Presentation “Switching the lights on at a remote project in Africa”

Introduction

- This presentation “switching the lights on” is to give you a perspective that mining projects in Africa are not necessary all about the outstanding achievements of constructing a gold ore milling plant or the head gear construction at the vertical shaft or the development of the mine.

- At some of these remote mining sites electrical power is not always available and consequently the generation of power plays a major role in the economic viability of the project and has the highest profile of importance in the implementation of the mining project.

- Costly diesel generators have to be used at some mining operations. But having the accessibility to a natural resource of a flowing river to generate hydro power, brings a new economic dimension to the mining project by reductions to the mine’s operating cost and alleviating the logistical dependence on the transportation of high volumes of fuel.

- The presentation refers to the Kibali Gold Project located in the North Eastern region of the DRC where diesel generated power is supplementary to the base load of hydo generated power.

- The video presentation covers the logistics of the project, with a flyover view of a 3 dimensional model of the gold plant backed up with video snapshots, a google earth overview of the hydropower project with video visuals, a gloss through of pictures of the infrastructure and finally the high lights of the project.

- In the limited time available please allow the indulgence of a 60 second introduction to DRA and apologies in advance for any perceived commercial opportunism.

DRA has an ethos of “peoples based safety” and it is our duty to warn the viewer in advance of flash light photography in the presentation material.

The Kibali project is the largest project undertaken by DRA outside of South Africa and is one of the largest gold projects in Central Africa.

Logistics

- The project site is located within 10km of the town of Watsa in the north east portion of the DRC in the Orientale Province.
- The nearest port was Mombassa in Kenya which is 1800km and approximately 2 weeks by gravel road and crossed 3 borders, Kenya, Uganda and DRC.
- 56 days was the average transportation time of materials from South Africa to site.
- Equipment was shipped from as far as Vancouver and Melbourne Australia. All the steel was shipped from Jeddah in Saudi Arabia.
- Mobilising South African contactors, DRA engineers and Vendor to site took two days on a journey via commercial an airline to Entebbe to overnight and depart the next day for site on an air charter.

Gold ore Milling Plant

- The 7.2 MTPA capacity plant consist of 2 streams separately treating oxide ore and sulphide ore.
- Each stream has a ROM tip, primary crushing through to milling.
- Oxide ore is processed conventionally using carbon in leach for gold extraction.
- Sulphide ore is concentrated using flotation and gold extraction is by ultra-fine grinding, leaching and carbon in pulp.
- Reagents storage is ware housing with a stock level of 4 months.
- This gold plant covers nearly every aspect of gold ore processing and extraction.

Power Generation

- The Kibali Mine is located in the North of the DRC and is approximately 300km from the nearest commercial electrical supply.
- The mine has a planned average power requirement of 40 kW at its peak planned production period.
- Due to the large load variation due to both mining and concentrator plant requirements a Power Management System was introduced to stabilize the electrical supply and to ensure maximum production efficiency from an electrical point of view.
- The heavy loads at Kibali consist of two 7 MW ball mills and a vertical winder. Due to the cyclic operational nature of rock winding the impact of the acceleration peak powers causes significant voltage swings to be induced on the system.
- A STATCOM device which is a dynamic reactive compensation device was installed to ensure complete reactive power compensation during winder acceleration and subsequent perfectly stable voltage on the supply network.
- The system was further supplemented by a carefully designed automatic Power Factor Correction control system so as to ensure optimize power transfer and minimized losses from the hydro power station to the main consumer substation.
- It should also be noted that the mine in in one of the world's most lightning dense areas which required special attention to both protection grading and overhead line designs.

Hydro Power

- The hydro power plant consists of 4 x 5.5 MW hydro turbines.
- To reduce the diesel power consumption of the mine to a minimum a further 2 hydro power stations are planned each with 2 x 5.5 MW turbines. The first of the two additional power station is presently in the construction phase and should be able to produce power early in 2016.
- The mine will be capable of producing a total of 44 MW during the wet raining season. The diesel generators would be used to handle the instantaneous load demands where the hydro power stations would handle the base load. The diesel generators would also be required to supplement the electrical power during the dry season (2-3 Months per year).

- The turbines are fed from the Nzoro River through a canal constructed by DRA to optimize the head on subsequent power output of the turbines.

- A river weir was built across the Nzoro River to give a constant level of flow through the canal via the intake. The canal is 6 kilometres in length, 3 m deep and 20m wide.

- At the forebay where the water is channelled into two 3.6m diameter penstock pipes.

- The two penstock pipes direct the downhill flow to the power house which is 1.2 kilometres away at an elevation 60metres below the forebay. Water from the turbines is discharged in to the Kibali River.

- Each turbine is controlled via its own dedicated PLC based control system. The four turbines is then managed through a master PLC which receives power set points through the PMS.

Diesel Generated Power

The diesel generator farm consists of 3 generators banks each consisting of 12 high speed 1.2 MW CAT generators (Total 36). Project plans is in place to increase the number of generators to 48 should it be required in the future.

All generators was fitted with ComAp Ineligen controllers which allowed each bank to be controller by its dedicated generator bank controller (ComAp Bank Controller). The ComAp banks controllers was specially designed by ComAp for the project.

One banks controller is thus responsible to control 12 Generators. The bank controllers and generator controller both have has the functionality to synchronize in the forward and backward direction.

The system further offers automatic load balancing between the banks and generators.

The starting and stopping of the generators according the required demand is carefully controlled by the Power Management System developed by DRA.

Power Management System

The primary purpose of the PMS is to ensure a robust, stable and cost efficient electrical grid to the end user. The PMS has the following functions:

- Diesel generator monitoring and control

- Hydro / Gas turbine control or other power source control

- Load authorization.
- Gradual and fast load shedding
- Automatic blackout recovery
- Power channelling for emergency purposes
- User defined SCADA interface
- Power Factor Correction (PFC) Control

PMS is in essence the brain of the complete system. It continuously monitor the power requirements of the network from both a load point and a supply point of view. Whenever a big load (Active Power > 132 kW) is to be started the load first needs load authorization from the PMS. The PMS takes the starting factor of the load into consideration and authorize the load if sufficient active and reactive power is available. This process takes approximately 200 ms. Should there be a power deficiency additional generators is started to supply the requested load. This takes 2 minutes.

Sufficient spinning reserve is maintained by the PMS so as to cater for the following scenarios:

- A generator goes down (Either hydro turbines, other power sources or diesel generators)
- There is another disruption to the supply
- The load suddenly increases

Under normal conditions, the spinning reserve is always at least the capacity of the largest generator plus a fraction of the peak load.

The PMS also has the capability to shed loads should it be found that insufficient power is available on the network and that a blackout would be imminent. The PMS uses a load priority system to trip loads almost instantaneously.

INFRASTRUCTURE

Tailings Storage Facilities

- Lined CTSF (75 Ha) tailings dam with penstock and return water pump station.
- Unlined FTSF (85 Ha) tailings dam with penstock and return water pump station.

Shaft Head Gear - Electricals and earthworks by DRA.

Fuel Depot

- 3.6 million litre fuel farm including light vehicle and heavy vehicle dispensing.
- 1.2 million litre Open Cast Mining fuel farm including light & heavy vehicle dispensing

Boxcut – earthworks and wall stabilisation.

Backfill Plant - designed by DRA Mining, largest belt filter, 164m2, 4.2m x 40m.

Highlights

First gold pour on 24th September, 20 months from start of construction on 2nd February 2012.

Safety

- Total Project Manhours - 14 063 872
- LTI Free Manhours - 9 863 594
- LTI free shifts - 1 138 341
- Peak Labour - 4547 (October 2013)
- Total Inductions completed - 8615