

Emirates Aluminium Starts Up World's First Fully Integrated Power Distribution System From ABB



From the 220kV Gas Insulated Switchgear (GIS) to the 220/33kV step down transformers, the 33kV and 6.6 kV switchgear all the way to the plant wide 400VAC distribution a fully integrated power distribution system nears completion. ABB's local manufacturing capability, engineering resources and experience were fully utilised to make it all possible.

EMAL's world first smelter fully integrated power distribution system will set new standards for green field smelter projects. In line with ABB's enabled Industrial^{IT} (Industrial Information Technology), the overall system integration, maintenance simplification and after sales services has been optimised throughout the plant. With the full scale level of integration the most cost effective operation and maintenance

as well as spare parts management, has been achieved with EMAL's advanced looking forward strategy.

Introduction

Emirates Aluminium (EMAL), a joint venture between Abu Dhabi's Mubadala Development Company, the investment arm of the Government of Abu Dhabi and Dubai Aluminium Company DUBAL, are building a green field US\$5b smelter at the Taweelah industrial zone close to Abu Dhabi. The first phase of the EMAL project will be operational in 2010 with around 700,000-tons annual capacity. Upon completion of all phases, the smelter will have a capacity of 1.4 million tons, which will make it the largest single site aluminium smelter in the world. SNC-Lavalin International, in

joint venture with Worley Parsons, as an EPCM-contractor, leads the complete plant project and is responsible for engineering, procurement, construction and management.

ABB scope of supply is the total integrated power distribution and control system from the 220kV GIS all the way to the 400VAC plant wide distribution for the power plant and the smelter. The SCADA (Supervisory, Control And Data Acquisition system) has been integrated from the top to the bottom. In addition also the 400kV feeder protection system and SCADA interface as well as the telecom interface was supplied at the EMAL substation as well as the utility sub-station side.

ABB's power quality system Switch-synTM, which has become industry standard for switching large loads within Aluminium smelter substations, will energise all large loads with minimal power distortion impact to the feeding generation plant and the power conversion station.

ABB's ELK-14, 300KV rated GIS



Switchsync™ for highest power quality performance



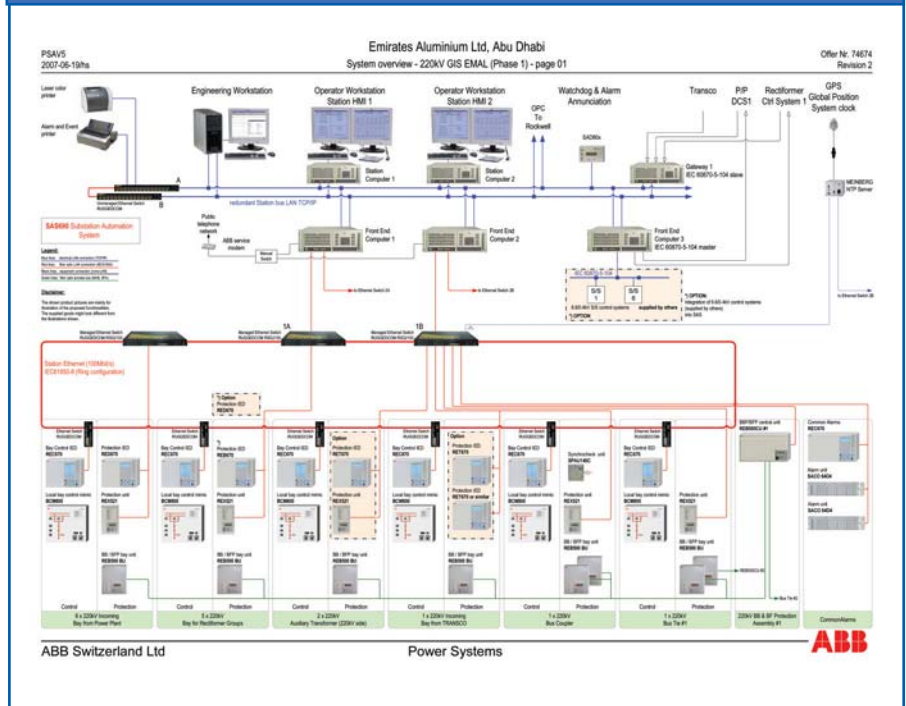
The 400/220kV step down transformer 350MVA has also been fitted with this system to minimise inrush currents and prolong the equipments life time. The 400kV feeding GIS switchgear for the step-down transformer is also equipped with ABB's REC670 bay control unit to make it possible to enable a plant wide interface with the SCADA system.

EMAL's advanced looking forward strategy made the full integration possible and will result in most cost effective operation

One 220kV GIS Substation for power plant and Smelter

With the location of the power plant and the smelter within a close area it was possible to have a single GIS for the power plant and smelter. The GIS on the one side is directly connected to the generator step up transformers and on the other side to the rectifiers and auxiliary power transformers. The interfacing of the GIS controls and protection

EMAL Control and protection architecture



is a very demanding task for the EPCM engineers, normally ending up in a long lasting painful exercise. At EMAL all power distribution levels 220kV, 33kV, 6.6kV and 400VAC have been integrated on the same control and protection architecture platform simplifying this task tremendously. The GIS design is as such that the circuit breakers can be controlled for switching three phase or single phase with a phase switching accuracy of less than 1ms in difference.

This switching accuracy of the 220kV GIS circuit breakers is required to allow the installation and make use of ABB's power quality system Switchsync™, for switching large loads within Aluminium smelter substations with minimal power distortion impact to the feeding generation plant and the power conversion station.

The ELK-14 single-phase, earthed metal enclosure, guarantees maximum operational safety and reliability as all parts are enclosed and effectively protected and insulated against negative

external influences. The system is of a modular architecture and permits individual solutions that can be adapted to changing needs at any time. The modular design has the advantage of a reduction in space requirement of up to 40% compared to previous GIS systems.

The use of Aluminium enclosures reduces the weight of the switchgear as well as reducing cost for civil foundations and load-bearing components.

The substation automation system SAS690 is designed for controlling and

Cooling design for 55° C Power Transformers



ZX2 33kV Double busbar Metal glad GIS insulated switch gear



monitoring the primary and secondary equipment of a substation. Typical applications are substation for power utilities, industry and power plants. At EMAL all three applications had to be integrated on the SAS690 substation automation system. The SAS690 is part of ABB's SAS600 series solutions for substations automation based on IEC61850. It provides the communication and integration of ABB's bay control and bay protection solutions (REC670 and RED 670), all the station level functions and as an option the remote link to e.g. a network control centre.

The use of industrial Ethernet and the compatibility of the station equipment allow solution independent selection of different communication topologies to ensure maximum performance and availability to optimal cost. The use of standard hardware and Windows-based applications for the station computer / HMI (Human Machine Interface), allows a system to be designed that is open for other Windows and MS Office-based business applications. It also makes it easier to source spare parts locally and reduces the training costs for the system administrators.

220/33kV Power Transformers

ABB's trafostar design is constantly updated and is used as a standard design within all ABB transformer factories around the world. The standard design allows for a wide variation on ambient temperatures which makes it simple to apply. In particular for high ambient temperature the cooling concept and design is very important. As the ambient temperature at the EMAL

Modular mechanical and electrical principle reduces space and allows for flexible and compact design

site can easily reach 55°C close attention the cooling of the transformers had to be taken. The location of the smelters power transformers is normally close

UniGear Type XS1 rated up to 24kV



the GIS and the 33kV switchgear to avoid long cable runs. Also at the EMAL site this was made possible due to a compact substation arrangement.

33kV Switchgear ZX2 with latest control and protection relays

ABB's ZX2 metal glad GIS insulated medium switchgear has been selected by EMAL and is installed within the 220kV GIS building allowing shortest cable connection from the GIS to the step down transformers and to the 33kV switchgear. The 40 breaker cubicles with gas-tight busbar system in a hermetical sealed compartment as well as the circuit breakers within their own SF6 gas compartment guarantees for highest safety operation standards and are in normal operation maintenance free. Other features like stainless steel enclosure, modular design and plug in panels make this type of switchgear simple to install and operate. The control and protection relays are connected via a serial bus to the main substation control system reducing

Typical MNS Low Voltage Switchgear



cabling requirements by some 50 tons of copper cables for such a large installation.

6.6kV Switchgear UniGear XS1

ABB's UniGear XS1 is an arc-proof, air-insulated metal-clad type switchgear which is used in many different industries on shore and off shore like oil platforms and ships. The switchgear is modular and built up by placing standardised units side by side in a coordinated way. The switchgear is simple and apparatus and instruments can freely be configured. The functional units of the switchgear are guaranteed arc proof in accordance with ICE 62271-200 standards. All start up and service operations can be carried from the front. The switchgear and the earthing switches are operated from the front with the door closed. The switchgear can be installed close to the wall. The range of apparatuses for UniGear

switchgear is the most complete available on the market, being able to count on vacuum and gas circuit breaker and vacuum contactors with fuses. All this apparatus is interchangeable inside the same switchgear unit. This makes use of a single switchgear-user interface possible, with the same service and maintenance procedure and operations. Apart from the traditional functional units, the solutions, compact units equipped with contactors with fuses and double busbar systems. The use of these units allows extremely efficient use of space.

Low Voltage Switchgear type MNS

The MNS low voltage switchgear system is designed and built to be the heart of any modern, highly automated motor control or power distribution system. The consistent application of the modular principle both in electrical and mechanical design as well as the

use of standardised components allows its flexible and compact design. Depending on customer requirement, operating and environmental conditions different designs levels are available. EMAL's MNS low voltage switchgear was manufactured at ABB's Dubai production facilities which also produced EMAL's control and protection system for the 33 and 6.6kV switchgear as well as the SCADA system for the MV and LV distribution system.

The consistent application of the modular principle both in electrical and mechanical design as well as the use of standardisation components allows its flexible and compact design.

Summary

EMAL's world first smelter fully integrated power distribution system will set new standards for green field smelter. In line with ABB's enabled Industrial^{IT} (Industrial Information Technology), the overall system integration, maintenance simplification and after sales services has been optimised throughout the plant. With the full scale level of integration the most cost effective operation and maintenance as well as spare parts management, has been archived with EMAL's advanced looking forward strategy. ■

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