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BSIET is an international engineering company, established through reorganization of Beijing Shougang Design Institute, which is invested by Shougang Group who takes relative majority of the share.

BSIET has the Engineering Design Integrated Qualification Class A issued by the State, it is the first unit of Beijing municipal enterprises that awarded this Qualification and is able to undertake engineering design for all industries and all grades. Meanwhile, it can provide technical services such as planning consultation, equipment integration and general contracting. BSIET owns unique technology and rich practical experience in overall design of iron and steel plants, individual design for iron making, steel making, steel rolling, sintering, pelletizing, coking, industrial furnace and integration of metallurgical equipment.

BSIET has served more than 70 iron and steel enterprises in China, and has its achievements in more than 20 countries such as India, Malaysia, Brazil, Viet Nam, Bangladesh, the Philippines, Zimbabwe, Angola, Peru and Saudi Arabia, etc.

BSIET is Hi-tech Enterprise of Beijing City, and has been awarded with 30-odd national science & technology prizes and national excellent design prizes, nearly 300 metallurgical industry and Beijing city excellent design and achievement prizes, and hundreds of national patents. More projects have created the new records of the Chinese enterprises.

地 址：北京市石景山路60号
邮政编码：100043
电 话：(010) 68872480 (办公室)
(010) 88299085 (国内业务)
传 真：(010) 88295389 (办公室)
(010) 88294937 (国内业务)
网 址： www.bsiet.com 邮箱：bsiet@bsiet.com

Address: No. 60 Shijingshan Road, Beijing, P. R. China
Postal code: 100043
Tel: +86-10-88299017 +86-10-88299030
+86-10-88299033 +86-10-88299157
Fax: +86-10-88291231
Website: www.bsiet.com E-mail: bsiet@bsiet.com

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Expertise from hundred-year Shougang

新型长寿高风温顶燃式热风炉技术

NEW-TYPE LONG-LIFE HIGH-BLAST-TEMPERATURE DOME-COMBUSTION HOT BLAST STOVES

北京首钢国际工程技术有限公司
BEIJING SHOUGANG INTERNATIONAL ENGINEERING TECHNOLOGY CO.,LTD.

发展历程 HISTORY OF DEVELOPMENT

◎ 上世纪70年代，以首钢为代表的炼铁工作者在世界上首次成功开发和应用了顶燃式热风炉，并于70年代末成功应用于首钢2号高炉(1327m^3)。该热风炉正常工作22年以上，炉体结构完整，拱顶、燃烧口、热风出口及格子砖仅出现轻微破损。实践证明，顶燃式热风炉是一种长寿型热风炉，完全可以满足两代高炉炉龄寿命的要求；

◎ 2002年9月，首钢炼铁工作者再一次创造性地利用旧热风炉对助燃空气进行高温预热，开发出一种全新的高温预热工艺，并成功应用于首钢2号高炉，在单烧高炉煤气的条件下，可稳定地为高炉提供1250℃以上的高风温，为企业创造了巨大的经济效益、社会效益和环境效益；

◎ 2004年6月，在首钢顶燃式热风炉技术和助燃空气高温预热技术的基础上，首钢国际工程公司联合俄罗斯卡鲁金公司设计的新型顶燃式热风炉在首秦1号高炉(1200m^3)成功投产使用；

◎ 2006年，首钢国际工程公司全面开展顶燃式热风炉在特大型高炉上的应用研究，进行了数值仿真计算、冷态实验、热态实验等多项研究，并形成系列化成果；开始研究、开发、设计首钢BSK新型顶燃式热风炉；

◎ 2009年5月，首钢BSK新型顶燃式热风炉在首钢京唐5500m^{3}特大型高炉上成功投产应用，热风炉+预热炉+换热器的工艺流程，确保热风炉系统在全烧高炉煤气的条件下稳定高效地为高炉提供1300℃以上的超高风温；

◎ 至今，首钢国际工程公司设计总包的热风炉系统已服务于1000m^3～5500m^{3}的各级高炉，系列化、多样化的产品可为客户提供高效合理的解决方案。

◎ In 1970s last century, the iron-making workers represented by Shougang firstly and successfully had the dome-combustion hot blast stoves developed and applied in the world, and had the said stoves successfully used for Shougang's 2# blast furnace (1327m^3) at the end of 1970s. This hot blast stove had worked for more than 22 years. The structure of the stove body was complete and the dome, the burner port, the hot blast outlet and the checker bricks were slightly damaged only. It has been proven in the practice that the dome-combustion hot blast stove is a kind of long-life stove that can completely satisfy the requirements for the campaigns of two generations of blast furnaces;

◎ In September 2002, Shougang's iron-making workers, creatively preheated the combustion air in high temperature by using the old hot blast stove and developed a brand-new high-temperature preheating technology that was successfully applied to Shougang's 2# blast furnace. The hot blast stove, under the condition of combusting blast furnace gas only, can stably supply the blast furnace with high blast temperature above 1250℃. Thus, it has brought a huge economic benefit, social benefit and environmental benefit to the enterprise;

◎ In June 2004, based on the technology of Shougang's dome-combustion hot blast furnace and the technology of preheating combustion air in high temperature, the new-type dome-combustion hot blast furnace jointly designed by BSIET and Russian Kalugin was successfully put into operation and applied to Shouqin's 1# blast furnace (1200m^3);

◎ In 2006, BSIET comprehensively made a study of application of the dome-combustion hot blast stove to superlarge blast furnace and carried out such studies as numerical simulations, cold and hot experiments and so on that form a series of results. Meanwhile, BSIET began to study, develop and design Shougang's new-type BSK dome-combustion hot blast stove;

◎ In May 2009, Shougang's new-type BSK dome-combustion hot blast stove was successfully put into operation and applied to Shougang's Jingtang 5500m^3 superlarge blast furnace. Such process flow as hot blast stove + preheating furnace + heat exchanger ensures that the hot blast stove system can stably and efficiently supply the blast furnace with superhigh blast temperature above 1300℃ under the condition of combusting blast furnace gas only;

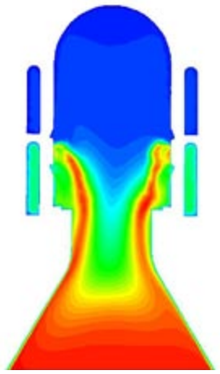
◎ Up to now, the hot blast stove system designed and generally-contracted by BSIET has been applied to all the blast furnaces from 1000m^3 to 5500m^3 and BSIET's serial products will provide the customers with high-efficient and rational solutions.

主要技术特点 MAIN TECHNICAL CHARACTERISTICS

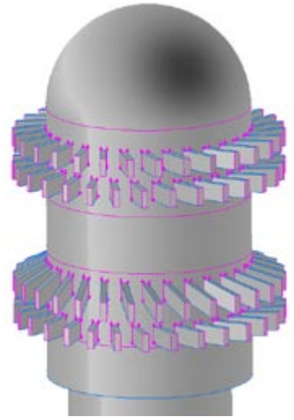
顶燃式热风炉高效旋流扩散式燃烧器
High-efficient cyclone dispersing burner for dome-combustion hot blast stove

◎ 燃烧产生的高温烟气形成均匀的旋流流场，有效提高了格子砖的使用效率和寿命；
◎ 对各种工况的适应性强，应用范围广；
◎ 燃烧器工作范围宽，可在设计正常燃烧流量的60%～140%的范围内可靠工作；
◎ 充分而均匀的扩散式燃烧，避免了局部高温区，有效控制了NOx等污染物的生成；
◎ 燃烧器结构稳定，制造及施工方便，寿命长。

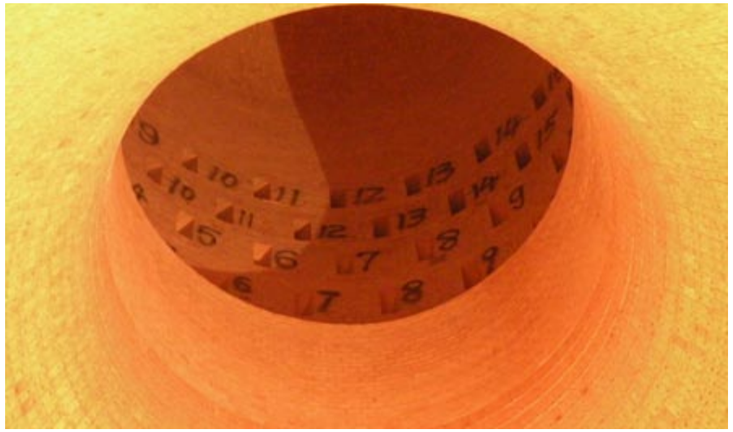
◎ A uniform cyclone flow field formed due to the high-temperature fume generated during combustion effectively improves the service efficiency and service life of the checker bricks;
◎ It has a good adaptability to all working conditions and a wide application;
◎ Burners with wide working range can reliably work within 60%～140% of the normal designed combustion flowrate;
◎ A sufficient and uniform dispersed combustion can prevent a local high temperature zone from occurrence and effectively control such pollutants as NOx and the like to generate;
◎ A stable structure and an easy manufacture and construction prolong the service life the burners.



新型顶燃式热风炉燃烧器温度场分布
Temperature field of burner for new-type dome-combustion hot blast stove



新型顶燃式热风炉燃烧器模型
Model of burner for new-type dome-combustion hot blast stove



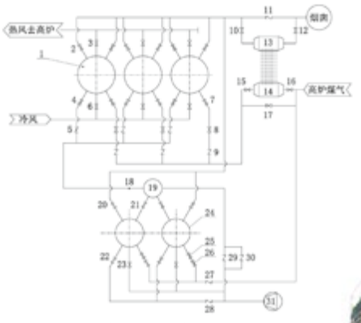
新型顶燃式热风炉燃烧器内部结构
Internal structure of burner for new-type dome-combustion hot blast stove

煤气、助燃空气高效预热工艺
High efficient preheating technology for gas and combustion air

◎ 利用2座小型顶燃式热风炉高温预热助燃空气至500℃以上；
◎ 全烧高炉煤气即可实现1300℃超高风温，高效经济的利用低热值煤气；
◎ 预热炉工作可靠，寿命与热风炉相同；
◎ 预热炉形式灵活多样，可与各种形式热风炉组合使用；
◎ 可与各种低温预热技术灵活组合；
◎ 煤气采用低温预热技术，安全而有效的回收烟气余热。

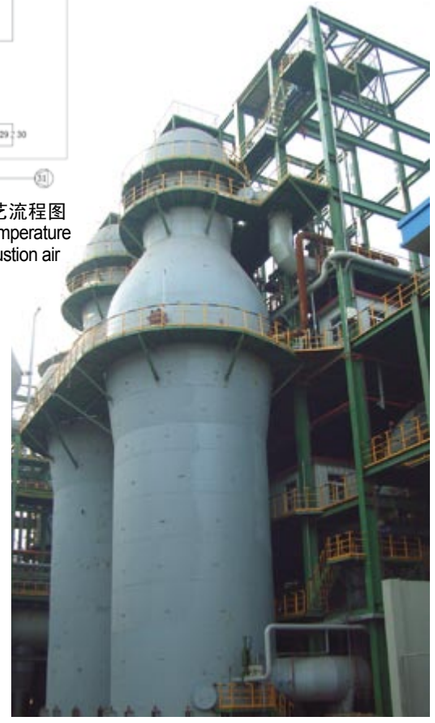
◎ Combustion air is preheated in high temperature to above 500℃ by using 2 small dome-combustion hot blast stoves；
◎ Fully-combusted blast furnace gas can not only realize 1300℃ superhigh blast temperature, but also efficiently and economically utilize the gas with low calorific value；
◎ The stably-worked preheating furnace has the same service life as the hot blast furnace；
◎ Flexible types of and varieties of preheating furnaces can be used in combination with all kinds of hot blast stoves；
◎ It can be flexibly combined with all kinds of low-temperature preheating technologies；
◎ A low-temperature preheating technology is adopted for gas to safely and effectively recover the waste heat in fume.

助燃空气高温预热控制画面
Control image of high-temperature preheating of combustion air



助燃空气高温双预热工艺流程图
Process flow chart of high-temperature duplex preheating of combustion air

首秦1号高炉热风炉采用的助燃空气高温预热工艺
High-temperature preheating technology of combustion air adopted for hot blast stove for Shouqin 1# blast furnace



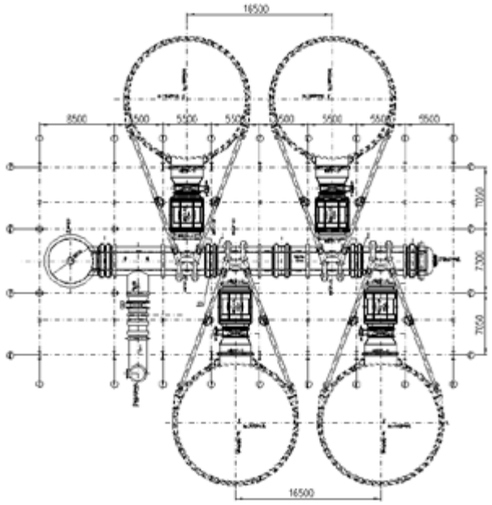
迁钢2号高炉助燃空气高温预热炉
High-temperature preheating furnace of combustion air for Qiangang 2# blast furnace

灵活多样的布置形式
Flexible and varieties of arrangements

◎ 热风炉布置形式有一列式布置、非对称矩形布置、三角形布置等；
◎ 热风炉区与预热炉区的位置可灵活组合，以满足不同总图布置的需要。

◎ The arrangements of the hot blast stoves are inclusive of one-line type, asymmetric rectangular type and triangle type, etc.；
◎ Relatively flexible positions of hot blast stove zone and preheating furnace zone can satisfy the needs of different general layout plans.

一种顶燃式热风炉的矩形布置结构专利证书
Patent certificate of rectangular arrangement structure of dome-combustion hot blast stoves



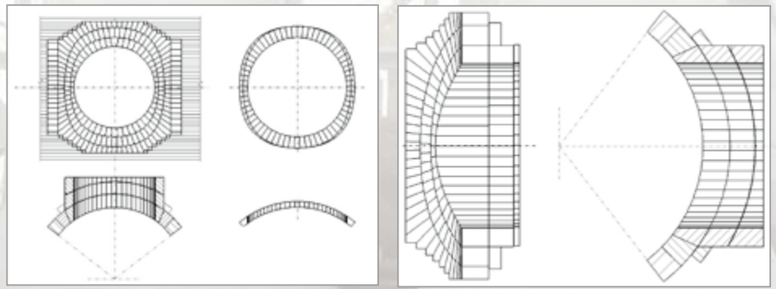
首钢京唐5500m^{3}高炉的4座热风炉采用非对称矩形布置
Asymmetric rectangular arrangement of 4 hot blast stoves used for Shougang's Jingtang 5500m^3 blast furnace

首钢京唐5500m^{3}高炉的4座热风炉采用非对称矩形布置
Asymmetric rectangular arrangement of 4 hot blast stoves used for Shougang's Jingtang 5500m^3 blast furnace

热风炉炉体结构优化设计
Optimized design of hot blast stove structure

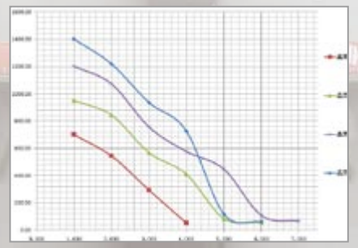
◎ 拱顶与大墙相互独立的砌砖结构，增强炉体稳定性，有效延长热风炉寿命；
◎ 热风炉整体应力分析计算，确保热风炉炉壳长寿可靠；
◎ 重要部位采用组合砖结构，增强砌体稳定性；
◎ 设计开发高效格子砖，增大蓄热面积，提高传热效率；
◎ 根据热风炉各部位工作温度、受力情况及化学侵蚀等工况特点，合理选择耐火材料。

◎ The dome of hot blast stove is separated from the wall masonry to form an independent structure of its own. Stability of stove will be strengthened and service life of HBS will be effectively prolonged;
◎ Hot blast stove overall stress analysis and calculation to ensure long life and reliability of stove shell;
◎ Important location adopts combined brick structure to enhance the stability of masonry;
◎ Design and develop high efficient checker to enlarge regenerative area and increase heat transfer efficiency;
◎ Rationally chose refractory based on working temperature, load bearing and chemical corrosion of each location of the hot blast stove.

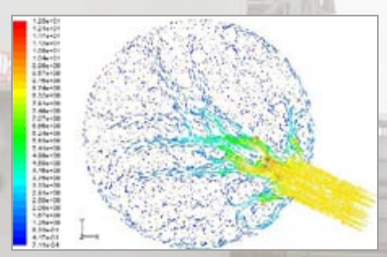


重要部位采用组合砖结构 Combined brick structure at important location

热风炉炉壳应力分析
Analysis of stress on shell of hot blast stove



炉墙传热分析计算
Analysis and calculation of stove wall heat transfer



冷风分配均匀性研究
Research on homogeneity of cold blast distribution

热风炉无过热、无应力管系设计
Non-over heat and non-stress pipe system design for hot blast stove

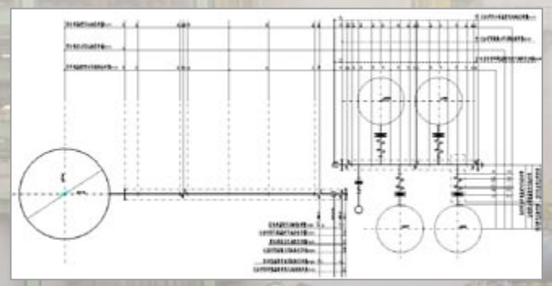
◎ 系统分析热风炉管系由于温度与压力引起的位移变化，合理设置补偿器；
◎ 自主开发传热计算程序，通过多方案比较，经济合理的选择热风管道等高温管道的砌筑方案；
◎ 重要的三岔口采用组合砖设计，提高砌筑稳定性；
◎ 管系实现全三维设计，有效避免碰撞，提高工作效率。

◎ Systematic analysis on the displacement variation in hot blast stove pipe system due to temperature and pressure, rationally arrange compensator;
◎ Independently develop a calculation program for heat transfer, rationally and economically chose the laying scheme for high temperature pipelines such as hot blast pipeline by comparison between several schemes;
◎ A combined brick design is conducted for important T-joint to improve a stable masonry;
◎ A three-dimensional design is realized in piping system to effectively prevent collision and improve the working efficiency.

自主开发的热风炉耐火材料优化选择计算程序
Independently-developed calculation program for optimized refractory selection of hot blast stove

自主开发的热风炉流体阻力损失计算程序
Independently-developed calculation program for fluid resistance loss of hot blast stove

自主开发的热风炉传热计算程序
Independently-developed calculation program for heat transfer of hot blast stove

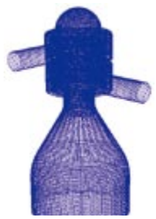


管系位移分析
Analysis of displacement of piping system

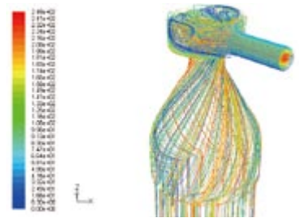
先进的数字化设计手段
Advanced digitized design method

◎ 热风炉系统实现全三维设计；
◎ 利用流场仿真计算技术，优化设计满足工程需要的高效燃烧器；
◎ 自主开发出热风炉燃烧与传热计算程序，提高设计效率与设计精度；
◎ 对热风炉炉壳、炉算子、重要的孔口等进行应力分析计算，确保工作可靠性；
◎ 对管系受力进行系统计算分析，减小应力。

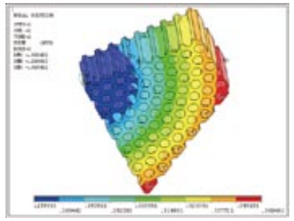
◎ Three dimensional design of hot blast stove system；
◎ High-efficient burners to meet the project needs by means of a simulation calculation technology of flow fields and optimize design；
◎ A calculation program for combustion and heat transfer of hot blast stove was independently-developed to improve the design efficiency and design accuracy；
◎ Stress analysis and calculations on hot blast stove shell, grates, important ports and so on are carried out to ensure a reliable operation；
◎ Systematic calculations and analysis are done on force of piping system to reduce the stress.



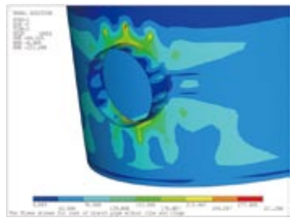
热风炉仿真计算模型
Simulation calculation model of hot blast stove



流场仿真计算得到的炉内流场分布
Distribution of flow fields inside hot blast stove obtained by way of simulation calculation

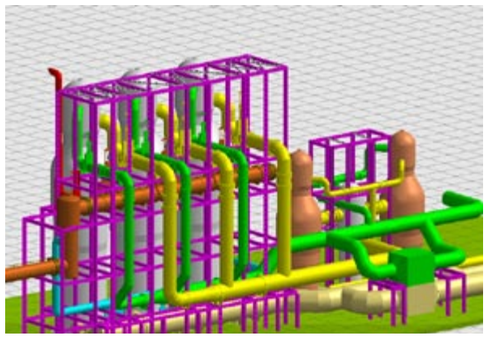


热风炉炉算子应力分析
Analysis of stress on grates of hot blast stove



热风炉关键部位应力分析
Analysis of stress on key positions of hot blast stove

自主开发的热风炉燃烧与传热计算软件
Independently-developed calculation software for combustion and heat transfer of hot blast stove



热风炉系统全三维设计
Three-dimensional design of hot blast stove system

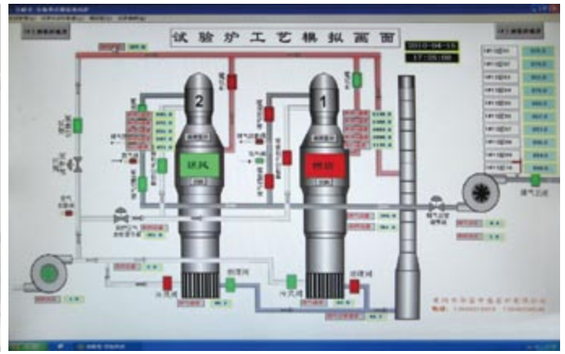
技术开发与创新 TECHNICAL DEVELOPMENT AND INNOVATION

◎ 拥有顶燃式热风炉高效旋流扩散式燃烧器、一种高风温长寿型两级双预热装置、一种顶燃式热风炉的矩形布置结构等多项热风炉相关专利技术；
◎ 结合流场仿真计算，搭建了热风炉冷态、热态实验台，利用实验数据校核修正计算结果；
◎ 在首钢京唐5500m^{3}顶燃式热风炉上进行冷态测试，取得了较详实的数据与影像资料。

◎ BSIET has many patent technologies related to hot blast stove such as high-efficient cyclone dispersed burners of hot blast stove stove, a high-blast-temperature long-life 2-stage duplex preheating unit and a rectangular arrangement structure of dome-combustion hot blast stoves, etc.；
◎ By way of a simulation calculation, cold test and hot test tables of hot blast stove are set up and the calculated results are checked and corrected by means of test data；
◎ A cold test was done on Shougang Jingtang 5500m^3 dome-combustion hot blast stove and more detailed data and image information were obtained.

顶燃式热风炉冷态实验台
Cold test table for dome-combustion hot blast stove

顶燃式热风炉热态实验室
Hot test laboratory for dome-combustion hot blast stove



顶燃式热风炉热态实验控制画面
Control image of hot test on dome-combustion hot blast stove

组织对京唐顶燃式热风炉进行冷态测试
Cold test on Jingtang's dome-combustion hot blast stove

拥有多项热风炉相关专利 Patents related to hot blast stove

工程业绩 MAIN REFERENCE

序号 No.	工程名称 Designations of projects	高炉容积(m^3) Volume of blast furnace (m^3)	投产时间 Date of operation	热风炉座数 No. of hot blast stoves	热风炉形式 Type of the hot blast stove	布置形式 Type of arrangement	服务方式 Service mode
1	首钢1号高炉 Shougang 1# blast furnace	2536	1994.8	4	首钢顶燃式 Shougang's dome-combustion type	正方形布置 Square arrangement	设计 Engineering
2	首钢2号高炉(第5代) Shougang 2# blast furnace (5th generation)	1327	1979.12	4	首钢顶燃式 Shougang's dome-combustion type	正方形布置 Square arrangement	设计 Engineering
3	首钢2号高炉(第6代) Shougang 2# blast furnace (6th generation)	1726	1991.5	4	首钢顶燃式 Shougang's dome-combustion type	正方形布置 Square arrangement	设计 Engineering
4	首钢3号高炉 Shougang 3# blast furnace	2536	1993.6	4	首钢顶燃式 Shougang's dome-combustion type	正方形布置 Square arrangement	设计 Engineering
5	首钢4号高炉 Shougang 4# blast furnace	2100	1992.5	4	首钢顶燃式 Shougang's dome-combustion type	正方形布置 Square arrangement	设计 Engineering
6	邯钢4号高炉 Hangang 4# blast furnace	917	1997.5	3	首钢顶燃式 Shougang's dome-combustion type	一列式布置 1-row arrangement	设计 Engineering
7	石钢4号高炉 Shigang 4# blast furnace	420	2003.5	4	首钢顶燃式 Shougang's dome-combustion type	正方形布置 Square arrangement	设计 Engineering
8	首秦1号高炉 Shouqin 1# blast furnace	1200	2004.6	3	新型顶燃式热风炉+预热炉 New type dome-combustion hot blast stove + preheating furnace	一列式布置 1-row arrangement	设计 Engineering
9	重钢4号高炉 Chonggang 4# blast furnace	1350	2006.3	3	新型顶燃式 New dome-combustion type	一列式布置 1-row arrangement	总承包 EPC
10	首秦2号高炉 Shouqin 2# blast furnace	1780	2006.5	3	新型顶燃式热风炉+预热炉 New type dome-combustion hot blast stove + preheating furnace	一列式布置 1-row arrangement	设计 Engineering
11	首钢迁钢2号高炉 Shougang Qiangang 2# blast furnace	2650	2007.1	3	内燃式热风炉+顶燃式预热炉 Internal combustion hot blast stove + dome-combustion preheating furnace	一列式布置 1-row arrangement	设计 Engineering
12	首钢京唐1号高炉 Shougang Jingtang 1# blast furnace	5500	2009.5	4	新型顶燃式热风炉+预热炉 New type dome-combustion hot blast stove + preheating furnace	非对称矩形布置 Asymmetric rectangular arrangement	设计 Engineering
13	首钢迁钢3号高炉 Shougang Qiangang 3# blast furnace	4000	2010.1	4	内燃式热风炉+顶燃式预热炉 Internal combustion hot blast stove + dome-combustion preheating furnace	一列式布置 1-row arrangement	设计 Engineering
14	首钢京唐2号高炉 Shougang Jingtang 2# blast furnace	5500	2010.6	4	新型顶燃式热风炉+预热炉 New type dome-combustion hot blast stove+preheating furnace	非对称矩形布置 Asymmetric rectangular arrangement	设计 Engineering
15	首钢宝业1号高炉 Shougang Baoye 1# blast furnace	3200	暂停 Pause	4	新型顶燃式热风炉+预热炉 New type dome-combustion hot blast stove+preheating furnace	一列式布置 1-row arrangement	设计 Engineering
16	印度BIL公司高炉 Indian BIL blast furnace	1780	暂停 Pause	3	新型顶燃式热风炉 New type dome-combustion hot blast stove	一列式布置 1-row arrangement	总承包 EPC
17	宣钢8号高炉大修改造 Overhaul and renovation of Xuangang #8 blast furnace	2000	2011.6	3	新型顶燃式热风炉 New type dome-combustion hot blast stove	一列式布置 1-row arrangement	总承包 EPC
18	文水海威1号高炉 Wenshui Haiwei 1# blast furnace	1380	在施 Under construction	3	新型顶燃式热风炉 New type dome-combustion hot blast stove	一列式布置 1-row arrangement	总承包 EPC
19	首钢通钢新2号高炉 Shougang Tonggang's new 2# blast furnace	2680	在施 Under construction	3	新型顶燃式热风炉+预热炉 New type dome-combustion hot blast stove + preheating	一列式布置 1-row arrangement	总承包 EPC
20	涟钢新3号高炉 Liangang's new 3# blast furnace	2800	在施 Under construction	3	新型顶燃式热风炉 New type dome-combustion hot blast stove	一列式布置 1-row arrangement	设计 Engineering

首秦1号高炉热风炉
Hot blast stoves for Shouqin 1# blast furnace

重钢4号高炉热风炉
Hot blast stoves for Chonggang 4# blast furnace

首秦2号高炉热风炉
Hot blast stoves for Shouqin 2# blast furnace

迁钢2号高炉热风炉
Hot blast stoves for Shougang Qiangang 2# blast furnace

首钢京唐1号高炉热风炉
Hot blast stoves for Shougang Jingtang 1# blast furnace

首钢京唐2号高炉热风炉
Hot blast stoves for Shougang Jingtang 2# blast furnace