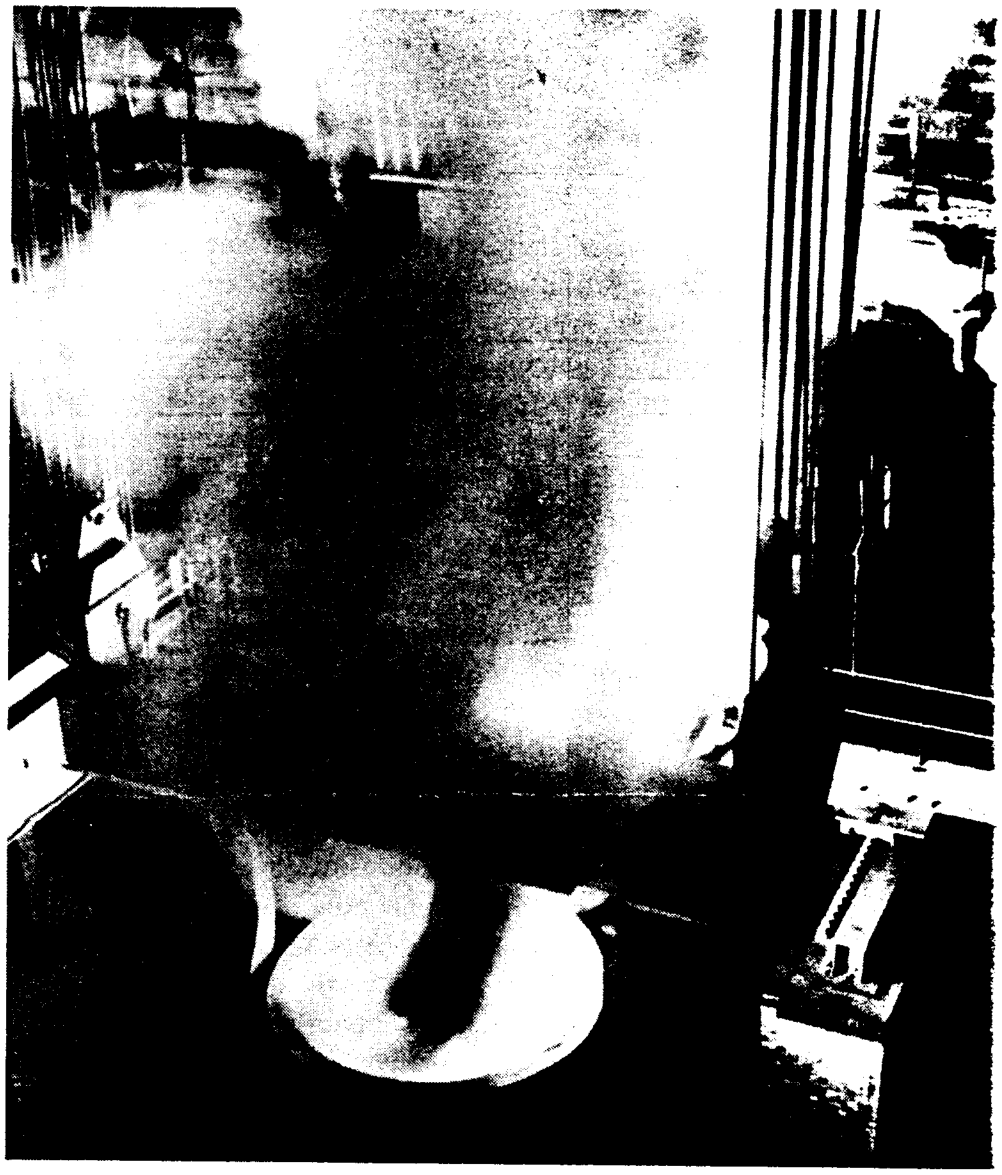
BSC fights back in drive to double stainless capacity

And what an investment it was—over $290-million—to modernize and expand stainless capability in a drive to recapture its home market share from imports and establish inroads to the export market



New melt shop houses a 110-mt, 60 MVA electric arc furnace. It's being used primarily to melt the raw materials while the new 130-mt AOD facility will carry-out the refining operations

Just as British Steel Corp has been experiencing severely failing financial fortunes during recent years, its stainless steel operations have also fallen victim to the passage of time. BSC Stainless has been able to hold onto a healthy 70% share of its home market for hot-rolled stainless coil. It has, on the other hand however, seen its share of market for the cold-rolled stainless sheets and coils fall about 35%. With the UK private sector stainless producers accounting for only 8% of the market, the majority share and remainder of the marketplace was left to imports—primarily from Sweden and France.

Dwindling share of market and increasing import penetration are only one set of problems facing BSC Stainless. Another is the tremendous lag in per capita consumption of cold-rolled stainless steel in Britain as measured against other developed countries. As evidence, a BSC Stainless marketing official noted, the per capita consumption of cold-rolled stainless in Japan is 15 lb; France, 12 lb; West Germany, 10 lb; and the US, 7 lb. In Britain, he continued, the per capita consumption is only 2.4 lb, while the average for the developed world is in the order of 5.5 lb.

The official, Gordon Hill, commercial manager, BSC Stainless, acknowledged that with the purchase of the remaining privately-held shares of Firth Vickers' stainless flat products operations, BSC Stainless was placed in an almost monopoly-type situation vis-a-vis the production of wide sheet and plate for the UK. Hill also notes that BSC Stainless was restricted to producing stainless only one m in width and did not have the ability to produce ferritic grades of stainless.

For all these reasons, British Steel in 1973 proposed—and the government approved in 1974—a major capital investment program to modernize and expand the stainless steelmaking operations of BSC Stainless. The total investment for the project was in the order of £130-million (equaling $291.2-million at a conversion rate of $2.24/£). BSC Stainless, a profit center within the Sheffield Division, raised its total output from 100,000 to 200,000 mtpy. Of this total, 50,000 mt will be designated to stainless steel plate for the food processing, chemical, and nuclear industries. The remaining 150,000 mt in cold-rolled sheet and coils will be earmarked for consumer durables, building products, and general industrial applications. Total melting capacity is slated for 400,000 mtpy.

The expansion/modernization program at the Shepcote Lane and Tinsley Park Works consists of a completely new melting, refining, and continuous slab casting facility; additional cold rolling, processing, and warehousing capacity; a bright new annealer; and additional plate finishing capacity. As part of the total package, several modernization programs (including updating the caster and finishing operations and balancing out of plant) were also effected at the stainless steel operations of the Panteg Works in South Wales. Shepcote will have a melting capacity of 350,000 mtpy and Panteg is slated for 50,000 mtpy.

Aside from the additional capacity, the new facilities enable BSC Stainless to increase sheet and coil width from 1.25 m to 1.5 m and plate width from two m to three m and 11 mt in weight.

According to Hill, BSC Stainless' goal was to attain 70% of the home market for stainless cold-rolled products. "We now have the opportunity to increase home sales in two ways," he reasons. "Imports will be displaced by the provision of adequate supplies of home-produced stainless that will be cost competitive and of excellent quality. The market can expand by simply making more home-produced stainless available."

The way Hill sees it, positive signs are already surfacing. The cold-rolled home market share has improved by some seven percentage points to 45%, with the anticipation that BSC Stainless' share will approach 50% by the end of this year. According to Hill, most of this expansion has been at the expense of imports, which have declined by a similar amount.

Exports have been running at about 45% of total BSC Stainless output, and officials hope to maintain the same percentage with the increased output. Confidence in this objective is based on the fact that the firm has wholly-owned sales organizations and warehouses in leading export markets such as Germany, France, Sweden, US, and Canada. "As far as British Steel is concerned, the US is still a virgin market for cold-rolled stainless, and the BSC Stainless sales force has hopes of winning a lot of new business there," an article published in the *Financial Times* noted recently.

Hill noted that BSC Stainless did not have any business in the US as far as cold-rolled products; however, he wants to sell some of the output in America. The British Steel executive did not want to venture a number as to market share since it was just "too hard to do." He did concede, however, that it wouldn't be "too large."

SMACC and SPACE spell it all out

The stainless melting and continuous casting (SMACC) plant has been designed to the world's best practice for speed of working and quality control. The stainless plate and coil expansion (SPACE) program not only doubles output, but increases BSC Stainless' product capability.

Steelmaking is based on an electric arc furnace which mainly melts raw materials with refining carried out in an argon oxygen decarburizing vessel. There is a three-way split in the process after steelmaking, approximately 70% of the output will go through the continuous slab caster, with 12% cast into slab ingots and 18% cast into square ingots.

The square ingots are then rolled into billets and rounds at the Sheffield Div's Stocksbridge and Tinsley Park Works. Most of the slab ingots are rolled on the Tinsley Park 42-in. mill while some are sent to the Lackenby slabbing mill for the production of slabs for wider hot band.

All of the continuously cast product, plus the slab rolled at Tinsley Park, are surface ground in the SMACC slab processing bay before hot rolling. Approximately 150,000 mtpy of slabs are sent to Lackenby for rolling into hot band and returned to Shepcote Lane for cold rolling and finishing.

All raw materials, whether scrap or ferroalloys, are assembled in skips in the service bay as called for by the Least Through Cost Mix system. Based on a visual display unit, this system calculates the mixture of raw materials to be used for each melt. The computer indicates the best overall steelmaking strategy based on the current market price of each raw material and related processing costs.

The service bay crane loads the skips into a bottom opening basket standing on a rail mounted transfer car. A weighing machine is incorporated into the transfer car rails at the loading position. The basket is then transferred to the steelmaking bay and picked up by the ladle crane; the contents are then emptied into the arc furnace.

A 6.7-m dia electric arc furnace, powered by a 60 MVA tranformer, and equipped with 24-in. dia electrodes, has the capacity to produce 300,000 mtpy of liquid steel. Each heat has a capacity of 120 mt and a tap-to-tap time of three hr during the commissioning phase of operation. According to Dr. David Hall, melt shop manager, the tap-to-tap time will be slightly over two hr during normal operations. The furnace is used generally for melting, with little or no refining performed. When melted, the liquid steel is tapped and transferred to the AOD vessel.

Materials from the storage hoppers are monitored by a weigh and feed system and top-fed into the 130-mt AOD vessel from twin chutes through the vessel hood. This allows continuous feeding into the vessel while it is on blow at rates up to 10 mtpm.The direct fume offtake hood on the AOD vessel is fabricated of stainless steel and avoids the need for water cooling by a 5:1 air ingress. According to Hall, quite a bit of work was done by the Corporate Laboratories in determining the ultimate shape of the hood. The vessel also has a five-tuyere configuration with a gas control system allowing blowing rates of up to 100 cubic mpm of various mixtures of oxygen and inert gases. There is also an inert gas provision for pure argon, crude argon, and nitrogen.

Cold rolling operations will take place on one of four Sendzimir mills, enabling BSC to roll wider widths of stainless steel. Rolling operation is under direction of a computer-based program

The steelmaking facility is equipped with an integrated fume extraction system with a bag filter plant. The high-temperature gases from the arc furnace and AOD vessel are ducted into a mixing chamber together with lower temperature gases from the roof hoods. Four 1200-kw fans then blow the mixture into the 20 compartment filter baghouse.

After being tapped from the AOD, the stainless steel moves to either the continuous slab caster or to the ingot casting area. Ingot sizes used are 7.5 and 14.5 mt for slabs and 4.6 mt for billets. The slab caster is a curved mold unit capable of producing slabs 800- to 1550-mm wide, 140- to 200-mm thick, and 4500- to 9000-mm long. It is anticipated that slab thickness will be restricted to sizes of 150, 170, and 200 mm. The caster is equipped with a turntable to facilitate sequence casting operations.

The twin tundish cars are hydraulically powered and the eight-mt capacity tundish comes equipped with a stopper rod operated either manually or automatically via a hydraulic cylinder connected to the mold auto level control system. In the casting position, the tundish sits on a weighbridge which provides a display of the weight of liquid metal content.

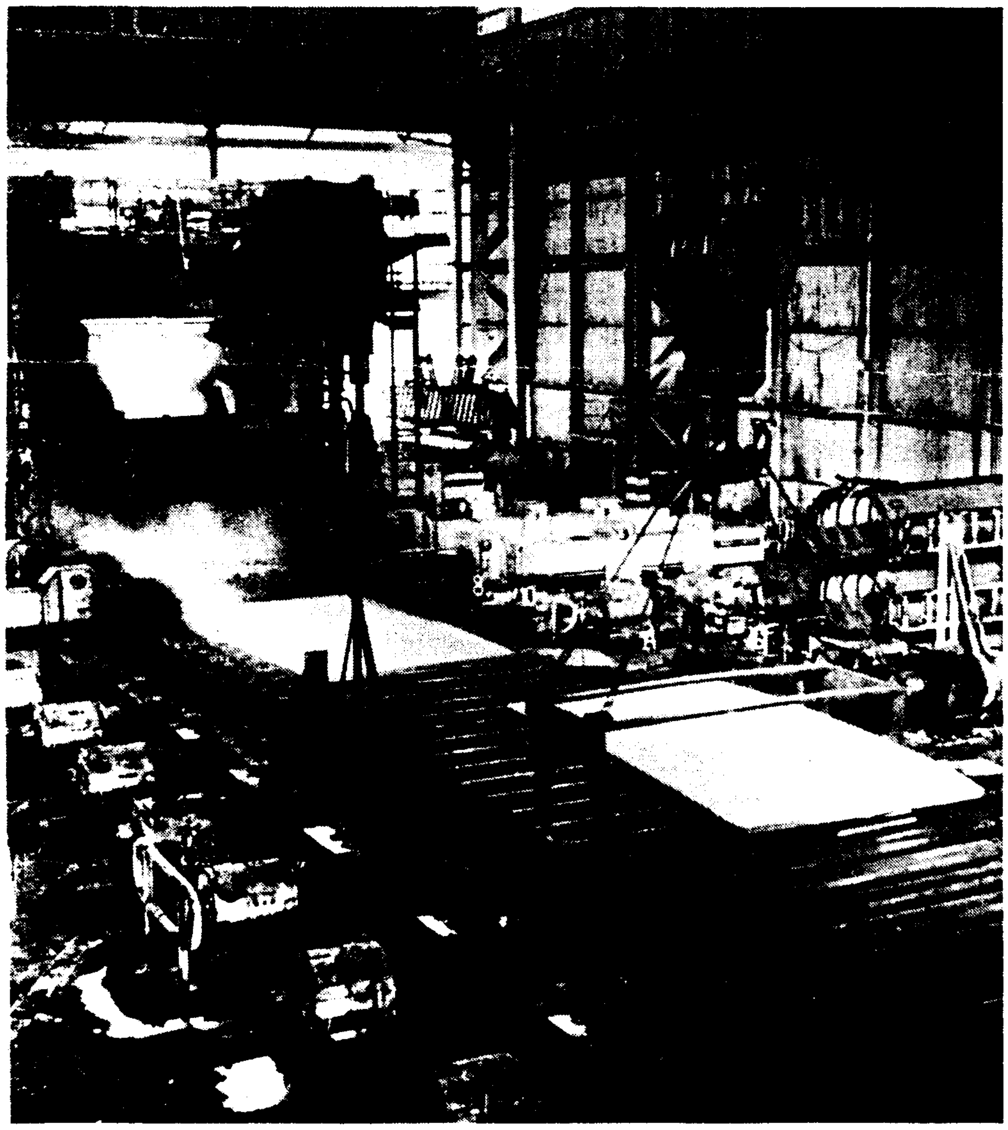
Two size ranges of molds were provided. They were initially designed to allow width changes to be made in place by means of a twin lead-screw arrangement, which maintains constant percentage taper of the end plates. The top zones have grids in the upper half and four closely-spaced rollers per side in the lower half.

The dummy bar is parked on a ramp above the runout table. The runout is outfitted with a twin-headed flame cut-off machine equipped with length measurement.

Three high-capacity slab grinding machines are used to grind the surface of all slabs, and in some cases, the edges. Each is capable of processing slabs at a rate of 10 mtph. The machines are equipped with a main surface grinding wheel 36-in. x 4-in. thick powered by a 375-kw motor. A separate edge wheel 24-in. dia x 4-in. thick is powered by a 75-kw motor. The machines are of the fixed grinding head type with the workpiece mounted on a trolley.

According to BSC Stainless officials, the machines have been provided with twin handling gear, each of which can remove a slab from a trolley, walk it to an inspection position, show the slab to an inspector tilted at an angle, and turn the slab over. While one slab is being inspected, another can be loaded on the trolley and surface ground. This arrangement enables the grinding wheels to operate a high proportion of the time, thus reduce unit costs for the investment.

Shepcote Lane Works plate mill will be supplied with 47,000 mtpy of slabs for rolling up to two-m wide. Another 20,000 mt will go to Dalzell Works in Scotland for processing into plates



Computer plays role in control

Coordination of production, dissemination of manufacturing instructions, and feedback of processing information is performed by a computer-based production planning and process control system. Each major operating point in the melt shop is equipped with a visual display terminal and keyboard connected to a dual computer configuration located in the office area.

The terminals provide the operator information on manufacturing schedules, material and quality specifications, and processing instructions. Melt details from area to area are transferred as the process progresses. Detailed production data is recorded into the system by the operator using the special keyboards. BSC personnel report that conventional paperwork in the production areas is eliminated and formal melting reports are produced automatically by the system.

Measurement and control instruments are linked to the computers to automatically display and record process data. An automatic data link to the analytical system computer allows steelmaking analysis results to be displayed on the terminals. According to company officials, the computer system has considerable scope for the extension into automatic power control in the arc furnace, AOD steelmaking calculations, optimization of cut-up slab and so forth.

On-line analytical facilities are provided by the instruments and sample preparation equipment is installed in the chemical laboratory. The melting shop is linked to the laboratory by a high-speed pneumatic sample carrying system and a data transmission network. Three computer-controlled emission spectrometers are the main instruments provided for the analysis of steelmaking samples and raw materials. They are coupled to a common computer for the generation of analytical records and for the control of the transmission of analytical information back to the steelmaking areas.

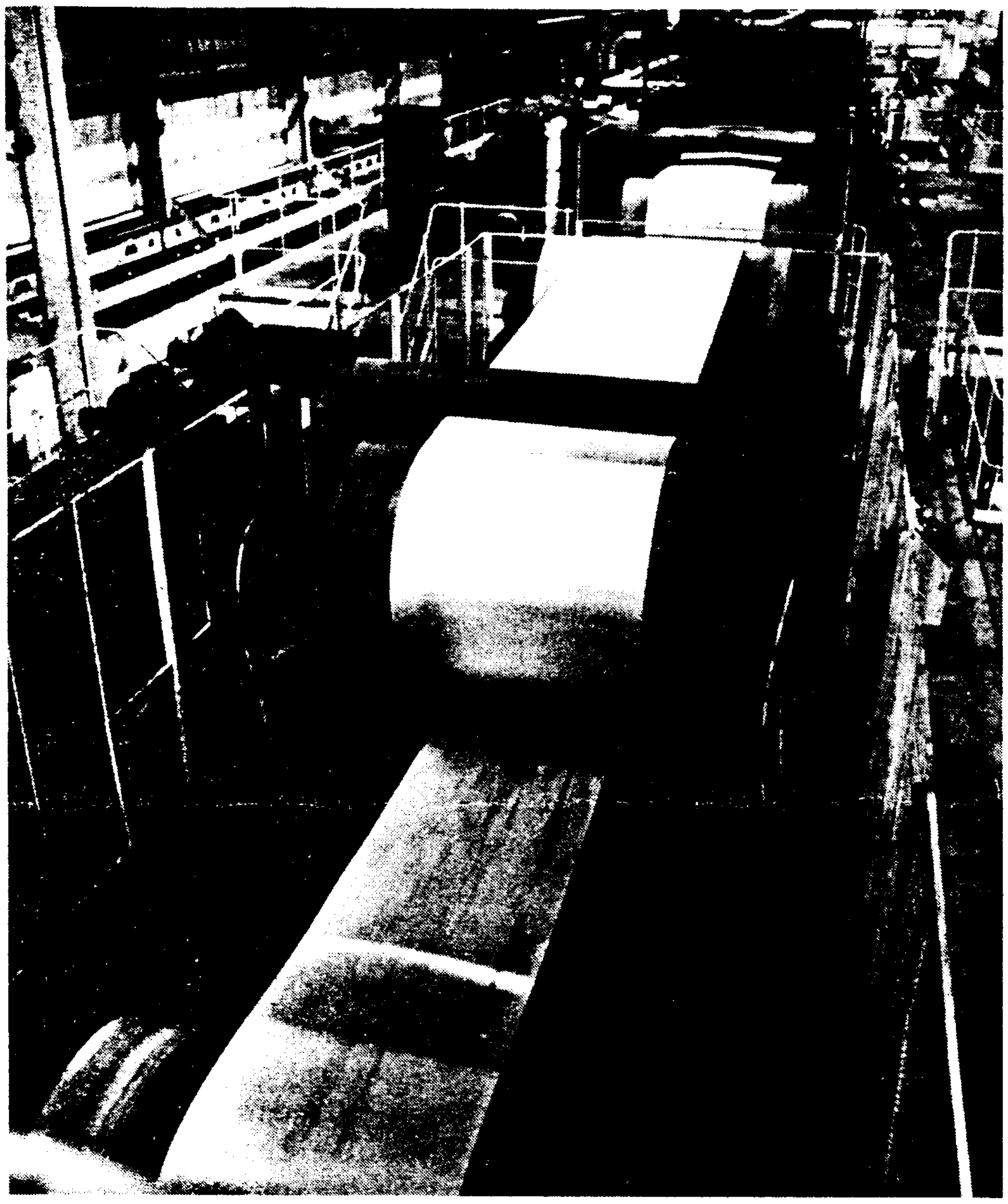
Producing stainless coil and sheet

Lackenby Works performs the hot rolling operations of the slabs produced at Tinsley Park Works. The slabs are rolled on a six-stand hot strip mill producing coils between 10 and 17 mt. Once returned to Tinsley, the coils are butt-welded to produce a 25-mt coil for processing through the Works.

The new coil build-up line has facilities for storing up to four coils on a walking beam system at the entry end to feed an expanding double stub mandrel uncoiler designed to handle coil bores between 610-mm and 763-mm dia. Entry and exit end pre-flattened tails are entered into the line after this area by a vacuum side piler which selects tails, depending on width from a number of pre-positioned pallets. A shearing and welding machine is used for preparing edges and butt welding either tail-to-coil or coil-to-coil.

A post weld heat treatment unit is provided to reduce the possibility of weld fracture on martensitic and ferritic material. The line can process material up to eight-mm thick and 1600-mm wide at speeds of up to 130 mpm.

The batch annealing area comprises three gas-fired furnaces operating on nine work bases, for the annealing of ferritic and



Softening and descaling line is designed for the intermediate and final processing of cold-rolled strip. This is one of four separate lines in place at the new BSC Stainless facility

other special quality steels. Three sets of instrumentation are provided in a central control panel.

The furnaces are designed to achieve higher production rates and lower energy consumption by substituting ceramic fiber lining above the burner level in place of the more conventional refractory brick. Annealing atmosphere gas is supplied from bulk hydrogen and nitrogen storage via an in-line mixer panel capable of precise proportioning over a wide flow range.

Four separate lines provide the facility for the initial, intermediate, and final softening and descaling of the coils. The newest addition—No. 5 softening and descaling line—is designed for the intermediate and final processing of cold-rolled strip. The line is capable of processing 25-mt coils, 1600-mm to 600-mm wide, and in gages from 0.5 mm to 3.5 mm.

The cold-rolling mills at BSC Stainless for the production of wide strips are comprised of two 1.5-m Sendzimir mills. The No. 4 (commissioned in 1977) and the No. 5 (commissioned in 1979) are the newest and part of the expansion/modernization project. The mills are designed to roll 25-mt coils in widths 1600-mm to 600-mm maximum ingoing gage 8 mm down to 0.35 mm at rolling speeds of up to 500 mpm.

The basic mill layout comprises a decoiler, feeder/leveler, and retractable carry-over table capable of feeding strip into the mill at a maximum pay-out of 184 mpm. The mill consists of a minimum crown type housing fitted with an upper and lower 1, 2, 3, 4 roll cluster arrangement. The nominal work roll dia is 85 mm.

Stressometers are fitted to the ingoing and outgoing sides of the mill to provide an indication of strip shape. The operator can then make the necessary adjustments to the crown adjustment system. X-ray gages measure strip thickness on each side of the mill. The automatic gage control equipment and fast response hydraulic system provide automatic control of the outgoing strip thickness.

A computer-based system provides automatic control of rolling according to pre-programmed rolling schedules. This feature includes facilities for automatic slowdown and stop, reversal and mill set-up at pass ends, slowdown and speed-up at strip defects and welds, engineering fault reporting, and production logging.

A skin pass mill was installed in 1975 to perform light skin pass rolling operations. The facility operates at speeds up to 300 mpm and designed to handle strip widths ranging between 560 mm to 1600 mm in thicknesses from 0.5 mm to 6.35 mm in coil weights of 25 mt.

The No. 4 coil grinding line went into operation in 1978. Designed to process 25-mt coils and used for grinding the top surface only of stainless strip, its line speed is between 5 to 30 mpm and a high strip tension of 40 mt is available at the recoiler to assure accurate stock removal across the full width of the strip.

BSC Stainless has also installed a bright annealing line. The facility is designed to bright anneal cold-rolled stainless strip with anticipated output of 12-mtph austenitic material based on a strip of 1600-mm width x 1-mm thick processing at 15.8 mpm. The entry section comprises a duplicate decoiling system, multi-spot welding machines, spray type alkali degreaser, entry looping tower, and speed/tension control bridles.

The annealing furnace is a free-standing vertical unit measuring 36 m in height and surrounded by a structure incorporating seven platforms for maintenance purposes. The furnace is a direct radiation type unit equipped with molybdenum heating elements. Total rating is 3200 kw with length of the heated section measuring 16 m. Furnace temperature ranges between 830 and 1200C.

The strip travels vertically up the ingoing leg of the furnace, passes over a steering roll, and descends vertically down the outgoing leg (the heating and cooling takes place in the outgoing leg). After the strip leaves the heating section, it enters a cooling chamber where it is cooled to below 100C.

The heating elements are arranged in four zones with individual temperature control and indication and over-temperature protection. Cooling is achieved by 16 pairs of jet plates shaped to promote symmetrical cooling across the strip width on both sides. Each jet plate applies cooled cracked ammonia gas to the strip at high velocity rates. While atmosphere purity is important to the process, BSC Stainless officials explain that furnace entry and exit ends are sealed with felt pressure pads. To prevent the entry of air, cracked ammonia gas is replenished at a rate controlled from the furnace pressure sensor. Hydrogen and oxygen levels and atmosphere dewpoint are continually monitored by analytical instruments. The furnace is closed and purged with nitrogen automatically if a predetermined oxygen level is exceeded. The installation of the bright annealer makes it possible for BSC Stainless to provide the market with 1525-mm wide bright annealed material.

As Hall noted, the project is manned to Japanese standards and incorporates the "best world practice—nothing innovative—only the best available technology." **33**