

Cold mill repowering project for Ilva

Ilva SpA in Novi Ligure, northern Italy, is a cold rolling and processing unit of the Riva Group headquartered in Milan. It is one of three locations where the hot rolled product of Ilva is cold rolled to further undergo downstream processing such as annealing, galvanizing, and tinplating. The other two cold rolling units of Ilva are in Genoa and Taranto. Recently the main drives and controls on the five-stand pickle line tandem cold mill at the Ilva mill in Novi Ligure have been upgraded within the framework of a repowering project.

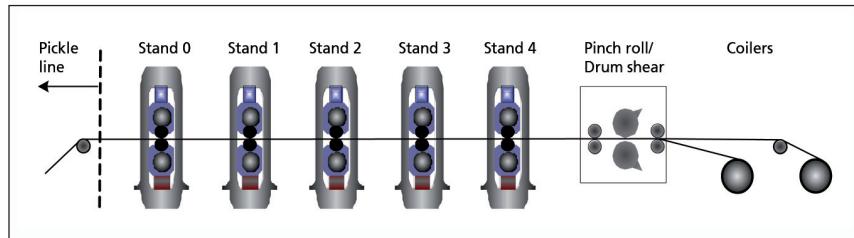


Figure 1. Five-stand tandem cold mill

The Ilva cold mill (figure 1) in Novi Ligure, Italy, uses hot rolled mild steel and produces strip widths from 700 mm up to 1,850 mm wide. The delivery thickness varies from 0.4 mm to 3.0 mm, with delivery speeds up to 1,515 m/min.

In the original configuration, each of the five stands of the cold mill was powered by four 600-750 V DC motors of 1,287-1,305 kW each. The motors were shunt wound for adjustable speed, non-reversing service. The largest stand therefore had a total power of 5,220 kW.

Ilva wanted to raise the mill power level to increase production, and decided to replace the older DC motors with modern, more powerful AC motors and drives with less maintenance. The decision was made to initiate a two-phase modernization program, with the first phase to replace the four motors on the center three stands with larger three-

phase AC induction motors of 7,000 kW size. These are 6-pole motors with a speed range of 345 to 1,075 rpm and voltage of 3,300 V. The second phase of the program is to replace the process automation and control system, and replace the remaining eight DC motors with two AC motors, at sometime in the future.

The existing mechanical mill stands were not modified. Figure 2 illustrates the replacement of the motors on one stand. As a result, for Stands 2 and 3 the power available was increased from 5,148 to 7,000 kW, and for Stand 1 it was increased from 5,220 to 7,000 kW. Details of the Phase 1 repowering are shown in table 1 .

It was necessary to build new gearboxes with only one input shaft to couple the single motor to the mill stand; as before there are two output shafts to drive the upper and lower rolls.

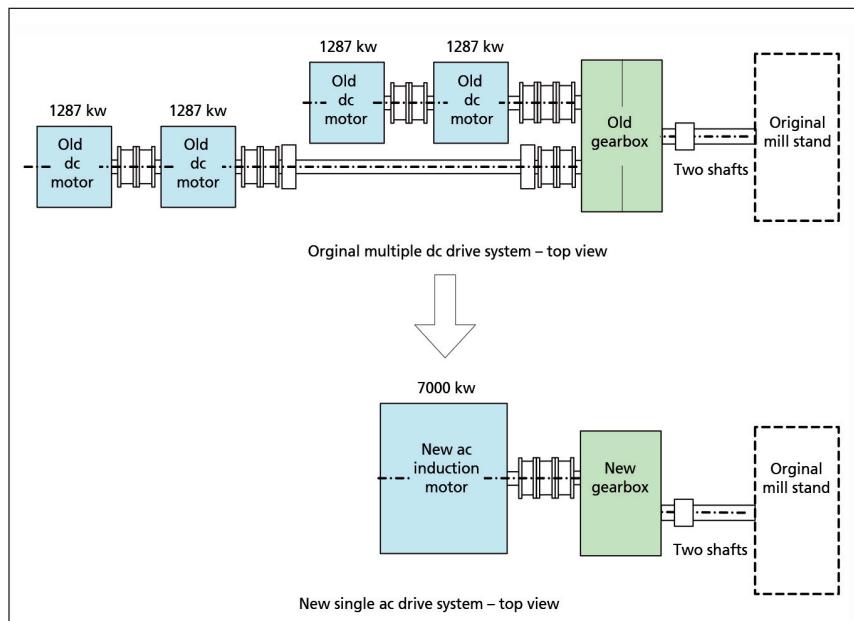


Figure 2. Replacement of four DC motors with one large AC motor

Paul Blaiklock, Marketing Manager,
TMEIC GE, Roanoke, VA, USA

Contact: www.tmeic-ge.com
E-mail: metals@tmeic-ge.com

One of the new induction motors is shown in figure 3. It is totally enclosed with IP44 protection and has Class F insulation. The photo shows fans on top of the motor to circulate cooling air through the heat exchanger and down through the motor stator and rotor. Green pipes on the side bring 900 l/min of cooling water into and out of the overhead cooler. The tachometer is mounted on the motor stub shaft. The lubricating oil reservoir in the foreground has two pumps, one as standby, feeding the motor journal bearings. The reservoir is fitted with a heater, heat exchanger, and oil flow sight gage. Since this is an induction motor there are no exciter slip rings.

Variable frequency drives

The three AC motors are driven by large AC variable frequency TM-drive-70 drives with power regeneration, running on 3,300 V AC supply. The drives use injection enhanced gate transistors (IGBT), a breakthrough in power switch technology. IGBTs have a low voltage gate drive with high-speed switching to deliver a smooth sinusoidal waveform to the motor, and low harmonics to the power system. With an active converter, the power factor to the system grid is maintained at unity, and any energy developed as the mill decelerates is regenerated and returned to the supply.

The TMdrive-70 is water cooled using a closed loop circulating de-ionized water system. Plant water piped through an external heat exchanger cools the circulating water. The cooling water cabinet has a deionizer and dual pumps for increased reliability.

Speed control is fully digitalized vector control, and a Profibus LAN connection allows high-speed communication from the master controller. Power frequency to the motor can be varied from 17.5 to 54.6 Hz.

Control system. The original drive control functions for the DC drives were duplicated for the AC drives using a new Innovation Controller. This is a VME rack controller using a Celeron processor and with interface cards for Profibus (for the new drives), C-Bus for the existing drives, Series 6 for the old I/O, and Genius I/O. All the original I/O

	Original mill motors		Repowered mill motors	
Stand 0	4x 1,305 kW	2x 600 V DC	4x 1,305 kW	2x 600 V DC
Stand 1	4x 1,305 kW	2x 600 V DC	7,000 kW	3,300 V AC
Stand 2	4x 1,287 kW	750 V DC	7,000 kW	3,300 V AC
Stand 3	4x 1,287 kW	750 V DC	7,000 kW	3,300 V AC
Stand 4	4x 1,287 kW	750 V DC	4x 1,287 kW	750 V DC

Table 1. Modernization of mill motors - Power and Voltage



Figure 3. New induction motor and gearbox driving the cold mill

and wiring were kept to reduce the cost and simplify the installation. To implement this, new interface devices were installed linking the new system to:

- the existing master control,
- the existing DC drives and new AC drives,
- the existing controller networks,
- the existing controller I/O racks.

Control functions were expanded beyond those of the original system. The new controller provides additional permissive functions to the existing master control. The system also includes local operator stations, programming workstations, and associated control and programming software.

only 17 days. The second shutdown to install two motors took 27 days with the same manpower parameters. During this shutdown there was much more civil construction work required for these two motors. The drive modernization has provided the mill with a number of benefits:

Increased power and performance. The increased power of the three new motors allows greater reduction capabilities and opens up opportunities for new products to be rolled. Improving the rolling capability of the heavily loaded middle stands allows the mill to run at the maximum available speed by removing the torque limit bottleneck.

Benefits of the new drives

Installation work was performed on the day turns using only one shift of manpower for civil construction, mechanical, piping and electrical work. The length of the first shutdown necessary to remove the existing DC motors and install the new AC motor was

Reduced maintenance costs. The DC motors have brushes, which wear and have to be replaced periodically, while the new induction motors are a much simpler design with very little maintenance. Also the new system replaces 12 DC motors with only three AC motors, allowing a big reduction in maintenance.

Cold rolling - Automation

	Stand 0	Stand 1	Stand 2	Stand 3	Stand 4
Motor rating, kW	5220	7000	7000	7000	5150
Motor speed, rpm	399 / 900	345 / 1,075	345 / 1,075	345 / 10,75	225 / 650
Motor torque, kNm	125 / 55.4	194 / 62.2	194 / 62.2	194 / 62.2	219 / 75.7
Rolling speed, m/min	332 / 748	308 / 960	399 / 1,242	522 / 1,626	543 / 1,570
Rolling torque, kNm	261 / 116	377 / 121	291 / 94	223 / 71	157 / 54

Table 2. Characteristics of the modernized mill

Reduced energy consumption. Ilva Novi Ligure has seen a reduction in energy cost with the new equipment. The energy savings are achieved since the DC drives and motors run at lower efficiency and lagging power factor, while the AC drives and motors run at unity power factor.

Reasonable cost upgrade. Using induction motors instead of synchronous motors (the other choice) allowed

a lower capital equipment cost and installation expense. All of the old I/O, modules, racks, and wiring were integrated into the new system, which further reduced the control system capital cost and the installation expense.

Future production increases. With Phase 1, mill speed was not increased. Technically, the AC drive speed step response looks much better than that of the existing DC drives. However, the TM-

70 drive step response was reduced to match the existing DC drives so that no tension transients were caused on acceleration and deceleration on the master ramp. Since only three of the five main drives were replaced, it was critical that the speed responses remain the same. In the future, if the remaining main drives are upgraded, the speed responses will be changed to the optimal settings and the improved performance and increased production will be realized. M