



## REPLACING DC-DRIVES WITH DTC AC-DRIVES – LKAB KIRUNA, SWEDEN

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**Key words:** DC-motor, DTC AC-Drives

### **Abstract:**

In many countries there is an aging installation of DC-motors. Over the years, the installation is deteriorating and repair is increasingly expensive and time consuming. Today's AC-drive technology in general presents interesting benefits and advantages, which will improve the performance and capacity of a mine hoist. Typical benefits with ABB DTC-technology for AC-Drives are: no reactive power consumption, low level of harmonics to supply network, reduced voltage drop and voltage variations. Example of a mine, which has made an upgrade from DC-Drives to DTC AC-Drives, is LKAB Kiruna mine in Sweden. Four mine hoists at sub-vertical level underground (-740) have been upgraded from DC-technology to AC-technology including a payload increase from 24 ton to 34 ton. The presentation includes a multimedia program, which make it possible to do a „walk around” in the LKAB Kiruna mine and see the new installation.

### **1. LKAB mining company**

LKAB is a Swedish state owned company that operates two major mines in the north of Sweden. The iron ore is refined to pellets and fines. Yearly production is about 25 million tonnes. LKAB plans to increase production to 30 million tonnes of pellets and fines.

#### **1.1. LKAB Kiruna mine**

The LKAB Kiruna mine produces 26 Mtonnes of crude ore per year (33 Mtonnes/year with the new haulage level at -1365m). By means of 2-stage hoisting with 12 production hoists (5 + 7) the ore is brought to the surface. The production is fully automatic from train loading pockets to unloading pocket in the head frame.

- LKAB prepares for increased production,
- LKAB prepare for increase of production from 37 to 52 million ton per year of crude ore,
- LKAB has underground mines in Kiruna and Malmberget,
- LKAB is building new haulage levels both in Kiruna and Malmberget in order to meet new production targets.

#### **1.2. New main level Kiruna**

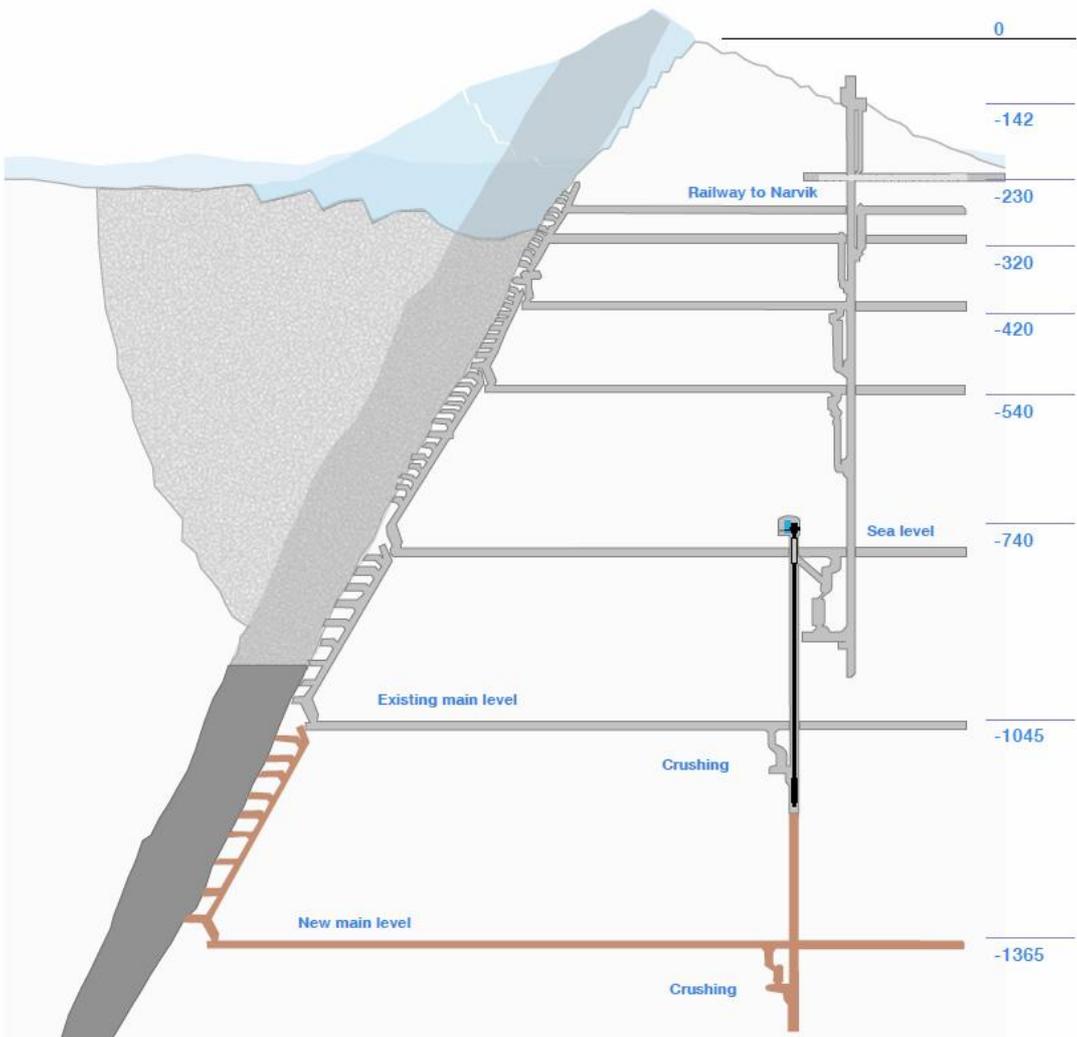
When LKAB increases the production from 26 to 33 million tonnes of crude ore per year, hoist capacity is of vital importance. The first measure taken was to upgradethe four sub-vertical level hoists from DC to AC-technology. The second is to install a fifth double skip hoist on this level in order to start operating the new production level at -1365 m. The present four hoists will continue with the -1045 production level until production on this level ceases. The present main level in Kiruna, at 1,045 meters, is the sixth level since underground mining began in 1957. When the -1,045 m level was built it was estimated that it would support mining until the year 2015, or perhaps several years beyond. But

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today, the situation is different. A higher production rate necessitates a more rapid rate of vertical mining than expected. Now, production demands are increasing, thanks to high delivery volumes. Decision was taken for the next main level located on -1365 m. Based on current production plans, a new vertical system ought to be operational by the year 2013.



**Fig. 1** LKAB Kiruna Mine



**Fig. 2** LKAB Kiruna Mine - cross section

### 1.3. Exploration of the orebody

LKAB is surveying the ore body in preparation for the next main level. There is a good knowledge of the ore body down to a depth of about -1,500 m. Data confirms that the ore body widens towards the north. At depth, the ore is large, high-grade and contains very little phosphorus. It appears to be twice as wide as at the present mining levels, up to 150-180 meters.

### 2. Mine Hoist Project with ABB

ABB Contract for mine hoists with LKAB Kiruna.

- Rebuild of 4 mine hoists from DC-technology to AC-technology +1 new hoist with same AC - technology at sub - vertical level (underground -740).

Payload increase from 24 ton to 33,4 ton and hoist distance will increase from 355 m to 705 m.

-Additional 1 new hoist with DC-technology at Head frame (surface level) based on "used electrical equipment" from rebuild at sub-vertical level (same DC drive as existing 6 hoists at surface level) plus new mechanical equipment.

Upgrade schedule: May 2007 - Oct 2008

**New Hoist in operation:** Jan 2013

#### 2.1. Why did LKAB select ABB hoist technology?

- High operation availability
- Production friendly operating system
- Safe and precise interaction between brake hydraulics and motor drive control
- Good experience from previous installations

#### Why did LKAB select the ABB AC drives?

- Motor and drive operate at a power factor of 1.0
- Low voltage drop, so that more than one hoist can be started at the same time
- Smaller size transformers
- Low harmonics levels
- High efficiency

Hoist data	sub-vertical level -1045	sub-vertical level -1365
Number of hoists	4	5
Production	1560 tonnes/hour/hoist	1510 tonnes/hour/hoist
Hoisting distance	355 m	710 m
Speed	11 m/s	17 m/s
Pulley diameter	3.25 m	3.25 m
Number of ropes per hoist	6	6
Hoisting	Skip / skip	Skip / skip
Payload	30 tonnes	34 tonnes
Skip including rope attachment	36.5 tonnes	40 tonnes
Motor power	5,600 kW	5,600 kW
Motor voltage	3 x 3150 V	3 x 3150 V
Motor speed	64.7 rpm at 8.6 Hz	100 rpm at 13.3 Hz
Drive system	AC with Direct Torque Control	DTC
Upgrade schedule	May 2007 - Oct 2008	2012



**Fig. 3 ABB hoist technology**

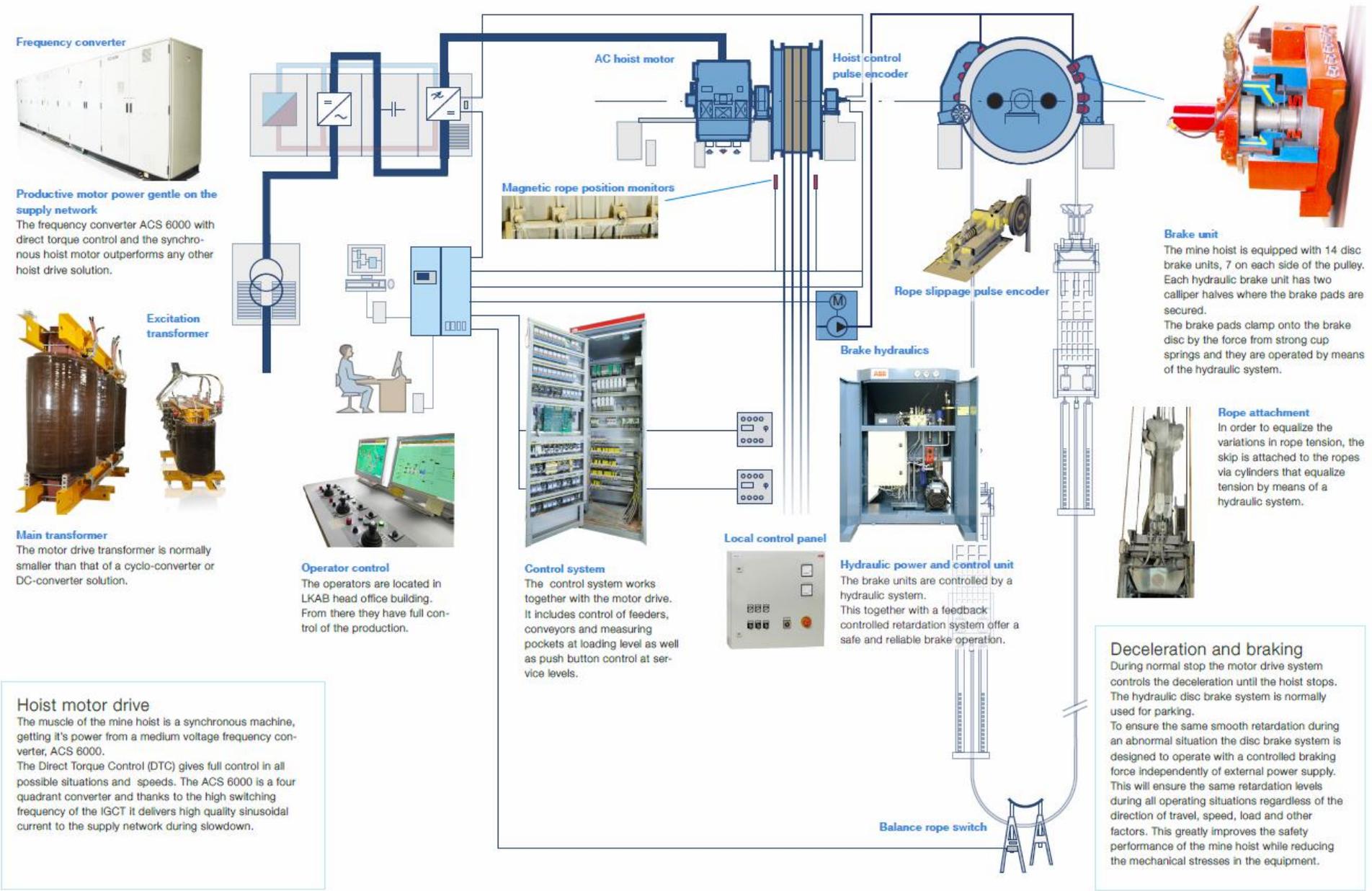
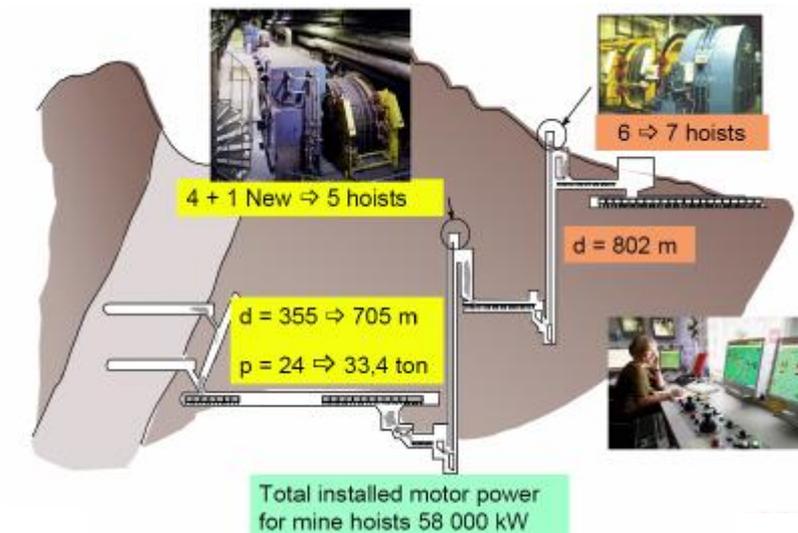


Fig. 4 The ABB hoist system



**Fig. 5** LKAB Kiruna and ABB Mine Hoists

**References:**

**Recenzia/Review:** Ing. Janka Šaderová, PhD.