



20 years of CSP®

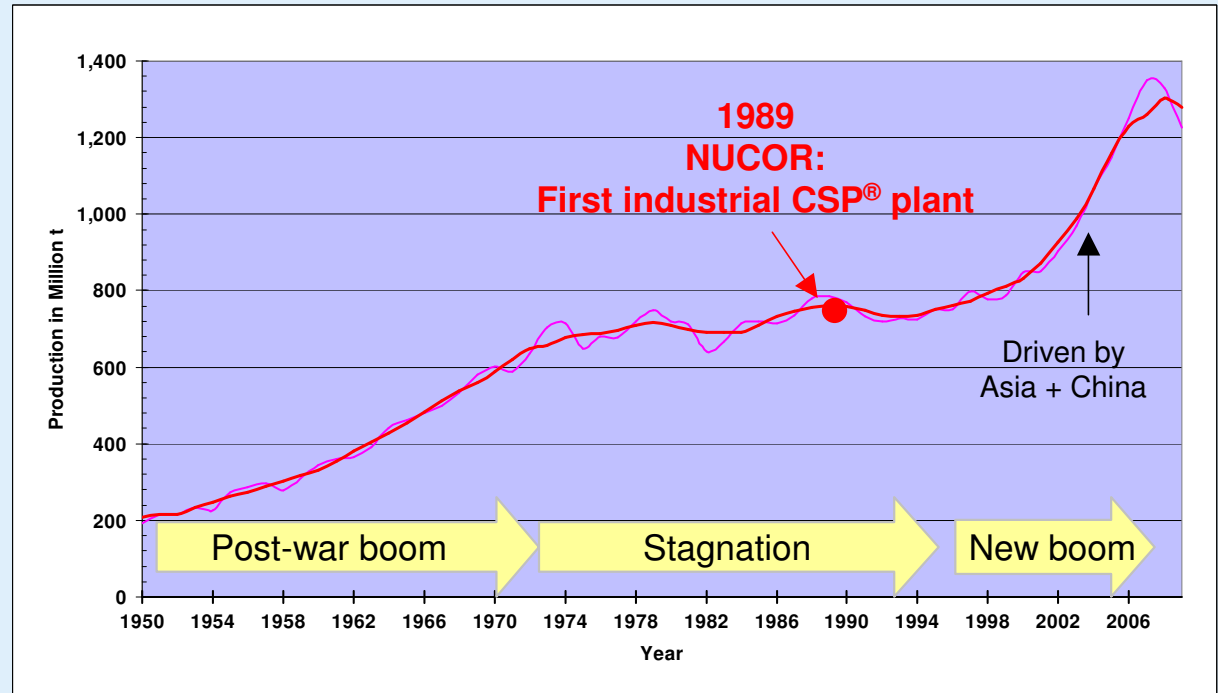
The success story of an outstanding technology

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SMS Siemag AG, Germany

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Situation of the steel industry in the mid-eighties

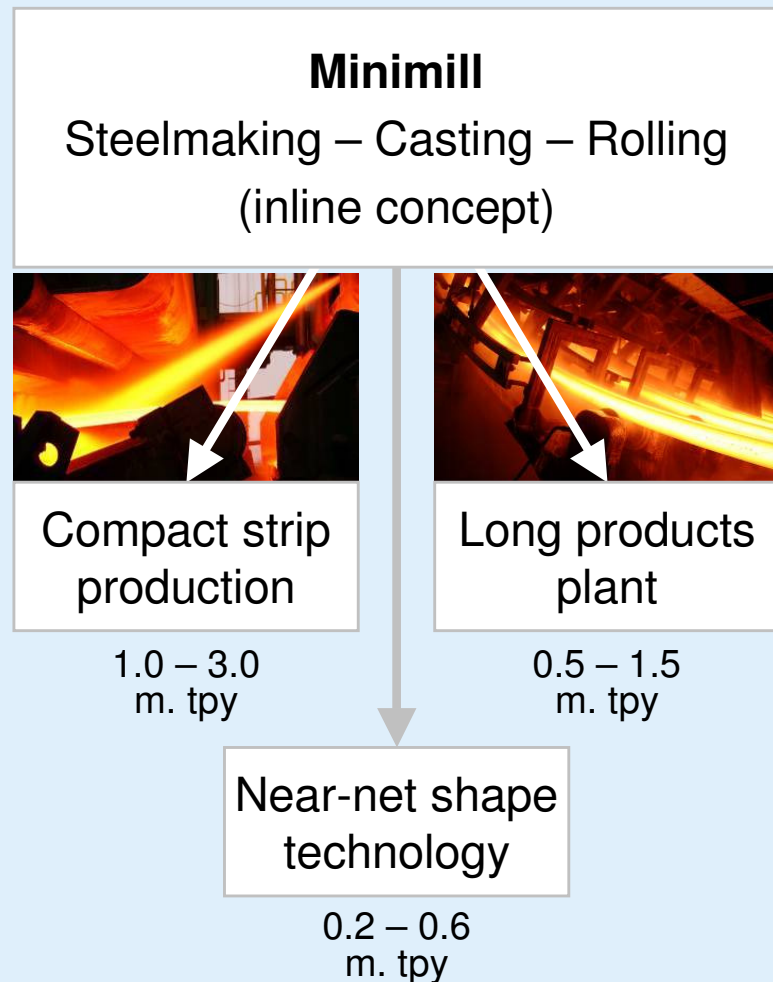
World steel production 1950 – 2009



- Worldwide stagnation of steel consumption, reduction of production capacities in Europe and America
- No investment in new hot flat rolling facilities
- Mini-mill concept using electric steel making already established for long products

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Definition of 'minimill'



- Compact design
- Small plant footprint
- Economics of local sourcing of scrap
- Local product supply
- Strong in regional markets



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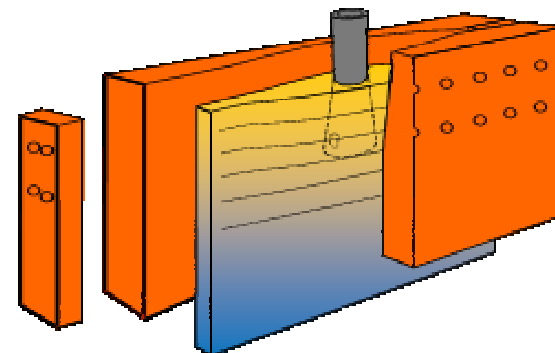
Introduction of CSP®: Market demands meet technology

Market demands



- Tailor made and economical production plants
- Minimized investment and operation costs

Technology



- Heart of the CSP® technology
- Patented funnel-shaped mold

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The success story of Nucor Steel, USA

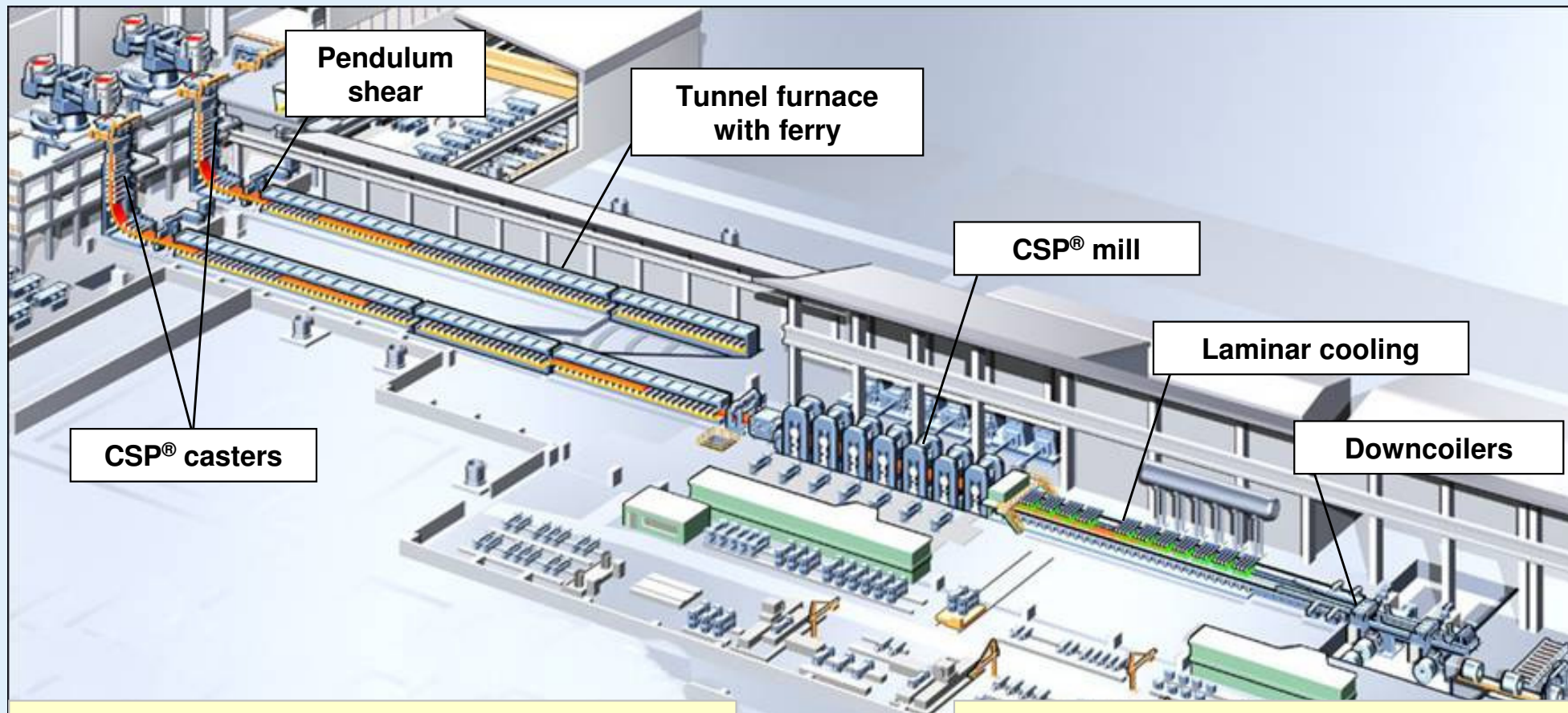
NUCOR: minimill pioneers in long and flat products

- 1966: Entering the steelmaking business
- 1969: First minimill for long products (Darlington works)
- 1989: First minimill for flat products (Crawfordsville works) by commissioning the world first thin slab CSP plant
- Today: Largest steelmaker and most profitable steelmaker in the United States (20.4 m. tons in 2008)



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CSP® plant concept

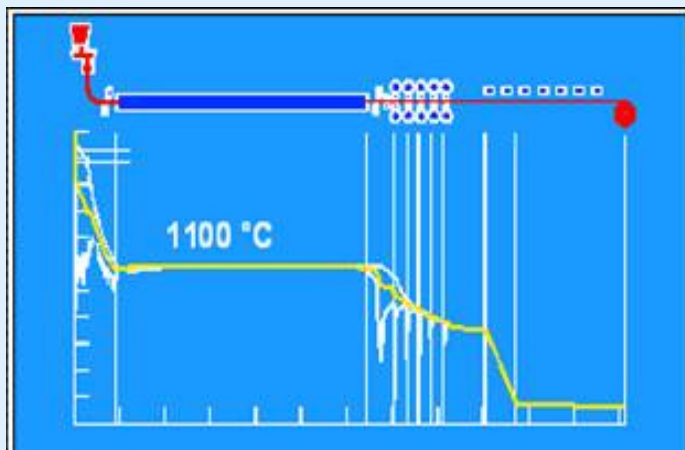


Thin slab thickness: 50 - 90 mm
Strip thickness: 0.8 - ca. 16 mm
Strip width: 800 - 1,880 mm

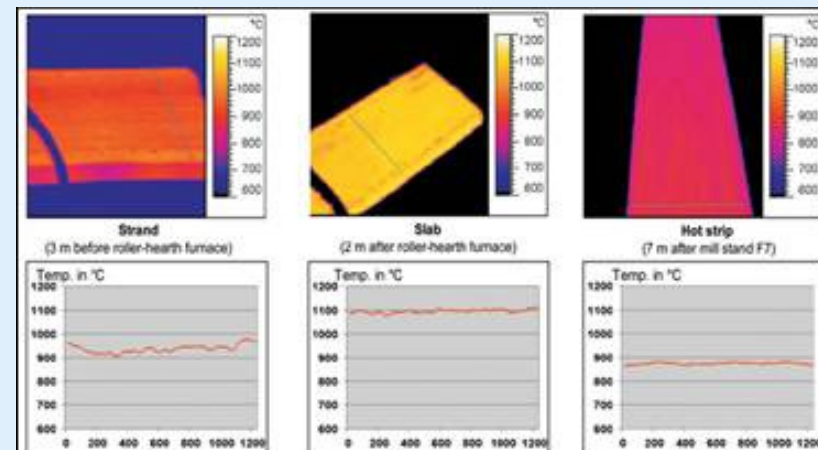
1-strand: up to 1.5 m. tpy
2-strand: up to 3.0 m. tpy
3-strand: up to 4.0 m. tpy

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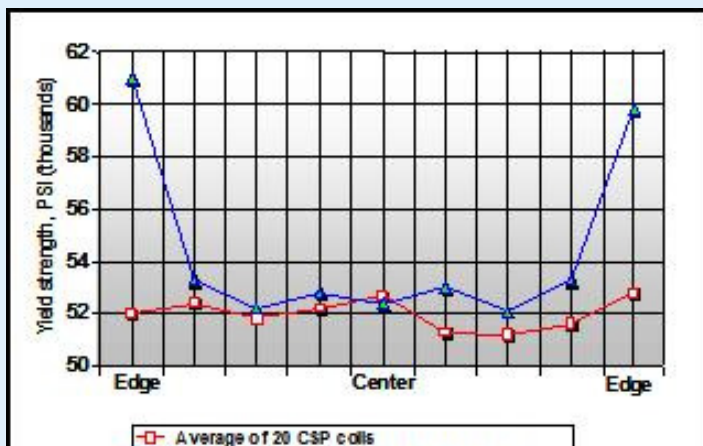
Advantages of CSP®



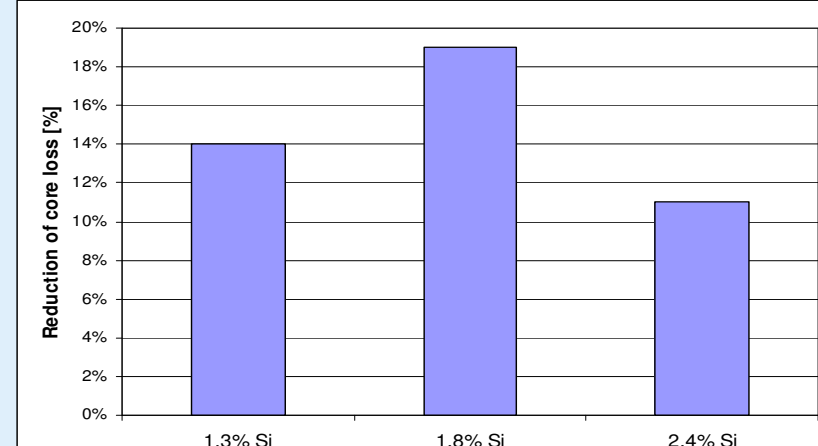
Reduced conversion costs



Constant process conditions



Excellent mechanical properties

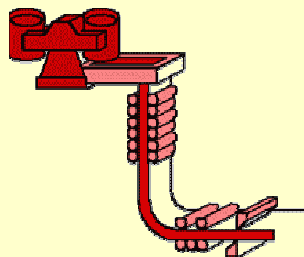


Excellent metallurgical properties

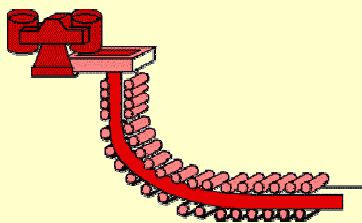
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Flexibility of CSP® process

Casting concepts



Vertical bending caster

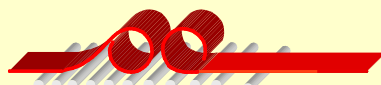


Bow type caster

Connecting concepts of casting and rolling



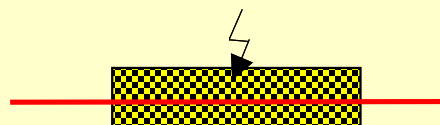
Tunnel furnace



Coilbox

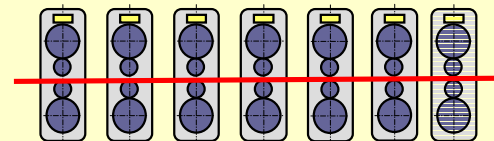


Heat panels

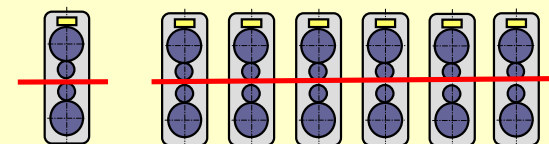


Inductive heating

Rolling mill concepts

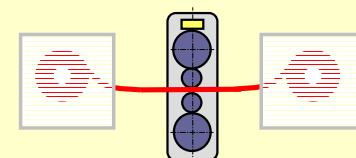


FM



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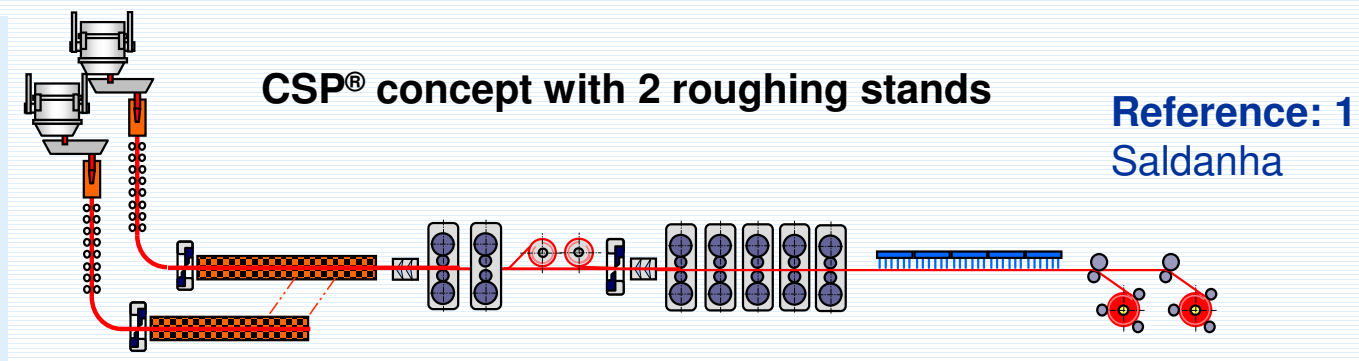
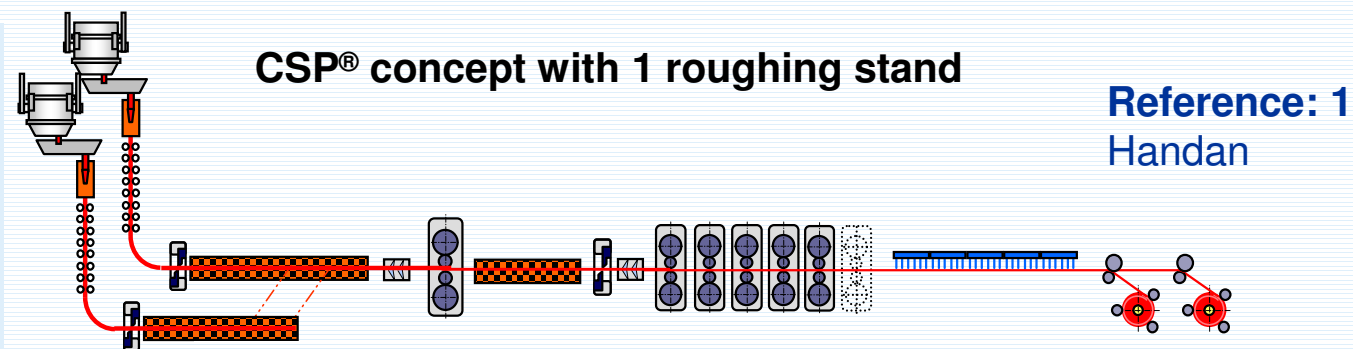
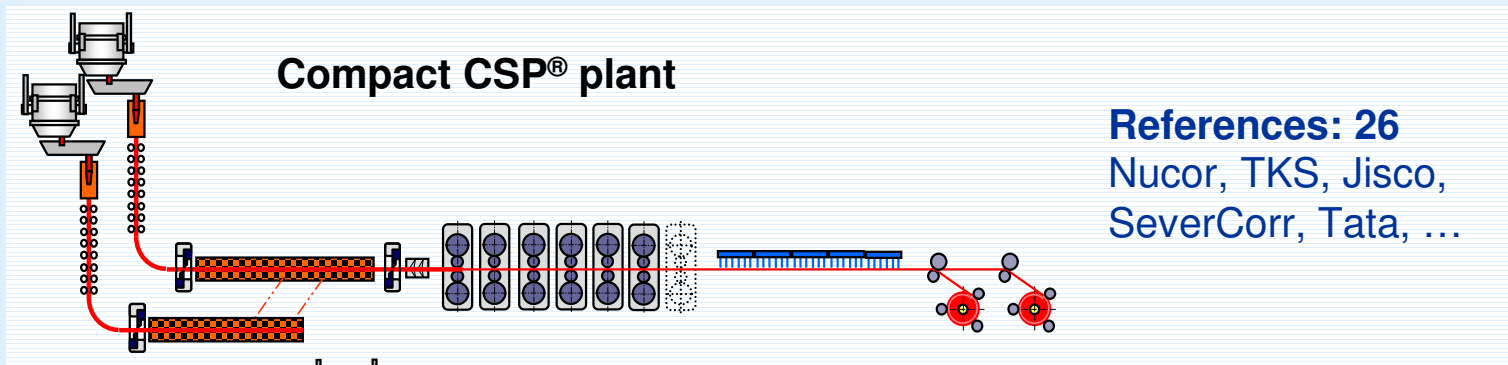
FM



Steckel Mill

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Realized concepts



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References since 1989



Remark:

- 1) Plant converted into Thick Slab Plant
- 2) Thin slab caster SMS, Rolling Mill MHI

1	Nucor Crawfordsville	USA	11	Nucor Berkeley	USA	21	MaSteel	China
2	Nucor Hickman	USA	12	GJS (NSM)	Thailand	22	LYSteel	China
3	AST/TKAST ¹⁾	Italy	13	Megasteel	Malaysia	23	JISCO	China
4	Ternium Hylsa (Hylsa)	Mexico	14	Saldanha	South Africa	24	Bushan	India
5	Hyundai (Hanbo)	Korea	15	Zhujiang	China	25	SeverStal	USA
6	Gallatin	USA	16	Handan	China	26	WISCO	China
7	SDI	USA	17	Baotou	China	27	Essar	India
8	ISPAT Industries	India	18	TKS	Germany	28	Tata Steel	India
9	AM Sestao (ACB)	Spain	19	EZDK (ANS DK)	Egypt			
10	AM Riverdale (ACME)	USA	20	Corus ²⁾	Netherlands			

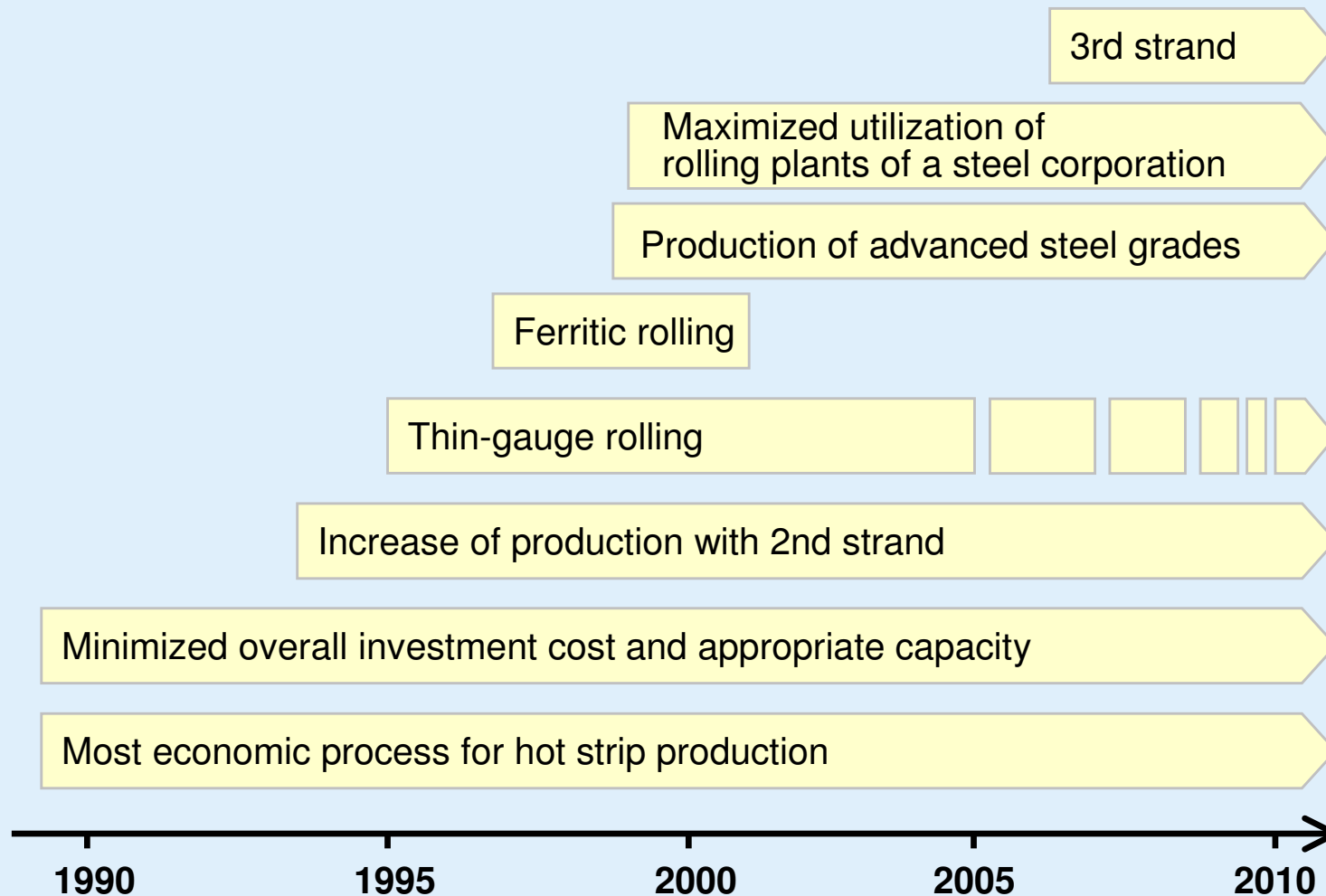
28 Plants in total
49 Casting lines

26 Plants in operation
169 Mill stands

2 Plants still to start up
54 Mio TPY rated capacity

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Changing market and adjusted customer demands on CSP® since 1989



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Customer demands on CSP® since 1989

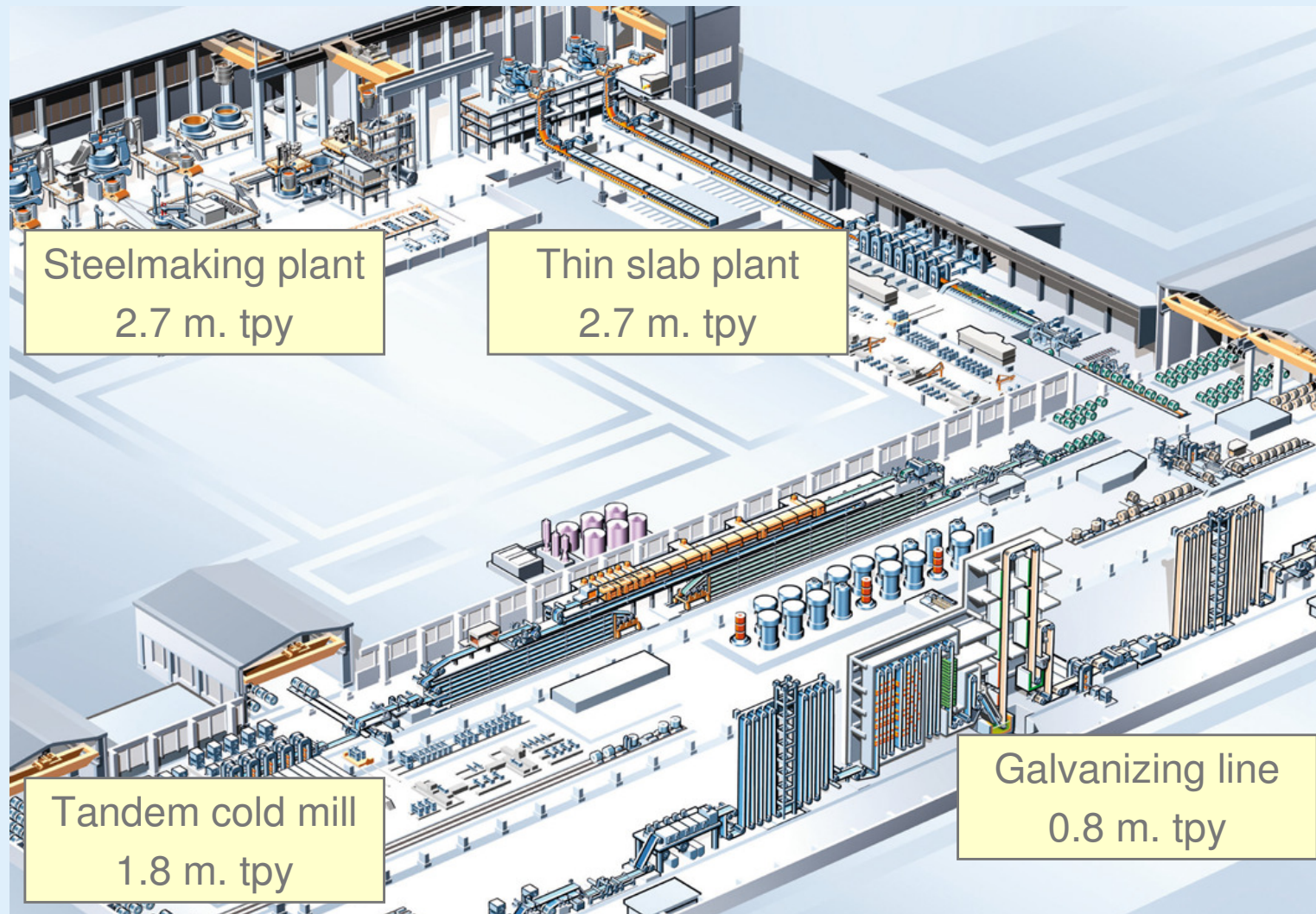


CSP® plant Nucor Crawfordsville 1989

Casters	1
Finishing stands	4
Downcoilers	1
Strip thickness	2.5 - 12.7 mm
Production	990,000 tn sh/year

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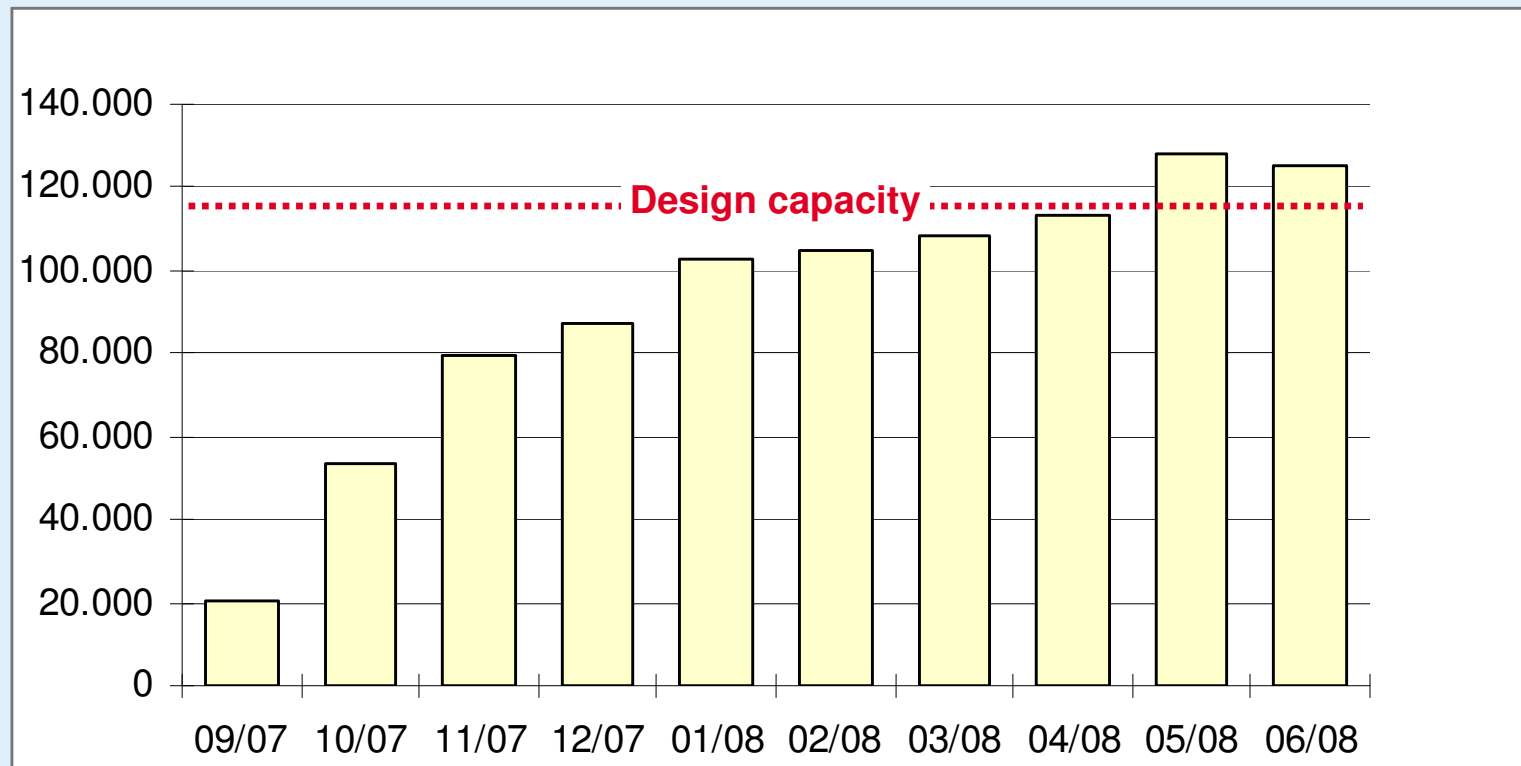
Severstal North America – Minimill close to customer market



- Greenfield-supply from a single source
- Complete electrics and automation system
- Two phases

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Severstal North America – Ramp-up curve



- Minimills today: Proven concepts and technology by complete mechatronical solutions and overall project responsibility
- Quick entry into the market and cash flow generation
- Reliability for minimill operators

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Thin-gauge rolling: Substitution of cold rolled strip with thin hot strip

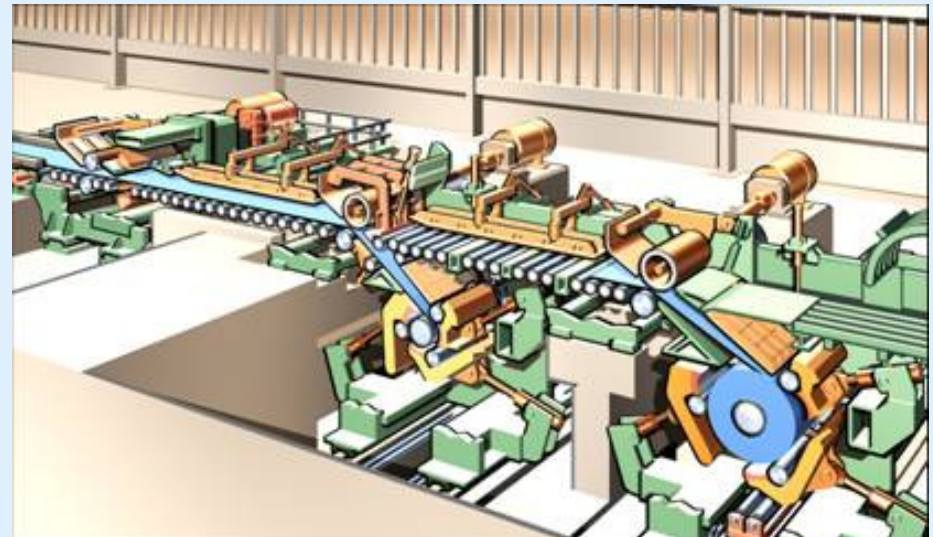
Batch rolling

- Utilization of capability of CSP® mill by using new automation system
- Hylsa: min. thickness 0.91 mm (1996)
- ANSDK: 1.0 mm six months after start-up (2000)



Semi-endless rolling:

- Extension of mill area by flying shear and modification of downcoiler
- Masteel: min. thickness: 0.9 mm (2004)
- Lysteel: min. thickness 0.78 mm (2004)

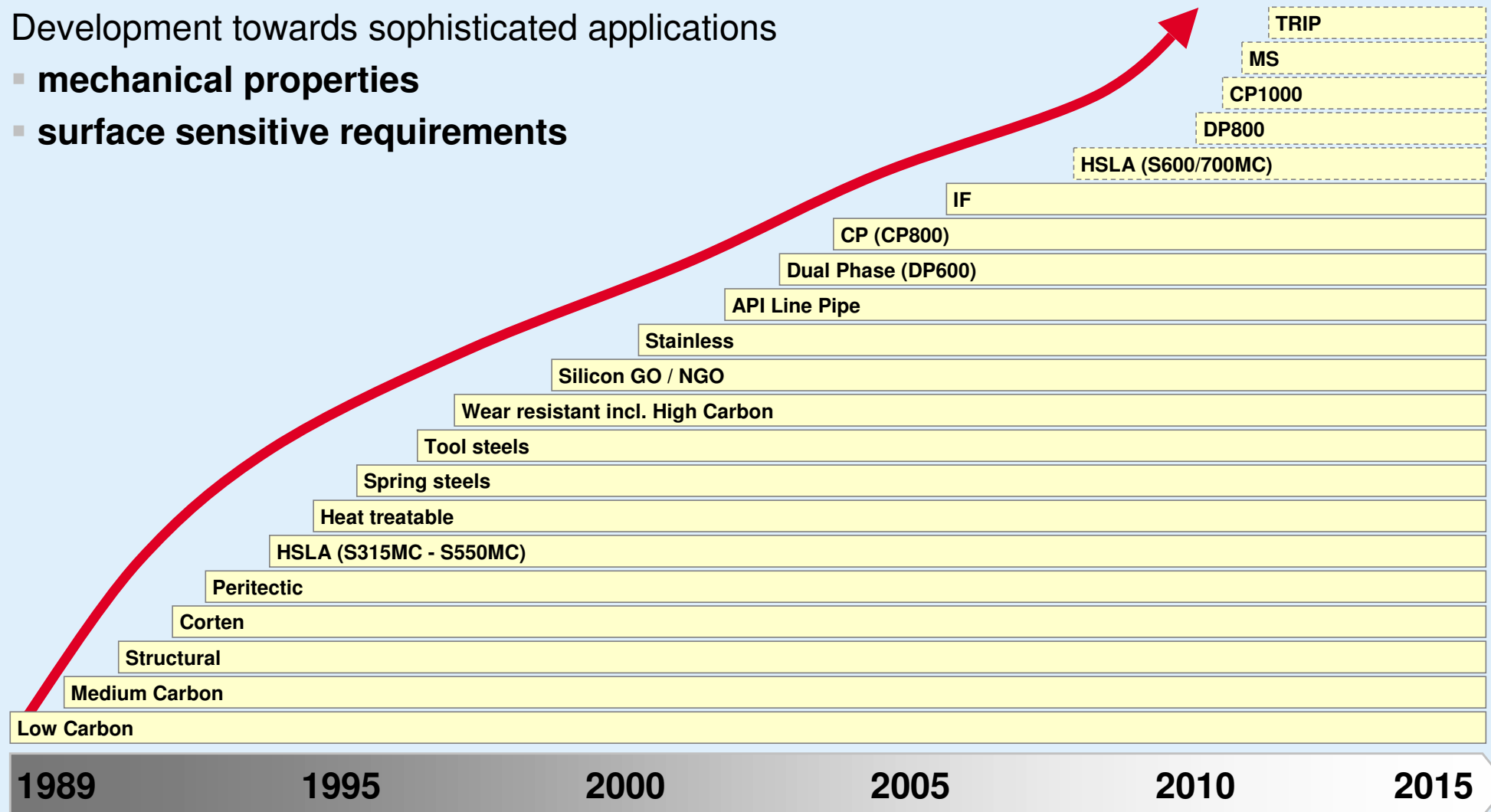


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Production of advanced steel grades

Development towards sophisticated applications

- **mechanical properties**
- **surface sensitive requirements**

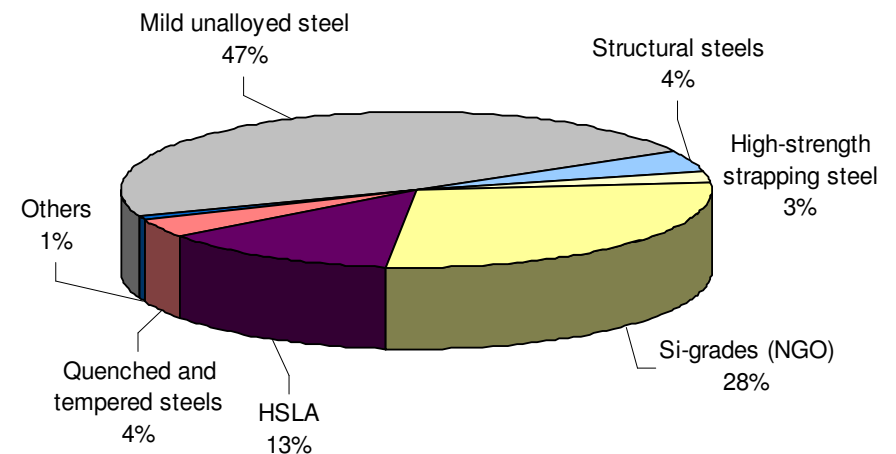


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Production of advanced steel grades (Si-grades, Dual- and Multiphase steel)

- Use of all process advantages of CSP®
- Maximization of production of rolling plants of a steel corporation (combination of conventional HSM and CSP®)

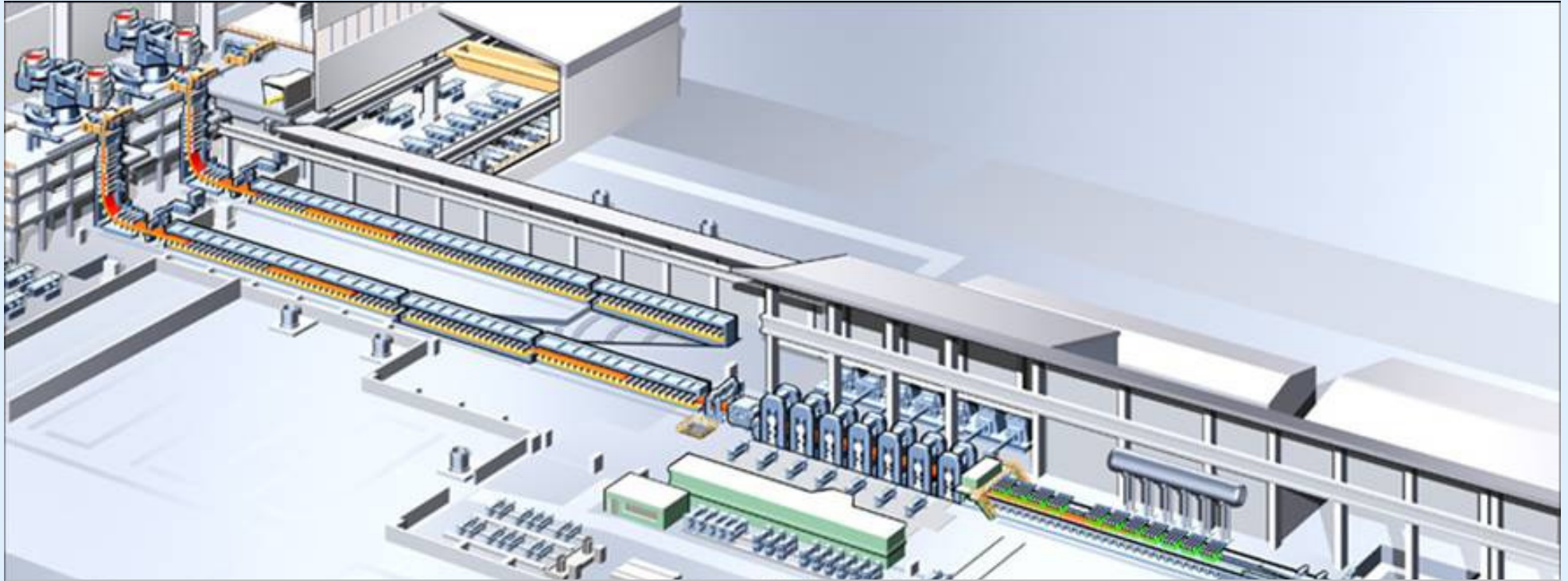
References: ArcelorMittal, ThyssenKrupp Steel, Wisco, Tata Steel



Product mix TKS CSP® plant, 2005/2006 Source: TKS

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Example: Wisco, China (Start-up 2009 / 2.5 m. tpa)



Technical main data

Heat size / TTT time	150 tons / 36 min BOF	RHF length	261 m
Slab thickness	52 – 90 mm	Final thickness	0.8 – 12.7 mm
Slab width	900 – 1,600 mm	Rolling speed	23 m/s
Containment length	10.3 m	Main drive power mill	64.2 MW

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Example: Wisco, China – Product mix (scheduled)

No.	Group	Grade	Share
1	Silicon grades	50W310 – 50W1300	37%
2	High quality carbon steel	08, 08 Al, 10 – 45	23%
3	Carbon & structural	Q195, Q215, Q235	14%
4	Container steel	SPAH, 09 Cu P Ti Re	12%
5	Automotive body	DP, Trip	5%
6	HSLA	Q345 – Q460	5%
7	Pipe steel	API X42 – API X70	2%
8	Low & ultra low carbon	LC, ELC, ULC	2%

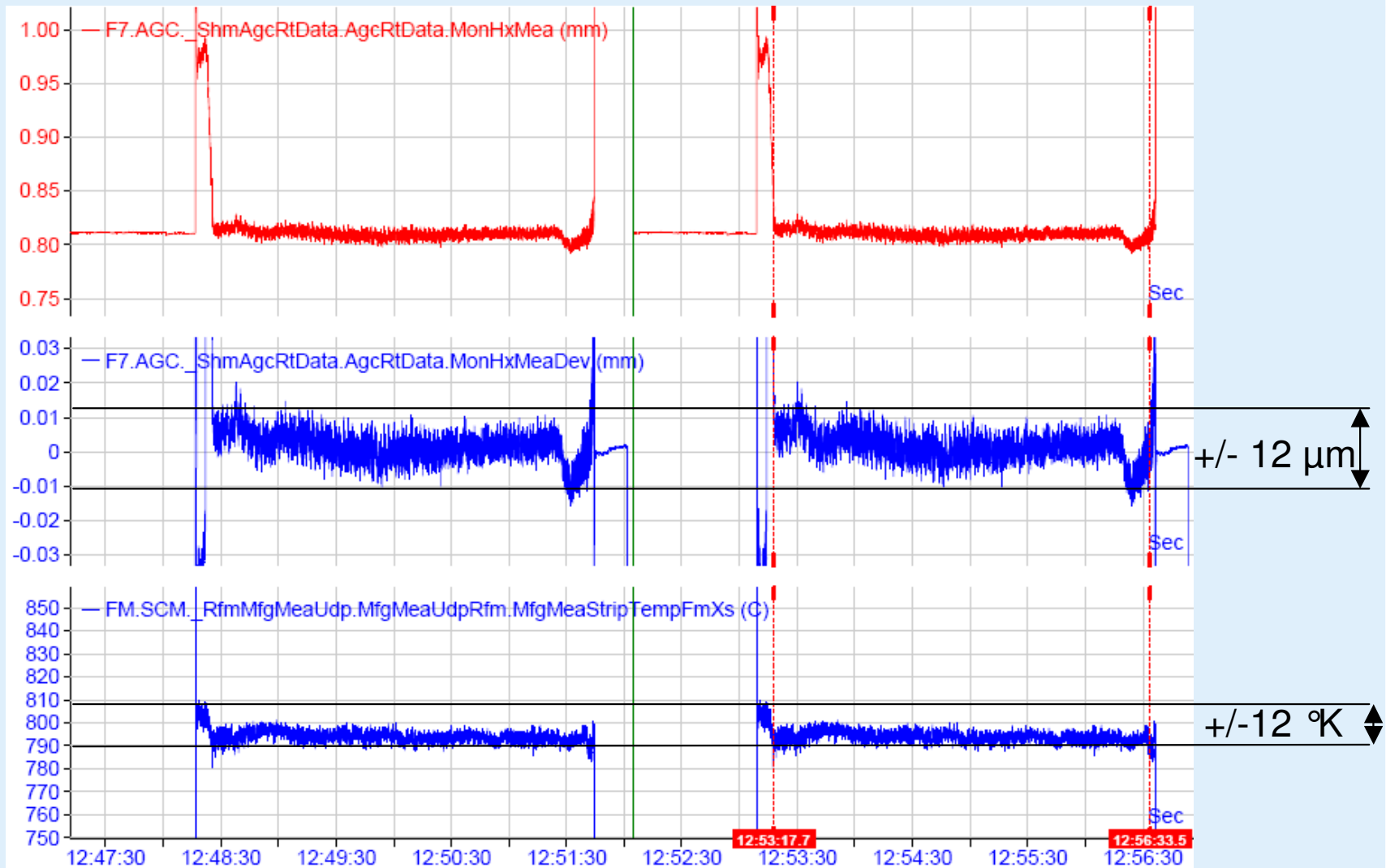
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Example: Wisco, China – Final strip thickness 0.80 mm (08. September 2009)

Thickness

Deviation
of thickness

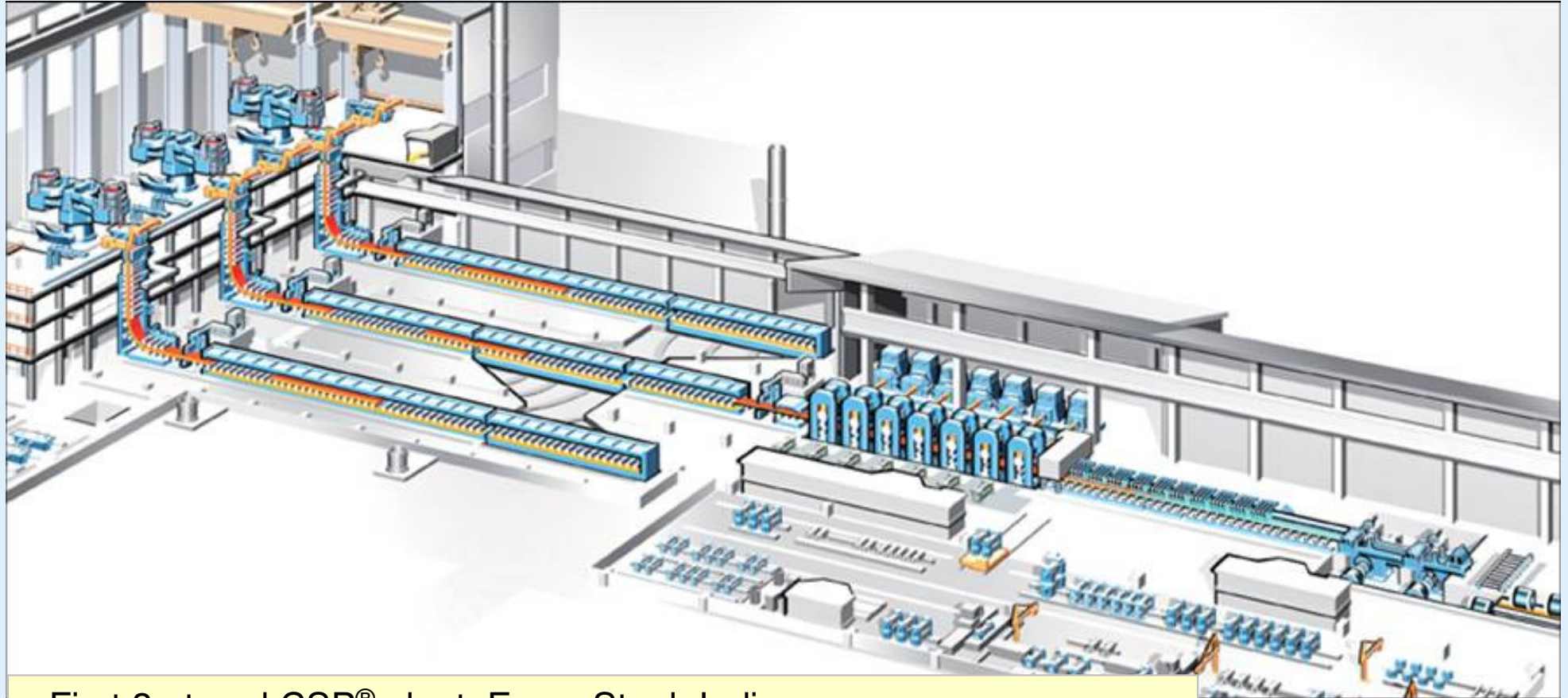
Temperature



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Customer demands on CSP® since 1989

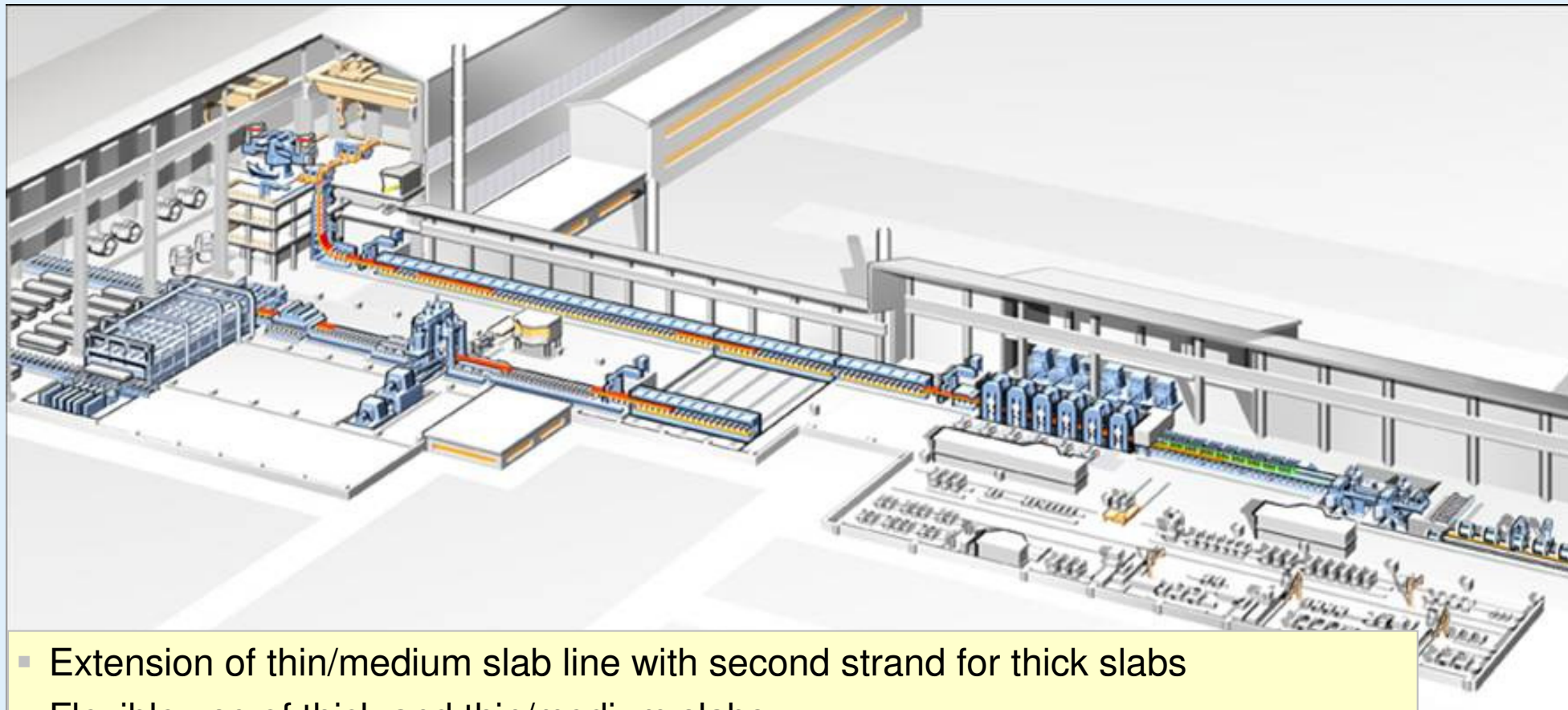
3-strand CSP® plant



- First 3-strand CSP® plant: Essar Steel, India
- Capacity: up to approx. 3.5 million tpy
- Commissioning: 2nd quarter 2011 (strand 1 and 2), end 2011 (strand 3)

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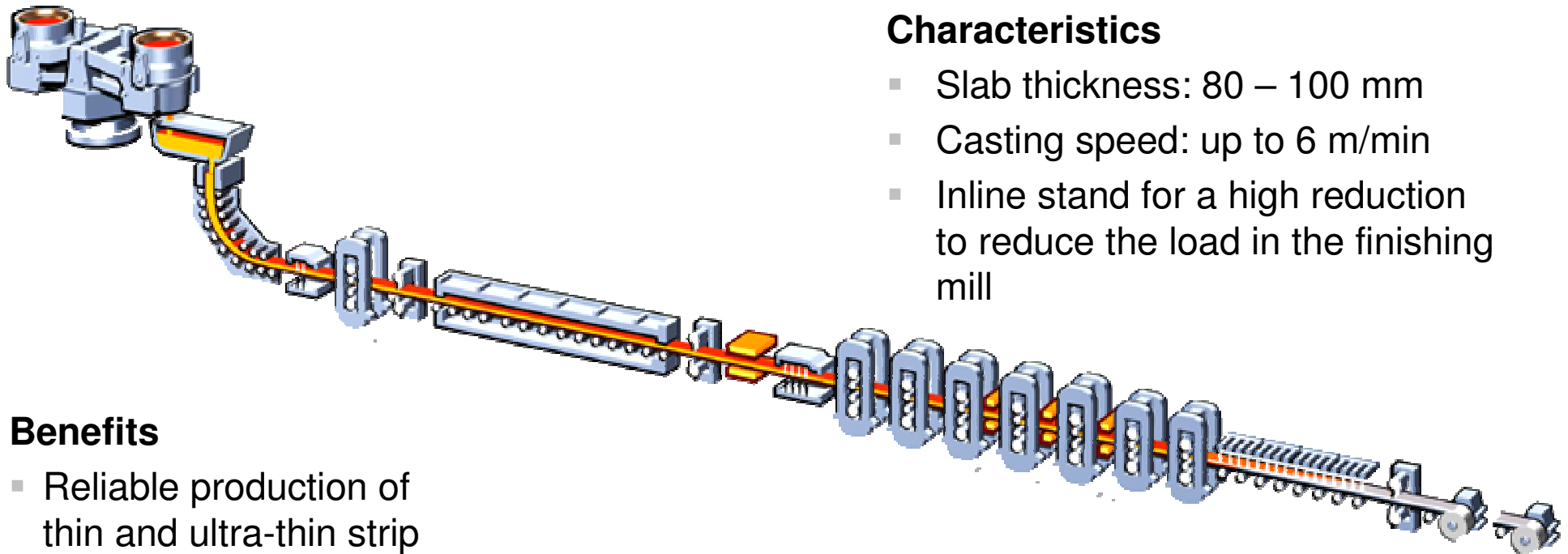
Alternative concepts – CSP® line connected with parallel thick slab line



- Extension of thin/medium slab line with second strand for thick slabs
- Flexible use of thick and thin/medium slabs
- Extension of product spectrum (e.g. heavy gauge pipe grades, stainless steel)
- Reference: G Steel, Thailand

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Alternative concepts – CSP® endless



Characteristics

- Slab thickness: 80 – 100 mm
- Casting speed: up to 6 m/min
- Inline stand for a high reduction to reduce the load in the finishing mill

Benefits

- Reliable production of thin and ultra-thin strip
- Homogeneity of metallurgical and mechanical properties
- Batch operation mode possible
- Compact layout with economic equipment
- Low investment and operation costs

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Summary

- 1989: First CSP® plant built at NUCOR, showing the expected advantages
- During the last 20 years, CSP concept in its basic configuration met changing demands of the market
- CSP has the right answers for the future of the steel industry
 - High economic efficiency
 - Saving of resources
 - High flexibility with respect to product spectrum
 - Possibility for a quick reaction to the market

Outlook

- Further optimization of CSP® technology
 - Improvement of strip surface
 - Increasing of productivity (higher casting speed, 3-strand solutions)
 - Extension of product spectrum

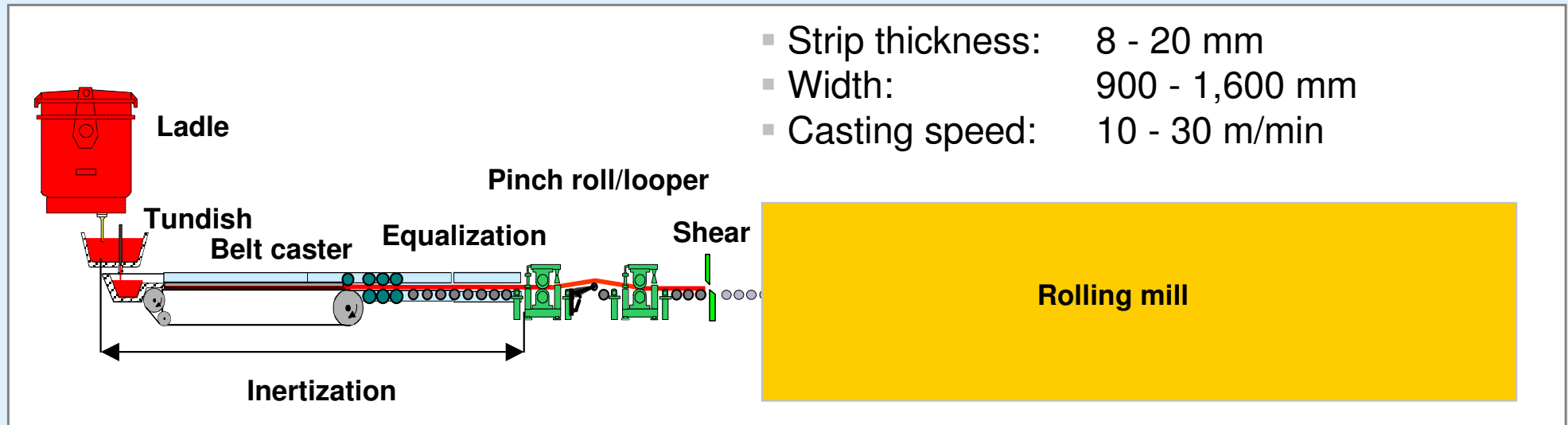


MEETING your **EXPECTATIONS**



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Outlook: New casting technology for production of highly-alloyed steel grades



Technical benefits

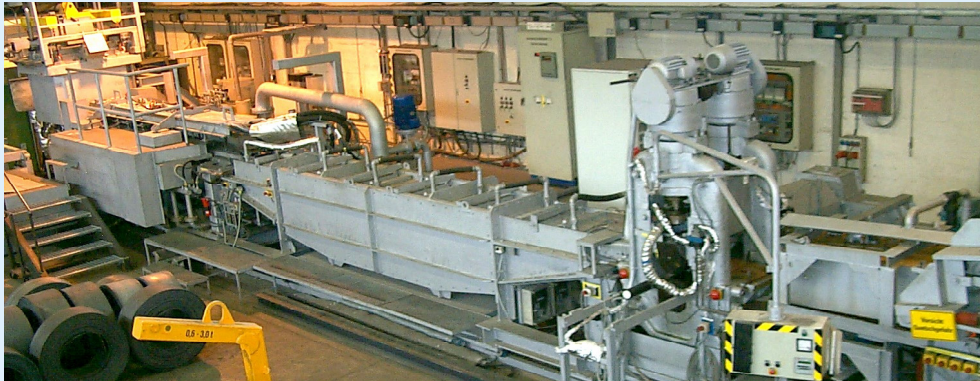
- Fast solidification
- No mould powder required
- No bending and straightening of cast strip
- Suitable ratio of thickness reduction by rolling

Economical benefits

- Compact plant layout, low investment costs
- High flexibility in production rate and amount
- Easy to integrate in the different steel making routes

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Outlook: A new micro-mill concept?



...2050

