LNS – A Mining and Tunnel Contractor for Challenging Project in the Arctic

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Professor II, UiT - The Arctic University of Norway
What is LNS competitive advantage?

LNS is a mining owner, tunnel contractor and mining contractor. We combine the best from the mining industry and tunnel industry.

LNS philosophy is based on long-terms projects and never looking for short-term profit.

LNS has a lot of experience from projects where the logistic has been very challenging!

LNS is using few workers on each shift, teamwork, multiskilled, cooperation, "flat" organization of work – efficient!

The Norwegian Tunnel Methode

LNS has unique competence from a lot of projects for the mining industry and civil works from the polar area.

We prefer tough winter condition!
Cooperation with mining companies

- LKAB 35 years
- Outokompo 16 years
- Nikkel og Olivin 13 years
- North Cape Minerals 1 year
- Sydvaranger 4 years
- Store Norske 11 years
- Elkem 15 years
- Franzefoss 13 years
- Skaland Graphite 13 years
- Rana Gruber 9 years
Project challenges
- geographical location at 78° N latitude
- logistics
- geology
- project progress
- excavation of tunnel close to coal layer
DRILLING BELOW THE ARCTIC ICE

Tunellers claim world record under the Spitsbergen glacier

On the remarkable island of Spitsbergen, about half way between the Arctic Circle and the North Pole, a coal mine lies beneath a permanently frozen sheet of ice. Yet despite the remote location and extreme conditions, the Svea North mine is strengthening its position as one of Europe's top coal producers.

The Arctic Circle, glaciers, remote villages, frozen ports, snowmobiles, polar bears – and a mine bored beneath a glacier. Not exactly the kind of environment to attract most miners. But the Svea North coal mine on the Norwegian island of Spitsbergen boasts one of the world's most efficient underground coal operations.

Spitsbergen, meaning “Cold Edge” in Norwegian, is the largest of the islands that make up the Arctic archipelago of Svalbard. It is located at the top of the world about 1,000 km north of the tip of Norway and 1,500 km east of Greenland. Sixty percent of the area is covered with snow and glaciers and the shores are inaccessible for most of the year.

The mine is located some 40 km from Spitsbergen's main town of Longyearbyen (pop. 1,100) but there is no road. The only way for the miners to reach “civilisation” is by boat in the summer, snowmobile in winter or by daily flights into the local airstrip. On top of that, the constant presence of roaming polar bears present a constant danger.
(f) State-of-the-art experience and practice of relevant overseas projects (including projects in Scandinavian countries) on deep hard rock tunnelling below sea level
Svalsat and Trollstasjonen
Bharati, Larsemanns Hill, Antarktis

Indian Scientific Organization: National Center for Antarctic & Ocean Research
Cutter tracks, TBM
TBM, Øvre and Nedre Røssåga HPP

First TBM in Norway for 22 years!!
Ny gruve i Trælen 2007

New mine, Trælen, approximately 12 km from Skaland

At the moment the production of concentrate is around 10000 ton per year. Can be increased a heavily.

Average carbon in situ 25-40 %. Worldclass!

Production for 30 years, most probably 75 years!
• LNS has been the owner of Rana Gruver since 2008

• Producer of Hematite and Mangetite concentrates

• Underground- and open pit mining

• Iron content in raw ore 30 - 33 %

• Since 2008 the production has increased 400 % and the number of workers 30 - 40 %!

• The production will increase 100 % from todays level during the next 7 – 8 year
Important decision for increasing the production:

- Changing from Open Stop to Sublevel caving
- The excavation of drifts was outsourced to LNS
- Rana Gruber is still executing long-hole drilling
Rana Gruber, mining methods

Open Stop
Mining method between year 1998 -2010

vs

Sublevel Caving
late 2010-
Kvannevann underground mine
part of Rana Gruber

North-East

1200 meters

120 meters

Shaft 1
Ventilation shaft

Shaft 2
Crusher

Shaft 3

Shaft 4

Main Access to mine,
Length 900 meters

Silo access
Length 1400 meters

L219
L167
L155
L123

Loading of trains

New access tunnel
Length 2200 meters

Tunnel from L250 to L123
Length 1200 meters

Conveyer belt tunnel
Length 550 meters
Changes done by LNS at start of excavation of drifts:

New equipment; computer operated jumbo, rock bolt rig, shotcrete rig, charging rig etc.

Facing the project as a tunnel project, not mining operations. Decreased numbers workers per shift

Other methods for rock support, more use of shotcrete – earlier access to faces

Using specialized tunnel workers – multiskilled

Using emulation explosives

Bonussystem for tunnel workers – paid per meter tunnel, rock support and HSE
Excavation of drifts, Rana Gruber

Before 2008:
Typical performance from 50 to 65 m/week (1 jumbo)

After outsourcing the excavation of drifts to LNS:
Typical performance from 110 to 175 m/week (1 jumbo)

Under special good rock condition it has been possible to achieve 200 m/week!
Produksjonsutvikling 16 % vekst pr. år
Changes in Rana Gruber because of low prices for iron ore

- In 2012 the prices for iron ore was up to 185 USD/t, in 2016 the prices for iron ore has been down to 37 USD/t
- The workforce has been decreased with 100 people in 2015
- The production of iron ore increased with 29 % in 2015
- The production of iron ore increased with 65 % for each employees
- Rana Gruber is one of the most efficient mining company in the world!
LNS Greenland

Greenland Mining Service (LNS Greenland):

LNS
LNS Spitsbergen
Rana Gruber
Greenland Venture

2 166 086 km²
410 449 km² er isfritt.
Befolkningen 57 600.
3,5 milliarder danske kroner fra Danmark pr år.
Aappaluttoq Mine, ruby mine

Current 9-Year Pit
(Pink area in opposite image)

Non-compliant Geological Structures in Red
Aappaluttoq Ruby Mine

Corundum Grade – Primary Pit

<table>
<thead>
<tr>
<th>Category</th>
<th>Volume (m³)</th>
<th>Tonnage (Tonnes)</th>
<th>Average Grade (Grams/Tonne)</th>
<th>Average Grade (Carats/Tonne)</th>
<th>Contained Corundum (Grams million)</th>
<th>Contained Corundum (Carats million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicated</td>
<td>59,110</td>
<td>169,150</td>
<td>313.33</td>
<td>1.566</td>
<td>59.27</td>
<td>296.33</td>
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<tr>
<td>Inferred</td>
<td>24,110</td>
<td>77,160</td>
<td>263.46</td>
<td>1.417</td>
<td>21.87</td>
<td>109.35</td>
</tr>
</tbody>
</table>
Greenland – Ruby mine
Greenland – Ruby mine
Greenland – Ruby mine
Greenland – Ruby mine

From the testproduction this winter
LNS
from POLE to POLE
from WEST til EAST
Probably the world’s most geographical widespread contractor!
Thank you for kind attention!