SGJT leads the way for the future of thin slab casting & rolling. 
Danieli, in consortium with the Japanese electrical company TMEIC, will supply an innovative Danieli Universal Endless (DUE®) plant to Shougang Jingtang United Iron & Steel Co. Ltd. - SGJT, P.R. China, to produce 2,100,000 tpy of high value-added products, for the new facility in Caofeidian. 
For the first time ever, coil-to-coil and endless, thermo-mechanical and multi-phase, ultra-thin and thick products are now all possible in a single production line, making both niche products with high value-added and the mass production commodities segment within reach of this new plant concept. 
With its characteristics of low consumption, low emissions and high efficiency, the DUE® perfectly fits to the “new normal” vision that establishes the guidelines for industrial development in the People’s Republic of China, which includes the steelmaking sector. 
After several years of successful co-operation, SGJT once again confirmed its trust in and satisfaction with the “product” supplied by Danieli, placing another order to the Group for a Danieli Universal Endless (DUE®) plant, to be installed in Caofeidian Industrial Area, Tangshan City, Hebei Province, P.R. China. 

**Keywords:** Danieli Universal Endless, DUE®, Vertical-curved Caster, Tunnel Furnace, Mill, Induction Heating, Coil-to-Coil, Endless, SGJT

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INTRODUCTION

Over the past 25 years the thin slab casting and rolling process has been gaining a greater share of the global market in the production of hot rolled strip, mainly thanks to the competitiveness of the process over conventional routes, and to the growing ability of this technology to cover the majority of all market requirements, not only the commodity sector.

Over these years, Danieli has progressively developed, together with its customers, a new generation of thin slab casting and rolling layout, marking a new phase in the evolution of this process.

Danieli, in consortium with the Japanese electrical company TMEIC, will supply to Shougang Jingtang United Iron & Steel Co. Ltd. (SGJT), P.R. China, an innovative Danieli Universal Endless (DUE®) plant, single strand caster based, to produce 2,100,000 tpy of high value-added products.

DISCUSSION

For the first time ever, coil-to-coil and endless, thermo-mechanical and multi-phase, ultra-thin and thick products are now all possible in a single production line, making
both niche products with high value-added and the mass production commodities segment within reach of this new plant concept.

The layout configuration and the optimized, effective combination of different energy sources make the DUE® a truly “green” plant, while also significantly reducing the OpEx compared to the current thin slab-based benchmark plants. With its characteristics of low consumption, low emissions and high efficiency, the DUE® perfectly fits to the “new normal” vision that establishes the guidelines for industrial development in the People’s Republic of China, which includes the steelmaking sector.

![Fig.2 Danieli Universal Endless (DUE®) configuration](image)

After several years of successful co-operation, SGJT once again confirmed its trust in and satisfaction with the “product” supplied by Danieli, placing another order to the Group for a Danieli Universal Endless (DUE®) plant, for the new facility in Caofeidian Industrial Area, Tangshan City, Hebei Province, P.R. China.

The new DUE® plant features an innovative layout configuration (Danieli patented technology – US patent n. 8087449, January 3rd, 2012), which Danieli has developed in a continuous effort to improve existing processes and technologies and overcome their current limitations.
What makes the DUE® different is the ability of “universal” rolling modes thanks to the fact that, now, within one single plant it is possible to perform endless and coil-to-coil rolling modes, making this “dual use” process a major technology innovation compared to the previous generation.

In fact, this new concept in thin slab casting and rolling plant is able to unify in a single production line all the winning features that up to now have been achieved using either endless or coil-to-coil rolling modes in separate production lines, while eliminating the limiting factors of each one of them.

Hence, this new plant will be the first thin slab casting and rolling plant in the world able to reach all the production niches of the flat products market, by applying the process that is best suited to each steel grade and product:

> Coil-to-Coil rolling mode, where caster and mill operate independently with different mass flow and the slab is cut to length by the pendulum shear at the caster exit (one slab for each coil).

> Endless rolling mode, where caster and mill operate with the same mass flow in order to ensure an uninterrupted process and the coils are generated by the high-speed shear before the downcoiler.
Shougang Jingtang’s DUE® plant will be designed for the production of 2,100,000 tpy of high value-added hot rolled coils, for a wide steel grades mix and strip dimensions from 0.80 to 12.7 mm thick and in width from 900 to 1,600 mm.

Fig.4 Danieli Universal Endless (DUE®) configuration

The DUE® unique vertical-curved caster features a 5.5 m main radius, over a containment length of approx. 26 m, designed to operate with a single slab thickness of 110 mm after dynamic soft reduction (130 mm at mould exit), with a casting speed in excess of 6 m/min, depending on the steel grade. Such an unprecedented combination of slab thickness and speed makes it possible to easily reach the mass flow conditions required by the full endless production mode, necessary for effective production of ultra-thin gauge.

Danieli, since the beginning of the nineties, has been the first company to develop and then utilize in an industrial way the dynamic soft reduction as basic tool in all its thin slab casters, in conjunction with the vertical curved design, which provides the best control of internal and surface slab quality in any casting conditions. Additionally, the ability to provide the mill with a thicker slab, compared to the traditional thin slab approach, is reflected into a remarkable increment in the reduction ratio from slab to strip, which in turn allows the production of a wider product mix, which includes steel grades such as low, medium and high carbon, high strength low alloyed, peritectic, silicon, pipeline, AHSS and more.

This caster is the logical development of Danieli’s already consolidated vertical curved design, taking full advantage of the operational experience acquired over
more than 25 years, as well as the considerable experience gained in high-speed casting.

The tunnel furnace, developed in-house by Danieli Centro Combustion, provides a fundamental buffer function that increases plant flexibility. Thanks to the tunnel furnace, the mill’s work rolls change can be performed as a background task, without affecting the operation of caster and meltpshop. Additionally, it allows to easily switch from endless to coil-to-coil operating mode and vice versa. It ensures the slabs temperature uniformity along thickness/width/length at mill entry side and, particularly important for an effective endless rolling mode, it guarantees a constant and homogenized slab temperature at furnace exit, regardless the casting speed. The overall length is limited to approx. 80 m (first to last roll), including a shuttle furnace for slab or bar rejection from the rolling line in case of emergency. Notwithstanding the reduced length, it allows the production of full coil weight in coil-to-coil mode, ensuring at the same time uniform temperature distribution along the slab width and length. Hence, the DUE® line is very compact compared to traditional thin slab rolling plants, resulting in an overall footprint of approx. 290 m x 90 m from TSC turret centerline to second downcoiler axis.

The DUE® mill features the well-known and already successfully proven configuration with separation of the mill stands into high reduction units and finishing units, in order to perform the dual step rolling.

Fig.5 The DUE® mill transfer bar area
The transfer bar area includes:

> A crop shear, used to cut the transfer bar head and/or tail end, particularly for coil-to-coil rolling mode, in order to have smoother threading into the finishing mill as well as reducing tail chew-up. It also provides the bar chopping function, in case an emergency occurs.

> A dedicated high-pressure descaling unit at finishing mill entry (in addition to the one at high reduction stand entry), to eliminate imprinting scale phenomena on the final strip, thus significantly improving the relevant surface quality.

> An intensive cooling system, incorporated into the descaler box at finishing mill entry, used for thermo-mechanical rolling (TMR) when producing Advanced High Strength Steel (AHSS) and API grades in order to guarantee the correct bar temperature profile and proper control of grain growth that are essential features of the true TMR process.

> An induction heating system, designed and manufactured in-house by Danieli Automation, for consistent production of thin and ultra-thin gauges in endless mode, in which the modules can be individually retracted off-line when not in use (i.e. during coil-to-coil production mode) or for maintenance purposes.

> The mill stands, designed to guarantee superb geometrical and mechanical properties of the final product, are equipped with all the state-of-the-art features for utmost strip crown and profile control, bearing in mind that these control functions also have to be operational under-load conditions as required by the endless rolling process.

The mill area is followed by the laminar cooling system, consisting in a combination of power and normal units for cooling strategy optimization in accordance to the selected process mode, which in turns allows the production of a huge variety of grades, including but not limited to Dual Phase (DP) and Advanced High Strength Steel (AHSS) grades.

At the same time, the use of a powered cooling system allows further grain refinement and transformation hardening on thermo-mechanical rolled products, with cost saving on alloy additions and increasing the strength of the produced coils.

The line is completed by the coiling area, already fully tested and presently in operation in a pure endless rolling line in Italy, made up of a high-speed shear to cut-to-length the coil when working in endless mode, pinch rolls and downcoilers.
Danieli Automation will develop and supply the induction heating system, along with the automation of the caster and tunnel furnace area, while TMEIC will be in charge for the rolling mill automation together with on-line instrumentation and MV/LV drives for the whole DUE® line.

Danieli Automation, will also supply several automation packages such as Danieli Maintenance Management System (DMMS), Condition Monitoring System (CMS) and process and quality management and reports (Q3-Intelligent), all part of DIGI&MET platform for “Danieli Intelligent System” solution, which will coordinate the production quality control along the whole production chain, from liquid steel down to finished product.

The DIGI&MET platform will allow to SGJT group a further step ahead in big-data collection, for the use of the new DUE® line itself as well as integrated with all other plant expansion projects.

CONCLUSIONS

Thanks to decades of research and development, comprehensive engineering and to its own state-of-the-art workshops, Danieli is in a position to offer a complete package of exceptional quality to ensure optimal process performance and cutting-edge equipment.

This new approach can be seen as the natural evolution of the original Danieli concepts that marked the progress of the thin slab route, namely the application of the vertical curved design thin slab caster and the dual step rolling, which have become a source of inspiration for most of the recent innovations in the industry, confirming the advantages of Danieli’s original ideas.

The DUE® layout configuration, together with an effective and optimized energy consumption, represent today the most extensive application of Danieli’s concept of flexibility.

With this project, which will represent a benchmark in the steel industry, Danieli proves once again that it is a worldwide leader in advanced thin slab casting and rolling equipment.