NLMK GROUP

NLMK Group Corporate Magazine

No. 4 (52) October – December 2015

FEATURE

Colleagues, have your say!

All you wanted to know about communications within NLMK Group

Success factors

An overview of the most important issues discussed at NLMK Group President's meeting with heads of units at Novolipetsk

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NLMK GROUP
Corporate Magazine
No. 4 (52) October – December 2015

12+

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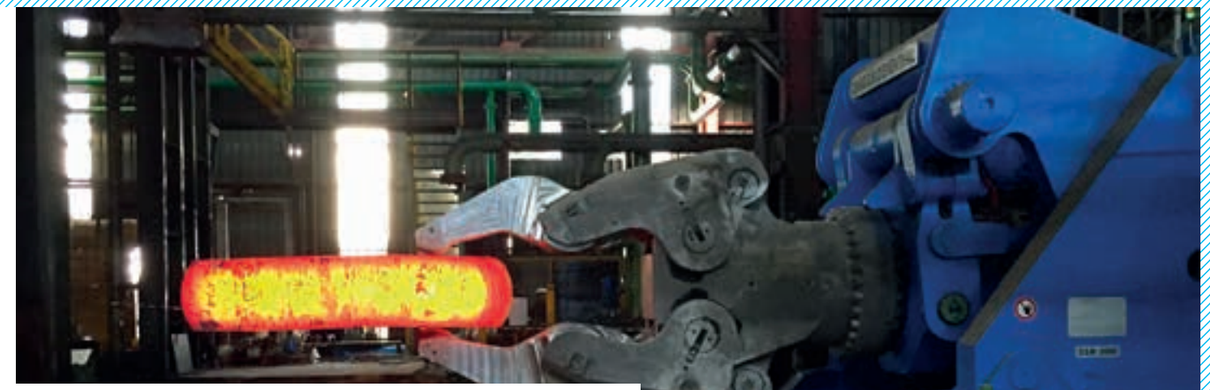


New press for NLMK Verona

NLMK Verona, an Italian based NLMK Europe Plate production asset, has completed the commissioning of upgraded press equipment. The project will allow for expansion of the product mix and will increase the reliability and stability of deliveries to its clients in the machine-building industry, as well as reducing production costs.

As part of the facility upgrade project, NLMK Verona has completed testing and began full-scale operation of a new manipulator which rotates the ingot during the forging process. It has also completed the modernization of its existing press that has enabled the forging of ingots in three planes: by thickness, by width and by length. NLMK Verona was previously unable to do so due to the press configuration and lack of equipment for transporting hot ingots; and the company had to outsource the processing of ingots, which led to higher production costs. Marcello Calcagni, NLMK Verona Director, said:

"Whilst up till now third party contractors processed our ingots and forged 800 mm plates, our move away from outsourcing will result in significant production cost cuts; as well as increased product quality and reliability of supplies, as we will be able to control the entire process chain. New equipment will also enable the company to increase production of heavy plates by 35%."

In order to increase the production of heavy plates using the new equipment, NLMK Verona will install an additional furnace for heating ingots during the forging process; and a unit for hot cutting plates by the end of 2015.

Steel plant NLMK Verona is located in Verona, Italy. It is part of NLMK Europe Plate. It specializes in the production of thick plates and the forging of ingots used for the production of mill rolls, thick plates, turbine rotors, etc. Around 2/3 of its products are sold in Italy. NLMK Verona's production capacity is about 450,000 tonnes of steel products per year.

Investment in the project will total approximately 9 million euro; and will have a payback period of 1.6 years.

Medals from Metal-Expo

NLMK Group's projects win gold and silver medals at Metal-Expo'2015

NLMK Group received a gold medal at Metal-Expo'2015, the 21st international industry awards for creating a breakthrough technology for the production of dynamo steel used in power engineering. The Company also received a silver medal for its environmental project at the Lipetsk site.

Metal-Expo has been endorsed by the Ministry of Industry and Trade of the Russian Federation, the Government of Moscow, the Russian Union of Industrialists and Entrepreneurs, among others, for over 10 years. It's the event of the year for leading steel companies in Russia. In 2015, the exhibition brought together more 570 companies from 34 world countries.

Sergey Filatov, Novolipetsk Managing Director, said: *"We are pleased that NLMK was once again recognized in this prestigious international competition. The gold and silver medals were awarded to our experts for the creation and implementation of unique technologies in rolling operations and waste management. This confirms once again that we are on the right path with our Strategy 2017 aimed at achieving best global practices in efficiency across all stages of steel production."*

The gold medal was awarded for NLMK's efforts in producing three new grades of electrical isotropic (dynamo) steel that were previously unavailable on the domestic market in Russia. In response to growing demand from key customers, experts from NLMK's Engineering Center developed and launched production of a series of new grades of electrical steel. The use of this steel in generators and turbines at power plants boosts energy generation by 15%. When used in industrial and household appliances, their efficiency is increased by 10%. NLMK Group currently supplies this innovative electrical steel to the domestic market, as well as to international consumers including ABB of Sweden, Helvar of Finland, LCI of France, Siemens of Germany, among others.

NLMK Group received a silver medal for the successful implementation of its environmentally friendly waterless BG slag cooling technology at the Lipetsk site that resulted in a more than 8-fold reduction in emission of hydrogen sulfide.

In 2014 NLMK Group was also a Metal-Expo winner. The gold medal was awarded for a unique environmental project – a biochemical waste water treatment facility at coke and chemical operations at the Lipetsk production site.

Best in steel sector

NLMK Group corporate media takes first place in Metal-Expo'2015 competition

NLMK Group's corporate media, including NLMK-TV online television; NLMK Group corporate magazine; and Stoilensky's 'The Big Ore' newspaper topped their respective categories in the 'Best Corporate Media in the Steel Sector in Russia and the CIS –2015' competition, which is held annually in Moscow as part of the Metal-Expo international industry exhibition.

NLMK Group's corporate television, launched in April 2014, tops the 'Best Online Corporate Media' category for a second year running. NLMK-TV has a target audience of more than 50,000 people. It is broadcasted through the Group's internal intranet portal. Videos are published on NLMK Group's YouTube channel, allowing employees from all NLMK Group sites to watch NLMK-TV releases at any convenient time.

NLMK-TV delivers up-to-date online information on the Company's production and social issues to employees of all NLMK Group production sites, allowing them to follow all the latest Company news.

NLMK Group's Corporate Magazine also topped the 'Best Corporate Magazine' category for a second year running. NLMK Magazine has been published since 2005. The goal of the magazine is to bring together NLMK Group's production sites in Russia, the USA, and Europe. The magazine is published in Russian and in English. The concept of the magazine has been completely transformed over the last two years: an exclusively intracorporate magazine turned into one of the Company's trademarks.

'The Big Ore', Stoilensky's (part of NLMK Group) corporate newspaper, topped the 'Best Mining Industry Publication' category. 'The Big Ore' newspaper is a Metal-Expo winner for the second year running. The newspaper has been published since June 1982. Published bi-monthly, with a print run of 6000 copies, 'The Big Ore' is distributed free of charge to current and former Stoilensky employees. In 2014, the newspaper was rebranded and its structure changed to a 16-page edition that features a modern design.

The Group has an effective system of internal communication covering all production sites which comprises several communication channels: an intranet information portal; corporate newspapers at NLMK's Russian production sites; NLMK Group Corporate Magazine; newsletters at NLMK Europe and NLMK USA; NLMK-TV online television; an email subscription; accounts in social networks; a system of feedback for employees; and other channels.

A well-developed system of internal communication enables NLMK Group to not only deliver information to each and every employee in a timely fashion; but to deliver information that is important and interesting in a convenient format. Company employees have the opportunity to not only read interviews and articles; but to contribute to the communication agenda themselves by posing questions to the management or PR staff. For more information about internal communications see our feature story on **page 16.**

Success factors

An overview of the most important issues discussed at NLMK Group President's meeting with heads of production units at the Lipetsk site (Novolipetsk)

Maria Simonova

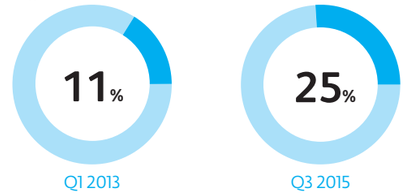
President's visits are always packed with meetings with employees, debriefings, and a nonstop flow of direct and sometimes uncomfortable questions which go on until late in the evening

THE CRITICAL SUCCESS FACTOR IS THE ABILITY TO SUPPORT CHANGE THROUGH PERSONAL LEADERSHIP AND INITIATIVE

NLMK IN FIGURES

Production

EBITDA margin



It has long been customary for the last issue of the year to feature an interview with NLMK Group President Oleg Bagrin. This November, however, we managed to sneak into his meeting with heads of operations at Lipetsk, where the situation on the global steel market, the implementation of the Group's strategy, ongoing and future projects, as well as a number of issues of concern to all NLMK companies were discussed. We believe this meeting must be of great interest to you, our reader. So rather than doing another annual interview, we decided to tell you all about it.

Oleg Bagrin's visits to NLMK Group companies, are always packed with meetings with employees, tours of problematic and successful production facilities, debriefings, and a non-stop flow of direct and sometimes uncomfortable questions which go on until late in the evening.

This time Oleg Bagrin visited all production stages at Novolipetsk. He inspected the blast furnace and BOF shops and the galvanized steel shop, which has embarked on a major upgrade of one of its four lines. The visit took longer than expected, causing a one hour delay of the meeting with heads of Lipetsk's key production units and shops.

Mr. Bagrin opened the meeting by noting that he took charge of the company three years ago to transform it from a growing steel producer into one of the world's most efficient steelmakers. Given the severe crisis facing the global steel industry, this was quite a challenge.

The market is oversupplied as a result of unprecedented growth in production which has been further aggravated by the global economic downturn. Excess global steelmaking capacity was ten times the total volume of steel produced in Russia. China made almost as much steel in 2015 as all other countries combined, and accounted for the lion's share of this increased production capacity. More than 100 million metric tons a year of cheap Chinese steel exports led to a collapse in prices, sending them crashing to a twelve-year low.

The US and the EU have begun to impose protective import tariffs in a bid to support their steelmakers. Around 20 investigations have been launched into steel companies from various countries, including Russia, since the beginning of 2015. The US re-introduced protective tariffs on hot-rolled steel from Russia. Europe launched an investigation into cold-rolled steel imports and introduced minimum prices for electrical steel, which has impacted upon NLMK Group products. Russian companies were forced to address challenges in international markets, while domestic demand showed a double-digit decline. For example, demand for steel products used in

OUR GOAL IS TO STRENGTHEN OUR MARKET POSITIONS IN NICHE HIGH-MARGIN SEGMENTS, WHERE WE HAVE A COMPETITIVE ADVANTAGE IN TECHNOLOGY, QUALITY AND COST

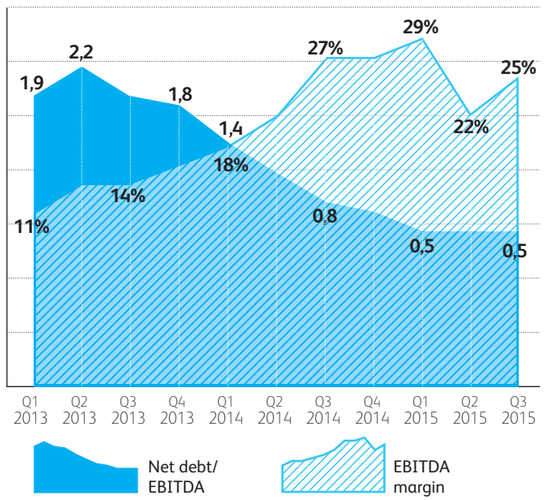
construction fell by 14% in the first nine months of 2015. The slowdown in Russian demand in 2015 was worse than in any other country, and will continue in 2016 in almost all sectors of the Russian economy.

Despite this extremely challenging environment, NLMK Group has managed to complete all the projects it started, taking its steel production to a record high, maintaining almost 100% utilization and achieving greater profitability at the same time. Profit margins improved from 11% in early 2013 to 25% in the third quarter of 2015, twice the global industry average, and the Group's leverage is four times lower than that of its international peers, which is not only a sign of financial stability but represents sufficient resources for the Group to invest in new facilities and technologies.

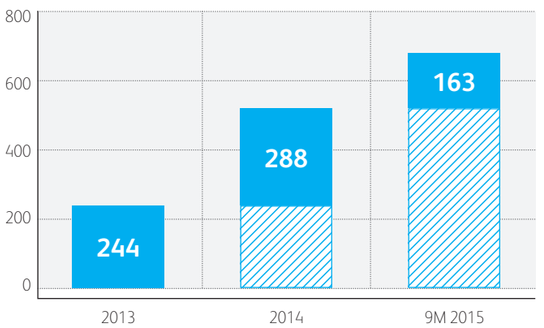
Mr. Bagrin explained that improved profitability was driven by operational efficiency projects based on NLMK Production System, which are part of the Group's Strategy 2017. The projects delivered a long-term gain of around $600 million to date. In the first nine months of 2015 alone this gain exceeded $160 million, and the Lipetsk site accounted for 70% of this figure. It is a good sign that other Group companies have also got in on the act, while earlier 100% of savings were generated by Lipetsk.

The important success factor is the ability not only to expand capacity and adopt new technologies, but to effectively manage it

EBITDA MARGIN AND NET DEBT/EBITDA IN 2013-2015

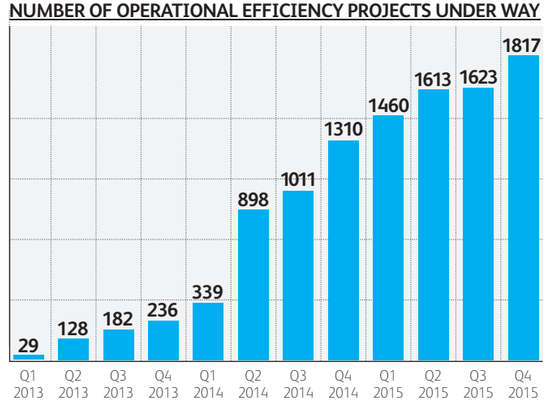


OPERATIONAL EFFICIENCY PROGRAM GAINS IN 2013-2015, $ M



New projects will create comparable value to the construction of a new blast furnace

NUMBER OF OPERATIONAL EFFICIENCY PROJECTS UNDER WAY



"We met here at the beginning of 2013 to talk about our development priorities and the ways we would improve how we manage the business to further work toward our goal. We discussed the need to establish continuous improvement programs that would be a cornerstone of our growth. We reviewed our development goals, focusing on the performance of the Group as a whole rather than as individual companies, and introduced individual KPIs for managers and divisions, translated into a management by objectives system (MBO). The next step was to create a new organizational model combining divisional and functional responsibility, making interaction between companies and project management more efficient. We

We managed to sneak into the president's meeting with heads of operations at Lipetsk

also developed and implemented operational efficiency programs, the cornerstone of NLMK Group's development and the pillar of Strategy 2017. Time has shown that our decisions and actions laid the foundation for the company's success," Mr. Bagrin said.

To illustrate this point he reviewed the Group's operational efficiency projects. Their number has increased fiftyfold since the beginning of 2013, when there were just 29. Much has been done to develop the NLMK Production System. Today there are around 200 ongoing A3 projects as well as 550 active initiatives sourced directly from the shop floor. Other new tools are being introduced, including more than 1,000 6C initiatives and over 2,000 projects involving implementation of control charts. Mr. Bagrin added that the latter have reached the minimum required level.

"The accountability of managers as well as each and every member of the team drives the growth of the company. The critical success factor is the ability to support change through personal leadership and initiative," Mr. Bagrin emphasized.

He noted that between 2013 and 2015, the main results of Strategy 2017 were driven by operational efficiency programs, while in 2016-2017 the main contribution will come from investment projects.

"Our largest project at present is the construction of a pelletizing facility at the Stoilensky plant. The facility will be launched in August 2016. The cost of producing pellets in-house will be less than half of what the Group pays for them today. The project will generate a structural annual gain of about $200 million. Stoilensky will also complete upgrades of two beneficiation units that will result in an increase in our output of iron ore concentrate. To name a few projects elsewhere, the Lipetsk site will upgrade its first continuous hot dip galvanizing line, commission a new slab warehouse that will expand the capabilities of its BOF operations, and overhaul blast furnace No. 6 by launching a gas recovery turbine. Lipetsk also plans to build a briquetting plant, replace one of its turbine generators and design a new galvanizing line, which will be its fifth. This is quite a large portfolio of projects which are no less ambitious than, and create comparable value to, say, the construction of a new blast furnace," Mr. Bagrin said, inviting his colleagues to ask questions and discuss the issues that are of the greatest concern to NLMK Group employees.

Here is a selection of some of the themes discussed during the Q&A session at the meeting hosted by NLMK Group President Oleg Bagrin.

In 2016-2017 the main contribution will come from investment projects

Q: One of the four goals set out in Strategy 2017 is to develop a world-class resource base. Thanks to the Group's self-sufficiency in iron ore, the cost of steel production is among the lowest in the world. However, we depend on the market for coal. How do we plan to develop in this area going forward?

Oleg Bagrin:
Production of our own coal remains a very important issue and we are looking for possible solutions. We have licenses to mine coal in Russia in both Kuzbass and the Komi Republic. Over the last few years we've been revising our plans for these deposits – we wanted to reduce costs and improve productivity. These projects were not included in Strategy 2017 as market conditions were not supportive of developing greenfield coal deposits. We are also reducing our dependence on third-party coal suppliers by introducing pulverized coal injection in blast furnace operations, optimizing coal blending and reducing coke consumption. These initiatives drive our costs down, while launching coal production, which requires a sizable capex outlay on infrastructure, is a matter for the future. Besides, the Russian coal market is oversupplied, with more than a third of coal mined being in excess of demand on the domestic market.

This time the president visited all production stages at Novolipetsk, including the blast furnace and BOF shops and the galvanized steel shop

New competitive advantages are gained through innovative ideas, entrepreneurial drive, and the ability to make rational decisions and take calculated risks

IT MAY TAKE FIVE, OR EVEN TEN YEARS FOR THE DEMAND-SUPPLY BALANCE IN THE MARKET TO BE RESTORED, BUT THIS WILL HAPPEN

Q: What are the prospects for NLMK's downstream expansion in the near future? Are you considering building a new hot rolling mill?

Oleg Bagrin:
It's difficult to speak in certain terms about potential large-scale capacity growth until the issue of oversupply, or adequate demand is addressed by the market. At the same time, there is little doubt that consumption will grow. It may take five, or even ten years for the demand-supply balance in the market to be restored, but this will happen in the end – this is not the first overproduction crisis that the steel industry faces.

Expansion of production could well become a driver for the development of the company after 2017. NLMK has the necessary capabilities and resources to do this. The question is exactly what we should produce. Given the decline in the demand for steel, it doesn't make a lot of sense to build greenfield upstream facilities. With regards to the new hot rolling mill, Russia's output of hot-rolled products today is 70% higher than the domestic market consumes. It would be unprofitable to export additional volumes of the finished products that we could make at the new mill given the intense competition from China, which sells steel at prices below the cost of production. Our goal is to strengthen our market positions in niche high-margin segments, where consumption is growing and where we have a competitive advantage in technology, quality and cost.

Let's take, for example, our projects to increase the supply of slabs to OCTG producers. Today the market for steel products used for large-diameter pipes manufacturing is one of the few growth markets. It was a strategically wise move to enter this market at the right time.

Let's take another example. We now see strong demand for galvanized steel and import substitution opportunities in the product segment. Consumption of galvanized steel in Russia is estimated at six million metric tons, with more than 20% of this being imported. In order to increase its share of the market, Novolipetsk began renovation of its first continuous hot dip galvanizing line, which will make it possible to produce an additional 120,000 metric tons

NLMK Group
No.4 October - December 2015

Despite the extremely challenging environment, NLMK Group has managed to complete all the projects it started, achieving greater profitability at the same time

WE NEED TO ENSURE THAT OUR INCENTIVES ARE ACCESSIBLE, TRANSPARENT AND EASY-TO-UNDERSTAND FOR ALL EMPLOYEES

a year. Another such line – HDGL-5 – reached its final design stage, and once launched, it will produce another half a million metric tons of galvanized steel. These two projects will enable Lipetsk to increase its capacity for this marketable product by 50%, up to 1.7 million tons.

Q: Strategy 2017 is designed to run until 2018. What are your plans for the years after that? Will the company create a corporate ideas pool?

Oleg Bagrin:
This is a very timely question. The next phase of the strategic planning cycle will commence in 2016. Most of the work will be done in 2017, but we are going to start discussing the main hypotheses and ideas for the new development cycle as early as this year.

The management board and heads of all the Group's divisions and functions will hold a strategic session later this year to define the company's trajectory of growth from 2017. Strategy development is a very important issue that requires careful attention from everyone. By working together today we will shape the company's future for many years to come. We have two years to collect, review and evaluate ideas and identify priorities. I hope that managers and employees of all our companies will be actively involved in this process.

Q: Which of our global competitors can serve as a benchmark for strategy development?

Oleg Bagrin:
I believe there are no ideal companies or examples to follow. I would like to answer this question by rephrasing a quote from one of the greatest Russian writers: successful companies (just like families) are successful in their own way, all unsuccessful companies are alike. All industry players produce steel, but only a few of them manage to create value for many years. The important

All industry players produce steel, but only a few of them manage to create value for many years

success factor is the ability not only to expand capacity and adopt new technologies, but to effectively manage it and build complex business systems linking together people, operations, management and information processes into a coherent whole. Human capital has enormous value: facilities and technologies are bound to become outdated; and new competitive advantages are gained through innovative ideas, entrepreneurial drive, and the ability to make rational decisions and take calculated risks.

Q: Industry leaders are known for their strong incentive systems. Will there be any changes in NLMK's incentive system?

Oleg Bagrin:
NLMK Group is working hard to introduce incentives at all levels: management by objectives (MBO) for the Group's and companies' management and a system of rewards for initiatives and ideas sourced directly from the shop floor. Our goal is to fine tune the existing tools rather than invent new ones.

For example, the Group adopted the MBO system, which currently covers around 450 employees, including about 200 people in Lipetsk. In the future, we plan to roll out the MBO system to include decision makers, which means thousands of employees at all levels. A similar approach to end-to-end individual performance assessment will be applied across the entire Group.

We are also restructuring the HR function, which, among other things, is responsible for talent development and motivational strategies. It seems to me that we have made the system of rewards too bureaucratic and now we need to ensure that our incentives are accessible, transparent and easy-to-understand for all employees.

Nine questions
from the readers of the magazine to NLMK Group President Oleg Bagrin

We need to create professional growth and fulfillment opportunities for a new generation of employees

NLMK GROUP CONTINUES TO LOOK FOR WAYS TO FURTHER INCREASE WAGES THROUGH INCREASED LABOR PRODUCTIVITY

Question #1
Do you plan further salary increases for NLMK employees given the deteriorating economic situation in Russia, purchasing power of the ruble, price inflation, etc.?
Konstantin Kazmin, Novolipetsk

As the Russian economy has continued to deteriorate, many Russian companies have been forced to halt wage increases and make substantial cuts to their labor force. We at NLMK Group have taken a different approach, instead increasing the output of our production facilities and improving the efficiency of our operations. Every year, the company invests more than a billion rubles in wage increases. In addition to this, 200 to 300 million rubles generated during each of the previous three years through operational efficiency programs is distributed to personnel at our production facilities. Thanks to the increased labor productivity over this period, worker wages were pushed over the set pay rise cap by 6%; with NLMK Group workers today earning about 70% more than the average salary in their respective regions.

NLMK Group continues to look for ways to further increase wages through increased labor productivity and operational efficiency. Also, in addition to its commitments under collective agreements, the Group will allocate about three billion rubles each year for social and economic development in our regions of operation, including on preventive health care, education and leisure opportunities for employees.

Question #2
With regard to the corporate HR strategy covered in Issue No. 3 (51) of NLMK Group magazine, do you plan to create a shared vacancy pool, for example on the intranet portal, for all the Group's companies, so that every employee would be able to apply for any vacancy?
Elena Nezhelskaya, Novolipetsk

We plan to introduce such a tool, particularly for the benefit of our subsidiary companies in regions with a depressed labor market. NLMK Group has always based its strategy for career management on the talent pool approach and will continue to do so. We begin our search for talent within our existing workforce and only consider external candidates afterwards.

There are plans to launch an information service for employees on the intranet portal in 2016, which will list open vacancies with details of requirements and application deadline dates. In addition to this initiative we are taking steps to better inform the communities in which we operate of the employment opportunities available at NLMK Group.

Question #3
Russian steelmakers find themselves in a battle for market leadership. Customer orientation (product differentiation, response times, paying the greatest attention to the needs of end users, and so on) is coming to the fore as a key focus. What steps are being taken by the company take in this regard?
Natalya Vassilyeva, Novolipetsk

The focus of the ongoing transformation of the sales function at NLMK Group is to develop a customer-oriented culture. I would say that our key target areas for improvement are listening to our customers and what they really need, a focus on direct sales, timely technical and administrative support, and remote sales and order tracking. We've already started these initiatives allocating the resources necessary to implement them.

We have merged the sales departments of the long steel and flat steel divisions; and put together new sales teams specializing in sales to end customers and distributors. We have significantly increased our front office headcount, and the number of technical support employees has seen an almost fourfold increase. We have also established a unit which focuses on product mix development and customer complaints. As a result, the average time taken to resolve complaints decreased by 20% in the first nine months of 2015. The Group's Russian companies won more than 150 new customers during the year.

We have much to do in 2016 to improve our product mix, promote new brands and create new products for our customers in the machine building, power engineering and automotive industries.

Question #4
What import substitution projects will be implemented by NLMK Group?
Natalya Vassilyeva, Novolipetsk

NLMK Group's business model is based on gaining a competitive advantage in attractive segments and achieving an optimal presence in regional markets. Import substitution is not a goal within itself. Our objectives are to be close to our customers and to beat our competitors on quality and price. We compete with both international and Russian producers, which is why it's not import substitution that we focus on but rather building local plants and creating growth points in attractive market segments.

For example, we opened NLMK Kaluga mill in 2013 to gain market share in Central Russia, where the market was previously dominated by imports. Today, the mill is running at full capacity, and has become the most efficient mini-mill in Europe.

The Group's global production chain is another example of this local production strategy . On the one hand, NLMK's rolled steel operations in the USA and Europe enable us to utilize our Russian production facilities at full capacity; whilst on the other hand the stable supply of high quality steel from Russia gives our international operations a competitive edge in their local markets. Our rolled steel facilities outside Russia also ensure the Group's presence in markets which are; or may become; closed to Russian steel due to growing protectionism.

Every year, the company invests more than a billion rubles in wage increases

Question #5
What cutting edge developments, technologies and steel products were displayed by NLMK Group at Metal-Expo'2015?
Ekaterina Rakova, Novolipetsk

Metal-Expo is not a venue for the showcasing of new technologies. We keep our customers well informed of our

On the one hand, NLMK's rolled steel operations in the USA and Europe enable us to utilize our Russian production facilities at full capacity; whilst on the other hand the stable supply of high quality steel from Russia gives our international operations a competitive edge in their local markets

new products and production techniques. Metal-Expo is primarily an opportunity for NLMK sales staff to meet with hundreds of customers within a short period of time, and to discuss new partnerships and agreements. About 4,000 people visited NLMK Group's exhibition stand this year. Our sales team held negotiations with more than 300 prospective customers and signed a number of important framework agreements. Another important aspect of these meetings is the opportunity for our customers to share their ideas on how we can improve our products and services; valuable feedback that enables NLMK Group to strengthen its competitiveness.

SPORTS ACTIVITIES ARE AN INTEGRAL PART OF OUR EVERYDAY LIFE, AND THIS IS ESPECIALLY TRUE FOR THOSE WHO SEE THEMSELVES AS LEADERS

In addition to its commitments under collective agreements, the Group will allocate about three billion rubles each year for social and economic development in our regions of operation

Question #6

I am interested to learn your opinion about the promotion of sports and active lifestyle among NLMK Group employees. It has been noted that my fellow employees at Stoilensky are losing interest in sports activities. As the person responsible for sports at Stoilensky this is of concern to me. We should certainly work hard to improve efficiency for the benefit of our plant and the shareholders, but we should not forget about health, respect, honor and good conscience.
Sergei Khlebodar, Stoilensky

This is certainly a cause for concern because sports activities are an integral part of our everyday life, and this is especially true for those who see themselves as leaders. NLMK Group allocates about 250 million rubles for promoting sports and an active lifestyle among its employees and local communities each year.

Stoilensky will increase its budget for sporting events by 35% in 2016. In addition to the traditional annual sports competitions, the company plans to hold 12 new sporting events including youth games, winter sports events, a cycling relay race, and competitions between Stoilensky and Novolipetsk. Additionally, in a joint project with the Starooskolsky District authorities, Stoilensky will renovate a swimming pool in the Zvezdny neighborhood of Stary Oskol which was shut down in 2008.

Question #7

I'd like to address a sensitive issue for Novolipetsk employees who don't have a vehicle pass. There is a serious shortage of parking spaces. The existing parking lot behind the clinic is not large enough and there are no free spaces as early as 6:30 a.m. Would you consider building parking areas on the plant premises, on the empty plots of land near the administrative building?
Anton Vostrikov, NLMK-IT

Our Lipetsk management is aware of this problem and is working on it. We plan to build two parking areas near security gatehouses No. 40 and 30 by the end of this year. If this does not happen, please tell me about it on NLMK's intranet portal.

I would like to encourage all of our employees to make greater use of the available feedback tools – including contacting our management on the corporate portal, sending text messages or calling hotlines – to tell us about their problems; many of which can and should be quickly resolved.

Question #8

Will NLMK Kaluga employees have an opportunity to apply for mortgage programs to buy property with a lower interest rate, or for some other special housing programs? Thank you.
NLMK Kaluga, anonymous question

NLMK Kaluga is now running a program designed to partly cover employees' rental costs. The program serves about 200 employees in certain occupations who have moved from other regions.

NLMK's market leadership depends greatly on the contribution of each and every employee toward achieving our common goals

The company will consider NLMK Kaluga's participation in the affordable housing programs established by Kaluga Region's Ministry of Economic Development; and the decision will be announced in due course.

Question #9

Please set out the company's three main priorities; and three problems and risks that vertically integrated companies currently face. What should NLMK employees expect from efficiency improvements in the future?
Pavel Laskurinsky, Novolipetsk

NLMK's priorities are laid out in Strategy 2017, which the Group has been pursuing since 2013. These priorities are leadership in operational efficiency; a world-class resource base; leading positions in strategic markets; and leadership in sustainability and safety. We have specific, measurable targets for these priorities and are meeting most of them ahead of schedule.

On the one hand, NLMK Group's problems and risks are the same as those of its peers. For example, the weak market environment; the 12-year low in global steel prices; growing tariffs in Russia; and the protectionist measures adopted by other countries. These are external challenges that we respond to by further improving the efficiency of the company. On the other hand, we also face internal challenges. The most important internal challenge is perhaps human capital development. We need to create professional growth and fulfillment opportunities for a new generation of employees in order to ensure the leadership of NLMK Group in the future.

The more efficient our company becomes, the more investment opportunities it has – not only for building facilities or introducing new technologies, but also for developing human capital. In turn, the stronger the commitment of our staff and the more involved they are in efficiency and process improvements and innovations, the more successful the company becomes. NLMK's market leadership depends greatly on the contribution of each and every employee toward achieving our common goals, especially in today's environment.

Colleagues, have your say!

What is the current situation and future trends in the area of corporate communications at NLMK Group? Why does the Group use several channels of communication? How do employees influence the content of the corporate newspaper? For answers to these and other questions about the corporate media, read our feature story.

Alla Nepochatikh

Today's corporate communications are a tool for the staff to influence decision making in the Group

NLMK Group has developed comprehensive corporate communications that encompass both traditional mass media such as information stands, a magazine and newspapers at each production site, and new media such as blogs and social networks, NLMK-TV corporate television, newsletters and a corporate intranet portal, which is becoming a platform where employees can get access to all aspects of the company's activities. These channels are designed not only to provide quick and up-to-date information on the Group's news and events, but also to get timely feedback from the company's employees.

KEEPING IN TOUCH WITH STAFF

Today's corporate communications are a tool for the staff to influence decision making in the Group: corporate media are all developing in this direction. Newspaper editors are guided by employee feedback when planning an issue, employees send their questions to the president for an annual interview, and the intranet portal has a dedicated Q&A section, which raises the most pressing issues of concern for the readers.

Besides, we now have a new service called "Provide Feedback to the Management", where each employee can ask a question or share a problem addressing directly the president or function heads.

"Our main objective is to make useful information available to every employee," says Andrey Kazantsev, Editor-in-Chief of NLMK Group's corporate publications. *"It's important to understand which information seems useful to the employees. We rely on those active readers who are ready to share their points of view with the editorial staff. Their opinions help us set a more relevant agenda, and we are going to engage as many employees as possible in working on our publications."*

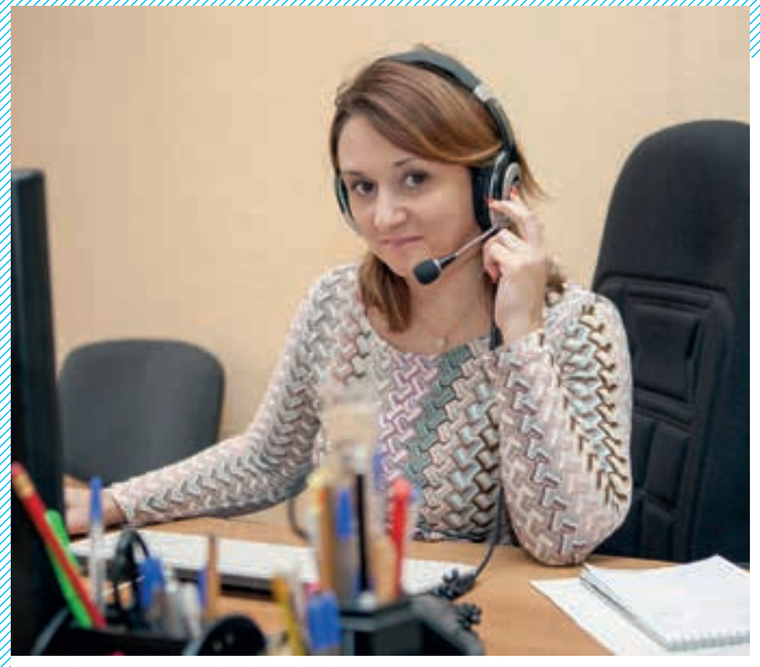
Modern means of communication such as email, the corporate portal or company's page on social networks make it possible for every employee to share their problem anonymously or openly (see contact details at the end of this feature). One of the editors' tasks is to monitor employees' queries and adjust the information agenda accordingly. Besides, many employees know the contributors in person and tell them about the issues they want to draw attention to in the corporate media.

"People's Journalist", a project that has been underway for some years already, provides an opportunity for every company employee to write for the corporate media. This year, a section with corporate blogs was launched on the intranet and the texts posted there are sometimes published in the corporate magazine or newspapers. Also, employees act as experts in their professional areas both on the corporate TV and in the printed media. However, according to the internal communications team, the most interesting feature is the president's year-end interview based on questions asked by the magazine's readers.

"We were surprised and pleased to see such a huge number of letters and comments," says Natalia Sviridenko, Topic Editor. *"Some of them were published in the magazine, other were used as a starting point for new stories."*

In addition to readers' feedback, our information agenda is also based on communication initiatives that cover all key strategic goals of NLMK Group. For example, a large-scale program aimed at promoting health and safety involves various printed materials for all the Group's media, as well as social advertising campaigns and short films. Another example is a communication

According to the internal communications team, the most interesting feature is the president's year-end interview based on questions asked by the magazine's readers



The Big Ore newspaper Editor-in-Chief Yulia Telenkova

The communications function includes experts from all Group companies, both in Russia and abroad

program for the Strategy 2017, which helps inform all our staff about the progress of NLMK Group's most important projects implemented under the new strategy.

"Our communication programs help filter the huge array of information to prioritize and cover the most important and useful events," says Marina Saifiyeva, Editor, *NLMK Long* newspaper. *"It's kind of a guarantee that every employee across our operations will always have access to the most up-to-date and important information about their companies and the Group as a whole."*

HOW IT WORKS

The communications function includes experts from all Group companies, both in Russia and abroad. They were traditionally responsible for communications at the local level only, but today they are involved in shaping the agenda for the entire Group as part of a joint editorial board established two years ago. Thanks to this integration, all Group companies are now operating in a shared information space. The joint editorial board includes both internal communications experts and employees from other functions and divisions, making up a truly cross-functional team. In practice it ensures that miscommunications occur very rarely, since readers receive information straight from the source at each of the company's sites and much faster than before. Access to the intranet makes company news available simultaneously across the entire Group, be it Lipetsk or Altai. Besides, topics and themes for all corporate media – newspapers, the magazine, intranet and NLMK-TV – are selected as part of one process.

Transformation of all corporate newspapers carried out in 2014 was in line with the overall concept of the new editorial board. The transition to a common format, despite the concerns of readers, didn't eliminate typical features of every publication: newspapers' titles, latest news from each site on front pages, classifieds and technical data on the back ones – all these remained unchanged. At the same time, all publications got a common style and layout, as well as common information standards and policy, and streamlined work processes. These improvements and well-coordinated work of the joint editorial board have taken all publications to a new level of quality.

"Planning a newspaper or magazine issue and developing the editorial agenda is perhaps one of the most difficult aspects of our work," Andrey Kazantsev says. *"When preparing a new issue, we usually have an array of topics not covered in the previous issues and face a difficult choice: on the one hand, we must be sure not to miss something important, on the other hand, we don't want to bore the reader with one and the same theme. Besides, apart from the issues that need to be highlighted, such as launch of new equipment, start of new projects, and other events, the editorial board puts a great deal of effort in monitoring the most intense discussions in blogs on the portal and in social networks. This way we are trying to find the right balance between important operations-related topics and issues of everyday concern for company employees."*

The joint editorial board includes both internal communications experts and employees from other functions and divisions, making up a truly cross-functional team

THE JOINT EDITORIAL BOARD: AN INSIDER'S VIEW

Yana Larina, Editor-in-Chief of the corporate portal, spoke in more detail about topic and story selection for NLMK Group magazine issues:

"We make an overview of all key events related to operations in the first place – signing of contracts, launch of new equipment, renovations and repairs. We find out details and in some cases we do interviews to explore the topic in more depth. Second, we monitor employees' queries on the portal, in social networks and editorial email boxes. We find out details and check information on the most urgent topics and answer readers' questions in social networks and on the portal. When we gather enough material to write a feature article or a Q&A post, we publish it in all text-based media, in some cases supporting it with a video story. Also, to extend the central theme, we make surveys on the portal and interview people for NLMK-TV. Third, we work in parallel on a number of topics which need to be explored in more depth and do not get out-of-date before a new issue comes out. These include technology reviews, features on history, profiles of distinguished employees, stories about family dynasties, and infographics.

Topic Editor Natalia Sviridenko taking an interview

Readers' questions and queries are certainly of great help to us. We hope our readers will continue to be actively involved in the work of the joint editorial board, since the more supporters we have, the more interesting our corporate media will be."

The editorial staff say that the joint editorial board is not a secret committee convening behind closed doors. To communicate with colleagues from all the sites, the editorial employees regularly tell about their work on the corporate portal in a blog called "Dear editors"; newspaper editors give interviews to NLMK-TV to announce new issues; and all of them can be reached by phone or email.

"We are open to newcomers who are interested in the behind-the-scenes life of corporate journalists," says Olga Nikulshina,

Joint editorial board

Shared email: press@nlmk.com

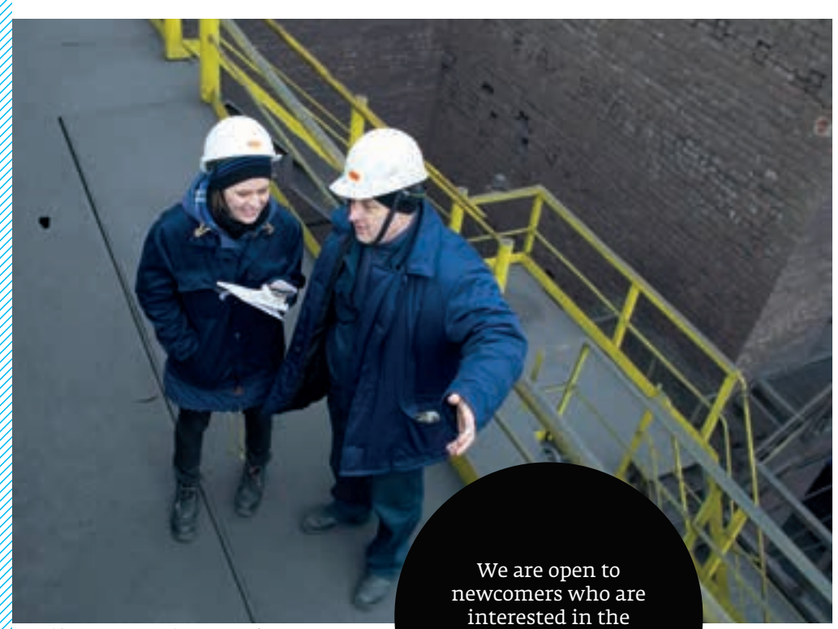
"OUR PLANT"
Novolipetsk's corporate newspaper.
Editor-in-Chief: Andrey Kazantsev.
Email: gazeta-nk@nlmk.com

"VERKH-ISETSKY WORKER"
VIZ and VIZ-Steel's corporate newspaper.
Editor-in-Chief: Natalya Kachmasheva
Email: vir@nlmk.com

"THE BIG ORE"
Stoilensky's corporate newspaper
Editor-in-Chief: Yulia Telenkova
Email: sgok@list.ru

"COKE CHEMIST OF ALTAI"
Altai-Koks' corporate newspaper
Editor-in-Chief: Polina Dyachkova
Email: ak-a-info@nlmk.com

"NLMK LONG"
NLMK Russia Long division's corporate newspaper
Editor-in-Chief: Marina Saifiyeva
Email: so-a-press@nlmk.com



Working on a story about NLMK's sintering operations

We are open to newcomers who are interested in the behind-the-scenes life of corporate journalists

Chief Production Editor of NLMK-TV. *"Any employee can become part of the joint editorial board; the only condition is your desire. We reject no one and here's why: we believe that if just one percent of the Group's sixty thousand employees take part in shaping the editorial agenda, corporate media can compete with the web in terms of diversity and wealth of content. In other words, we will find ourselves in another information paradigm where everyone can influence the information agenda."*

JOINT COMPANY – JOINT TEAM

No doubt, the shift of the corporate media editorial policy to transparency and cross-functionality cannot occur overnight. The joint editorial team says this process will take years to complete.

"We understand those who are skeptical about the very possibility of such changes in corporate communications: in many companies corporate newspapers and magazines remain a one-way top-down channel of communication, from the management to the staff, and are not really trusted," Andrey Kazantsev says. *"On the other hand, major multinational companies use their media just the other way round – as an effective channel for employees' ideas, suggestions and opinions, which ultimately improve the life of employees and hence the life of the company as a whole. After all, everybody knows what to do to make the work easier and more efficient, but nobody believes that there is a way to get an idea across to the top management. The purpose of internal communications is to become a communication link between employees and the management and give everybody the chance to be heard.*

When making plans for the function's future development, the editorial team strives for even more increased openness of all corporate media and greater employee involvement. The editors also attach great importance to social networks and the intranet portal as the most promising forums for experience sharing and communication for the Group's employees. Besides, there is a goal to make the corporate media outlets available from any mobile device.

"We want to make access to the information as easy as possible," the portal's Editor-in-Chief Yana Larina says. *"We want to provide a possibility to read corporate publications, find archive stories, subscribe to news, write a blog post on the intranet or send a question to the editors simply by SMS from any mobile phone or tablet; or share personal achievements or problems."*

We hope our readers will continue to be actively involved in the work of the joint editorial board, since the more supporters we have, the more interesting our corporate media will be

The company is getting ready for the imminent launch of another interactive company-wide project dubbed "NLMK Group. The joint company. The joint team."

The company is getting ready for the imminent launch of another interactive company-wide project dubbed "NLMK Group. The joint company. The joint team."
The project will start off with a series of professional and amateur videos showing everyday life of the Group's companies.

"The purpose of the project is to connect people across various NLMK operations in Russia, USA and Europe with each other, unite all of us within the work environment and beyond, show the scale of the company and highlight our common goals and objectives," says Sergey Babichenko, Head of Public Relations.

"Today we are open to new ideas and will be happy to welcome all employees to take part in the project. It goes without saying that we will keep you up-to-date about its progress in the corporate media. Join in!"

Contact details:

email: magazine@nlmk.com
intranet: home.nlmk.ru
plus:
vk.com/nlmk
facebook.com/nlmk.press
youtube.com/nlmkonair
instagram.com/nlmk

Corporate media:

NLMK Group intranet portal
A group-wide electronic communications platform
Editor-in-Chief: Yana Larina
Email: press@nlmk.com

NLMK-TV
NLMK Group's corporate television
Editors: Olga Nikulshina, Nikolay Zasolotsky
Email: press@nlmk.com

Weekly newsletter
An overview of NLMK Group's most important events over the week for all employees who use email
Editor-in-Chief: Yana Larina
Email: press@nlmk.com

Learning from the president

Participants of the NLMK Group Leaders 2025 program speak about their meeting with NLMK Group President Oleg Bagrin.

Yana Larina

The president talked to the participants about how to develop the skills of building and managing a team; about personal efficiency and balanced growth

NLMK Group President Oleg Bagrin held the fourth training session of the NLMK Group Leaders 2025 program, which looked into how the company's leadership stems from the leadership of individual employees and what qualities one should have to become a leader and make a successful career at NLMK Group.

Session participants share their memories of meeting the president.

While playing a business game, participants chose those who showed leadership in various situations

You could feel the top managers' genuine friendliness and interest in the participants

Dmitry Tishchenko,
Deputy Head, Project Planning and Control, Novolipetsk:

This was the first time I met the president in person. I had only seen him in video conferences before. Our work meetings usually look like this: the president listens very carefully to the speakers and then asks them clear and succinct questions which are always to the point. This meeting was different: the president made a presentation on leadership himself, and then participants had a chance to ask questions.

The meeting with the president helped me gain new perspectives on my professional growth based on the two rules that he presented during his speech. The first rule says: if you make an informed decision based on verified facts and figures, you don't need to be afraid of taking a step forward to achieve your goals, which means that you don't need to be afraid of difficult decisions and the responsibility they entail. The second rule states that to be a leader and be capable of leading a team, you need to keep yourself fit and healthy. This means that leaders should be able to manage their time so that they could systematically practice their favorite sport and live a healthy lifestyle.

The president emphasized the importance of knowing specific "numbers" – quantitative indicators of both the department you work in and the company as a whole, because this is how you can obtain a realistic picture, a, so to say, coordinate system which shows where we are now and how we progress towards our goals. To this end, together with my colleagues I plan to create a section on our function's page of the Intranet, which will display historical trends to monitor our key performance indicators over time, as well as near-term targets. I believe this information resource can be really useful if all employees coordinate their actions with the plan and see their contribution to achieving common goals.

Maxim Petukhov,
Senior Expert, Process Equipment Unit, Novolipetsk:

The most vivid impression the meeting left on me is the atmosphere created by Stanislav Tsyrlin and Oleg Bagrin. You could feel their genuine friendliness and interest in the participants of the NLMK Group Leaders 2025 program. The most relevant thing to me, of all the things the president spoke about, was how to develop the skills of building and managing a team. As for my personal prospects, I saw that I can become a leader in an existing or new function of the company and what it takes to do this. This was the most memorable session of all.

Denis Ognev,
Shift Supervisor, Coal Blending Shop, Altai-Koks:

The meeting gave us both detailed practical advice that we can apply immediately and also some valuable information "to grow into." Oleg Bagrin explored the topic of key leadership skills, a very relevant issue to me. I remember his words: "Leaders are made, they are not born." He also spoke about the prospects of career growth at the company and convincingly illustrated that everything is in our hands. I liked very much an assignment that had to do with how to identify a leader. I am going to apply the lessons learned both at work and at home.

Alexey Gorilenko,
Foreman, Electrical Equipment Repair Shop, Coke Plant, Altai-Koks:

"The leader is not the one who leads, it is the one who is followed," – this is the phrase from the president's speech that has stuck in my mind the most. A leader should not be afraid of difficult decisions and even mistakes. This is an open-minded, goal-oriented person who is able to take initiative and strives for constant improvement and development. And, of course, the leader cannot do everything himself, he needs a strong team; and the true leader is capable of building such a team.

The president seemed to me a calm, well-balanced person who is in control of the situation and can keep the conversation going, no matter what the topic is. He is committed to further development of the Group and interested in improving professional, leadership and management skills of both the participants of the NLMK Group Leaders 2025 program and all the company's employees. It was nice that the president, however busy, spent more time than planned answering all our questions.

> *"THE MEETING WAS OPEN AND HONEST AND RAN IN A RELAXED AND INFORMAL ATMOSPHERE"*

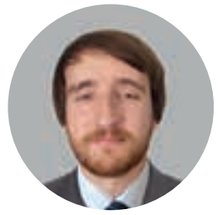
Ivan Nagorny,
Head of Production Efficiency Improvement, Stoilensky:

Oleg Bagrin underlined the importance of the NLMK Group Leaders 2025 program and its graduates. While playing a business game, we chose those who showed leadership in various situations, and then the president gave examples of how we could have done better. We also discussed what our strategy could bring in the future.

Following the meeting, my colleagues at Stoilensky came up with ideas on how to streamline the organization of operational efficiency programs. We realized once again that in addition to operational efficiency initiatives which are already underway at Stoilensky, we need to develop and implement more complex projects.

Alexander Borodin,
Head of Heating Unit, Cold-Rolling Shop, VIZ-Steel:

The meeting with the president left a vivid impression on me. His words that in the highly competitive market environment, all production processes need to be as efficient as possible seemed the most relevant to me. They allowed me to fully understand the importance of the Strategy 2017 and the role of a leader in its implementation, even on the lowest level. I am going to get the information obtained from the president across to the employees of my unit.



Nikita Vorobyev,
Senior Expert, GR, NLMK:

I liked that the meeting was open and honest and ran in a relaxed and informal atmosphere. I came away with a couple of simple principles the president spoke about. The first one says: know the KPIs in your area of responsibility – know your numbers. The second principle says: follow up on what's been agreed to ensure that the decisions you made are implemented. The third principle says that mistakes do happen; it's not the end of the world. And finally the last one: your work must not overshadow your personal and family life – find the balance.
I wish that such meetings with the top management would be held on a regular basis, since they inspire and allow you to get a clearer view of where the company is going and how you can help it get there.

Business without borders

Technology sharing is a way of interaction between all NLMK Group companies where a shared system for planning, accounting, monitoring and technology improvement is used at all production stages, from iron ore mining to high value-added products. NLMK Group expanded its reach beyond the Russian boundaries: today it spans across different continents. Technology sharing erases the borders to create an efficient production process stretching across multiple geographies. In this issue we launch a new section titled "Technology. Business without borders," in which we'll be telling you about NLMK Group's technology sharing process.

Natalia Sviridenko

What's new?

August 2015
Novolipetsk and NLMK Europe Plate developed a joint program aimed to raise end product quality. Besides improving the smelting, secondary metallurgy and casting techniques, the program will introduce end-to-end quality control covering the entire process, from slab treatment in the warehouse of BOF shop No. 2 to delivery to the customer's warehouse, including audits of transfer of slabs from rail cars to ships.

September 8–10, 2015
Novolipetsk, Vyksa Steel Works and OMK held their tenth technology meeting, which coincided with a landmark moment in the history of their partnership: the amount of pipeline steel supplied to Vyksa Steel Works reached two million metric tons. Among other things, the meeting discussed the improved quality of Novolipetsk slabs: the companies recorded a significant decrease in the number of slabs with steelmaking-related defects in the second half of 2015.

September 20–23, 2015
Siemens AG and Alstom Power carried out an audit of Novolipetsk's capabilities to make grain oriented and non-grain oriented electrical steel. They looked into the process flow chart, studied the basic principles of the company's approach to the development of new products and technology, and inspected state-of-the-art laboratory equipment used to test new products for compliance with standards. Novolipetsk maintained its status of Siemens AG's grain oriented steel supplier and was recommended as a qualified supplier for Alstom Power.

October 6, 2015
Novolipetsk hosted a meeting for colleagues from NLMK Clabecq on October 6 and from NLMK DanSteel on October 14–15 to discuss ways to ensure consistently high quality of slabs supplied to the Group's European companies, launch new steel grades, improve production technology and reduce defects.

Collaboration between NLMK Group companies

Altai-Koks – Novolipetsk
Coke and blast furnace operations of Novolipetsk and Altai-Koks started working closely in 2013. Their collaboration has already helped cut costs and improve coke quality; the companies continue to work on reducing coal consumption per metric ton of pig iron. In the first months of their joint effort, Novolipetsk and Altai-Koks managed to produce the highest quality coke in Russia.

Stoilensky – Novolipetsk
Thanks to the companies' collaboration, Stoilensky boosted its sinter ore and iron ore concentrate production in 2015. Novolipetsk's sinter plant increased production by 3.5% and enhanced its quality performance.

Novolipetsk –Stagdok – Dolomit – Stoilensky
NLMK Group added a technology sharing section to its intranet portal in 2015. The section can be accessed by Novolipetsk, Stagdok, Dolomit and Stoilensky employees to share data on the quality of iron ore, limestone and dolomite in real time.

Novolipetsk – NLMK Clabecq –OMK
The companies have recently started producing sulfide stress cracking resistant steel. Structures and pipes made of this steel remain intact in seawater and other aggressive environments. Vyksa Steel Works regularly uses NLMK stabs to manufacture steel that meets sulfide stress cracking resistance requirements. The October 2015 order book for such slabs was 14,100 metric tons.

NLMK DanSteel – Novolipetsk
The companies are taking steps to cut steel production costs. The cost of slabs supplied to NLMK DanSteel was brought down by reducing the amount of niobium – an expensive metal used for alloying –or removing it altogether. This helps improve crack resistance, enhance the quality of slabs and steel, and cut alloying costs. In 2015, they were lowered by 10%.

Wind of change

Wind is the fastest-growing energy source in the world. For instance, Denmark is already generating 48% of its electric energy from wind. It plans to increase the share of wind energy to 85% by 2035. One of the largest beneficiaries of this boom is Dansteel, an NLMK Group company, that is growing its share in the wind turbine market in North Europe. Read all about why wind energy is growing so fast; what benefits this holds for steel companies; and how a typical wind turbine works; in our article.

Alexander Yusupov

Today wind power makes up 48% of the country's energy mix, and it is likely that Denmark's target to increase this figure to 50% by 2020 will be met earlier than planned

AS FAST AS THE WIND

The wind energy market is constantly growing: its annual average growth rate was 23% between 2005 and 2014. Making up half of the increase, China added 23 GW of wind power last year, which is comparable to the cumulative installed capacity built in Spain in the past 20 years. The global investment in wind energy rose by 11% in 2014 to 100 billion US dollars, one third of the total investment in alternative energy.

What does this mean for the steel industry? The global wind power industry is estimated to consume roughly 5 million metric tons of steel each year. The Global Wind Energy Council (GWEC) forecasts that the industry's steel needs may double in the next five years, and this does not include the multiplier effect resulting in the construction of extra cargo ships, vehicles, cranes, rail cars, ports, submarine cables and transmission towers. This is good news for the steelmakers as the demand for the thick plates used in wind turbines may increase.

THE DANISH PHENOMENON

There are a few reasons for Denmark's obsession with wind turbines. The country started building them mainly because oil and gas prices soared in the 1970s and it needed to find alternatives. The most popular solution to this problem was to build coal-fired power plants, but their damaging environmental impact was a big drawback (China is a good example of this today). The second most popular solution was nuclear power plants, but after the Chernobyl disaster the Danish government decided to stay away from the peaceful atom.

With over 1,500 islands, the Jutland peninsula is an ideal place to build wind turbines, which need a wind speed of at least 4.5 meters per second to operate efficiently. Surrounded by water on two sides, Denmark borders the Baltic and the North Seas and has an average wind speed of 5.6 meters per second on land and 9 meters per second at sea. These are almost ideal conditions for wind turbines. Moreover, waters are not more than 15 meters deep along a large portion of the coastline, which means much lower construction costs. This is why the alternative energy was a natural choice for Denmark.

Today wind power makes up 48% of the country's energy mix, and it is likely that Denmark's target to increase this figure to 50% by 2020 will be met earlier than planned. The next goal is for wind energy to occupy an 85% slice of electricity generation by 2035, and experts say it's quite realistic.

It is interesting to know that despite Denmark's energy security success, it accounts for as little as 1.3% (or 4.8 GW) of the global wind power capacity. Strange as it may seem, the global leader is China (31%), followed by the US (17%), Germany (10%), Spain (6%), India (6%) and the UK (3%). According to the Global Wind Energy Council, all these countries combined make up 70% of the world's wind power capacity, which reached 369 GW in 2014.

THE WIND BLOWS FROM THE FIELD

According to the European Wind Energy Association (EWEA), a wind turbine can produce enough electricity to supply 1,500 average EU households. However, a city would need a large wind farm, i.e., a huge number of interconnected wind turbines covering an extended area. For example, if Moscow decided to switch to wind power completely, wind turbines would need to cover an area the size of Moscow, Tver, Lipetsk and even Voronezh Regions combined. This huge wind farm would generate enough electricity to power home lighting and appliances, but street lighting, businesses and factories would need more than that. However, some wind power advocates believe that the land between the turbines may be safely used for agricultural purposes and one-family home development.

The need to build wind turbines in huge numbers,

The diameter of the blades of the world's biggest wind turbine, the Vestas, is 164 meters, which is equal to the height of the Swissotel building near Paveletsky railway station in Moscow

A windmill, a precursor to today's wind turbines

scattering them across the land like dandelion seeds, is due to their small power capacity (only 2–3 MW), which is however becoming higher as the technology advances. Yet another problem is the low output of onshore wind turbines. As the wind does not blow all the time, wind turbines generate only 25% of their installed capacity on average. As many as 5,600 wind turbines would be needed to replace Sayano-Shushenskaya HPP; 3,000 turbines to replace Novovoronezh NPP; 2,000 for Moscow's CHPP-26; and 366 for Lipetsk's CHPP-2. In terms of efficiency, i.e., electrical production per megawatt of capacity, onshore wind turbines are inferior to heat and power plants (2.2 million kWh), but the offshore ones can even compete with nuclear power plants (about 7 million kWh).

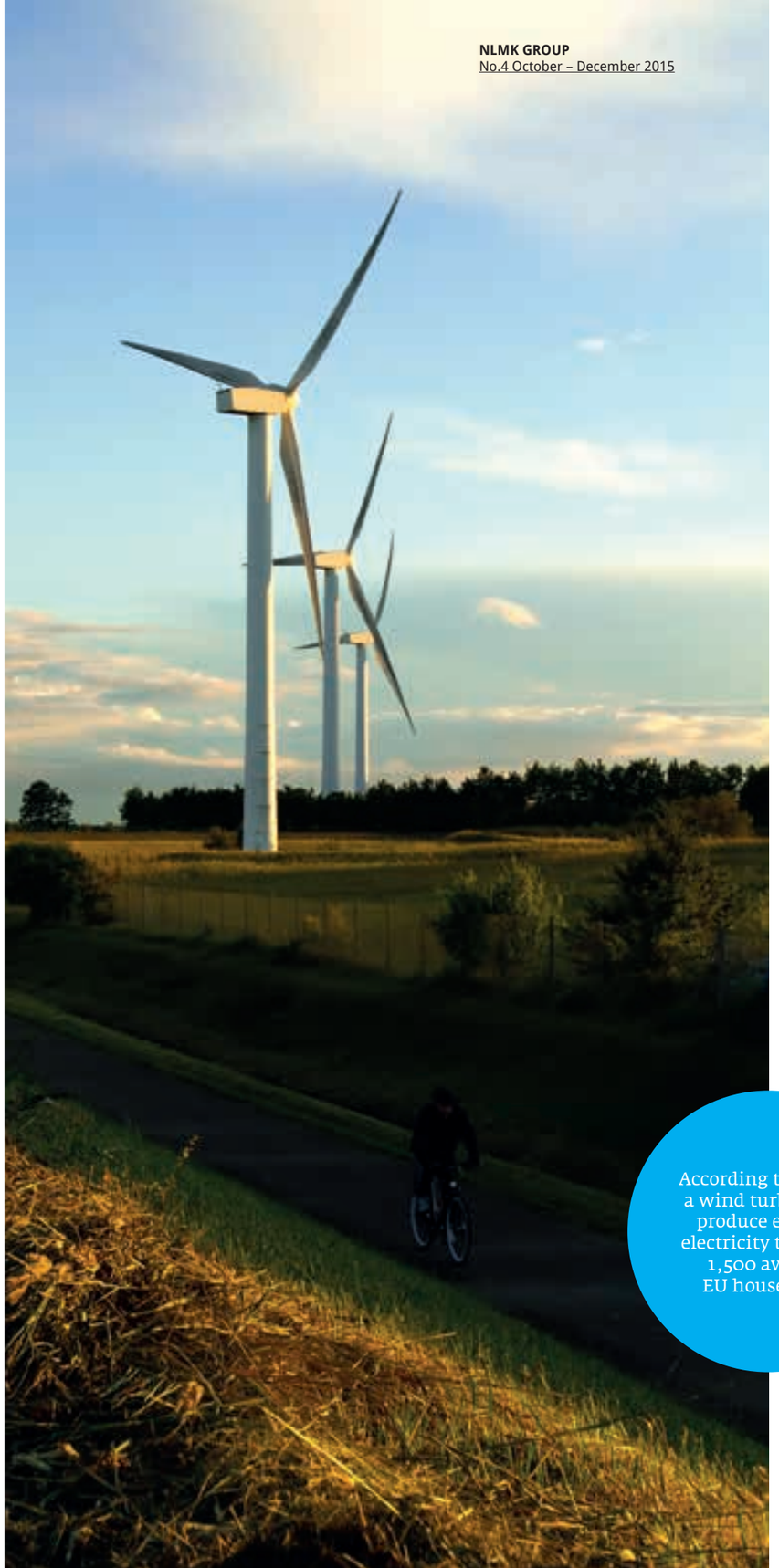
The world's largest wind farm, Alta Wind Energy Center (AWEC), is in the US. It consists of almost 500 wind turbines and produces the same amount of electricity as CHPP-2 in Lipetsk, which is albeit twice as efficient. However, AWEC will soon be outstripped by China's Gansu Wind Farm Project to be completed by 2020. It will comprise over 20,000 wind turbines generating 60–90 billion kWh annually. This is equal to the capacity of seven nuclear power plants.

China has very ambitious wind energy plans. GWEC estimates that the country accounts for more than 50% of the new wind farms built around the world. Most of the construction projects are in the western provinces (Xinjiang, Inner Mongolia, etc.) favored for their vast expanses and high average wind speeds. The electricity generated by the wind turbines is now sold at 8 cents per kWh, but the country plans to eventually reduce the rates to 4–5 cents. The main obstacle to the industry's growth in China is the lack of infrastructure: the country does not have enough distribution lines to service new capacity, and construction of new ones progresses quite slowly.

The cost of electricity from wind is actually higher than the cost of electricity generated by the old European power plants, but lower than that of power produced by the new ones. This is due to high prices for natural gas in Europe and the fact that the EU forces power companies to reflect their emissions in electricity rates. This also leads to the need to use specific technology at the newly built power plants which generate electricity from fossil fuels.

In general, building wind turbines is a costly affair. According to EWEA's estimates, an average onshore turbine has a total investment cost of around 1.2 million euros/MW; an offshore turbine, 2.5 million euros MW; a gas-fired plant, 600,000 euros/MW; a coal-fired plant, 1.6 million euros/MW; and a nuclear power plant, 6 million euros/MW. Yet another problem is the need to build extra infrastructure and the extreme reluctance to connect wind turbines to the grid because of their inconsistency (wind energy must be backed up by standby generation). This is why the only way to make companies invest in the construction of wind turbines is to use the so-called green tariffs and guarantee that the state will buy the electricity. However, wind is a very cheap source of power when compared to solar energy.

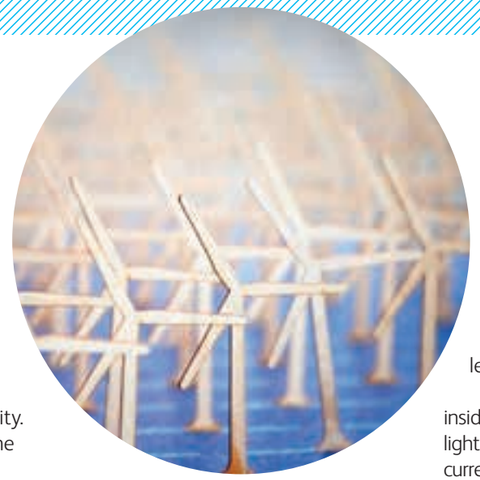
Wind energy is, to put it mildly, not the best choice for Russia, where retail gas prices are low and the rates are subsidized by the industry. Besides, a constant wind of 5 meters per second can be found perhaps in the country's north or Far East only. So you'd better think twice before installing a wind turbine at your country house. A 2 kW mini wind turbine (a complete set that includes batteries and an inverter) will now cost you about 180,000–200,000 rubles (~$2250-2500). With an average wind speed of 3–5 meters per second, it will generate 100–150 kWh a month, and it will take you 24 years to cover your outlay given that the grid electricity price is 2.07 rubles per kWh. Wind turbines have a service life of only 25 years; batteries, 10–12 years (these cost about 30,000 rubles (~$375)). However, it will be a different story if retail electricity prices go up to the levels seen in Moscow (4.5 rubles). And certainly we should not forget that the wind does not blow all the time, which means that quite often you'll have only just enough electricity to boil two kettles. And one more thing: it's not that easy to sell excess power to the state in Russia.



A wind farm near Copenhagen

According to EWEA, a wind turbine can produce enough electricity to supply 1,500 average EU households

If Moscow decided to switch to wind power completely, wind turbines would need to cover an area the size of Moscow, Tver, Lipetsk and even Voronezh Regions combined



HOW IT WORKS

People learnt to harness the energy of the wind back in the Middle Ages. Mills converted the kinetic energy of wind into the mechanical energy of the millstone to grind grains. After the invention of wind turbines in the 20th century, it became possible to convert the mechanical energy into electricity.

How does a modern wind turbine capture the energy of the wind? Thanks to the special design and position of the rotor blades. Each of them is similar in shape and design to an aircraft wing. The blades are slightly twisted, or tilted at an angle relative to the plane of the hub cover, as a specification would describe it. In physics, it is called the “angle of attack.” Anyway, the blade splits air into two currents, with high pressure under the blade and almost no pressure on top because of its streamlined, convex shape. The difference in the air currents exerting a force on the blade generates lift, which pushes it upwards. The larger the blade area is, the stronger the lift force. In airplanes, this means the larger the wing, the bigger the aircraft it can lift into the air.

You can feel what lift is like if you take your hand out of the car window while driving: if you hold your palm at an angle against the wind, it will start "taking off." If you put mini wings on a propeller, the lift force will make them rotate. This is where the most interesting part begins. Who would have thought that an airplane propeller is quite similar to the manual transmission or bicycle gears? It's just that the gear shifting is done by changing the position of the blade (the angle of attack): it can rotate around its axis, too. In the takeoff mode, the blade pitch should be minimum, i.e., the flat side of the blade should face into the wind. As the speed picks up, the edge of the blade turns into the wind, and the blade pitch increases.

By upshifting we can gather momentum while keeping revolutions unchanged, or increase a wind turbine's capacity. For example, if we sharply reduce blade pitch at a high speed, the aircraft will start slowing down, and the engine will begin overheating. The same is true for cars: downshifting will result in slowing down and bringing revolutions up. If a cyclist does this, he won't be able to pedal (without risk to health) before the speed decreases, and a wind turbine will simply start generating less electricity.

Often made of fiberglass and hollow inside, wind turbine blades are very light to maximize their sensitivity to air currents. This is why blades are perhaps the only part of wind turbines that are not made of steel. Their angle of attack changes automatically: this is done with the help of anemometer, which is located at the far end of the nacelle, the cover that houses all of the generating components of a wind turbine. When the wind changes direction, this wind speed measuring device sends a signal to the rotary mechanism, and the entire structure turns, together with the rotor. When the wind speed changes, the anemometer makes blades change their angle of attack.

The nacelle houses the rotor shaft, which has a brake system: in case of hurricane winds, it disconnects the rotor from the generator and does not let the blades turn like a propeller. The rotor shaft is connected to a gear box, which is similar to the one used in cars: it increases revolutions from 20 to 3,800 per second for the generator to start producing electricity.

One more detail: most wind turbines are designed in such a way that the generator's capacity peaks at a wind speed of about 15 meters per second. This is done to reduce the cost of turbines as such strong winds are very rare. When the wind gusts exceed the turbine's limit, the anemometer reduces the angle of attack of the blades to return to the turbine's 100% efficiency.

HOW MUCH STEEL DOES IT TAKE TO BUILD A WIND TURBINE?

The complex generating components of wind turbines use both high yield strength steel and special highly conductive electrical steel.

The global wind power industry is estimated to consume roughly 5 million metric tons of steel each year

Blades are perhaps the only part of wind turbines that are not made of steel

Most of the steel – up to 80% – is used to make the tower, for which steel sheets are rolled into a tube and joined together. Towers are usually transported in one piece, and only very high ones are assembled on site. The tower has stairs and an elevator inside for maintenance staff to access the top, as well as a cable for electricity to be transmitted from the generator to the batteries at the bottom. The batteries are critical for providing steady power supply as wind turbines don't generate electricity all the time. Then the inverter increases voltage from about 24 V to 220 V, and the transmissible current is fed to the grid. A power cabinet at the bottom of the tower controls contacts and circuits.

Wind turbines can be different in size: the taller the tower and longer the blades, the more electricity the turbine produces. This is why the recent trend is to build less wind turbines but increase their size and capacity. The EU is now developing a 20 MW turbine. The world’s biggest wind turbine, the Vestas V164-8.0 MW, was built by a Danish company. The diameter of its blades is 164 meters, which is equal to the height of the Swissotel building near Paveletsky railway station in Moscow.

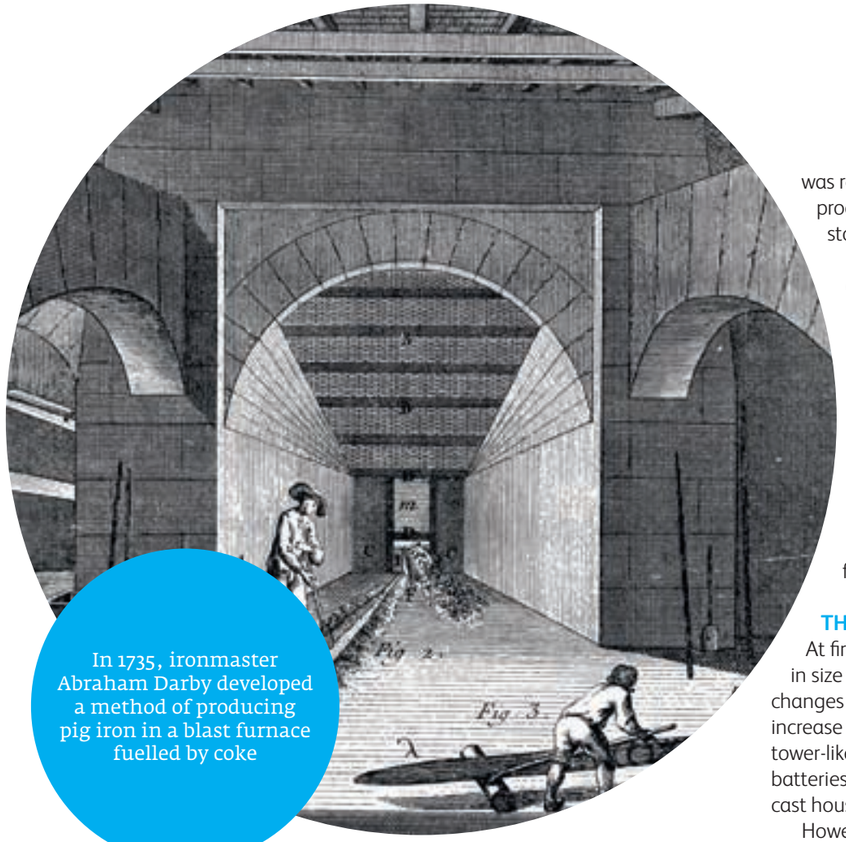
The heavier a wind turbine is, the more steel it takes to make it. Of course, manufacturers are looking to use thinner and more expensive steel grades to make the structure lighter. The World Steel Association estimates, for example, that by switching from S355 to S500 the turbine's weight can be reduced by 30%; the cost, however, increases by 20 to 25%.

Naturally, most of the huge wind turbines are built at sea. Offshore generation has more potential compared to onshore because of the high wind speeds sustained for longer periods of time. But offshore wind turbines need costly foundations. These can be platforms (in shallow waters or on land), monopiles (which require deeper drilling into the seabed), tripod platforms, lattice towers that look like transmission lines or the Eiffel Tower, or floating platforms (for deep waters). Such foundations need huge amounts of steel. For example, Swedish company Hexicon is developing a hexagonal floating platform with a diameter of almost 500 meters, which will house a 54 MW wind farm. A platform of this kind would need at least 30,000 metric tons of steel.

Scottish innovations

How could the late 16th century's small furnace producing less than a metric ton of pig iron a day turn into a powerful, high-performance machine capable of making thousands of tons of metal in 24 hours?

Oleg Golubev, Pavel Chernousov



In 1735, ironmaster Abraham Darby developed a method of producing pig iron in a blast furnace fuelled by coke

THE WHEEL WAS NOT ENOUGH

The invention of the blast furnace and its evolvement was driven primarily by the "tectonic shifts" in the social and economic life of the Western civilization, in which the society and technology were closely intertwined. One of such "shifts," known as the Industrial Revolution, started in the UK in the 18th century and continued on the Continent in the 19th century.

The new trajectory of social and economic development significantly increased the demand for metals and power. It became clear that the water wheel was not enough anymore. The situation was saved by coal; besides, the UK was rich in it. In 1735, ironmaster Abraham Darby developed a method of producing pig iron in a blast furnace fuelled by coke. In the late 18th century, James Watt entered a partnership with Mathew Boulton to commercialize steam engines, which became widely used in factories. This was also the time when the bloomery process employed for refining pig iron was replaced with the puddling process, making it possible to use stone coal.

The transition from the agrarian society to the industrial one required enormous amounts of metal, and the innovations helped meet the demand. Coke was more durable than charcoal, so the blast furnaces became higher, and the steam engines that powered blowers made it possible to blow air through the blast furnace burden more efficiently.

The transition from the agrarian society to the industrial one required enormous amounts of metal

THE TIGHTFISTED SCOTSMEN

At first, blast furnaces simply grew in size without any fundamental changes made to their design. To increase their output, the huge tower-like furnaces were grouped into batteries with a single top platform and cast house.

However, most of these "city walls" were built in South Wales, while the more rational, tightfisted and ingenious Scottish ironmasters started changing the design of the blast furnace back in the late 18th century to use less construction materials and simplify the construction process. Most of the changes were about making the shell in the upper part of the furnace thinner. The thickness of the walls surrounding the hearth was kept unchanged, as they believed

Rolling mills, Merthyr Tydfil

this helped prevent heat losses in this important part of the furnace.

Thanks to the use of more efficient blowers, which were often powered by steam engines, the amount of blast entering the furnace was increased. Also, the air was now blown into the furnace through two, or sometimes even three tuyeres. The number of tuyere cooler holders placed near the entrance to the hearth was also increased from two to four. Besides, special passages were made inside the shell for easy access from one tuyere to another and their maintenance.

Coke was more durable than charcoal, so the blast furnaces became higher

HOT BLAST: FUEL EFFICIENCY AND VARIETY

All changes made to the design of blast furnaces in the 18th century were basically cosmetic. More fundamental ones started in the middle of the 19th century, after transition to the hot blast process. Quite ingenious for the time, this technology was invented by James Beaumont Neilson, also a Scotsman.

Its main advantage was great fuel efficiency achieved through the use of exhaust gas for heating up the air blown into the hearth. However, it was only in the 20th century that steelmakers realized they could save fuel by using this method and pretreated feedstock.

In the 19th century, the hot blast process proved a real boon to the industry mainly because it helped increase the amount of heat supplied to the hearth. This gave a boost to productivity thanks to faster chemical reactions and allowed for using different types of iron ore and fuel that could not be used earlier for a number of reasons. This was of great importance for Scotland, as it opened up opportunities for mining local iron ore called blackband ironstone. Thus the discovery gave fresh impetus to the region's mining and steel industry.

The transition to the hot blast process marked a new stage in the history of blast furnace design. Before this invention, it was important to keep as much heat in the hearth as possible, and now the designers worked hard to cool it down. This gave rise to furnaces with thinner brick shells seated on corner footings, which were moved away from the hearth at the maximum distance with the help of iron beams and rings.

In the middle of the 19th century, Scottish ironmasters "abandoned the practices of the olden time" – as described by Adolf Ledebur – and removed the outer shell from the design, placing the stack on an iron ring resting on columns and surrounding it with an iron shell only.

The Scottish furnace was a real break with the Middle Ages and marked the dawn of the new industrial world

A BREAK WITH THE MIDDLE AGES

Finally, in the middle of the 19th century, Scottish ironmasters "abandoned the practices of the olden time" – as described by Adolf Ledebur – and removed the outer shell from the design, placing the stack on an iron ring resting on columns and surrounding it with an iron shell only.

The transition to the hot blast process marked a new stage in the history of blast furnace design

This type of furnace – dubbed Scottish, as you might have guessed – was a real break with the Middle Ages and marked the dawn of the new industrial world. It was cheaper to build and more durable. And while most blast furnace men expected an increase in fuel consumption and breakdowns due to heat losses, this did not happen.

The shaft of the "Scottish" blast furnace seated on a huge iron ring, which was later named "mantle ring," or simply "mantle." The ring supported a shell made of 10 to 20 mm thick iron sections riveted together. The hot blast main connected with tuyeres was fixed to the columns, and the lack of a more solid shell, which was characteristic of the 18th century furnaces, made it possible to increase the number of tuyeres and distribute them around the circumference more evenly.

The upper part of the new, lighter shell had transverse brackets that supported the top platform. It was thanks to the brackets and the platform that the "Scottish" blast furnace got its unique, easily recognizable look.

Since the iron shell constituted a large portion of the costs to build the furnace and created difficulties for repairs, it was soon replaced with special fasteners holding the bricks together. This was a free-standing stack-type furnace.

German steelmakers picked up the baton in 1864 by developing a shell-less furnace with the shaft hooped with iron bands. This type of furnace started to spread around Europe in the early 1870s, after its design was slightly improved and patented by German ironmaster Bütgenbach.

The design was gradually improved based on practical experience, and many of the blast furnaces built in continental Europe in the early 20th century had a free-standing stack. Later the designs with and without shell evolved into two main types, the "American" and "German" furnaces. We will tell you about them in our future issues.

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