Terms of Reference for Environmental Impact Assessment

Kvanefjeld Multi-Element Project

Approved July 2011
Amended July 2014
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INTRODUCTION

1.1 The EIA Process

On 9 December 2010 Greenland Minerals and Energy (“GME”) Ltd was given permission to conduct feasibility studies into the Kvanefjeld Multi-Element Project (“Kvanefjeld”, “the Project”) by the Bureau of Minerals and Petroleum (“BMP”). The feasibility studies, inclusive of an Environmental Impact Assessment (“EIA”) for Kvanefjeld, are a pre-requisite for obtaining an Exploitation Permit.

In January 2011 the BMP issued updated Guidelines for Preparing an EIA report for Mineral Exploitation in Greenland (“Guidelines”). This document has been prepared in accordance with these Guidelines.

In January 2014, it was announced that the BMP was to be renamed to the Mineral Licence and Safety Authority (MLSA). The MLSA is the overall administrative authority for licences and mineral resources activities, and is the authority for safety matters including supervision and inspections.

The Ministry of Industry and Mineral Resources (MIM) is responsible for strategy-making, policy-making, legal issues, marketing of mineral resources in Greenland and socioeconomic issues related to mineral resources activities, such as Social Impact Assessments, Impact Benefit Agreements and royalty schemes. The Ministry deals with geological issues through the Department of Geology.

The Environment Agency for the Mineral Resources Activities (EAMRA) is the administrative authority for environmental matters relating to mineral resources activities, including protection of the environment and nature, environmental liability and environmental impact assessments.

Collectively this group is referred to as the mining resources authority (MRA).

An EIA is required to identify and analyse all potential environmental impacts of any proposed mining activities and determine preventative and mitigating measures for negative impacts. In addition the EIA must also incorporate conceptual plans for the final decommissioning and reclamation of the project. The EIA to be prepared for the Kvanefjeld project will:

- Identify and analyse environmental impacts in all Project phases from before mine start to beyond closure,
- Help to develop measures to address and mitigate adverse environmental impacts,
- Help to preserve environmental values, and
- Help to realize sustainable development opportunities.

In accordance with the Guidelines the following issues will be covered in the EIA:

- An extended, non-technical summary
- An introduction which describes the mine project, its background and objectives
- A thorough description of the environment before mine start
- A description of the mine project with all phases from exploration to closure and beyond
- An assessment of environmental impacts of the project with an evaluation of alternatives compared to the preferred option
• An Environmental Management Plan (EMP) which describes how the identified impacts are dealt with
• An Environmental Monitoring Plan with a description of e.g. samples, stations and parameters to be monitored
• Public consultations
• Conclusions
• References used in the EIA process and Glossary of terms and abbreviations

The EIA will cover the entire region that might be affected by the project. If the Project includes use of areas outside the mining area for e.g. roads, harbours, airstrips and shipping routes, effects of these will also be covered.

The purpose of this document, which has been prepared by Orbicon on behalf of GME, is to provide a detailed plan of the Environmental Impact Assessment (EIA) process for Kvanefjeld for consideration by the MRA.

A number of other studies and assessments, for example a Social Impact Assessment (“SIA”) and a Bankable Feasibility Study, will be carried out during 2014 and 2015 in order to finalise the design and prepare applications for the permits and licences that will be required to develop the Project.

1.2 The Project

In 2007, Greenland Minerals and Energy (GME) A/S acquired the licence to explore the Kvanefjeld project area. GME A/S is a subsidiary of Greenland Minerals and Energy Ltd, an Australian company listed on the Australian Securities Exchange. Greenland Minerals and Energy Ltd owns 100% of the shares in GME A/S.

The Project area is located in South Greenland approximately 10 km from Narsaq and approximately 35 Km from Narsarsuaq. The main commodities of interest in the Kvanefjeld ore-body are rare earths elements (REEs). There are also sufficient levels of uranium and zinc in the orebody to produce commercially viable by-products.

The Project includes the development of an open pit mine, a processing plant, a port, mine accommodation, tailings facility and roads connecting the parts of the project.

1.3 Scoping workshops

The first step in the preparation of an EIA is a scoping phase.

As the public should be involved throughout the EIA process and informed continuously as the Project moves through the development phase and into production, stakeholders were consulted as part of the scoping phase.

a. Initial Scoping Phase: (up to July 2011)

As a part of the initial scoping phase, four stakeholder workshops were held in Greenland. During these workshops GME took the opportunity to present and discuss planned EIA activities.

The workshops were held as follows:

• on 30 March 2011 in Qaqortoq;
• on 31 March 2011 in Narsaq; and
• on 4 and 5 April 2011 in Nuuk.
The objectives of these workshops were to present the Project to participants and to receive input from the stakeholders on issues to be covered in the SIA, and EIA, processes.

Prior to the holding the workshops, the methodology for the workshops and the list of stakeholders invited to participate were approved by the BMP. The key findings from the workshops were presented to the BMP in Nuuk on 7 April 2011.

b. Developments since July 2011

In 2013 GMEL commenced an additional round of key stakeholder consultation in order to assess an alternative option for the project, namely only constructing a mine and mineral concentrator in Greenland and relocating the hydrometallurgical refinery for separating the uranium and REO mixed carbonate off-shore.

In August 2013 two workshops were held with Government Institutions to present an alternative project design, present the status of the EIA/ SIA processes and to receive input to the EIA/ SIA processes based on the alternative project design.

Since August 2013, GMEL has conducted a number of constructive and informative workshops with representatives of the Mining Licence and Safety Authority (MLSA), the Ministry of Industry & Mineral Resources, the Environmental Agency for the Mineral Resources Area (EAMRA) and the Kommune Kujalleq, to discuss the various development options available. This is discussed in detail in Section 2: Scoping and Environmental Study Plan.

1.4 The Terms of Reference (“ToR”)

In July 2011, after extensive consultation GME received approval for the Terms of Reference for the Environmental Impact Assessment (EIA) and the Social Impact Assessment (SIA).

In the three years since, as further information became available on the design, location and size of the Kvanefjeld Project, additional workshops and meetings have been held with key stakeholders. Based on discussions with the MRA, it has been agreed that the Terms of Reference should be updated to reflect the latest understanding of the Project.

The Amended Terms of Reference (July 2014) for the EIA of the Kvanefjeld project incorporate the results of the original scoping phase and the outcomes of the most recent stakeholder engagement phase. It contains a summary of the field work and studies completed to date and an updated plan for the preparation of the EIA. Comments and input from the stakeholders received during the workshops have been incorporated in these ToR.
2 SCOPING AND ENVIRONMENTAL STUDY PLAN

2.1 Initial Terms of Reference Approved July 2011

A detailed plan for the EIA process, including plans for environmental studies, must be forwarded to and approved by the Mineral Resource Authority (MRA) prior to the start of the EIA process.

In February 2011, public meetings were held in the southern Greenland towns of Narsaq, Qaqortoq and Nanortalik to advise the general public of the process to scope the terms of reference for the EIA and SIA. Then through early April a series of public meetings and stakeholder workshops were held in Greenland’s capital, Nuuk, along with Narsaq and Qaqortoq; the main two towns of southern Greenland that are in close proximity to the Kvanefjeld project area. These events were followed by an Open Day in Qaqortoq, and public meetings in Narsaq and Nanortalik in early June. The June meetings provided the opportunity for the Company to provide an overview to the public on the outcomes of the stakeholder workshops, and the preferred development scenario options to be evaluated.

The workshops held in Nuuk in June were attended by representatives from a range of government departments including Finance; Health; Social Affairs; Fishing, Hunting and Agriculture; Business and Workforce; Internal Affairs, Nature and the Environment; Culture Education and Science; the National Museum; Institute of Natural Resources; and the National Association of municipalities. The Nuuk workshops were also attended by representatives from the Employees and Employers Unions, and the Fisherman and Hunters Association.

The workshops held in the south Greenland townships of Narsaq and Qaqortoq were attended by a greater proportion of local non-government organisation groups in addition to local government representatives. Local government representation included the Mayor’s Department, Social Services and Finances. Non-government representation included the Women’s and Elders Associations, along with the Sheep farmers, Environmental, Local Trade, and Tourist Associations.

The workshops provided a forum for Company representatives to present on the status and future plans for the Kvanefjeld project, which was followed by in-depth discussions in regard to the scope and coverage of both the EIA and SIA. Following the workshops, the draft terms of references were compiled and made available for public review.

Following a review process by both the BMP and NERI (Denmark’s National Environmental Research Institute; advisor to the BMP on environmental sustainability) the ‘terms of reference’ for both the EIA and SIA on the Kvanefjeld multi-element project were approved in July 2011.

2.2 Developments since July 2011

Since the initial approval GME has concluded a number of work programs in Greenland that contribute to feasibility studies and environmental and social impact assessments on the Kvanefjeld project.

The work programs undertaken included:
- environmental baseline monitoring, building on data gathered in previous years;
- background radiation monitoring;
• geological and geotechnical mapping in potential infrastructure locations;
• ongoing stakeholder engagement that included presentations to the smaller settlements outside the main townships of south Greenland;
• workshops with representatives from the MRA and other key stakeholder groups to review the requirements and scope of an exploitation license application.

a. Environmental Baseline Studies

GMEL has been conducting extensive environmental baseline studies in the Kvanefjeld project area for several years, as a basis to evaluate the potential environmental impacts of a mining operation. The baseline studies provide an indication of the natural chemistry of the broader project area, and the background concentrations of radioactive and non-radioactive elements in all environmental ecosystems (land, water and air). The Ilimaussaq Alkaline Complex is the geological entity that hosts defined mineral resources, and is renowned for its unusual minerals and chemistry. Rocks of the Ilimaussaq Complex are actively eroded into the Narsaq valley and surrounding areas, resulting in naturally elevated levels of a number of trace elements (Figure 2.1).

The environmental baseline studies have been conducted in conjunction with Orbicon, GME’s primary environmental consultant. In 2013 a botanical survey was completed and marine biota along the fjord at the base of the Narsaq valley were sampled for analysis of ecotoxicological and uranium and thorium series radionuclide analysis. Freshwater and stream sediment sampling stations were revisited to build on data gathered in previous years, with samples also to be analysed for ecotoxicology and radioactivity. Terrestrial sampling stations were also revisited with samples of both soils and lichens collected. The baseline sampling was repeated in 2014.
b. Background Radiation Monitoring

Comprehensive background radiation monitoring was also undertaken in the broader project area along with the town of Narsaq, and builds on data gathered over several years.

Short term (several days) passive monitoring of radon and thoron was conducted and long term (three month) monitoring devices will be collected sequentially over the coming months. Water and soil samples were also collected for radionuclide analyses. High volume air samplers have recently been installed for the purpose of dust and air monitoring.

A gamma radiation survey was also conducted in 2013 to repeat the surveys carried out in previous years. New additional points in the Narsaq valley were included to provide more detailed coverage from the town of Narsaq to where ore material outcrops on the Kvanefjeld plateau.

c. Geotechnical Mapping

Geological and geotechnical mapping programs were undertaken in areas that are currently being investigated as potential infrastructure sites. These programs set out to assess foundation conditions including rock and soil types, as well as identifying potential geohazards and areas that require further geotechnical drilling. The outcomes provide important information to support the selection of infrastructure locations.

d. Stakeholder Engagement Program

GME has maintained an active stakeholder engagement program in relation to the Kvanefjeld project since 2008. This has primarily focussed on participating in community hall meetings in the main townships of south Greenland, which includes Narsaq, Qaqortoq, and Nanortalik. The aim of these meetings is to provide updates on the Kvanefjeld project and potential development scenarios, and importantly to identify the key areas of interest from the local populace. These forums provide the opportunity for local stakeholders to put forward questions, voice concerns and identify areas where they would like further information.

In south Greenland, the majority of the populace live in the three major towns, however, a considerable proportion lives in settlements outside of these townships. In August 2013, GME personnel undertook a tour of these regional settlements to present overviews of the Kvanefjeld project, and to provide a forum in which people could put forward questions. The settlement tour was aimed to ensure that all local stakeholders in south Greenland are included in the ongoing dialogue surrounding the potential development of the Kvanefjeld project.

Eight settlements were visited where presentations were made and followed by informal discussions (Figure 2.2). The presentations focussed on the potential development scenarios for the Kvanefjeld project, and the work programs involved in the environmental and social impact assessments. The meetings were all well attended, with the most frequently asked questions focussed on employment opportunities, and the environmental and social impacts.
2.3 Current Status July 2014

GME is currently working on economic calculations of the costs of carrying our processing wholly or partly in Greenland as opposed to abroad.

The MRA have advised that it follows from the section 18(3) of the Mineral Resources Act that the extent to which the licensee must process exploited mineral resources in Greenland may be laid down in a licence.

In order to be able to make this specific assessment about the possibility of carrying out chemical processing in Greenland, the different scenarios should be clarified in the application material, including the EIA and SIA reports and in the Terms of Reference.

After extensive consultation, GME and the MRA have concluded that the Terms of Reference should consider the following three development scenarios:
### Table 1: Development Scenarios considered

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<th>Extent of processing in Greenland</th>
<th>Jobs in and outside Greenland</th>
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<td><strong>Scenario 1</strong></td>
<td>Mechanical processing (concentrator): The ore containing steenstrupine (REE + uranium + thorium) and zinc is ground and the two mineral phases are separated into two concentrates. REE and uranium are at this stage forming part of the same mineral (steenstrupine). If this is sold, both REE and uranium are sold at the same time. The zinc concentrate can be sold instantly.</td>
<td>1,000 jobs during the construction phase (primarily from abroad) and around 458 jobs during the operational phase of which 134 will be locals and 73 from the rest of Greenland and 251 from abroad.</td>
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<td><strong>Scenario 2</strong></td>
<td>Chemical processing (refinery): REE and uranium are chemically separated and become two products. The uranium is further chemically processed into a uranium product called yellowcake. All sale of yellowcake is subject to export control with international regulations. The REE product is now a total rare earth oxide (TREO)</td>
<td>Up to 2,000 jobs during the construction phase (primarily from abroad) and another 277 jobs in addition to the already planned 458 jobs during the operational phase (i.e. around 735 jobs during the operational phase).</td>
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<td><strong>Scenario 3</strong></td>
<td>Through additional chemical processing the TREO is refined into a product where first the light and then the heavy REE is separated from each other, if this has not already taken place in Scenario 2. The individual REE will through additional chemical process be segregated into a number of REE elements and will be sold.</td>
<td>The number of jobs is unknown at this point, but the figure is, other things being equal, higher than the 735 jobs stated in Scenario 2.</td>
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The Ministry of Industry and Mineral Resources is of the immediate opinion that the processing requirement in Greenland would naturally include Scenario 1 and 2. However, there will be a need in relation to Scenario 3 for a sensitivity analysis in order to make, on an equal footing with Scenario 1 and Scenario 2, an informed decision as well to assess the socioeconomic and environmental effects.

The processing of minerals often involves complex chemical processes and may thus cause environmental impacts. It is not known on the basis of existing data which and to what extent the processing of the minerals at Kvanefjeld will have environmental consequences. This will be identified through the preparation and public consultation of an EIA report which specifically concerns a chemical processing plant.
3 REGULATORY FRAMEWORK

3.1 The political situation in Greenland

Greenland is a self-governing country under the Danish Kingdom. On 21 June 2009, Greenland assumed self-determination with responsibility for self-government of judicial affairs, policing, and natural resources. This followed a referendum on greater autonomy, which was approved on 25 November 2008. Previously, Greenland operated under a combined Greenlandic and Danish government, having been granted “home rule” by Denmark in 1979.

With the introduction of “self-rule” Greenlanders were also recognised as a separate people under international law. Denmark maintains control of foreign affairs and defence matters. Two Greenlandic elected representatives take part in the Danish Parliament.

The Greenlandic Parliament, Inatsisartut (the legislative power and assembly), is put together by 31 members elected by Greenlandic people for a four-year term meeting through sessions twice a year. A Premier is elected by Inatsisartut. The Greenlandic Cabinet is put together to form nine ministries by the elected Premier. The ministries, Naalakkersuisut, form departments which are run all year round. Inatsisartut works out laws and appropriations that Naalakkersuisut must conform to and also supervises Naalakkersuisut’s activities (www.nanoq.gl).

In 2009 18 municipalities were merged into 4 large municipalities; Qaasuitsup Kommunia, Qeqqata Kommunia, Kommuneqarfik Sermersooq, and Kommune Kujalleq. The municipalities have these following fields of responsibilities: Culture and education, social and health, economy and taxes, engineering, housing and environment (www.sermersooq.gl and www.kanukoka.gl). Narsaq is part of Kommune Kujalleq.

Greenland is a member of the Nordic Council and Nordic Council of Ministries. This membership, together with other Nordic Countries and autonomous regions, facilitates parliamentary cooperation among the members particularly in relation to nature and environmental issues.

The Nordic Council has prepared an Environmental Action Plan, 2013-2018 which focuses greater resource efficiency and reduced environmental impact through inclusive green development, climate change and air pollution, protection and utilisation of biological diversity, and chemicals with adverse impact on human health and the environment.

Greenland is also member of the Inuit Circumpolar Council (“ICC”) and has been a member of the Arctic Council since 1996.

3.2 Legislation in Greenland

This section lists the regulations and guidelines relevant for the project, particularly for the issues and areas of interest for the Environmental Impact Assessment.
The main legislation under which this project will be developed and operate will be the Greenland Parliament Act no. 7 of 7 December 2009 (the Mineral Resources Act) which came into force on January 1, 2010. This Act regulates mineral resources and mineral resource activities. In addition, the project will be developed and operate under the Amendments to the Mineral Resources Act (2012) Greenland Parliament Act No. 26 of December 18, 2012, effective 1 January 2013.

In Greenland nature conservation and environmental regulation are administrated in accordance with the Nature Protection Act (Landsting Act no 29 of 18 December 2003 on Protection of Nature) and the Lov nr. 850 af 21. December 1988 for Grønland om miljøforhold m.v (Act number 850 of 21 December 1988 for Greenland regarding environmental matters). The relevant paragraphs of the new Mineral Resource Act are in general agreement with these two Acts.

In addition, the following international guidelines and standards will be included in the assessment.

UN conventions:

- UN Recommendations on Transport of Dangerous Goods;
- International regulations and Codes of Practice concerning maritime transport of dangerous goods including Conventions (e.g. SOLAS 1974, MARPOL 73/78 and STCW Conventions);
- Convention for the Protection of the World Cultural and National Heritage (UNESCO / World Heritage Convention); and
- United Nations Framework Convention on Climate Change.

International Atomic Energy Agency Safety Standard:

- Occupational radiation protection in the mining and processing of raw materials, IAEA Safety standards series No. RS-G-1.6, Vienna 2004. 95 p. (supersedes IAEA Safety Series No. 26); and

The OECD Nuclear Energy Agency (NEA):

- Managing Environmental and Health Impacts of Uranium Mining. OECD Nuclear Energy Agency (NEA), 2014.
4 \hspace{1em} **BRIEF DESCRIPTION OF THE PROJECT**

4.1 Initial Terms of Reference Approved July 2011

For the original, approved Terms of Reference (July 2011) GME had proposed to develop Scenario 2, and the following project brief was provided.

The Project will consist of an open pit mine, a processing plant, a port, mine accommodation, a tailings facility and roads connecting the parts of the project.

GME is considering two potential scenarios with locations for the accommodation facility, processing plant and port. One scenario is construction of the processing facilities within the Narsaq valley and a new port immediately to the north of Narsaq in Narsap Ilua (West). The other scenario is construction of processing facilities approximately 15 to 20 km northeast of Narsaq and a new port to the east of Illunnguaq opposite Nunarsarnaq (East). Figures 4.1 and 4.2 illustrate the two scenarios (East and West).

Significant further investigation and community consultation and engagement was carried out to confirm the preferred location.

**Figure 4.1: Scenario East**
Figure 4.2: Scenario West

The main components of the project are:

- **The mine**: An open pit mine, from which the ore is extracted.
- **The processing plant**: Where metals are extracted from the ore using hydrometallurgical techniques to produce saleable products.
- **The tailings facility**: Where residues from the processing plant are securely stored.
- **The port**: For ships delivering supplies to the mine and transporting products from Greenland to the Company’s customers.
- **The accommodation**: For mine workers when working at the mine.
- **Associated infrastructure**: To ensure power supplies, effective communications and safe access to the mine.

### 4.2 Current Project Brief (Scenario 2)

Based on the agreed, updated scoping and environmental study plan discussed in Section 2, GME proposes to develop Scenario 2 as the preferred development plan. Scenario 1, the mine and concentrator only, will be addressed as an alternative case in EIA. A sensitivity analysis will be presented on Scenario 3, which considers further chemical refining of the TREO into separate light and heavy rare earth products.
The current development plan differs from the project brief presented in the Approved Terms of Reference (July 2011) and the key differences are highlighted below:

- After extensive community and key stakeholder consultation the preferred location for the Project’s accommodation, port and processing plant is in Narsaq valley (referred to above as Scenario West);
- The mining rate and associated processing facilities have been reduced from 7.2 - 10.8 million tonnes per year down to 3.0 million tonnes per year;
- The process flowsheet has been modified and the whole of ore: pressure alkaline leach process has been replaced by a mineral beneficiation: atmospheric acid leach stage;
- Labour requirements for both the construction phase and the operational phase have been revised upwards;
- The preferred options for the location of the residue storage facilities have been identified.

A brief, non-technical description of Scenario 2 is provided below and the layout is presented in Figure 4.3:

4.2.1 The mine

The plan is to locate the mine at Kvanefjeld on the Ilimaussaq Intrusive Complex approximately 10km from the town of Narsaq and approximately 35 km from Narsarsuaq in southern Greenland.
4.2.2 The processing plant

The processing plant will be located at the upper end of the Narsaq valley. It is currently expected that the plant will operate for 365 days per year and it is proposed that the plant will be designed to treat 3.0 million tonnes per year of ore.

The key advantage to the Kvanefjeld project is the unique rare earth and uranium-bearing minerals and the purpose of the processing plant is to extract these products from these minerals. These minerals can be effectively beneficiated into a low-mass, high value concentrate, then leached with conventional acidic solutions under atmospheric conditions to achieve particularly high extraction levels of both heavy rare earths and uranium. This presents a simple process route with low technical risk that effectively concentrates uranium and REEs to a form that can be sold.

It is currently proposed that the processing plant will consist of sections for crushing, grinding, flotation, leaching, filtration, uranium extraction and for the concentration of REEs.

![Flow Diagram](image-url)

**Figure 4.4**: Flow Diagram Scenario 2

Water will be used in the processing plant and after it has passed through the plant it will be treated before either being recycled back to the plant or returned to the environment. Concentrations of contaminants in the discharges to the environment shall comply with established threshold values and requirements.

It is planned to place the saleable products in drums and containerise them at the processing plant and to transport the containers of drummed product from the processing plant to the port on trucks. The plan will then be to ship them to customers around the world.
The tailings storage facility

The material left over once it has passed through the processing plant is called tailings (a mixture of fine crushed rocks and water). The majority of the sulphides, the fluorine and the rare earth elements will all have been removed or stabilised by this stage in the process. A portion of the uranium and thorium that is not recovered is disposed of in the same mineralogical form as the parent material.

The tailings storage facility will store the wet tailings from the flotation process. A number of alternative locations for the tailings storage facility, e.g. valley deposition, lake deposition and deposition in the fjord system/deep sea, are being evaluated. The location of the tailings storage facility will be influenced by environmental considerations and by the chemistry of the tailings. The current preferred options are to either use the lake Taseq or to locate the facility adjacent to the mine waste rock stockpile.

In addition to the processing plant tailings, other waste streams may be generated and these will need to be recovered, treated and recycled if practical to do so. Otherwise they can be diverted to the tailings storage facility. While not all of these potential waste streams have yet been identified, they will include, for example:

- Residues from REE acid extraction and precipitation circuit;
- Drainage from the mine and waste rock stockpile.

The port

The port facilities will consist of a wharf for ships up to 32,000 DWT (Dead Weight Tonnes) and a service wharf for receiving equipment and products with a smaller capacity. The port will also have storage facilities for saleable products and ship loading facilities. GME is considering alternative locations for the port within Narsap Ilua.

The accommodation

The accommodation will include a canteen, a laundry and opportunities for leisure and spare time activities. GME is considering alternative locations for accommodation, either within the town planning boundary or further up the valley.

Other infrastructures

The main elements of infrastructure to be provided by the project will be:

- Roads from the port to the mine, processing plant and other items of infrastructure
- A source of power, fossil fuel fired initially and then hydro-power
- Water supply and storage for the processing plant, potable water and fire protection
- Buildings and support facilities including accommodation
- A helipad for staff and emergency medical evacuation
- Heating and heat recovery
- An IT and telecommunication system
- Sewage and waste management
4.2.7 Expected workforce

During the construction phase, GME expects a workforce up to 2000 people at the maximum. The construction period is expected to run for approximately 2 years.

During operations, GME estimates a total workforce of 735 people and approximately a third to be recruited locally from either within Narsaq or from the rest of Greenland. The optimal rotation scheme(s) will be discussed and agreed during the SIA process and further if needed in order to maximise the amount of local workforce.

4.3 Alternative Case (Scenario 1)

In 2013 an alternative project design was developed by GME. This project design includes the development of an open pit mine, a concentrator, a port, mine accommodation, tailings facility and roads connecting the parts of the project, and is referred to as Scenario 1.

The original project layout (Scenario 2) included a refinery plant near to the concentrator facility and open pit mine. The decision to consider locating the refinery offshore or remotely at another location in Greenland was a major amendment resulting from stakeholder engagement, assessment of social and environmental benefits, as well as economic viability. Further consultation with stakeholders and local authorities will help to determine the final location of the Refinery. The current proposed site layout breaks the project into three main locations, connected by process infrastructure and services.

The first location would be co-located at the Kvanefjeld mine site at the top of Narsaq Valley and would consist of the crushing, milling and flotation circuit (the concentrator).

The second location is the Port and mineral concentrate packaging facility situated at Narsap Ilua. Concentrate from the first location would be directed here via a pipeline, and the Port would be accessed from Narsaq by a 2.5km sealed road.

The third location is the new Accommodation Village for fly in-fly out (FIFO) employees, and would be situated on the northern outskirts of the Narsaq township.

These are shown in Figure 4.5
Figure 4.5: Map showing project layout areas.

It is planned to treat the Kvanefjeld ore by using a conventional froth flotation process to beneficiate the ore and to produce two different mineral concentrates. The first flotation stage will produce a high grade zinc sulphide concentrate, followed by a second flotation stage which produces a phosphate mineral concentrate.

The gangue minerals left behind after flotation will be dewatered and stored in the tailings facility. The recovered water will be recycled back to the concentrator, where it will be treated to remove fluoride as fluorspar (CaF2), which can be sold, along with the zinc sulphide concentrate, to international customers. A small quantity of excess water will be produced that cannot be recycled back to the concentrator. This water, once treated to remove fluoride, will be returned to the environment at a discharge point adjacent to the concentrator, in Ikerasuaq Bredefjord. Concentrations of contaminants in the discharges to the environment shall comply with established threshold values and requirements.

The phosphate mineral concentrate which contains both uranium and rare earth minerals, will be pumped via pipeline to the concentrate filtration and packaging plant located adjacent to the port.

The phosphate mineral concentrate is rich in valuable metals. It is expected that this product will be bagged, containerised and transported to an off-shore Refinery. The location of the Refinery is yet to be decided (see Figure 4.6)
It is expected that the plant will operate for 365 days per year and it is proposed that the plant will be designed to treat up to 3.0 million tonnes per year of ore.
5 THE EIA PROCESS

5.1 Approach to the EIA

Orbicon have produced this document at the request of GME. GME will continue to engage suitably experienced and competent advisors to assist in the completion of the EIA once these amended ToR have been approved. External international and local experts will be involved in the analysis of specific matters such as radiation effects, ecology, hydrology and geochemistry.

The Guidelines set out the framework for, the contents of, and the minimum level of baseline information required for an EIA.

During the planning and development of the EIA process, a number of references and sources will be considered in order to achieve international mining industry best practices for the EIA. These sources will include, amongst others:

- International Finance Corporation and World Bank Guidelines including the Equator Principles
- European Commission – Reference Documents on Best Available Techniques
- Arctic Council – Arctic Environmental Protection Strategy [EIA Guidelines 1997]
- Relevant Danish institutions such as NERI, GEUS and the DEA
- Arctic Council - Working groups
- United Nations – for example the Framework Convention on Climate Change
- SLiCA
- The International Council on Minerals and Metals (ICMM),
- The International Atomic Energy Agency (IAEA), and
- The International Reporting Initiative for Extractive Industries

In addition, knowledge and experience developed in Greenland will be utilised when evaluating and assessing the local environment and the impact of project activities.

The EIA will be based on a participative approach, involving the stakeholders as much and effectively as possible at all stages of the process. A high degree of communication will be a significant feature of the entire process.

Reference will be made to the Greenland Water Quality Guidelines for freshwater and seawater, developed in 2011. As Greenland has not yet developed guidelines that describe standards for environmental contaminants, dust and noise guidelines from sources outside Greenland will be considered in the process of establishing standards for environmental contaminants, dust and noise. Approval will be sought from the MRA prior to using guidelines from outside of Greenland.

5.2 Scoping phase

The initial assessment of the environmental, and social, issues likely to arise from the implementation of the Kvanefjeld Project was first discussed and reported in the “Preliminary Project Strategy – Kvanefjeld Multi-element Project” by Coffey Natural Systems in September 2009.

A second study, the “Socio-economic Desktop Study for the Kvanefjeld Multi-element Project” was carried out by Grontmij Carl Bro in July 2010.

The main environmental issues identified by the above studies for the project can be summarised as follows:
Effects of discharges to water (surface waters, fjords and groundwater) including stormwater runoff from disturbed areas (such as the waste rock dump) and discharges from the open pits, process plant and the TSF.

Potential for contaminants to enter the food chain (e.g., fluorine, heavy metals and radionuclides of concern such as radium).

Management of biodiversity issues (terrestrial and aquatic), including the presence/absence of rare and/or threatened species.

Effects of atmospheric emissions such as radon gas, dust, combustion products and other gaseous emissions.

Effects of radiation from radioactive sources within the project area.

General waste management.

Where to safely deposit the tailings in a short and long term perspective.

The possibility of alkaline drainage, that has to be neutralised.

Rehabilitation of areas disturbed by the project and decommissioning of the tailings management system.

The significance of these will vary between construction and operational stages of the project. For example, downstream sedimentation is likely to be of more concern during construction, although it will remain an issue throughout the life of the project. Destruction of any significant habitat or sites of archaeological/cultural significance, if present, would be associated primarily with initial clearing works during construction. In contrast, potential impacts on downstream water quality due to poor quality water discharges would continue beyond construction and may encompass both the entire operational life of the mine and a considerable period after closure.

In March 2011, a Strategic Environmental Assessment workshop was held in Perth, Western Australia. The workshop was attended by representatives of Grontmij and Orbicon and the social and environmental aspects of the project were assessed. The outcome of the workshop formed the basis of a “Project Brief”, which described the project in lay or non-scientific terms.

The next step was to commence the Stakeholder Engagement process. Four stakeholder workshops were conducted as part of the Social Impact Assessment;

- on 30 March 2011 in Qaqortoq,
- on 31 March 2011 in Narsaq, and
- on 4 and 5 April 2011 in Nuuk

During these workshops GME took the opportunity to present and discuss planned EIA activities.

Prior to holding the workshops, the approach to the workshops and the list of identified stakeholders were both approved by the BMP.

Invitations to attend the stakeholder meetings were sent to all agreed stakeholders together with a Project Brief describing the project in lay or non-scientific terms. This was done with the objective of promoting more informed participation in the workshops themselves and to provide opportunities for stakeholders to ask clarifying questions of, and to express concerns to, company representatives and both the SIA and EIA consultants during the workshops.
Currently, GME is working with two development options, scenarios 1 and 2. The scoping phase took as its starting point Scenario 2 and looked at two layout options (East and West). Stakeholders were invited to discuss opportunities and concerns that they may have had for each.

In 2013 GMEL commenced an additional round of key stakeholder consultation in order to assess an alternative option for the project, namely Scenario 2.

In August 2013 two workshops were held with Government Institutions to present Scenario 2 and the then status of the EIA/ SIA processes and to receive input to the EIA/ SIA processes based on the alternative project design.

Since August 2013, GMEL has conducted a number of constructive and informative workshops with representatives of the Mining Licence and Safety Authority (MLSA), the Ministry of Industry & Mineral Resources, the Environmental Agency for the Mineral Resources Area (EAMRA) and the Kommune Kujalleq, to discuss the various development options available.

Additional stakeholders have been identified during the stakeholder workshops in 2013, especially the Police department.

Based on responses from the workshops, common concerns and opportunities were identified. The ToR set out in this document have been developed in part from the responses from the workshops. This feedback has been supplemented from a number of sources including;

- the Guidelines (BMP),
- Previous baseline sampling – refer Section 5.1

Furthermore, Greenlandic research documents and studies such as SLiCA (Survey of Living Conditions in the Arctic) were used.

### 5.3 Environmental Study Program

Annual baseline sampling in the Kvanefjeld – Narsaq area has been carried out since 2007. The sampling has followed a protocol developed by the Danish National Environmental Research Institute (NERI), and has been approved by the BMP.

A summary of environmental baseline studies carried out from 2007 to present is provided in 6.1.

The environmental study program will include a number of additional baseline studies as well as project related studies which were identified in the Approved Terms of Reference (July 2011). These studies commenced in 2011 and will be completed in 2014.

Detailed proposals of each Environmental Study Program have been submitted to MRA for approval. These submissions included details such as maps indicating sampling stations and study scope, description of timing of studies, parameters for measurement, methodology and equipment.
As needed, the environmental study programs are updated in consultation with the MRA.

Data obtained from these studies are submitted to NERI and will be stored so that it is available to the MRA and NERI.

A summary of the additional studies required to complete the Environmental Study Program is provided in Table 1, Section 5.2, along with details of these studies.

### 5.4 Assessment and modelling

The background and project specific environmental studies will be assessed to conclude
- A comprehensive description of the environment and local use values
- Potential environmental impacts of the project
- Any areas of knowledge that are lacking and need ongoing study or further research.

### 5.5 Environmental Management Plan and Environmental Monitoring Program

An environmental management system (EMS) consistent with the internationally recognised continuous improvement model ISO14001:2004 will be developed.

The environmental management plan will be developed on the foundation of knowledge of the environment, local use values and potential environmental impacts.

The plan will propose mitigating measures developed to reduce or eliminate potential environmental impacts. A description will be provided of the anticipated effectiveness of these mitigating measures and where residual effects exist, these will be described. Residual effects will be supported by necessary monitoring methods and compensatory measures.

Monitoring will be described in terms of assessing the performance of mitigating measures, and quantifying project outputs to the environment including greenhouse gases.

This plan will describe in detail how the mitigating measures will be organised and who is responsible for carrying out mitigating and monitoring measures.

A plan for acquiring data will be included within the Environmental Monitoring Program.

The Environmental Management and Monitoring plans will be finalised in 2014, however they will developed during the project lifetime, in consultation with the community and MRA.

### 5.6 Public consultation

Public consultation is essential throughout the EIA process so that community concerns can be integrated. A series of public consultation meetings will be held to present and discuss relevant information about the EIA process. Objections and comments will be considered by GME and feedback provided to the public.
Community consultation will be addressed within the EIA document and extensively discussed in a document complementing the EIA, the 'White Paper'. The White Paper will document public consultation comments, and explain how public comments have been incorporated into the EIA and subsequent management plans.

All data collected in connection with the EIA including baseline and monitoring studies are made available to the public.

Following review by the MRA, the final EIA report will be made available for public consultation.

5.7 **Study area and temporal boundaries**

The environmental studies cover the areas directly impacted by project, including options to the west and east. This will include ancillary facilities and will include downstream environments and the towns and settlements where the impacts and benefits are expected to be more noticeable.

The environmental studies will assess the following phases of the project:

- Construction phase;
- Operations phase, and
- Closure and rehabilitation phase.

Maps will be provided describing environmental study areas in detail within each Environmental Study Program proposal document. These proposals have been approved by MRA before commencement.
6 THE ENVIRONMENTAL STUDY PLAN

This Environmental Study Plan is drafted in accordance with the new EIA guidelines (January 2011) issued by the BMP and provides information about the planned contents of the EIA report and the approach to be taken when preparing the report. In addition to that, the plan provides a description of the environmental studies that have been carried out and the studies planned for the coming years which will form the basis for the environmental assessment of the mine project.

The Environmental Study Plan consists of three parts:

- Summary of environmental baseline studies previously commissioned by GME and approved by the BMP (from 2007 to date) (section 6.1)
- Summary of the additional studies to be implemented or sourced in order to complete the EIA (Environmental Study Program) (section 6.2)
- The proposed Table of Contents for the EIA report. (section 6.3)

Public consultation is essential throughout the EIA process so that community concerns can be integrated. Community consultation will be addressed within the EIA document and extensively discussed in a document complementing the EIA, the ‘White Paper’.

6.1 Previous baseline sampling

Annual baseline sampling in the Kvanefjeld – Narsaq area has been carried out since 2007, to study and document the natural levels of heavy metals, radioactivity and other elements. The sampling has followed a protocol developed by the Danish National Environmental Research Institute (NERI), and has been approved by the BMP and has included fresh and saltwater, sediment, lichens, soil, leaves, grass, fish and mussels.

The baseline sampling in 2007 – 2010 mainly took place in the Narsaq Valley and the adjacent areas because this was where it was believed that the mine facilities would be constructed.

Since the Approved Terms of Reference (July 2011) baseline sampling has continued, with a focus on the Scenario 2 layout.

The number and position of sampling stations, which have also been approved by NERI, covers the entire coastline as well as rivers, lakes and terrestrial area within the area of the Scenario West plus a reference station further away (Figure 3).

All the collected water samples have subsequently been analyzed by NERI and Risø National Laboratories while the other samples are stored in a freezer at NERI. The results of the sampling have been documented in a number of reports and notes listed below.
List of environmental baseline studies already undertaken in Kvanefjeld – Narsaq area

2007


2008

Polonium-210 in environmental samples collected in 2008 from the Kvanefjeld area in Greenland Radiation Research Division. Risø DTU. March 2009. 2pp


2009
The Kvanefjeld Multi-element Project, SW Greenland Report on the environmental baseline sampling, August 2009, Orbicon, October 2009. 15 pp

Radioactivity in water sampled in 2009 from Narsaq area, Greenland. Risø national Laboratories. 3 pp.

Kvanefjeld water 2009. Test report no. 344. National Environmental Research Institute. 9 pp

2010
Analyses of radon-222 and radium-226 in samples of Taseq lake water collected August 2010. Risø National Laboratories. 1 pp


Archaeological Survey Narsaq 2010, Greenland National Museum and Archives. 18 pp

2011

2012


Kvanefjeld Multi-element Project – the natural environment of the study area. Orbicon. 51 pp.

2013


2014

Figure 6.1: Sampling stations for the 2007 – 2010 baseline studies
6.2 Additional studies to be implemented

Table 1 provides a summary of the additional studies that are proposed for the EIA. This includes a number of additional baseline as well as project related studies. All these studies will be carried out in 2014 so that the results can feed into the EIA report.

Each study is summarised with an objective, approach, schedule and final outcome.

Detailed proposals of each Environmental Study Program will be submitted to EAMRA for approval. Detail will include maps indicating sampling stations and study scope, description of timing of studies, parameters for measurement, methodology and equipment.

If needed, the environmental study programs will be updated in consultation with the EARMA.
Table 2: Summary of additional studies required

<table>
<thead>
<tr>
<th>Study</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Baseline dust and ambient air emission monitoring</td>
<td>ongoing</td>
</tr>
<tr>
<td>2 Dust and ambient air emission dispersal modelling</td>
<td>2014</td>
</tr>
<tr>
<td>3 Mine waste geochemical characterisation and ecotoxicological testing of leachate waters from tailings</td>
<td>2014</td>
</tr>
<tr>
<td>4 Hydrology and water balance</td>
<td>2014</td>
</tr>
<tr>
<td>5 Noise study</td>
<td>2014</td>
</tr>
<tr>
<td>6 Impact of hydrocarbon spills</td>
<td>2014</td>
</tr>
<tr>
<td>7 Local use</td>
<td>2014</td>
</tr>
</tbody>
</table>

The details of each study is presented in the following study plans.
1. Baseline Dust and Ambient Air Emission Monitoring

**Objective:**
To compile background data of ambient concentrations of air pollutants, including particulate matter (PM).

**Approach:**
A permanent monitoring station for PM\(_{10}\) will be established at Narsaq town, with filter and real-time measurements continuing after the baseline period.
The following data will be collected:
- PM\(_{10}\) filter samples (24-hour and 14-day)
- PM\(_{10}\) continuous monitoring (hourly)
- NO\(_2\), SO\(_2\), O\(_3\), NH\(_3\) passive samplers (monthly)
- Dust deposition (monthly)
- Element composition of PM\(_{10}\) and dust deposition samples by PIXE (Proton Induced X-ray Emission)
- Radionuclides in dust and radon in air.

Monitoring station locations during baseline monitoring period
- Narsaq town
- Climate station Kvanefjeld
- Sheep Farm
- Regional background location, to be selected
- Additional locations for passive samplers.

**Outcome/ deliverables:**
Report summarising baseline results.
Study report will be a key reference in providing a comprehensive description of the ambient environment before mining.
Ambient conditions during various weather conditions will assist in air emission modelling.
Information will be an essential reference assessing potential environmental impacts and designing methods of mitigation.

**Schedule:**
A detailed proposal including maps with the position of sampling stations and lists of items to be collected will be forwarded to the EARMA shortly.
Baseline measurement is ongoing and will continue throughout 2014.
2. Dust and Ambient Air Emission Dispersal Modelling

**Objective:**
To predict impacts on ambient air quality in areas surrounding the project, in particular work areas and residential areas.

**Approach:**
Modelling analyses most likely using the CALPUFF system will be carried out. The modelling will include all major emission sources. Deposition rates will be predicted based upon available hourly meteorological data. The modelling results will further be based on receptor locations.

Climate monitoring and studies conducted by GGL from 2010 to 2014 will be incorporated into models.

Study of background ambient air quality will be relevant to selection of standards and emission rates. Study conclusions will establish parameters for emission quality and monitoring methods.

**Outcome/deliverables:**
Report including several scenarios including estimates of emission factors and rates. Supporting maps showing spatial distribution of predicted air quality will also be developed.

Predicted air quality will meet ambient air quality standards. These standards must be supported by EAMRA.

**Schedule:**
Final project layout and meteorological and topographic studies must be complete before the design of the modeling study can be finalised. A detailed proposal will be forwarded to the BMP for consideration.

Modelling will take place during 2014.
3. Mine Waste Geochemical Characterisation and Ecotoxicological Testing of Leachate Waters from Tailings

**Objective:**
To develop an understanding and assess any potential acid rock drainage and/or metals leaching associated with waste rock/lean ore and tailings from the Project.

To determine if water from the tailings pond is toxic to aquatic organisms (such as trout).

To assess the long term stability and rehabilitation capability of waste rock, tailings and regolith.

**Approach:**
The following test types are proposed:

- Acid-base accounting
- Shake-flask test
- Sequential extraction
- Toxicity test
- Total trace element content
- Full metal screening
- Radon release
- Humidity cells testing.

**Outcome/deliverables:**
Report presenting and discussing results, suggesting management considerations if required.

Information will form a foundation of knowledge that will enable GME to assess potential environmental impacts and designing methods of mitigation such as tailings, waste rock dump design, monitoring and environmental management.

**Schedule:**
A number of tests have already been conducted on both the flotation tailings and chemical residue including acid-base accounting (ABA), shake flask extractions, humidity cells testing, particle density, and particle size analysis. A detailed testing protocol will be forwarded shortly to the EAMRA.
4. **Hydrology and Water Balance**

**Objective:**
To characterise the hydrology of the Project area. This includes developing a conceptual understanding of the hydro-geological features of the project area and the pathways of potential contamination of aquifers and risk of transport of contaminants.

**Approach:**
A hydrological model will be developed for the Project area based on the ongoing stream flow measurements, historical data and physico-chemical measurements.

The model will be based on data collected from hydrological stations at major rivers and streams throughout Scenario East and West including Narsaq River.

**Outcome/ deliverables:**
Report discussing the hydrogeological features of the Project area, seasonal fluctuations and potential contamination risks from contaminant transport.

**Schedule:**
A detailed proposal including maps will be forwarded to the EAMRA shortly.

Measurements of water flow data will continue throughout 2014.
5. **Noise Study**

**Objective:**
To characterise impact of the Projects major generators of noise.

**Approach:**
Model spatial distribution, intensity and frequency of noise from major sources such as blasting at mine site, the crusher and air traffic (helicopters and fixed winged aircraft) using the SoundPLAN program.

**Outcome/deliverables:**
Noise model predicting the magnitude and extent of noise produced by the Project.

**Schedule:**
A detailed proposal will be forwarded to the EAMRA shortly.

The study will be carried out in 2014.
6. Impact of hydrocarbon spills

Objective:
To understand the impact oil spills may have on terrestrial, freshwater and marine ecosystems.

Approach:
Desktop study that compiles the existing knowledge in the field of impact of oil spills on Arctic ecosystems with special reference to the Narsaq area. A key source of information will be the NERI Environmental Oil Spill Sensitivity Atlas for the South Greenland Coastal System.

Outcome/ deliverables:
To understand the impact oil spills may have on terrestrial, freshwater and marine ecosystems and determine the most effective actions to minimise any impact or manage an incident.

Schedule:
The study will be carried out in 2014.
7. Local Use

**Objective:**
Documentation of local use of the Project area. The study will provide data that will facilitate resolving any conflicts between the Project and the present utilisation of the area.

**Approach:**
Interviews with relevant stakeholders, including fishermen, hunters and sheep farmers. The study will be carried out in close liaison and cooperation with the SIA team.

**Outcome/deliverables:**
A report will be prepared that summarises the findings. Important fishing and hunting areas will be shown in maps.

**Schedule:**
The survey will be carried out in 2014.
6.3 Proposal for a Table of Contents for the EIA report

The main report will commence with an Extended, non-technical summary (“the Executive Summary”. The Executive Summary will describe in short the project and a conclusion including preferred options compared to alternative solutions, important potential environmental effects, mitigating actions, decommissioning and remediation, uncertainties and public concerns. The Executive Summary will be presented in Greenlandic, Danish and English.

The structure of the rest of the report will follow the format proposed below:

1. INTRODUCTION
   1.1 Description of the Company
   1.2 Project setting (regional environmental setting, including geography, geology, climate, local population, etc)
   1.3 Background and objectives
   1.4 Timetable for construction, mine start and operation
   1.5 Legal and Regulatory Framework

2. EIA METHODOLOGY
   2.1 EIA aims and objectives
   2.2 EIA process
      - Environmental Study Plan
      - Baseline studies
      - Other sources of information
      - Impact assessment
   2.3 Public involvement
      - Public hearing

3. EXISTING ENVIRONMENT
   3.1 Physical Setting
      - Climate
         - Arctic
         - Wind direction and wind speed
         - Noise
         - Air quality including background Radon concentrations at different wind speeds and directions
         - Meteorology (including maximum precipitation (rain and snow))
      - Terrestrial
         - Geology
         - Topography (including flood plains, landform)
         - Soils
         - Geochemistry
      - Aquatic
         - Hydrology (including drainage)
         - Bathymetry
         - Water resources, including freshwater and seawater quality
         - Sea Ice
Radiation
  Background radiation (sources of natural radiation), radon levels

3.2 Living environment
  Terrestrial flora and fauna
  Aquatic ecology
  Marine ecology
  Biodiversity and protected areas

3.3 Land use, conservation and heritage
  Mining
  Tourism
  Local inhabitants and their use of the area
  Archaeology and cultural heritage

4. PROJECT DESCRIPTION

4.1 Objective of the project
  Objectives
  Project history
  Mineral exploration
  Research and engineering studies

4.2 Mining operations
  Mining methodology
  Mine design and plans
  Mine blasting and explosives
  Mine waste management (including conceptual design of tailings facility, site location and method, waste characteristics, implications of waste geochemistry, waste dam stability, tailings pipelines, waste treatment, waste seepage and runoff control, dam erosion control, waste monitoring program)
  Water use and disposal (including discharges to the environment, water from tailings facility)
  Mine Waste Water including potential alkaline drainage, and potential dissolution of fluoride and radionuclides, pit dewatering, runoff water from waste rock and ore stockpiles, tailings dewatering
  Slope stability
  Occupational health, safety and radiation protection

4.3 Processing operations
  Mineralogy and metallurgy
  Processing plant design
  Residue disposal and storage facilities including potential alkaline drainage, and potential dissolution of fluoride and radionuclides
  Product storage, handling and transport at project site
  Chemical reagents
  Mine and process consumables
  Mine waste management (including conceptual design of tailings facility, site location and method, waste characteristics, implications of waste geochemistry, waste dam stability, tailings pipelines, waste treatment, waste seepage and runoff control, dam erosion control, waste monitoring program)
4.4 Supporting infrastructure and services
   Port facility and shipping  
   Aeroplanes and airstrip  
   Helicopters and helipads  
   Mine vehicles and access roads  
   Gas and dust collectors and scrubbers including radon control  
   Energy demand and power supply  
   Water supply  
   Accommodation  
   Domestic waste disposal facility  
   Wastewater treatment facility  
   Workshops and stores  
   Workforce (all phases) including training and environmental duties  

4.5 Post mining closure  
   Conceptual decommissioning plan  
   Conceptual rehabilitation/ reclamation plan  
   Monitoring – i.e. Radon, radionuclides, fluoride, including parameters to be  
   monitored, sample location, sample type (air,  
   land, and water), suggested frequency, duration, assessment criteria,  
   QA/ QC, sampling location, data management, reporting  

4.6 Construction and Start up  

4.7 Project Timing  

5. IMPACT ASSESSMENT AND DEVELOPMENT OF  
   PREVENTATIVE AND MITIGATION MEASURES  

5.1 Impacts to the physical environment  
   Area impacted and possible landscape disturbed  
   Erosion  
   Long term stability of rehabilitated ground and tailings deposits  
   Hydrological changes of rivers, lakes and fjord, including long term impact on  
   Surface (river diversions, wetlands) and groundwater  
   Mine dewatering impacts  
   Qualitative and quantitative - impacts on freshwater and sea water including  
   alkaline drainage, dissolved radionuclide and fluoride concentrations and  
   any other chemicals from sources including mining, processing or tailings  
   Dust  
   Noise and vibrations  
   Light, heat and radiation  
   Gas emissions including greenhouse gases and Radon emissions  
   Fluoride (estimation of amount that will be dissolved from the mine, tailings and  
   from waste rock deposits, demonstration of how excess fluoride can be  
   removed from drainage water)  
   Radionuclides (estimation of amount that will dissolve from the mine, tailings and  
   waste rock and demonstration of how radionuclides can be removed from  
   the drainage)  
   Radon (estimation of the amount of radon that will evaporate from the mine,  
   tailings and from the waste rock deposit; calculation of concentrations in the  
   air in Narsaq and other places dependent on wind direction and speed)  
   Possible release of chemicals and radionuclides to the environment and the  
   impacts hereof (including runoff from mine ore stockpile, waste rock, pit  
   water, mineralised materials)
Alkaline drainage (testing if there are any problems with that and if this is the case, give methods to mitigate any problems)

5.2 Impacts to the living environment
   Impacts from ore, tailings and waste rock and potential impacts from alkaline drainage, and potential pollution from dissolved radionuclide and fluoride concentrations and any other chemicals
   Removal or damage of vegetation and effects on possible carbon sinks
   Disturbances of wildlife
   Loss of habitats
   Loss of biodiversity
   Introduction of non-native species of flora and fauna
   General impact on ecosystems
   Creation of new habitats

5.3 Impacts to the land use, conservation and heritage
   Hindrance of other land use
   Increased demand on existing resources
   Open up the area for other land use through major changes in infrastructure

5.4 Cumulative impacts

6. ALTERNATIVES CONSIDERED FOR THE PROJECT

6.1 Implications for preferred option

7. ENVIRONMENTAL MANAGEMENT SYSTEM

7.1 Company Environmental Policy

7.2 Environmental Management Plan (EMP) (to manage impacts for construction, operation, closure and post-closure) including risk assessment
   Implementation
   Management plans
   Procedures
   Responsibilities
   Training
   Emergency preparedness
   Emergency planning and response (fire, radiological event (mineral processing spill, product packaging, contaminated sites) and transport of product) and unplanned disaster

7.3 Decommissioning and closure process

7.4 Compliance assessment, auditing, review, continuous improvement

7.5 Reporting on effectiveness of mitigation/management

8. ENVIRONMENTAL MONITORING

8.1 Results of baseline studies

8.2 Conceptual monitoring program (for all mine phases), including parameters to be monitored, sample location, sample type (air,
8.3 Calculations of greenhouse gas emissions

9. PUBLIC CONSULTATION

10. CONCLUSION

10.1 Summary of Proposed Project

10.2 Potential Significant Environmental Impacts

10.3 Mitigation/ management including mitigation of alkaline drainage, potential environmental contaminants including fluoride, radionuclides, and other chemicals

10.4 Decommissioning and rehabilitation

10.5 Uncertainties/ Public Concerns

11. GLOSSARY

12. REFERENCES/ AUTHORS

Appendices

#. Public consultation – White paper
Annex 1: Notes to Draft ToR for EIA, June 2011
Notes to

Draft ToR for Environmental Impact Assessment, Kvanefjeld Multi-Element Project, May 2011

June 2011

In general the “Draft ToR for Environmental Impact Assessment” forms a sound base for preparing the Environmental Impact Assessment for the Kvanefjeld project. We have some comments:

Page 7:
On what background is the Scenario East included in the considerations?

The reader of the “Kvanefjeld EIA ToR” should be aware that this description in its nature is a huge oversimplification of the complex series of chemical reactions needed to produce a REE (rare earth elements) concentrate, uranium oxide and a zinc-product. From Figure 3 on page 9 one could draw the false conclusion that there will be only one waste stream. Clearly, there will be many. Here is a list of possible waste streams. Some of the items on the list below might prove to be nonexistent and some might have been forgotten on the list:

- flotation tailings,
- waste water from the uranium hydrogen-precipitation,
- waste product after acid extraction of REE,
- waste water after REE precipitation,
- wash water from product washing,
- barium sulphate sludge from radium removal,
• drainage from waste rock piles,
• drainage from the mine,
• waste after zinc extraction,
• water from the hydrogen plant,
• sludge from fluorine removal from drainage water from mine and waste rock.

In addition the reader should be aware that the project includes handling of large volumes of ore and chemicals that might release chemicals and radionuclides to the environment. Both short-term and long-term risks by release of chemicals and radionuclides via dust, spill and waste water should be described in EIA.

In the political part of the report we note that there is no mentioning of the ‘zero tolerance’ for uranium mining. This is a political problem that has to be solved before any mining at Kvanefjeld can start.

Page 11   4.2

The main social issues (both positive and negative) identified for the project were summarised as follows:

- No social impacts are mentioned.

Potential for contaminants to enter the food chain (eg fluorine, heavy metals and uranium).

- Remember all radionuclides of concern eg. radium

The main environmental issues identified by the above studies for the project can be summarised as follows:

One could add:
1) Where to place the tailings and how to place it safe in a long time and short term perspective.

2) The possibility of very alkaline drainage, that has to be neutralised.
Table 1 page 19.

| 5 | Mine Waste Geochemical Characterisation and ecotoxicological testing of leachate waters from tailings | A detailed testing protocol will be forwarded to the BMP in 2011 |

Note that item 5 - geochemical testing etc. is a very complex point. It is dependent of a detailed knowledge of the planned processes, and it needs waste products from a small scale experimental extraction plant (pilot plant). In addition residual concentrations of chemicals used in different processes should be addressed.

Page 20.
Where in the landscape are the two site candidates for marine tailings disposal?

Page 21

2. **Baseline Dust and Ambient Air Emission Monitoring**

The ambient air monitoring should include radionuclides in dust and radon in air.

Page 24

5. **Mine Waste Geochemical Characterisation and Ecotoxicological Testing of Leachate Waters from Tailings**

Note that this point is quite complicated. All waste streams must be tested and analysed. The test results shall be used to calculate the concentrations of the relevant elements and chemicals in the environment. These concentrations should then be compared with guideline values.

The method: “Acid-base accounting” is mentioned. We can expect very basic percolates. The method should be performed so that the basic percolates are treated as the items to worry about. The acid-base accounting is originally designed for waste that might generate sulphuric acid during weathering.

Page 24.
Toxicity tests are mentioned. Since there are trouts in the Narsaq Elv the toxicity tests should include tests on trouts or a similar fish.
5.3 Proposal for a Table of Contents for the EIA report

This table seems to be ok, and it is not very different from any other mining projects in Greenland. It must, however, include points that are typical for the Kvanefjeld. We suggest that the following points are added to the Table of Contents:

- Estimation of the amount of fluoride that will dissolve from the mine, tailings, and from waste rock deposit
- Demonstration of how excess fluoride can be removed from drainage water.
- Estimation of the amount of radionuclides that will dissolve from the mine, tailings, and waste rock and demonstration of how radionuclides can be removed from the drainage.
- Estimation of the amount of radon that will evaporate from the mine, tailings, and from waste rock deposit.
- Calculation of the radon concentration in the air in Narsaq and other places dependent on wind direction and wind speed.
- Evaluation of the possible release of chemicals and radionuclides to the environment and impacts hereof.
- Testing if there will be any problems with alkaline drainage. And if so give methods to mitigate those problems.

These points can all be placed in the proposed table of content. Note that all rocks that contain sodium fluoride have been naturally extracted by rain water in the layers that are positioned close to the rock surface. Fluoride tests have to be performed on deep rock samples.

Kind regards

Gert Asmund
Annex 2: Comments to Amendment to the ToR for EIA and Draft Plan of Study EIA of Kvanefjeld Multi-Element Project 2013
To Miljøstyrelsen for Råstofområdet

The Kvanefjeld project, license No. 2010/02

The reason for the amendments is that the project design has been changed. The revised project design includes mining, crushing, grinding, flotation, cleaning of waste streams, export of several concentrates and deposition of waste. The important changes are: Flotation is now included and will be performed in Greenland, but chemical treatment of concentrates is now proposed to occur outside Greenland. The comments below have been prepared in cooperation with The Greenland Institute of Natural Resources.

Figure 1 in ToR
DCE/GN recommends that the company is urged to consider locating the power station at the harbour to minimise transportation of fuel and to be in a better position to use hydro power if this option becomes available.

Guidelines.
Orbicon states: It is understood that new Guidelines have been drafted and are due to be released in 2013. This will probably be in 2014.

Orbicon and GME intend to use standards from other countries if there are no Greenlandic standards. DCE recommends that Greenlandic guidelines are established as soon as possible so that it will not be necessary to use foreign guidelines.

Flotation chemicals.
The plan of study should include flotation chemicals. The following should be investigated: Which chemicals are meant to be used? Which degradation products will arise and how much will be discharged to the environment?
Study on process water and tailings should include: leaching test, short and long-term toxicity test (at least on algae, crustaceans and fish), bioaccumulation and
chemical analyses incl. metals, flotation chemicals and the degradations products and radionuclides.

It should be mentioned that the authorities need detailed information on each product/chemical including adequate and detailed information on composition of all substance in the product.

**Arctic char**
A dam across the Narsaq river is planned in the upper part of Narsaq valley. The influence of this dam on the population of Arctic Char should be described.

**Chapter 5.3.1 Hindrance of other land use.**
This chapter should include the effects on agriculture and sheep farming in Dyrnes Valley and the surrounding land area during mining and after mine closure.

**Power supply.** The project overall energy requirements have been determined to be in the order of 16 MW. A new HFO-fired power station will be established to meet this load.
The company should consider using hydropower. Permission for the use of heavy fuel oil (HFO) is a topic that has to be considered by the Greenland authorities.

**Tailings.**
The use of Taseq for tailings deposition: At least one alternative should be considered.

**Radon and dust**

5.1.11 Radon (estimation of the amount of radon that will evaporate from the mine, tailings and from the waste rock deposit; calculation of concentrations in the air in Narsaq and other places dependent on wind direction and speed)
The company should carry out a study that assesses the impact of dust including radionuclides on the population in Narsaq. The ‘Dust chapter’ should encompass the composition of dust and a calculation of dust deposition in the catchment area for drinking water during mining and after mine closure.

**Measuring particulate matter in air.**
The EU air quality standard ([http://ec.europa.eu/environment/air/quality/standards.htm](http://ec.europa.eu/environment/air/quality/standards.htm)) states that after 2015 there will be limits for PM2.5. We suggest that the background measurements for the Kvanefjeld project should include measurements of PM2.5 in addition to measurements of PM10.

**Toxicological studies:**
Toxicological studies should include short- and long-term toxicity tests at least on algae, crustaceans and fish to investigate possible effects on the biota. The tests must be
performed on tailings undertaken flotation in order to also cover effects of chemicals, degradation products of the chemicals and radionuclides. End point of the toxicity test must also cover effects of radioactivity.

Kind regards

Gert Asmund
Annex 3: Stakeholder Consultation

STAKEHOLDER ENGAGEMENT PLAN FOR THE KVANEFJELD MULTI-ELEMENT PROJECT

<table>
<thead>
<tr>
<th>EIA Phases</th>
<th>Stakeholder</th>
<th>Objective of the involvement</th>
<th>Involvement</th>
<th>Proposed time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoping and ToRs</td>
<td>Participants at the workshops on 20 and 21 August 2013</td>
<td>The involvement is to report on feedback received at the workshops</td>
<td>Report from the workshops to be distributed with an invitation to provide additional feedback/comments for the report</td>
<td>Deadline for comments 21 September (Done)</td>
</tr>
<tr>
<td></td>
<td>Participants at the workshops and the invited institutions who did not participate</td>
<td>The objective is to share the amendment of the ToR (the plan forward on the EIA)</td>
<td>Amendment to TOR to be distributed</td>
<td>December 2013 (Done) Re-issue of current ToR for public review July 2014</td>
</tr>
<tr>
<td>Baseline studies</td>
<td>MRA, and other relevant Authorities</td>
<td>The objective is to involve the Authorities and key informants in the preparation of any additional/continuing baseline studies</td>
<td>Collect information which is not available from the secondary sources, confirm standards and data capture methods required, gain approval prior to initiating field work</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>MRA, and other relevant Authorities as well as Focus groups and key informants (focus groups to be appointed later)</td>
<td>The objective of the involvement of the focus groups the baseline study is to collect information and perceptions (fears, expectations, etc) from specific groups of stakeholders that are relevant for the project.</td>
<td>Collect information and perceptions (fears, expectations, etc) from specific groups of stakeholders that are relevant for the Project</td>
<td>2014</td>
</tr>
<tr>
<td>Development of Impact Analysis and Mitigation Measures</td>
<td>Municipality (Kommune Kujalleq)</td>
<td>The objective is to involve the communities of the Municipality (Kommune Kujalleq) and to collect information and perceptions (fears, expectations, etc) for input into the EIA.</td>
<td>Validate the baseline data at household level</td>
<td>2014</td>
</tr>
<tr>
<td>Development of draft EMP</td>
<td>MRA, and other relevant Authorities as well as focus groups and key informants (focus groups to be appointed later)</td>
<td>The objective of the involvement of selected groups is to assist with the identification of the potential main areas of impact and the possible mitigation measures.</td>
<td>Define how to monitor and develop possible mitigation measures in consultation with the MRA</td>
<td>2014</td>
</tr>
<tr>
<td>Development of EMP and monitoring plans</td>
<td>MRA, and other relevant Authorities</td>
<td>The objective of the involvement is to define and agree on the extent of the EMP and the standards to be adopted with the regulatory authorities, and the requirement for programs for monitoring and evaluation</td>
<td>Development of EMP and monitoring plans will be developed in consultation with the Community and MRA</td>
<td>2015</td>
</tr>
<tr>
<td>Draft EIA Report and Public Hearing</td>
<td>MRA, Key stakeholders, General Public</td>
<td>The objective of the involvement is to present, clarify, validate and receive feedback on the findings of the impact analysis, recommendations and draft Environmental Management Plan</td>
<td>2015</td>
<td></td>
</tr>
</tbody>
</table>