel System	35	250
Mechanical and Electrical Installations	15	180
Commissioning	20	120

Construction of the Project will be completed through a request for tender (RFT) process. As per the Nunavummi Nangminiqaqtunik Ikajuuti (NNI) Regulation, contractors will

be obligated to meet mandatory Inuit labour levels for all construction tasks.

Operations Labour

QEC has staff in Kugaaruk that are responsible for the daily operation of the existing power plant. This includes a Plant Superintendent (full time), and two Assistant Operators (part time). It is expected that existing staff will transition over to the new power plant once it has been constructed and commissioned. No new permanent staffing is anticipated to be required as a result of this project.

QEC has regionally based power line technicians and maintenance crews based in Iqaluit, Rankin Inlet, and Cambridge Bay. These crews travel to and from communities to provide support to the operations staff in each community on an as-needed basis and to respond to emergencies (for example major power outages) or for assisting with large-scale tasks such as complete generator overhauls.

Construction Materials and Equipment

The majority of construction materials for the Project will be delivered to the community by sealift. Depending on size and quantity, some materials may be sourced locally or delivered via cargo plane.

A list of the pieces of construction equipment anticipated to be required is provided below. It should be kept in mind that this is not an exhaustive list, given that the contractor will be responsible for choosing the equipment to be used.

- Excavator
- Backhoe
- Bulldozer
- Grader
- Compactor machines
- Dump trucks and articulated trucks
- Truck-mounted telescoping crane
- Pile drilling/boring/driving machine
- Towable portable generator
- Boom truck
- Tele-handlers
- Forklift truck
- Trailer with tractor
- Concrete mixers, vibrators, rotary finishers, and ancillary equipment

- Arc-welding machines
- Steel-cutting machines
- Towable air compressor
- Portable fuel tanks (double-walled)
- Testing, inspection and commissioning equipment such as load banks

The contractor who is awarded the construction tender will be responsible for sourcing the equipment. This may include a combination of sub-contracting locally available equipment or bringing equipment to the community through the annual sealift.

During both the construction phase and operation phase of the project, water needs will be met by trucked municipal water, and sewerage needs will be met by standard municipal sewage tanker truck. This directly mirrors the same water-supply-and-sewerage procedures used in the construction and habitation of housing and other buildings in the community.

There will be no impacts to water bodies. We note that our project does not entail any in-stream works nor water takings, nor any discharge of waste to water features. Our generator engines all discharge their heat directly to air via radiators. Therefore, there are no water-related permits applicable to this project.

Fuel Management and Pipeline

QEC envisions, plans, and designs all its new power plants to include direct fuel-transfer pipelines from the community PPD tank farm in mind. It is important to remember that these pipelines are only in use for purposes of replenishing our onsite power plants. This is done through fuel transfers, which are done at intervals ranging from one a month to once every few months, depending on fuel consumption (which itself is a function of power demand). In this way, and by having the pipeline charged with fuel for only brief periods, the risk for spillage is minimized. All fuel transfers are conducted in accordance with detailed safety and environmental procedures that include inspections that are done prior to and during each transfer. (This is in addition to regular monthly inspections of all fuel-handling infrastructure and further detailed engineering inspections at regular intervals as well.)

During the construction phase of the project, fuel storage and handling will be the responsibility of the contractor. Details regarding the location and exact volume of the fuel storage tank or the equipment-refueling procedures will be determined by the contractor. The contractor will be required to provide a portable fuel-storage tank that includes integrated secondary containment, and to have a suitable monitored refueling procedure as well as a spill-response plan in place.

For operational requirements of the new plant, the powerhouse will draw its fuel from two onsite tanks, each of size 90,000 litres (therefore 90 cubic meters per tank). The remaining fuel supply required for over-winter power-plant operation will be stored at the existing PPD bulk fuel facility. The final design of QEC's fuel system and the pipeline routing between the QEC power plant and the PPD bulk fuel storage facility will be determined as part of detailed engineering. The following fuel-system specifications are standard for our power plants in communities of this size.

- Two above-ground, horizontal fuel storage tanks, each with a nominal capacity of 90 cubic metres (therefore 90,000 litres per tank), designed to function 24 hours per day, and 365.25 days per year, with a minimum design life of 40 years.
- Fuel storage tanks will be shop fabricated as per the ULC S601 standard, will adhere to the National Fire Code of Canada (NFCC) and National Fire Protection Association (NFPA) 30 guidelines, and comply with Canadian Council of Ministers of the Environment (CCME) Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products and local, territorial and federal acts and regulation requirements.
- Fuel storage tanks will be double-walled with 110% containment, with an interstitial space consisting of a continuously monitored vacuum. The tanks will arrive from the factory with skid-type mountings. The tanks will include anti-corrosion features such as a zinc-rich primer and multi-layer baked-on urethane paint.
- Suitable leak detection monitoring system in accordance with Part 6 of the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.
- Applicable corrosion protection and monitoring in accordance with Section 3.8 of the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.
- Applicable overfill protection system with audible/visual alarm and automatic mechanism for shutting off the fuel supply such as per applicable standards.

The tanks will connect directly with the PPD bulk fuel facility by 4-inch interior-diameter steel pipeline for fuel transfers. The fuel tanks will also connect with the day tank inside the power plant by 2-inch steel interior-diameter pipeline. The day tank will supply fuel to the generators. The pipeline system will be designed to meet the federal Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations, and the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.

QEC will also work with PPD to confirm the pipeline connection is designed to meet facility-specific requirements. This will include having a metering device to measure and record fuel delivery. Prior to the onset of power-plant operation, the QEC fuel system will be registered with Environment Canada's Identification Registry for Storage Tank Systems.

In addition to connecting the power plant to the PPD bulk-fuel storage facility, a truck-based fuel-replenishment station will be constructed with applicable safety measures (such as bollards) and spill-prevention features. Also included will be a spill-containment box, as well as dual check valves and dual in-line shutoff valves for flow control and anti-backflow purposes. The truck-based fuelling connection point serves as backup in case the pipeline is out of service (for example for maintenance or for detailed engineering inspections). In cases where the direct pipeline from PPD might be constructed after the plant itself has been completed, the truck-based refueling station would be used until the pipeline connection is constructed.

Waste Management

During construction, the contractor will be responsible for appropriately handling, storing, and disposing of all construction waste, including hazardous waste such as waste oil, in accordance with municipal and territorial requirements. The contractor will be required to have a waste-management plan in place prior to commencing construction.

QEC has a number of environmental standard operating procedures (SOPs) that provide guidance on waste management during operations. Liquid waste (such as waste crankcase oil and waste glycol) is stored in drums or totes within secondary containment and disposed of as part of QEC's annual waste shipment from the community. Domestic waste during operations will be disposed of in accordance with municipal and territorial requirements. For standard household-type waste, this is expected to include disposal of waste at the community landfill with permission from the Hamlet. Non-household-type solid wastes would be shipped south for disposal at an approved facility.

Anticipated Permit Requirements

The permits approvals anticipated to be required prior to starting construction of the project are listed in Table 3. If additional permits or approvals are required as the process proceeds, then QEC is committed to working with the applicable agency in order to obtain the necessary approvals in a timely manner.

Table 3: Anticipated Permit Requirements

Agency	Permit Requirement
Nunavut Planning Commission	Conformity Determination
Nunavut Impact Review Board	Screening Decision
Hamlet of Kugaaruk	Development Permit
Government of Nunavut – Community and Government Services	Lease agreement for new lot (Planning and Lands)
	Approval Letter (Nunavut Airports)
	Building Permit (Safety Services)
NavCanada	Aviation Contextual Land Use Proposal Review
Transport Canada	Aeronautical Assessment

Engagement with the Community and with GN-CGS

Correspondence with representatives from the GN-CGS Planning and Lands Division has assisted in optimizing the proposed lot location.

QEC presented three proposed location options for the new power plant during a meeting with Kugaaruk Hamlet Council in 2020. On March 11, 2021, an approval letter was received from the Hamlet.

Environmental Effects

Potential environmental effects resulting from the Project and the proposed mitigation measures that QEC will put in place are given in Table 4.

Table 4: Potential Environmental Effects Resulting from the Kugaaruk New Power Plant Project (to replace the existing power plant)

Activity	Potential Environmental Effect	Positive, Negative, or Neutral Effect	Mitigation
Construction of all components of the Project	Construction of the power plant on a new lot will result in loss of space within the community for use by community members and wildlife	Negative	• The area proposed for the power plant has been designated by the Hamlet as industrial land use and was the location previously identified by the Hamlet for the power plant. This implies that the Hamlet is interested in or is willing to consider some form of development in this area. • Surrounding development in this area is industrial in nature (e.g., PPD bulk fuel facility). • Given that the proposed power plant will be on an existing road and in close proximity to the PPD bulk fuel facility, community members or wildlife using this area will already be accustomed to traffic activity in the area. • The location selected for the power plant is generally flat terrain and is geologically amenable to construction. • There will be no impacts to water bodies. We note that our plant does not entail any water-takings, nor in-stream works, nor any discharge of waste to these small water features. We note that our use of diesel generators uses radiators to air for cooling. Our domestic water usage the plant will entail a freshwater tank along with a sewage tank, both serviced via truck. Construction activities will also entail tanked water, with portable toilets for employees. The contractor will also be required to ensure that surface disturbance (e.g. disrupted soils) are not able to run off the site. For this purpose, standard silt fences are anticipated to be used. • There are no designated wildlife areas, marine protected areas, territorial or national parks or Inuit owned lands in conflict with the power plant location. That being said, it is acknowledged that terrestrial and marine wildlife may be observed in the surrounding area, especially by observers and photographers equipped with high-quality tripod-mounted telephoto lenses and spotting scopes.
	Construction of the power plant on a new lot may result in the disturbance or destruction of cultural or archaeological artifacts	Neutral, but Negative if hidden artifacts are found	• An archaeological impact assessment was carried out in the summer of 2021 in order to determine if archaeological sites are in potential conflict with the project and identify any necessary avoidance or mitigation measures. None were found. • In the event that latent cultural or archaeological artifacts are encountered during the construction at the site, construction activity will stop and the Government of Nunavut Department of Culture and Heritage will be contacted.
	Construction of all components of the Project may contribute to permafrost degradation	Neutral	• For all our power plants, the stability of the foundations/structural ground floor of the power plant are prime structural-design considerations. • The geology of this area indicates that bedrock is present within about a metre of the ground surface, with average permafrost active layer thickness is estimated to be approximately 1.5 metres. • Foundations will be built in the form of steel-reinforced-concrete that sits directly on bedrock, or with rock-

Activity	Potential Environmental Effect	Positive, Negative, or Neutral Effect	Mitigation
			socketed steel piles. Both designs very effectively bypass the typical permafrost-related geotechnical concerns of heaving, displacement, and destabilization. • The foundation design will be designed by external geotechnical engineers with expertise in Arctic construction. The design will be reviewed by QEC's in-house professional engineering team, which includes civil engineers in addition to qualified professionals from other fields. • For our storage racks for poles and transformers, piles will be used in structural supports.
	Construction of all components of the Project may contribute to additional dust and noise in the community	Negative	• This is self-limiting in time, since these impacts will end when construction is complete. • Contractors will be required to maintain equipment in good working order to reduce noise generation. • Construction will occur during typical working hours (for example 10 to 12-hour shifts). • Dust suppression (for example spraying with water) will be used on-site during construction as required. • Other development in the surrounding area is industrial in nature. With this in mind, it is likely that community members nearby are already accustomed to some level of dust and noise emanating from this general area, due to the combination of the existing gravel roads and the general industrial and other activities that take place here.
Fuel or hydraulic oil leak from equipment during construction	Fuel or hydraulic oil could leak or spill on to the ground resulting in contaminated soil or surface water	Negative	• Contractors will be required to use equipment in good working condition. • Contractors will be required to have a spill response plan as well as spill response equipment and materials available in the event of a leak or spill • In the event of a spill or leak, contaminated soil will be collected for disposal at an approved facility • Contractors will be required to have a fuel management plan in place that includes refueling procedures and proper bulk storage if applicable.
Fuel leak from the Fuel System during operation	Fuel stored within the QEC fuel system could leak on to the ground resulting in contaminated soil or surface water if it is not maintained	Negative	• Fuel tanks will be shop fabricated as per the ULC S601 standard, NFCC and NFPA 30 guidelines. • Fuel tanks and pipelines will be constructed and operated in compliance with Canadian Council of Ministers of the Environment (CCME) Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products • Fuel storage tanks will be double-walled with 110% containment, an interstitial space monitoring system and will be skid mounted to ensure longevity and durability of the installation.

Activity	Potential Environmental Effect	Positive, Negative, or Neutral Effect	Mitigation
			• Suitable leak detection monitoring system in accordance with Part 6 of the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products. • Applicable corrosion protection and monitoring in accordance with Section 3.8 of the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products. • Applicable overfill protection system with audible/visual alarm and automatic mechanism for shutting off the fuel supply such as per applicable standard. • Flexible couplings at the pipelines will ensure that pipes do not break if slight shifting of components occurs over time. • The QEC fuel system will be inspected by QEC personnel on a monthly basis. Annual inspection by the QEC Health, Safety, and Environment Department will also be done. • The QEC fuel system will be inspected by a qualified third-party contractor in accordance with API 653 as required. These inspections are rigorous, detailed engineering inspections. • A spill contingency plan and community specific spill plan will be updated to reflect the location of the new power plant. • Spill response materials will be kept on-site during operations. There will also be additional spill-response kits kept at the plant when it is complete and during operation. • Our plant does not entail any water-takings, nor in-stream works, nor any discharge of waste to these small water features. We note that our use of diesel generators uses radiators to air for cooling. Our domestic water usage the plant will entail a freshwater tank along with a sewage tank, both serviced via truck, therefore using the same methodologies as are used at residences in the community.
Fuel or oil leak from generators or other onsite activities during operation	Fuel or oil could leak or spill in the plant or on the ground resulting in contaminated soil or surface water	Negative	• Extensive containment measures will be present for fuel tanks, including double-walled fuel tanks with interstitial vacuum with integrity monitoring, automatic level monitoring with real-time deduction for fuel consumed (as recorded by each engine), as well as flexion couplings at junctures and anti-corrosion features on the tanks. • Surface water will be diverted around project components and towards drainage ditches established adjacent to roadways. This reflects standard practice for all buildings in general.

Activity	Potential Environmental Effect	Positive, Negative, or Neutral Effect	Mitigation
			• In the event of a spill or leak, contaminated soil will be collected for disposal at an approved facility • Environmental Standard Operating Procedures (SOPs) will be followed by operations staff • A lined berm will be onsite for storage of new and waste hazardous products (e.g., fuel, oil, glycol) • A spill contingency plan and community specific spill plan will be updated to reflect the new power plant location • Two sets of spill-response materials will be kept on-site during operations
Fuel spill during fuel transfer	Fuel could spill on the ground resulting in contaminated soil or surface water	Negative	• Fuel transfers can occur via both pipeline connection from the PPD Tank Farm as well as via filling from tanker truck, with the latter serving as backup for the former. • For the truck-based fuel-replenishment station, an appropriate secondary containment box will be included in the design. • QEC Environmental SOPs will be followed for all fuel transfers; this includes visual monitoring for the duration of the transfer, with all involved staff members being both physically present and attentive throughout the duration of the entire operation. • A spill-contingency plan and site-specific spill plan will be updated to reflect the new power plant location • Spill-response materials will be kept on-site during operation and will be readily available during fuel transfers
Operation of the Power Plant	Operation of the new power plant may contribute to additional noise or dust in the community	Negative in terms of power generation in general, but Positive when the new plant is compared against the old plant	• The new power plant location is well outside the community core. This distancing ensures that noise and dust that may be generated during operations will have less effect on the community, in comparison to the existing power plant, which is situated in the community core. • The prevailing wind is from the northwest. Therefore, there is limited potential for dust or noise to be directed towards the community. • New, more efficient generators and equipment are anticipated to generate less noise and dust in comparison to the vintage equipment at the existing power plant. Also, it is understood that the community requires electricity for functioning, and therefore a reliable power supply is considered absolutely essential. • New generators employ fully electronically controlled high-pressure fuel injection with precision monitoring of exhaust gas temperature and other real-time operational parameters, in order to ensure long-term high efficiency and confirmation of completeness of combustion. Because completely burned fuel translates into the fuel being converted into carbon dioxide and water instead of being blown out as carbonized fuel droplets or soot, the

Activity	Potential Environmental Effect	Positive, Negative, or Neutral Effect	Mitigation
			completeness of combustion also serves to visibly reduce emissions. • Generators employ heavy-duty two-stage turbocharged-intercooled four-stroke industrial diesel engines to ensure the maximum possible efficiency of combustion available in the required size range. • The engines employ fully replaceable cast-iron cylinder sleeves and other key components. All components germane to proper fuel combustion and motive-power conversion are fully maintainable and replaceable. Because these components are also essential to cleanliness of combustion, their replaceability enables the engines to burn cleanly throughout their entire life expectancies. • Electronic fuel metering at each engine ensures that each engine receives only the fuel that it needs, thereby averting the inefficiencies (and soot generation) inherent to older all-mechanical fuel-injection designs of vintage engines. The use of electronic fuel metering also serves to tangibly reduce emissions. • The new power plant will use four generators, thereby enabling close matching of generator capacity to actual power demand, thereby further maximizing efficiency. Having four generators also facilitates servicing and ensures good redundancy for safety, especially given that the remoteness of the community would complicate midwinter replacements of generator units. • The exhaust system will include the ability to remove diesel particulates. Full details will emerge at the detailed design phase, since the power plant's detailed internal layout (including choice of manufacturers of engines and other appurtenances) will be designed subsequent to all land-usage approvals having been granted. System details will also depend on the manufacturers of the equipment chosen. However, as a general guideline, diesel-particulate filters with catalyst capability are anticipated. (We do not use systems that require urea, DEF, or SCR technologies since these are unsuitable for our applications.) • The exhaust system will also include high-quality mufflers (silencers) in order to reduce the sound profile.
	The new power plant will be designed to meet the current and future energy needs of the community.	Positive	• No mitigation measures are applicable, given that this is a positive effect, and given that growth will not be constrained by power supply.
Reduction in diesel fuel usage	Operation of more efficient generators will result in a reduction in the amount of fuel used during operation of the power plant.	Positive	• No mitigation measures are applicable, given that this is a positive effect.
	Operation of more efficient generators will reduce the amount of fuel used during	Positive	• No mitigation measures are applicable, given that this is a positive effect.

Activity	Potential Environmental Effect	Positive, Negative, or Neutral Effect	Mitigation
	operation of the power plant which will result in the reduction of greenhouse gas emissions.		

Closure

This project is anticipated to provide an overall benefit to the Hamlet of Kugaaruk with more efficient use of diesel fuel as well as the reduction of greenhouse gas emissions as well as a reductions in both noise and in air pollutants. The proposed new plant will also allow QEC to improve power generation infrastructure in the community and will support continued community growth. The new plant will also enable QEC to satisfy its mandate of providing safe, reliable electrical power to the communities it serves.

If additional information is required, please contact QEC Environmental Applications:

QEC Environmental Applications
Qulliq Energy Corporation
Phone: 866-710-4200
Email: EnvApplications@qec.nu.ca

References

Canadian Council of Ministers of the Environment (CCME). 2003. Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (PN 1326). ISBN 1-896997-33-3. Available at: https://www.ec.gc.ca/lcpe-cepa/61B26EE8-AFB3-47AC-91AC-12AFBB0B549B/CCME_eng.pdf

Nunavut Bureau of Statistics. Nunavut Population Estimates and Projections by Community, 1996 to 2023. Source: Estimates - Statistics Canada, Projections - Nunavut Bureau of Statistics. Prepared by: Nunavut Bureau of Statistics, June 10, 2010.

Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations. SOR/2008-197. Government of Canada. Last amended on October 26, 2020. Available at: https://laws-lois.justice.gc.ca/PDF/SOR-2008-197.pdf

Attached Documents (filed as separate Adobe PDF files)

Letter of approval from Hamlet of Kugluktuk

KugaarukMotion_2021-03-11-02.pdf

Site Layout and Site Plan Drawings of the Proposed Power Plant at Kugaaruk

KUGA-SK-01_REV 3_29NOV2021-includes-site-plan-and-area-map.pdf