In 1977, then SKF Steel, installed a new bar and rod mill at Hällefors, Sweden. Now Ovako Steel, the mill was one of the first digitally controlled mills in the world, based on state-of-the-art technology. Its intention was to meet high product quality demands of the parent company for ball bearing steel.

Although still in good shape and performing well, current demands for performance and competitiveness have meant that the mill needed to be upgraded to tomorrow's needs. Key issues, such as improved mill supervision, auto product changeover, manufacturing instructions, production analysis, and easier maintenance, played an important role in deciding on ABB's new generation of RMC control coupled with the performance enhancement of Interstand Dimension Control (IDC). Together this will restore the Hällefors mill to the forefront of technical development in rolling mill design.

The SKF Steel Hällefors Mill was begun in 1975 on a green field site near an existing plant and is the main supplier of ball bearing steel to all SKF factories around the world. The mill was designed to meet exacting environmental, working conditions and product quality demands using what was then the state of the art in mill technology. The mill went on stream in September 1977.

Originally the mill was designed for 120 mm square billets but in 1995 a new 3 stand roughing mill was installed to handle 165 mm billets. A new control system was also installed using the ABB RMC 200 system, Advant Controller 450 and Operator Station 500 Series. The mill is operated remote from the existing pulpit. The following year the control for the walking beam reheat furnace was replaced and ABB RFC system installed to optimise performance and fuel consumption. To achieve closer final tolerances, the ABB ADC, Automatic Dimension Control system (ADC) was installed in 1996. The ADC system controls the roll gap of the final 2 or 4 stands with a feed back from a rotating ORBIS optical gauge meter.
New control systems from ABB
for optimised performance

**Control for the 21st century**

A core requirement of mill updating was to be able to meet today's high demands for quality and consistency in production of close tolerance rod and bar. In 1997, a decision was made to revamp the control system which consisted of DS8, a 8 bit microprocessor system for control and numeric presentation of data, PLC700 logic control and TYRAK 73 analogue thyristor convertors. ABB RMC, DVC 700 digital drive upgrade kits and IDC were chosen as the most effective method of achieving the Mill's ambitions.

**Simple installation for RMC**

The RMC concept is designed for easy addition and upgrading. As the new roughing mill was already equipped with Advant Controller 450, the whole mill could be controlled from the same processor rack by adding more processor capacity, with the necessary I/O remotely positioned in the relevant process area.

The revamp was carried out in three stages. First the DS8 and its operator communication were replaced by adding software to the Advant OS provided for Roughing Mill. Secondly, revamping the analogue thyristor convertors with digital control. By keeping the power supply and thyristor modules the revamp work was restricted to replacing the control, protection and field convertor. All components were mounted on a plate and pretested before fixing to the control cabinet door.

The third phase was to replace the old PLC logic control with Advant RMC. The existing PLC circuits were located in one cabinet with all process cabling terminated in an adjacent cabinet. This existing process cabling was retained and wired to the new ABB S800 remote I/O with bus communication to the Advant Controller.
**IDC – a new concept in rod and bar mill control**

A key element in managing control is accurate and rapid feedback of dimensional data and the effective continuous control of the roll stands themselves. In the past all control methods were based on the philosophy of maintaining a low tension in the metal, constant along the length of the bar. Principally due to lack of on-line feedback from process parameters like dimension and speed. This approach works well in the main but fails to adjust for temperature and dimensional variations along the actual bar.

IDC employs rugged solid state sensors which are insensitive to the hot damp conditions of the mill while providing accurate information about actual bar dimensions. Data from these measurements are taken into the control system and used to regulate bar tension by adjusting interstand speed. In addition to provide accurate and constant data about bar dimensions, IDC ensures maximum roll utilisation increasing the rolling mill capacity as the material width is continuously supervised and controlled, thus eliminating risks for under/overfill rolling.

The U-gauge measurement principle allows a wide measuring range that makes it possible to cover the complete mill with only a few different sizes of gauges. In line installation of the gauge is simple due to the special designed in/outlet guides and the sensor base plate. No on site calibration is needed.

Using the existing process cabling the new controller was rapidly connected by bus communication to the Advant Controller using ABB S800 remote I/O.)
The usual method of dimension control in rolling mills depends on the assumption that the properties of the front end of the material is relevant for the body and tail end in the first part of the mill. This known simplification fails to take into account temperature variations along the bar and during the rolling process, and inaccuracy in billet dimensions. The variations in spread are in many cases in the order of 1% on width dimension, for an oval this can be 2–3% on area. This mass flow variation is today taken care of by the loop control, but has influences on the final dimensional tolerances. The inadequacies also mean that the roll guides have to be set loose resulting in less good guiding with material twist problems.

- IDC uses the solid state sensors U-gauge to measure and feed back actual bar dimensions so that continuous dimension control can be achieved throughout the rolling process. Constant width is maintained by applying slight back or front tension in the order of some few N/mm². Material height is measured and corrections to compensate for roll wear or mistakes in initial settings is done by roll gap adjustments.

- Test pieces/billets can be reduced as the safety in start up a new dimension is improved by the knowledge of actual dimensions after each mill stand. This will improve both mill availability and yield.

- Collection of actual rolling data accurately logs mill performance, bar production rates and other critical quality data.

- As a result IDC can provide safer rolling with increased yield and availability.