THE KEY LAKE PROJECT
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SUMMARY

LOCATION: Key Lake is located in the Athabasca sandstone basin, 640 kilometers (400 miles) north of Saskatoon, Saskatchewan in western Canada.

OWNERSHIP: The project is owned by Saskatchewan Mining Development Corporation (SMDC), 50%; Uranerz Exploration and Mining Limited, 33 1/3%; and Eldor Resources Limited, 16 2/3%.

SMDC is a commercial corporation owned by the Government of Saskatchewan, Uranerz a wholly-owned subsidiary of Uranerzbergbau CmbH. of Germany and Eldor, a wholly-owned subsidiary of Eldorado Nuclear Limited, a commercial corporation owned by the Government of Canada.

The history of the ownership of the project is quite complex. Its early beginnings go back to 1968 when Uranerz Exploration and Mining Limited joined with Inexco Mining Ltd. and seven other companies to form a joint venture to explore the Athabasca sandstone region of northern Saskatchewan. By 1970, when the market price of
uranium was about $6 a pound, six companies dropped out, leaving Uranerz, Bell Oil and Inexco, all with equal shares. By 1974, discouraging results led Bell Oil Co. to decide to leave the joint venture. The other two partners (Uranerz and Inexco) offered Bell's one-third share to the Saskatchewan government who established SMDC to act as its agent. In 1978, Inexco decided to sell its 1/3 share to SMDC which sold one-half of this share to Eldor Resources Limited. Thus the partnership came to be the present arrangement of SMDC: one-half; Uranerz: one-third; Eldor: one-sixth.

**OPERATOR:** Key Lake Mining Corporation (KLMC), wholly owned by the joint venture partners, is the operator of the project.

**OREBODY STATISTICS:** The three sources of ore at Key Lake contain 70,100 tonnes U or 182,400,000 pounds $U_3O_8$, consisting of the following:
<table>
<thead>
<tr>
<th>ORE</th>
<th>PRODUCT</th>
<th>Pounds</th>
<th>% U</th>
<th>% U₃O₈</th>
<th>Pounds U₃O₈</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAERTNER</td>
<td>Tonnes</td>
<td>814,000</td>
<td>2.79</td>
<td>3.30</td>
<td>59,100,000</td>
</tr>
<tr>
<td></td>
<td>Tonnes U</td>
<td>2,117,000</td>
<td>2.11</td>
<td>2.49</td>
<td>116,200,000</td>
</tr>
<tr>
<td>DEILMANN</td>
<td></td>
<td>587,000</td>
<td>0.54</td>
<td>0.46</td>
<td>7,100,000</td>
</tr>
<tr>
<td>CIOBBLE ORE</td>
<td></td>
<td>3,518,000</td>
<td>1.99</td>
<td>2.35</td>
<td>182,400,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>7,762,000</td>
<td>1.99</td>
<td>2.35</td>
<td>182,400,000</td>
</tr>
</tbody>
</table>
PROJECT OVERVIEW

The Key Lake uranium deposits in northern Saskatchewan are high in grade and near the surface.

The first deposit was discovered in 1975. Uranerz Exploration and Mining Limited, the operator in a joint venture exploration project, struck high-grade uranium ore in a diamond drill hole near Key Lake. Subsequent drilling outlined the Gaertner orebody.

Continued diamond drilling in the Key Lake region resulted in the discovery, about one year later, of a second discrete high-grade uranium deposit, the Deilmann orebody.

Development of the project proceeded to the stage where an Environmental Impact Statement was prepared and filed with the Saskatchewan Department of the Environment in late 1979. The Key Lake Board of Inquiry was commissioned in December, 1979 and completed public hearings on the site-specific environmental and socio-economic aspects of the project by the end of 1980. In February, 1981 the Board recommended that the project proceed, subject to conditions which would protect employees and the environment and increase the benefits to residents of northern Saskatchewan. The provincial government accepted the Board's report.
and subsequently signed a surface lease agreement with KLMC on August 27, 1981 covering a 21-year period. For a brief historical background see Appendix 1.

On site construction began immediately under the supervision of the engineering, procurement, construction and management consultant, Wright Commonwealth Joint Venture. For a more detailed summary see Appendix 2.

Ore is extracted by open pit mining methods with separate pit development for each deposit. The mill is designed to process 700 tonnes (780 tons) of ore per day and employs conventional separation and extraction techniques to process the high-grade ore. Overall uranium recovery will be greater than 97% and annual production capacity will be 5,440 tonnes $U_3O_8$ (12 million pounds $U_3O_8$).

Although the maximum output capacity is among the largest by world standards, the design of the mill and the high grade of the ore permit efficient production at lower levels. This provides flexibility for the operator to respond to market conditions and customer requirements. For comparison to other uranium mines see Appendix 3.

Access to Key Lake is by air and road. A gravel airstrip has been constructed and an all-weather road to the mine site has been completed.
THE WORK FORCE

The Key Lake project employs 450 people. Following a study of employee turnover at similarly remote mines and taking into consideration the social fabric of the native people working at the project, it was decided not to establish a townsite at Key Lake. Instead, a 7-day in, 7-day out commuter system is in effect.

Under this system, employees are flown from six northern designated pickup points (La Ronge, Pinehouse, Ile a la Crosse, Buffalo Narrows, Cumberland House and Pelican Narrows) to the mine, where they work an 11-hour shift each day for seven days. They then return home for a seven-day period, while their replacements are working at the project site. Thus at any one time only half the work force is on site.

This work schedule has proven successful in other uranium operations in northern Saskatchewan. It avoids social problems that frequently arise in small, remote development-based communities. Since northerners comprise a substantial part of the Key Lake work force, this schedule should be less disruptive to their community lifestyle. For those who are accustomed to making their living by trapping and fishing, the routine of being away from home several days at a time is not new.
Overburden

The Gaertner pit is estimated to contain approximately 7.7 million cubic metres of overburden material (sand and till), varying in depth from 20 to 60 metres. Scrapers first, then shovels and trucks began removing overburden from an area approximately one-third the ultimate surface area of the pit. The material has been transported to the waste storage area.
Removal of overburden covering the Deilmann orebody will begin at a suitable time to provide continuity of flow of ore to the mill. The overburden from the Deilmann area is estimated to amount to 21 million cubic metres, almost three times the volume covering the Gaertner orebody. Removal of this material will generally follow the procedures used in developing the Gaertner pit.

**Groundwater**

The terrain in the Key Lake area, composed largely of glacial sand and till, results in ground water levels that are close to the land surface. Precipitation tends to seep into this glacial material, in part because of the porous nature of sand and in part because of the scarcity of vegetative ground cover owing to poor soil conditions.

Therefore, it was necessary to lower the ground water level while the overburden is being removed and throughout the period of mining, keeping the ground water level below the bottom of the pit. KLMC sank a series of wells around the perimeter of the Gaertner pit so that ground water could be pumped from the production areas into the natural water drainage system leading to the Wheeler River.

The mining of ore at Key Lake began in May, 1983 and will continue until at least the year 2000. Standard open pit mining techniques are employed. Rock containing the ore is broken using a
bulldozer and, when required, by conventional drilling and blasting. The ore is loaded onto trucks and transported to the primary crusher, which reduces it to a small, fairly uniform size. The crushed ore is transported to the stockpile area, where it is blended in order to achieve a uniformly graded material for metallurgical processing.

Most mining activities will be worked two shifts a day, seven days a week, 12 months a year. The ore zone, however, will probably be worked one shift a day, seven days a week, 10-12 months a year.

Once the Key Lake orebodies have been mined out, natural ground water levels will be restored in the area. The dump areas used to store the overburden will have an average height of approximately 20 metres above general topography, similar to the existing undulating terrain in the immediate vicinity.

For further information and statistics see Appendix 4.
THE MINE SHOPS FACILITY HOUSES THE FOLLOWING:

- Mine mobile equipment repair shops and washdown facilities (Decontamination Bay)

- Lube Bay - area where oil changes and lubrications are done

- Repair Bays - areas where the main repair work is done

- Machine Shop - area where the lathes, milling machines, etc. are located for specialized repair jobs

- Mine operations warehouse and tool crib

- Mine worker's shower and change facilities

- Office facilities for mine supervision, mine engineering, mine geology, mine training facilities, drafting and surveying
KEY LAKE DIAGRAM

Yellow Cake

Solvent Extraction

CCD

Bulk Neutralization

Power Plant

Acid

Compressor

Boiler

Leach

Oxygen

Lab

Administration Building
The Key Lake Process Block Flow Diagram
MILL PROCESS

In the process plant, the uranium is recovered from the feed ore with approximately 2.5% $\text{U}_3\text{O}_8$ and concentrated to an intermediate, semi-refined product often referred to in the industry as "yellowcake" (with approximately 90% $\text{U}_3\text{O}_8$).

The milling process at Key Lake is divided into five basic processing steps, comprising of the following ones:

1. Ore preparation consisting of crushing, blending and grinding.

2. Extraction consisting of a) a two stage sulphuric acid leaching step where the uranium is dissolved and transferred into a solution; and b) the separation of the uranium-bearing solution - the so-called pregnant solution - from waste solids. This liquid/solid separation is carried out in multiple installation of thickeners, to recover the pregnant solution from leached ore residues.

3. Solution Pre-treatment and Solvent Extraction, where the solution is clarified to nearly solids - free feed solution. The subsequent Solvent Extraction involves the interchange of ions between the pregnant solution and the liquid organic solvent. This exchange provides the means for a highly selective and nearly complete recovery of uranium from the leach liquor.
4. **Yellowcake Precipitation and Drying and Product Handling** - the solution from the Solvent Extraction operation is neutralized with anhydrous ammonia. The uranium precipitates as ammonium/uranyl sulphate and ammonium diuranate. A thickener is used to dewater the yellowcake. Before drying, the yellowcake is washed and dried in two stages with centrifuges.

The dried material is packed in 45 gallon drums containing about 380 kg yellowcake.

5. **Bulk Neutralization**, where all contaminated water streams from the mine and process plant are treated with brine and thereby rendered harmless. Solid wastes are treated and forwarded to the tailings storage facility for ultimate deposition.
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 3</td>
<td>Ore first submitted to Secondary Crushing and Grinding plant.</td>
</tr>
<tr>
<td>October 6</td>
<td>Start of atmospheric leach circuits.</td>
</tr>
<tr>
<td>October 7</td>
<td>Start of secondary leach circuit and CCD plant.</td>
</tr>
<tr>
<td>October 8</td>
<td>Uranium bearing solution begins arriving at Solvent Extraction plant.</td>
</tr>
<tr>
<td>October 9</td>
<td>Precipitation of yellowcake begins.</td>
</tr>
<tr>
<td>October 20</td>
<td>Start of the washing, drying, calcining and packaging circuit.</td>
</tr>
<tr>
<td>October 31</td>
<td>Mill operating at 35% of design capacity. 160,000 lbs of product packed.</td>
</tr>
<tr>
<td>November 9</td>
<td>First product shipped to refinery.</td>
</tr>
<tr>
<td>November 30</td>
<td>Mill operating at 55% of design capability. 550,000 lbs. of product packed in November.</td>
</tr>
</tbody>
</table>
THE CRUSHING AND GRINDING PLANT
SECON DARY CRUSHING AND GRINDING

Process

The ore has passed through the gyratory crusher to the blend piles and is then fed into the impact crusher. From there it passes to the ball mill and is ground to fine particles. The vibrating screens size the particles in the pulp, returning the oversize to the ball mill for further reduction and allowing the fine particles to flow into the neutral thickener.
The neutral thickener allows the solids to settle and be removed by the underflow lines. The thickener overflow is recycled back into the system. Ore from the mine has been reduced from boulders of 0.75 m or larger in size to a pulp that is 45 to 50% solids and contains particles that are less than 0.5 mm in size. The ore is pumped by positive displacement pumps through 1700 m of pipeline to storage pachucas in the leaching plant.

Special Features:

- Built into the side of a hill to utilize gravity as much as possible.
- Located between the two mines to minimize truck haulage distances.
- Location separate from the mill aids dust and noise control in the mill.
- Four storage pachucas (cylindrical tanks) each contain 8 hours of mill feed.
- Sulphuric acid added to leach out the uranium into solution in a two stage leach process.
- Counter current decantation used to separate the liquid from the solids.
- Solution pretreatment purifies the pregnant solution.
- Ammonia added to initiate precipitation of the yellowcake.
Final yellowcake product precipitates out of solution.
Yellowcake is then dried and packed in 45 imperial gallon drums.
Byproduct ammonium sulphate is crystallized in a separate process.
- Lime added to neutralize both the solid and liquid waste.
- Barium chloride added to precipitate the radium.
- After contaminants filtered out, the water is temporarily stored, then after treatment it is released to the environment.
- Bulk wastes to tailings pond.
THE TAILINGS POND
The tailings storage facility combines naturally occurring materials at the site with the sub-aerial technique of tailings deposition, to achieve a dense partially saturated tailings deposit with minimal propensity for long term seepage. A schematic cross-section through the tailings facility is shown above. The tailings facility is located on dense till and is underlain over the entire area by an underseal, constructed by modification of the till with bentonite, and a filter blanket. The tailings from the Key Lake mill will be discharged as a slurry from one end of the facility over the filter blanket in thin layers, allowing each layer to settle, drain and partially air dry prior to covering with a further layer. Vertical drainage from the initial layers will be collected in the filter blanket and drained by gravity to a sump outside the main embankment. Surface runoff will be continuously drained through an upstream pervious section of the main embankment.
The deposition technique will result in a structurally-stable laminated tailings deposit with a low coefficient of vertical permeability.

On decommissioning the tailings will be covered with an impervious surface seal. The location of the tailings area is such that the total tailings deposit will remain above the natural water table and the underdrainage system will remain as a long term monitoring point for seepage from the deposit. The design provides, therefore, for the total containment of all solid wastes, and control and treatment of all liquid wastes from the mining and milling operations throughout the operating life of the project and after decommissioning.
AUXILIARY MILL BUILDINGS

POWER HOUSE

- Provides power to the site from five 4.16 KV diesel generators

ACID, BOILER & COMPRESSOR BUILDING

- The acid plant produces sulphuric acid from molten sulphur
- The boiler equipment uses the waste heat from the diesel generators to heat other buildings

ADMINISTRATION AND SHOP COMPLEX

Contains:
- The administration and supervisory offices
- Laboratories for assay monitoring of mine and mill-
- Mill warehouse
- Mill maintenance shops
- First aid facilities
- Mill workers shower and change facilities
- Mill training facilities
PERMANENT CAMP

- Total of 300 beds in the 7 wings

- Workers off shift have their room occupied by a worker on shift

- Recreation and dining facilities located in the central core area

- Recreation facilities include:
  - Gym with basketball court
  - Exercise room
  - Whirlpool and saunas
  - Two racquetball courts
  - Beverage room
  - Games room
ENVIRONMENTAL FEATURES

In the following, some of the environmental features are described which were designed to meet environmentally acceptable standards during operation and to ensure performance which will endure over the long term after mining and mill operations are decommissioned.

- contaminated water from pit and various stockpiles is collected and pumped into a lined water reservoir close to the mill where it will be treated.

- stockpiles for ore and special ore are sealed with bentonite to prevent seepage of contaminated water into the ground.

- treated water is collected on a daily basis in monitoring ponds, where it is sampled and analyzed before it is released into the environment or recycled into the process.

- the design of the tailings pond is based on the requirement for total and secure containment of all solid wastes. The entire storage area is covered with filter drainage blankets to collect vertical seepage. The tailings are deposited in layers which have a low coefficient of vertical permeability. All free-draining water will be removed.
in the bulk neutralization plant all streams, solids and liquids, are neutralized. The radium and arsenic are taken out of the liquids and fixed to insoluble compounds.

At various stages of the process, ammonia is added, forming ammonium sulphate. In order to meet environmentally acceptable standards for ammonia, an ammonium sulphate crystallization plant has been added to the process which recovers ammonium sulphate.

two utilidors (grinding plant to mill and mill to tailings pond) were built to carry pipes for contaminated water, slurries, stream, sewage etc. Spills will be contained in these utilidors.
WORKER HEALTH AND SAFETY

The Key Lake facility was designed, engineered and built, and is operated from the point of view of the health and safety of workers and protection of the environment. The facility is comparable to all other open pit mines and chemical processing facilities in the area of potential hazards and the operations are determined by a combination of statutory requirements and company policy.

One factor not associated with conventional industrial health and safety is the presence of radioactive materials.

The Worker Health and Safety Department has responsibilities in the areas of health, safety, emergency response services and radiation protection.

Health services run a full range from preplacement and periodic medicals to providing assistance in cases of injury or illness. A physician is on call from Saskatoon and visits the site periodically.

Conventional industrial safety services are provided. These range from routine inspection of work places; contaminant surveys and accident prevention to training in specialized areas.

Emergency Response teams consist of regular members of the workforce and their activities are co-ordinated by the Worker Health and Safety Department staff who also provide training resources.
Radiation protection consists basically of two elements. The systems performance is monitored both from an emergency performance and from a radiation protection point of view. This latter consists essentially of making measurements to ensure that radiation levels are controlled in compliance with all requirements.

The second element consists of personal monitoring of each individual to obtain data on the actual exposures they receive. This is accomplished by the use of individual monitoring devices or by calculations based on radiation levels and time factor.

The essential role of the Worker Health and Safety Department at Key Lake is to keep a watch on the systems to ensure that engineering and administrative controls result in the level of protection desired -- both by the policies of a prudent operator and by statutory requirements.
Economic Benefits

Business Opportunities

- Air Transportation
- Truck freight hauling
- Consumable items
  - process reagents
  - fuels & lubricants
  - mine equipment repair parts
  - mill equipment repair parts
    - electric motors, lab chemicals
  - mine shop supplies - welding
    - cleaning tools

- Contracts for Services and Renovations
  - catering
  - T.V.
  - Telephone
  - Security
  - Advertising and Public Relations
  - Printing
  - Consultants

- Specific kinds of repair work
  - tire repair
  - undercarriage repair
  - Electric Motor rewind
  - Major Diesel engine repair
  - Major transmission repair
  - heavy machine tool work

Employment Opportunities

- Construction - 336,772 mandays of work for construction workers during August 1, 1981-August 31, 1983

- KLMC - Permanent work force of 450 people (Saskatoon and site)
### Appendix 1

**Historical Background**

<table>
<thead>
<tr>
<th>Date Range</th>
<th>Event</th>
</tr>
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<tbody>
<tr>
<td>Summer 1971</td>
<td>First radiometric and geochemical sampling in the Key Lake area</td>
</tr>
<tr>
<td>June 1975</td>
<td>Gaertner orebody discovered</td>
</tr>
<tr>
<td>June 1976</td>
<td>Deilmann orebody discovered</td>
</tr>
<tr>
<td>June 75–September 79</td>
<td>Delineation of orebodies</td>
</tr>
<tr>
<td>May 78–March 80</td>
<td>Feasibility studies</td>
</tr>
<tr>
<td>March 1978</td>
<td>First dewatering well started</td>
</tr>
<tr>
<td>February 1980</td>
<td>First public meeting of the Key Lake Board of Inquiry</td>
</tr>
<tr>
<td>February 1981</td>
<td>Key Lake Board of Inquiry Report issued</td>
</tr>
<tr>
<td>February 1981</td>
<td>Commencement of surface lease negotiations between KLC and the Saskatchewan government</td>
</tr>
<tr>
<td>August 1981</td>
<td>Surface lease agreement signed</td>
</tr>
<tr>
<td>August 1981</td>
<td>Start of site preparation</td>
</tr>
<tr>
<td>September 81–September 83</td>
<td>Building construction</td>
</tr>
<tr>
<td>January 82</td>
<td>Commencement of removal of overburden from Gaertner pit</td>
</tr>
<tr>
<td>May 1983</td>
<td>Ore mined in Gaertner pit</td>
</tr>
</tbody>
</table>
March 82- Tailings pond construction
August 1983

July -October 83 Mill commissioning

October 20/83 First drum of yellowcake produced
Appendix 2

SUMMARY OF CONSTRUCTION PROJECTS

1979
- 23 dewatering wells successfully drilled. Majority of pipeline work for well discharge was completed.
- Construction of Key Lake access road commenced.

1980
- No significant construction work.
- EPCM contract awarded to Wright Commonwealth.
- Construction of Key Lake access road completed with exception of traffic gravel.

1981
- Gaertner dewatering system completed.
- Construction camp and related services started.
- All weather access road completed.
- Twenty-two construction contracts awarded between August 27 and December 31. Primary underground systems, building foundations and structural steel, cladding system.

1982
- Contracts for mechanical, electrical, and architectural finishes were awarded for the Mill and Mineshop buildings.
- Tailings storage pond construction was started.
- Stripping of the Gaertner pit commenced.
- Permanent camp construction commenced.

1983
- Contract awarded for final site grading.
- Contract awarded for fire protection systems.
- Start-up maintenance contract initiated.
Appendix 3

<table>
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<tr>
<th>Reserves (tonnes U)</th>
<th>Exp. 84 Production (tonnes U/year)</th>
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<tbody>
<tr>
<td>Key Lake Mine</td>
<td>73,610</td>
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<tr>
<td>Total Free World</td>
<td>2,500,000</td>
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<tr>
<td>KLMC - other large producers</td>
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<table>
<thead>
<tr>
<th>Expected 84 Production (tonnes U/yr)</th>
<th>Average Grade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. KLMC</td>
<td>4,600</td>
</tr>
<tr>
<td>2. Rössing</td>
<td>4,400-4,500</td>
</tr>
<tr>
<td>3. Ranger</td>
<td>2,500</td>
</tr>
<tr>
<td>4. Rio Algom Elliot Lake (2 mines)</td>
<td>3,500</td>
</tr>
<tr>
<td>5. Cluff 2</td>
<td>1,000</td>
</tr>
<tr>
<td>6. Collins B. (1985)</td>
<td>2,120</td>
</tr>
</tbody>
</table>

Canada's rank as Uranium Producers

<table>
<thead>
<tr>
<th>1980</th>
<th>1985</th>
<th>1990</th>
</tr>
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<tbody>
<tr>
<td>1. U.S.A.</td>
<td>Canada</td>
<td>Canada</td>
</tr>
<tr>
<td>2. Canada</td>
<td>U.S.A.</td>
<td>Australia</td>
</tr>
<tr>
<td>3. S. Africa</td>
<td>S. Africa</td>
<td>S. Africa</td>
</tr>
<tr>
<td>4. Niger &amp; Gabon</td>
<td>Australia</td>
<td>U.S.A.</td>
</tr>
<tr>
<td>5. Namibia</td>
<td>Namibia</td>
<td>Namibia</td>
</tr>
</tbody>
</table>

1 tonne U = 1.18 tonnes U₃O₈
Typical KLM concentrate = 88% U₃O₈
Current Spot Price is US $23.50/lb U₃O₈ delivered
APPENDIX 4

MINING

1. Dewatering

Lake dewatering started in 1978 to remove surface water. This involved the deepening of existing water channels and the draining the following lakes:

1. Key
2. Upper Key
3. Kinikinik
4. Dieter
5. Karl Ernst
6. Sea Horse
7. Hourglass
8. Fred
9. Kathy

A system of wells now surrounds the pit to remove the groundwater to enable mining to proceed and to provide stable slopes in the pit. As well, there are in-pit wells in specific areas to assist the dewatering program.

2. Open Pit Mining

Conventional open pit mining methods are used in the extraction of ore and overburden from the orebodies.
a) Mine Planning and Open Pit Design

The two orebodies, the Gaertner and Deilmann contain in excess of 180,000,000 lbs. of recoverable \( \text{Fe}_2 \text{O}_3 \). The ore reserves are sufficient to last until the year 2000.

The overall stripping ratio for the Gaertner and Deilmann is approximately 35:1. This is the ratio of the number of tonnes of waste material which must be removed to mine one tonne of ore.

Bench heights are eight (8) metres.

Haul roads are designed at 20 metres wide. The haul road is the roadway which is used by the haul trucks when carrying ore and waste to their respective stockpile areas.

Blasting is done with Anfo and slurry based explosives. Anfo is a mixture of ammonium nitrate and diesel fuel. The explosives are loaded into holes drilled in the rock which breaks the rock into pieces small enough to haul away in the haul trucks.
b) Mine Equipment

The mine equipment that is used at Key lake is as follows:

Haul trucks - DJB - D44 (40 tonnes capacity)
Shovels - Liebherr 982 (4.5m³ capacity)
Loader - Caterpillar 988 (4.5 m³ capacity)
Drill - Atlas Copco - Rotamec (200 mm hole on 5m x 5m pattern)
All mine equipment is lead shielded and air conditioned.

c) Waste Storage

Material removed from the mine which has no uranium values or values too low to permit economic processing is stockpiled in separate areas.

Material below 0.03% U₃O₈ is hauled to the Waste Storage Area.

Material greater than 0.03% but less than 0.1% is hauled to the Special Waste Storage Area. This area is environmentally protected by a bentonite underseal which does not permit any contaminated water to enter the environment.
NORTHERN SASKATCHEWAN SURFACE LEASES OVERVIEW

Current Surface Leases

- 1978 Amok/Cluff Mining (Phase I)
- 1983 Amok/Cluff Mining (Phase II)
- 1981 Key Lake Mining Corporation
- 1983 Eldor Mines

General Provisions

- Access to lands for purpose of operating mines and mills.
- Conditions to be met in order for access to lands to be continued; payment of taxes, rents, assignments, claims for damages, etc.
- Assurance of environmental protection.
- Assurance of occupational health and safety of workers.
- Development of approved abandonment and decommissioning plans.
- Direct economic benefits for northern residents - employment and training; employment benefits and conditions; recruitment plans.
- Monitoring committees.
- Ministerial powers.
- Trade unions.
- Use of local goods and services.
- Compliance with statutes.
- Duration.

Definitions

Northerner - Amok Surface Lease - a person who has resided 15 years or half their lifetime in N.A.D. or on a northern Indian Reserve.

Northerner - Key Lake Surface Lease - a person of native ancestry who has resided 15 years or half their lifetime in N.A.D. or on a northern Indian Reserve.

AMOK/CLUFF MINING SURFACE LEASE

Specific Provisions

Employment

- Amok will ensure that 50% of all man days of employment will be performed by northerners.
- Amok will work towards maximizing the employment of northerners above the 50% level above.

- Amok will operate a 7 days in/7 days out commuter transportation system.

- Amok will establish a minimum of five northern pick-up points in operating the commuter transportation system.

- Amok will employ at least one native language speaking person on site, who will report to senior management.

- Amok will facilitate the establishment of an Occupational Health Committee.

- Amok will recruit regularly in northern Saskatchewan.

- Amok will provide NorSask Native Outreach or other employment agencies with at least six working days notice of any new or vacant positions to be filled.

- Amok will establish a northern scholarship plan.

- Amok will provide appropriate training and counselling programs to facilitate the advancement of northerners into positions throughout the operation at all levels.

**Monitoring Committee**

- The Minister and Amok will establish a committee of three to five persons for the purpose of reviewing and evaluating the recruitment, employment, and training of northern residents.

- They shall meet at least twice in each twelve month period.

**Northern Business**

- All purchases of goods and services shall be made according to firstly, a northern Saskatchewan preference; secondly, a Saskatchewan preference; and thirdly, a Canadian preference.

- Amok shall maintain an up-to-date Northern Bidder’s List.

**KEY LAKE MINING CORPORATION SURFACE LEASE**

**Specific Provisions**

**Employment**

- During the *construction phase*:

- 50% of all man days of work performed, other than by workers in the apprenticeable trades, shall be performed by northern residents of Indian ancestry (NRIA).
- 10% of all man days of work performed in supervisory and administrative positions shall be performed by NRIA.

- 15% of all man days of work performed in the apprenticeable trades shall be done by first level NRIA apprentices.

- 100% of all first level apprentices shall be NRIA.

During the operations phase:

- KLMC shall ensure that 50% of all man days of work performed shall be done by NRIA during 1982/83.

- KLMC shall ensure that in second year of operations, that 60% of all man days of work performed shall be done by NRIA.

- 20% of all on-site man days of work performed in the apprenticeable trades shall be done by Apprentices.

- 60% of all entry level positions on site shall be filled by NRIA.

- KLMC shall have at least one on-site position filled by a native language speaking NRIA who will report to senior management.

Recruitment and Training

- KLMC shall maintain their principle employment and business offices in La Ronge.

- Staff will undertake regular field recruiting trips throughout north.

- KLMC shall provide NorSask Native Outreach or other designated employment agencies with at least six working days notice of new and/or vacant positions to be filled.

- KLMC shall submit an annual training plan and semi-annual training progress reports.

- KLMC shall provide adequate orientation and occupational health and safety and radiation protection courses.

- KLMC shall establish an approved post-secondary scholarship plan.

- KLMC shall establish an approved affirmative action plan.

Northern Business

- KLMC shall submit an annual business opportunity plan.

- KLMC shall establish and maintain a purchasing and business contract office in La Ronge.

- KLMC shall provide northern businesses with preferential opportunities on
both the construction and operations phases of the project. A bid shall
be deemed equivalent as to its price if it is no more than 10% higher
than the low bid submitted by a non-northern business.

- KLMC establish policies to ensure that its contractors and sub-
contractors adhere to the intent of the terms agreed to by KLMC in its
own northern business opportunities plan.

**Monitoring Committee**

- It shall be established by the Minister and composed of six persons - 3 of
which shall be northern residents.

- The committee shall meet on site on a quarterly basis and on an annual
basis review and evaluate KLMC's: recruitment and employment program;
training programs; commuter transportation system; affirmative action
plan; scholarship fund; business opportunities plan; health and safety
plans.

**ELDORADO RESOURCES LTD. SURFACE LEASE**

**Specific Provisions**

**Employment & Business**

- To establish policies and implement programs and procedures to enhance
the positive economic climate in northern communities.

- To continue the employment practices and development programs followed
by Gulf Minerals Canada Ltd.

- To maximize employment and economic opportunities.

- During construction phase:
  - lessee will cause its contractors/sub-contractors to adopt practices
to achieve intent of above;
  - provide contractors with list of potential local employees;
  - provide contractors with lessee's selection and employment program;
  - lessee will encourage and utilize northern businesses whenever
possible.
  - All entry level positions will be given first preference to Wollaston/
Athabasca area residents.
  - Previous northern employees considered for employment as second
preference.
  - Provide OJT and supervision to compensate for lack of prior training and
industrial work experience.
Monitoring
- Responsibility of government.
- Will establish and maintain open dialogue and exchange of relevant info.
- Lessee will file employment statistics.
- Lessee will file info re: contractors/sub-contractors.
- Will undertake annual review of previous years employment plan.
- Will establish numerical or percentage objectives on an annual basis.
- Will prepare annual forecasts of economic opportunities.
Appendix 6

Key Lake Development and the Regulatory Agencies

The uranium industry is one of the most strictly regulated in Canada. Every phase of the industry, from exploration to sales to final decommissioning is regulated by a number of federal and provincial agencies.

1. Exploration

At this stage the Key Lake joint venture staked a claim and acquired exclusive exploration rights by applying to Saskatchewan Energy & Mines for a Mineral Disposition, renewable annually. To clear brush for the camp, the joint venture contacted the Department of Northern Saskatchewan and obtained a Temporary Work Camp Permit.

2. Environmental Review

Before proceeding with development, the joint venture prepared a Project Proposal for Saskatchewan Department of Environment giving complete information on all development plans.

After Environment's technical review of the Project Proposal, the joint venture prepared an Environmental Impact Statement (EIS).

The Minister of Environment decided to appoint a board of inquiry to further review the proposal before reaching a decision. The Key Lake Board of Inquiry sat for 13 months, from December, 1979 to January, 1981, and submitted its final report in February, 1981. Approval was given to the project.

3. Development and Construction

Once environmental approval was received, the Key Lake Mining Corporation, created in March, 1979 by the partners to build and operate the mine, had to obtain land rights by negotiating a Surface Lease with the province. The Surface Lease spells out detailed obligations to conform to provincial standards for occupational health and safety and environmental protection.

Throughout development, construction and operation, the company must report its activities, and project plans to AECB and receive Mines Facility Siting, Construction and Operating Licences. Approvals to proceed with each stage of commissioning are given and renewed annually following satisfactory performance assessments.

Saskatchewan Environment's Mines Pollution Control Branch requires Key Lake Mining Corporation to comply with all relevant regulations of the Water Resources Management Act and the Air Pollution Control Act. Before issuing Certificates of Approval to
Construct and Operate the company must submit and agree to implement detailed plans for waste management facilities, spill contingency, shut down, final abandonment and reclamation.

4. Operation

During mine operations the Mines Pollution Control Branch of Saskatchewan Environment performs monthly inspections of mines and effluent to ensure the company maintains air and water quality, minimizes mining impacts on local wildlife and vegetation and restores the area as close as possible to its original state when the operation is completed. Saskatchewan Environment also inspects the Key Lake Mine on behalf of the Atomic Energy Control Board and Environment Canada for compliance with the federal environmental regulations.

The company must carry out environmental monitoring and report the results to Saskatchewan Environment, the Atomic Energy Control Board, and Environment Canada.

Mines inspectors visit Key Lake at least monthly to monitor compliance with the province's radiological and general occupational health and safety standards. Saskatchewan Labour also inspect the working environment for compliance with federal occupational health and safety regulations on behalf of Labour Canada and the AECB, although AECB is currently reviewing this practice. The Atomic Energy Control Board inspects Key Lake several times a year to enforce federal standards and audit the work of provincial inspectors.

Key Lake must monitor and submit reports on workplace and individual radiation exposure to Saskatchewan Labour and AECB. The Board sends copies of the report to National Health and Welfare for use in the National Dose Registry, a continuous running record of individual worker exposure to radiation. The company receives quarterly print-outs of employee gamma ray exposures and accumulated lifetime exposures which must be posted. No worker can exceed allowable limits for annual radiation exposure.

During the company's final years of mine operation, Saskatchewan Environment will require detailed abandonment and reclamation plans as a condition of the annual operating licence.

When Key Lake has completed the mining operation, AECB must be satisfied with the company's plans for environmental restoration and long-term surveillance before issuing Shut-Down Decommissioning Approval.

5. Sales and Export

A Letter of Approval is required from the federal Uranium Export Review Panel, chaired by Energy Mines and Resources with representatives from External Affairs, Atomic Energy Control Board and the Department of Regional and Industrial Expansion. The Panel
reviews each proposed sales contract and makes case by case export decisions based on factors such as selling price, protection of domestic uranium supply and utilization of Canadian uranium processing capabilities.

The Atomic Energy Control Board attaches non-proliferation provisions to contracts by issuing an Export Licence for each contract which is annually reviewed and renewed if the safeguards agreements and conditions of the contract have been maintained and if the selling price is still acceptable to Canada.

An Export Permit issued by External Affairs is also required because uranium is on the export control list of sensitive materials and technologies.

6. Safeguards

Countries or utility companies that contract to buy uranium from Canadian producers must negotiate a Bilateral Nuclear Co-operation Agreement with External Affairs and the Atomic Energy Control Board. The Agreement repeats, reinforces and supplements the terms of international safeguards.

Uranium importers must also sign two international treaties administered by the International Atomic Energy Agency. Under the Nuclear Non-Proliferation Treaty, countries agree not to develop nuclear weapons and agree to allow IAEA inspection of nuclear facilities to ensure that materials are not being diverted for military purposes. The Full Scope Safeguards Agreement described IAEA inspection and inventory control specifics.