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The nuances of the organizational preparation the electrification of the Kharkiv plant of the Russian Locomotive-building and Mechanical Society (1895–1896)

Abstract. *The transition to an electromechanical drive of equipment has become a new milestone in industrialization, which has led to significant: an increase in labor productivity and a decrease in the energy intensity of production processes. But on the Ukrainian lands of the Russian Empire, this innovation was not introduced until the mid-1890s, and only since that time the process of electrification of production at Ukrainian enterprises has been developed, however, with a simultaneous retain the steam-mechanical drive of equipment also. The Kharkiv plant of the Joint-Stock Company Russian Locomotive-building and Mechanical Society became the first enterprise not only in the Ukrainian provinces of the Russian Empire, but throughout the country, which used solely an electromechanical drive for all equipment. Taking into account this priority, the organizational preparation for the process of electrification of this enterprise also became the first experience in the country of introducing such an innovation, comparable, perhaps, only with the experience of switching from a mechanical to a steam-mechanical drive, which, however, was not studied in the Russian Empire. Simultaneously, the level of technical literacy of a part of the management of the Joint-Stock Company Russian Locomotive-building and Mechanical Society was not high enough to give a technical and economic assessment of the relevant innovations. Therefore, the organizational preparation for the electrification of the Kharkov plant of this Society was carried out without any clear*



methodological approaches, which in the discussion regarding the electrification scheme of the enterprise led to the replacement of the issue of choosing the best option from the most effective ones to the question of choosing the best one from the cheap ones. As a result, the Society's experts developed terms of reference for a compromise version of the electrification project, the essence of which was to install relatively new electrical equipment in terms of technical level, but operated according to an already outdated scheme, which made this electrification option neither efficient nor cheap, but politically acceptable for the entire leadership of Society. Eventually, it was possible to achieve the expected benefits from the electrification of the plant not from the implantation of the chosen scheme for its implementation, but by concluding strategic agreements with Siemens & Halske, according to which the Company's Management Board ensured it won the competition for the electrification of Society's enterprise at an affordable price, and Siemens & Halske, in turn, subsequently supplied the Company with its products at significant discounts.

Keywords: electric drive; electromechanics; industrialization; innovations; mechanical engineering; production processes

Introduction.

The electrification of the Kharkiv Plant of the Joint Stock Company (JSC) *Russian Locomotive-building and Mechanical Society (RLMS)*, better known as the *Kharkov Locomotive-building Plant (KhLP)*, was a significant event for the entire Russian Empire, since it became the first enterprise in the country, where to drive all production mechanisms were carried out exclusively with the help of electricity (The State Archive of Kharkiv Region [SAKhR], 1897a). Certainly, not all equipment used at the plant was equipped with an individual electric drive, which, in fact, is mandatory in today's perception of the electrification of production. However, in the era under consideration in Russia, even the replacement of steam engines on the drives of gearboxes of overhead transmissions of workshops with electric motors was already considered a significant step towards the electrification of production processes and, moreover, the most cost-effective step (Livshic, 1929). Thus, *KhLP*, at the time of its commissioning in 1897, was the most electrified enterprise in the country according to the ideas that existed at that time about economically viable methods of electrification, which makes it very interesting to study ways to achieve this result. Despite such a significant role of *KhLP* in the electrification of the industry of Tsarist Russia, and then – Soviet Ukraine and the Soviet Union as a whole, historians have considered the issue of the origin of this process at the plant under research itself superficially, although quite a lot of scientific works devoted to the study of the history of this enterprise have been published. So, in the article *Background of creation, further development, and establishment of Kharkiv Locomotive Plant*, the authors outline those organizational, financial, construction, social, personnel and design problems that JSC *RLMS* had to face during the construction and commissioning of the plant in Kharkov, however the moment of electrification of this enterprise was completely missed (Strelko,

Berdnychenko, Khromova, Spys, 2022). Researcher O.V. Diakova also did not consider the process of electrification of the *KhLP*, concentrating on the problem of the financial and social situation of the plant workers (Diakova, 2018). In the scientific works of O. L. Sorochynska, the process of mastering new products by the enterprise has been studied, the general reasons for the intensive development of steam locomotive building in the Ukrainian provinces of the Russian Empire and the role in this *KhLP* has been researched, but neither the electrification of the plant itself, nor its role in the development of the electrification of the domestic industry as a whole have been considered in any form (Sorochynska, 2013, 2015a, 2015b). In the study by N. Annienkova *Vyrobnytstvo verstatnoho obladdannia na Kharkivskomu zavodi Rosiiskoho parovozobudivnoho i mekhanichnoho tovarystva (kinets XIX - pochatok XX st.)* regarding the stage of the creation of *KhLP*, there is only information that the enterprise was originally focused not only on the creation of steam locomotives, but also metal-cutting machines (Annienkova, 2014). Information that *KhLP* was electrified is available in the monograph by A. A. Voskresenskij *Revolucionnaya bor'ba rabochih har'kovskogo parovozostroitel'nogo zavoda (1895–1917)*, however, neither the degree of its electrification nor how this process was organized during the construction of the plant was described by the author (Voskresenskij, 1958).

To a certain extent, the electrification of the *KhLP* has been reflected in scientific works devoted to the study of the development of electrical engineering and the electric power industry in Ukraine. So, for example, from the publication: *The development of researches in the electrical engineering field in Kharkiv Practical Technological Institute*, it follows that the power plant of the plant under study was almost the first power generating enterprise in Kharkiv (Radoguz, Zaitsev, Gutnyk & Tverytnykova, 2019). And from the article: *Obsiahy vykorystannia elektrychnykh mashyn na promyslovykh pidpriemstvakh Slobozhanshchyny naprykintsi XIX st.* we can get information about the capacity of the factory power plant and the number of production equipment equipped with an individual electric drive, originally installed at *KhLP* (Annienkov, 2014). However, in the scientific works of this profile direction, as well as in the works on the history of the creation of the *KhPZ*, the issue of organizing the electrification of the plant at the building stage has not been covered, which allows us to consider it as unexplored.

Research methods.

In preparing the article, the following methods like: problem-chronological, retrospective, dia- and synchronic methods, as well as the periodization have been used. On the basis of the diachronic method, the dynamics of external factors influencing the nature of the production processes electrification carried out at *KhLP* have been monitored, and the synchronic method has been used in the static positioning of these factors among themselves. The periodization method made it possible to single out the individual stages of the electrification process of an enterprise during its creation, and the problem-chronological method has been used to sequentially study

each of these stages in the entire complex of profile problems being solved. The retrospective method made it possible, on the basis of the principles of historicism, to restore the scientific and technical- technological level of approaches to solving the problems of electrification of machine-building enterprises used in organizing this process in the study period. As a result of the application of this methodological apparatus, a real historical picture of the organization of the preparation of the process of electrification of the *KhLP* at the stage of creating an enterprise has been drawn up, which meets the principles of historicism and objectivity.

Results.

When planning activities for the creation of *KhLP*, the problem of the formation of its fixed assets by the Board of JSC *RLMS* was divided into three tasks: 1) design and construction of buildings and structures; 2) calculation of the necessary production equipment, auxiliary machines and mechanisms, and their arrangement of the plant; 3) design and equipping of the electric power supply system of the enterprise (SAKhR, 1895a). The organization of the solution of the last of them was entrusted to a member of the Board of JSC *RLMS*, mining engineer Nikolai Nikolayevich Koksharov [1857–1941] (SAKhR, 1895a). On his initiative, in November 1895, the Board involved in the development of technical specifications for the electrical-energy equipment of the *KhLP*: a lecturer of electrical engineering at the St. Petersburg Nikolaev Military Engineering Academy and the Electrotechnical Institute, a consultant of the Main Engineering Directorate of the Military Ministry, engineer-captain Ludomir Vatslavovich Sventorzhetsky [1865–1925?] (Fig. 1) and lecturer of the St. Petersburg Institute of Technology Alexander Aleksandrovich Voronov [1861–1938] (SAKhR, 1895b).



Figure 1. Ludomir-Mikhail-Octavian Vatslavovich Sventorzhetsky.

Meanwhile, already in December 1895, the director of the plant, Pavel Pavlovich Rizzoni [1857–1937], understood the need for constant expert-consulting support for the process of electrification of the enterprise for the entire period of its construction, about which he notified the Board of JSC *RLMS*. Members of the Board unanimously supported P. P. Rizzoni, approving as such a consultant with a salary of 150 rubles monthly L. V. Sventorzhetsky (Fig. 1) and with enrolling him in the service of the

RLMS from the time when he actually began to cooperate with the JSC, that is, from November 15, 1895 (SAKhR, 1896a).

An analysis of the preparatory steps taken by the Board of JSC *RLMS* to organize the electrification of its Kharkiv plant makes us pay attention to the fact that they initially did not consider any other options for the energy supply of *KhLP*, except as for exclusively electricity, what in the chronological period we are considering was atypical for the industrial sector Russian Empire. The most common in the country at the end of the nineteenth century the power supply scheme for the production equipment of machine-building plants was the transfer of mechanical energy to it through belt (and in some cases – chain) drives from transmissions located under the ceilings of workshops. The latter, in turn, were mechanically connected to gearboxes driven by steam engines, which had different combinations of placement: from one per shop to one for each overhead transmission – depending on the absolute value of the power consumption of the entire shop, as well as on the type of steam engine used (piston or turbine). Electricity at such enterprises, according to, for example, L. Davydova, was used only for lighting, although we cannot exclude cases of using electricity to drive industrial equipment, but these cases, if they did occur, were definitely isolated (Davydova, 1966). This statement is based on the fact that in the considered scheme of combined electric and steam power supply of machine-building enterprises, block-stations were used as electric generating plants. The principle of their design was that the electric power supply to the corresponding equipment was supplied from batteries charged by a generator connected to an external or internal combustion engine, which, in view of the low productivity of such systems due to the then imperfection of batteries, a priori excluded the possibility of connecting to them, along with lighting, any-more power electrical force devices. To the above, it can be added that if there are still references to the use of block stations for arranging factory lighting in historical literature or documents, then no information has yet been found about the use of these stations as power sources for power equipment, which, in fact, confirms the imperative stated earlier about the objective conditionality of the singularity of such cases at the machine-building enterprises of the Russian Empire in the era under study (Orlov & Budagov, 1894; Suvorin, 1895; Annienkov, 2014).

A less common, but actively gaining popularity in the second half of the 1890s [especially in the Ukrainian provinces of the Russian Empire], the power supply scheme for new metalworking plants was a combination of the use of steam engines and factory power plants. The high productivity of the latter [compared to block stations] made it possible to significantly electrify production processes, which, however, was limited by technological energy intensity, such as, for example, inherent in metallurgical operations. This restriction was caused by the imperfection of the “protectionism policy” pursued by the tsarist government, resulting in a very high price for practically not manufactured in the country and imported from abroad: both used directly by the siderurgy and in the electric power industry large electric machines [such as, for example, presented on fig. 2], made their use much less cost-effective than

the use of special steam engines (Alexandrov et al., 1957). Therefore, large-scale engineering plants, in production processes in which a large share was occupied by the manufacture of bulky and heavy metal blanks, as well as giant metallurgical plants, which have large repair and machine-building workshops, provided the electric power only metal-cutting and mechanical assembly equipment. Among such enterprises founded at the same time as *KhLP*, metallurgical plants can be attributed: the Belgian JSC *Iron-rolling plant* in Konstantinovka [1896], the *Donetsk-Yuryevsk metallurgical JSC* in Alchevsk [1895], the *Nikopol-Mariupol mining and metallurgical JSC* in Sartana [1896], *Russian-Belgian metallurgical JSC* in Enakievo [1897], as well as the Kramatorsk machine-building plant [1899], the *Naval machine- and shipbuilding plant* in Mykolaiv [1895]; locomotive-building plant Hartmann in Lugansk [1896] (Ministry of Finance & Ministry of Trade and Industry of the Russian Empire, 1911).

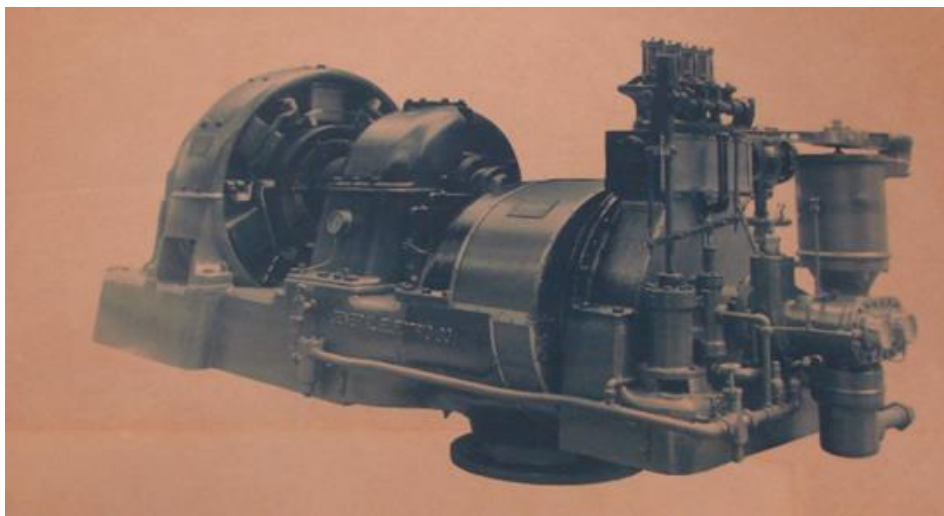


Figure 2. Electric power equipment consisting steam turbines geared to direct current generators 250V/5MW made by General Electric Company and which provided to Russian Empire at the end of the 19th – begin 20th century. (SAKhR, 1916).

Therefore, based on the situation described above, and also taking into account the type of the main product of the enterprise under study, we come to the conclusion that, when deciding on the full electrification of all production processes at the *KhLP*, the Board of JSC *RLMS* in advance intended to receive the large metal blanks necessary for the plant from outside. This is confirmed by the fact that even before the start of the construction of the plant, the Chairman of the Board of JSC *RLMS* entered into relations with the Boards of steel and copper rolling enterprises to discuss the possibility of concluding long-term contracts with them for the supply to *KhLP* of large-sized: steel casting, steel and copper rolled products, forgings (SAKhR, 1895c). This approach of exclusion from the technological chain of operations for casting and plastic deformation of massive blanks made it possible to carry out a complete electrification of production processes at *KhLP* without the need to purchase expensive electric drives for the corresponding equipment, what, however, it was not the know-

how of JSC *RLMS*, since in the 1890s it was already widely used in American mechanical engineering and begin mastered by European mechanical engineering (Atmakin, 1936). At least one of the co-founders of JSC *RLMS*, Philippe Bouheu [1836–1899], co-owner of the machine tool plant in Montzeron [France] that he and his brother Étienne inherited from his father, actively studied this American practice and applied it both at the specified plant, and at other enterprises created by the brothers in 1895 *Société Française des Corps Creux* in Montbard [France] (Morvan, 2023). So, there is every reason to believe that the method of placing orders for large: rolled products, forgings and castings at specialized factories, instead of being manufactured by machine-building enterprises on their own, was brought to the Russian Empire by Ph. Bouheu, as one of the directors of the Board of JSC *RLMS*. However, this method was approved for use only according to the conclusions from the excursion trip of P. P. Rizzoni 14–31 August 1895 in the engineering factories of France, during which he together Ph. Bouheu visited both the Bouheu brother's plants and other engineering factories, including plant of the *Société Alsacienne de Constructions Mécaniques* in Belfort (SAKhR, 1895d).

Meanwhile, the director of the *Société Alsacienne de Constructions Mécaniques* was Alfred George de Glehn [1848–1936], one of the most famous steam locomotive designer in Europe at the time¹, under whose leadership in Europe at 1895 were built already three successfully operating locomotive-building plants according to the same scheme for organizing the production process, according to which *KhLP* was later built (SAKhR, 1895d; The Times, 1936). Thus, as we can reasonably assume, the final decision on the full electrification of the JSC *RLMS* plant in Kharkov was made by the Board of the Company only after P. P. Rizzoni, who's delegated by it to assess the possibility of the effective functioning of the enterprise on the accompanying such electrification of the scheme for organizing production processes in the conditions existing in the Russian Empire, confirmed this. At the same time, attention is drawn to the fact that even before the specified trip abroad P. P. Rizzoni, and three and a half months before A. A. Voronov and L. V. Sventorzhetsky were attracted as experts [that is, before the official final approval of the decision on the full electrification of the *KhLP*], the representative office of *Siemens & Halske* in St. Petersburg has already sent to the Board of the *RLMS* a proposal (fig. 3) for its services in drawing up a project for the electrification of the plant (SAKhR, 1895e).

All other firms specializing in the Russian Empire in the electrification of industrial facilities: both with their own produced electrical equipment, and on the basis of purchased electrical equipment or in a mixed scheme, turned to JSC *RLMS* with similar proposals much later. So, for example, a representative of the Swiss electrical engineering concern *Brown-Bowery* submitted a corresponding proposal in October 1895, and representatives of the specialized Kyiv technical office of the *Henry Smith*

¹ His father was a nobleman of Prussian origin, who moved from near Tallinn (Estland province of the Russian Empire) to England, therefore, in the documents of the Russian Empire, the spelling of the surname "de Glehn" in its German transcription may be found: "von Glehen" or "de Glehen"].

& Co Trading House – at the end of November of the same year (SAKhR: 1895a, 1895f).

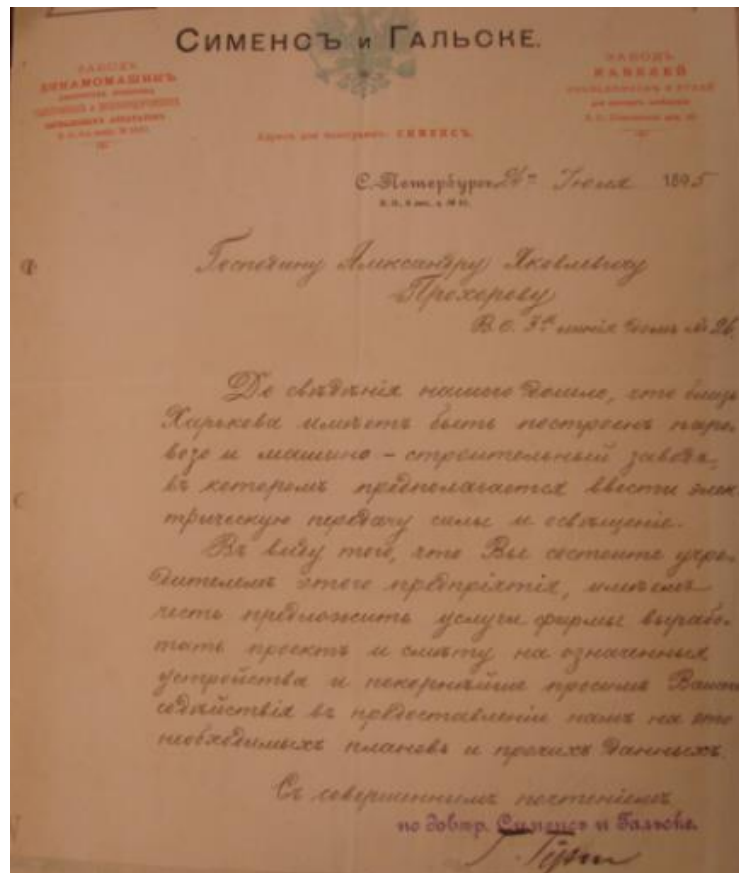


Figure 3. Letter of offer from *Siemens & Halske* for the provision of their services in the design of the electrification of *KhLP*, dated July 24, 1895 (SAKhR, 1895e).

However, on October 19, 1895 [one and a half months before the announcement of the tender for the *KhLP* electrification project], the *Siemens & Halske* representative already submitted a preliminary estimate for the plant's electrification, which could not be done without at least a preliminary corresponding design, which, in turn, also it would be impossible to draw up without having at least a master plan for an enterprise under construction with the power parameters of the equipment intended for use displayed in it (SAKhR, 1895g). By the way, chronologically, this event almost coincides with the refusal of *Usines Bouheu* to fulfill its shareholder contractual obligations regarding the provision of a detailed project for the construction of the *KhLP*, which occurred after the board of JSC *RLMS* received from it the master plan of the plant and before it was supposed to receive detailed design [before October 13, 1895] (SAKhR, 1895a). The mentioned refusal was never officially announced by *Usines Bouheu* and was realized by a simple failure by her to fulfill her obligations, which led to the need to hire the architect Alexander Ivanovich von Goghen [1856–1914] by the JSC *RLMS*, and subsequently made it possible for the Board of the JSC

to accuse *Usines Bouheu* of sabotage *KhLP* design work (SAKhR, 1896a). However, it should be noted that this accusation did not receive any legal formalization, whereas, for example, *Usines Bouheu's* untimely fulfillment of its shareholder obligations to supply *KhLP* with production equipment ended with the filing of financial claims against this company by JSC *RLMS*, which, after settlement of the issue of their magnitude, were recognized and satisfied by the *Usines Bouheu* (SAKhR, 1897b). That is, the failure to provide *Usines Bouheu* with a detailed *KhLP* project, apparently, did have reasons, however for the legal justification of which *Usines Bouheu*, most likely, did not have documented facts, and that did not lead to the official registration its refusal to fulfillment of its shareholder contractual obligations in this part. At the same time, these reasons, as we can assume, were of a discrediting nature for certain influential members of the Board of JSC *RLMS*, leading, if they were made public, to certain reputational losses of the Company even without documented facts, but only on the basis of a logical comparison of the showed results of the relevant events, which and became an obstacle for JSC *RLMS* to file appropriate financial and legal claims against *Usines Bouheu*.

In any case, the fact of leakage of information about the plans for electrification of the plant of JSC *RLMS* planned for construction in Kharkiv committed by the Board of this Society is obvious, as is the fact that the largest volumes of this kind of information were received by the St. Petersburg representative office of *Siemens & Halske*. This is what allowed *Siemens & Halske* to prepare more thoroughly than all other future bidders for the electrification of *KhLP* to prepare for the competition of projects, among other things, by initiated the use of a direct type of electric current at the plant, the advantages of which it was detailed by the company's engineers in the previously mentioned estimate of the electrification project enterprises dated October 19, 1895 (SAKhR, 1895g). In fact, all these arguments were used by A. A. Voronov, L.V. Sventorzhetsky and P. P. Rizzoni when they drew up the terms of reference for the electrification of the plant in November 1895, and if they were not quoted, then at least they were repeated very close to the text of the explanations of the *Siemens & Halske* engineers (SAKhR: 1895g, 1895h). However, otherwise, the specified terms of reference differed significantly from the method of electrification of the *KhLP* proposed by *Siemens & Halske*, primarily because of the chosen by A. A. Voronov, L. V. Sventorzhetsky and P. P. Rizzoni power generation scheme. So, *Siemens & Halske* proceeded from the need to use 6 dynamos with a total capacity of 1 250 hp, of which one machine in 250 hp had to work exclusively for lighting, while the specialists of JSC *RLMS* considered 3 dynamos with a total capacity sufficient of 900 hp, powering the lighting according to the traditional scheme – from a battery block-station charged by one of the total numbers of installed generators at a time when production processes at the plant were not carried out (SAKhR: 1895g, 1895h, 1895j).

The effectiveness of the proposed A. A. Voronov, L. V. Sventorzhetsky and P. P. Rizzoni plant power supply scheme requires additional historical research aimed at studying the economic efficiency of the use of battery block-stations in the era under

consideration in the Russian Empire in general and in its Ukrainian territories in particular. The absence of such studies greatly complicates the possibility of an objective technical and economic assessment of the option developed by these specialists for organizing the electric power supply of *KhLP*. However, it was in the economic context that the relevant terms of reference were studied by N. N. Koksharov, which, based on his approval of this option, as well as the information we have about the planned exclusively single-shift operation of the plant, allows us to assume it's then economic feasibility, unless, of course, we take into account the possible prospect of the plant switching to a multi-shift operation (SAKhR, 1895k). To the above, it should also be added that the current economic aspects in a whole influenced the preparation of the terms of reference for the electrification of the *KhLP* by the specialists of JSC *RLMS* more than the technical nuances that determine the prospective economic efficiency of the planned measures for the electrification of the enterprise. So, for example, when choosing the type of electric current used, as mentioned earlier, the arguments of *Siemens & Halske* engineers were used, based on the fact that current transportation within the enterprise will not cause a significant reduction in the efficiency of the power grid as a whole due to losses in her energy in the case of choosing direct current. However, it should be noted that this argument is unequivocally fair: 1) only when comparing the efficiency of the power supply network and the efficiency of the shafting network of the corresponding mechanical transmissions, and not the efficiency of the DC network and the efficiency of the network AC current; 2) on the condition that the power grid will not grow further due to the expansion of the plant, – and this was definitely known to such qualified specialists as A. A. Voronov and L. V. Sventorzhetsky, who's nevertheless supported this argument. At the same time, both them and P. P. Rizzoni, and N. N. Koksharov mentioned the technical side of the issue of choosing the type of current as if in passing, but the cheapness of complete electrical equipment operating on direct current compared to the same, but operating on alternating current, is considered in more detail, by the way, as well as by *Siemens & Halske* engineers (SAKhR: 1895g, 1895h, 1895k).

Meanwhile, the interest of *Siemens & Halske* specialists in focusing the issue of choosing the type of current on the cheapness of equipment is entirely understandable, since during the study period, two electrical companies, *Westinghouse* and *Allgemeine Elektrizitäts Gesellschaft* [AEG], had patent priority for the manufacture of equipment operating on alternating current, although it was disputed by them between yourself (Annikov, 2020). Therefore, by offering AC electrification at *KhLP*, *Siemens & Halske* a priori weakened their competitive position if *Westinghouse* and *AEG* were involved in the tender for this event. Although it should be recognized that the arguments of *Siemens & Halske* regarding the need to install additional transformer equipment when choosing an alternating current electrification scheme, which inevitably increases the cost of this project, are absolutely true, but do not take into account the fairly fast payback rates of the corresponding costs. In turn, the specialists of JSC *RLMS* also had a reason to lean towards choosing a direct current, since,

according to the agreement between the shareholders of JSC *RLMS*, part of the authorized capital of the Company, attributable to Ph. & É Bouheu, were supposed to compile, among other things, the necessary *KhLP* metal-cutting machines with an individual electric drive and electric overhead cranes manufactured by *Usines Bouheu* and consuming direct current (Annikenkov, 2014). That is, approximately 20% of the production equipment planned for operation at the *KhLP* (and de facto purchased) was already focused on the use of direct current even before the development of the technical assignment for the electrification of the plant.

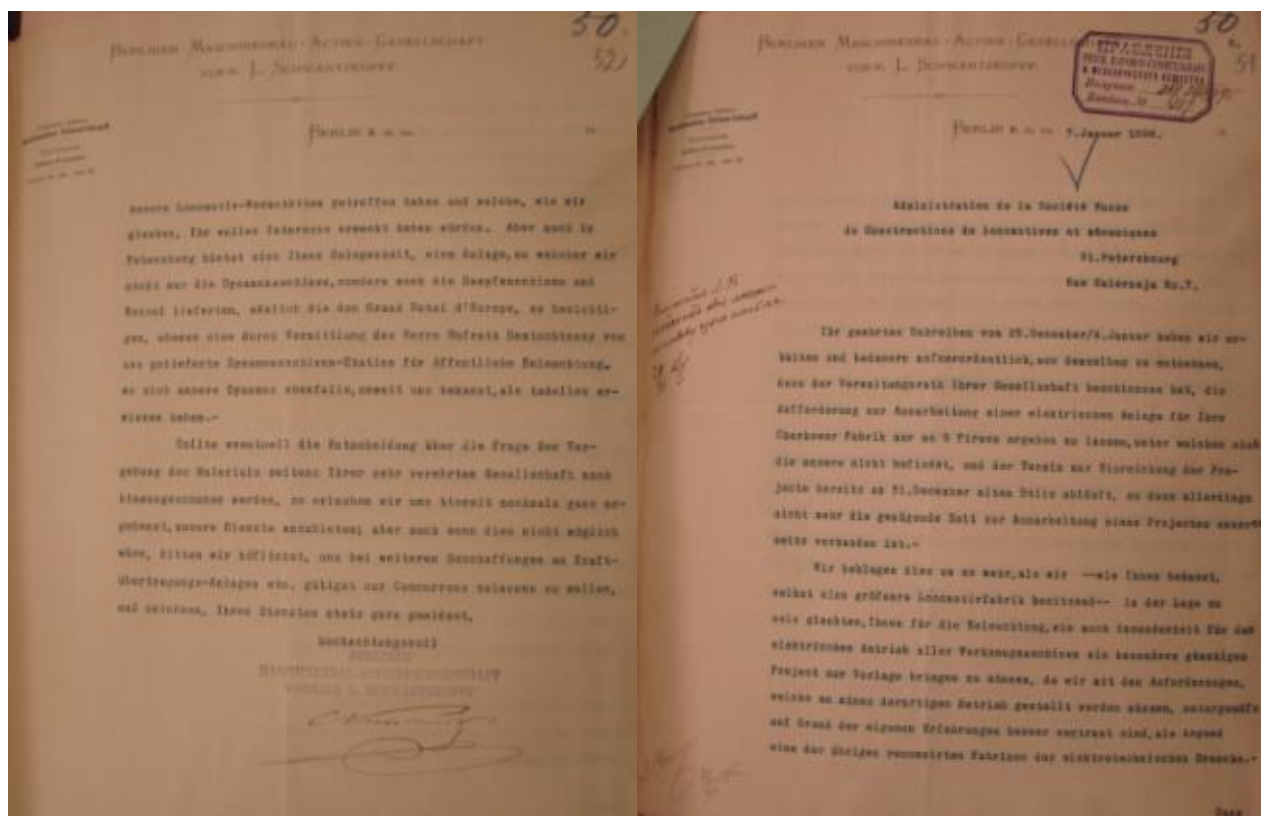


Figure 4. Letter from *Maschinenbau Schwartzkopf* to the Board of JSC *RPMO* regarding its participation in the tender for the electrification of *KhLP* (SAKhR, 1895).

Thus, according to the coincidence of opinions of the members of the Board of JSC *RLMS*, the director of *KhLP* and electrical experts, it was decided to use direct current at the enterprise, which formed the basis of the technical specifications for the project for the electrification of the plant, for which, at the insistence of N. N. Koksharov and L. V. Sventorzhetsky, only five European electrical companies that had a high reputation and guaranteed not only high-quality, but also fast execution of work were admitted – *Oerlikon* [Switzerland]; *Siemens & Halske*, *AEG*, *Lahmeyer* [all three from Germany]; *Hillaireret* [France] (SAKhR, 1895b). However, an analysis of the correspondence of JSC *RLMS* with foreign companies shows that, despite the official decision of the Board, the notice of this tender was sent not only to these

companies. So, for example, the German *Maschinenbau Schwartzkopf*, which owns both a steam locomotive plant in Germany similar in terms of production scheme and productivity to *KhLP*, and an electrical factory that produces the entire set of electric machines and equipment necessary for the electrification of such enterprises, also was receive notification of this tender, and simultaneously with the technical task for the relevant project and with notification of her non-participation in the competition, and just a week before it was supposed to take place. At least, this follows from the response letter from *Maschinenbau Schwartzkopf* to the Board of JSC *RLMS* (fig. 4), although such facts are not reflected in the minutes of the meetings of the Board of the Company (SAKhR, 1895l). This fact, as well as the refusal of JSC *RLMS* from the plan initially approved by its Board to take as the basis for the electrification scheme of *KhLP* the corresponding schemes already in use at enterprises similar to this plant, *Société Française des Corps Creux* or *Société Alsacienne de Constructions Mécaniques*, gives reason to believe that until the very end of the process of preparing for the tender for the electrification of *KhLP*, the Board of JSC *RLMS* was unanimous only in its opinion regarding the full electrification of the plant, but the ways of its implementation among the members of the Board caused disagreement. The essence of these disagreements lay in the plane of choice between the power supply of the electrical systems of enterprises, already dominant in Europe, exclusively directly from electric generators, and the power supply of factory power networks from battery block stations, which prevails in the Russian Empire.

The first option did not raise doubts about its effectiveness among Russian electrical engineering specialists, however, the lack of experience in its application in the country caused a certain wariness among the co-founders of JSC *RLMS*, who were far from the technical side – representatives of banking capital, who were more inclined towards the tried and tested second. Therefore, the proposed A. A. Voronov's and L. V. Sventorzhetsky's version of the *KhLP* combined electrification scheme became, in fact, a compromise from a technical point of view, but hardly the cheapest - from a financial point, since it required both a special project and an individual set of equipment, which, moreover, could only be provided by electrical engineering firms at the same time with strong research and production bases. At the same time, the use of ready-made standard projects and sets of electrical equipment for them, without a doubt, is a cheaper way of electrification, which could be organized by less powerful electrical companies, and even electrical divisions of similar to Kharkov's machine-building plant, that we studding, – based on the projects they have already acquired for own electrification and their experience in the purchase, installation and operation of the corresponding complete equipment. That is, considering the preparation for the tender for the electrification of *KhLP* through the prism of different positions of the founders of JSC *RPMO* on the financial side of this issue², previous example of

² Although not reflected in the documents of the Board, but objectively taking place due to the investment essence of the project of creating the Company as a whole: by combining a private capital of the banking and industrial sectors of the economy, as well as attracting personal financial resources of major government officials.

Maschinenbau Schwartzkopf is not an incidental case, but was the result of attempts by certain circles in the Board of JSC *RLMS* to find a cheaper and at the same time more technically effective than proposed by A. A. Voronov and L. V. Sventorzhetsky, the option of electrifying his plant so that the interest of all the founders of the Society in it would allow revising the results of the competition even if such a project would be presented after it was held.

Meanwhile, all sorts of attempts to reach a financial compromise in the decision regarding the electrification of *KhLP*, carried out bypassing the technical compromise, were initially doomed to failure, because, as mentioned earlier, a sharp transition to full electrification of production according to the Western model in Russia at the end of the 19th century considered to be an excessively risky financial undertaking. And the basis for the formation of its opinion was not only the lack of experience in operating such systems, but also the complete absence of any current policy in the field of electrification of the country, or at least a vision of the foundations of such a policy in the future at the level of state management institutions, which forced financial circles of the empire to be very wary of the relevant investments of capital. Thus, the need to reach a compromise in the technical scheme for the electrification of *KhLP*, as a palliative, allowing, on the one hand, to avoid the possible, due to the long-term uncertainty of the object of financing, a departure from the latest concept of full electrification of the plant to partial electrification, which has already become normal practice in Russia³, and on the other hand, to preserve the possibility of a subsequent rapid transition to the Western model of electrification, was indisputable for all technically competent founders of JSC *RLMS* or their representatives on the Board. This, taking into account the low awareness of electrical engineering issues that existed then in the Russian Empire, even among the technical intelligentsia, as well as the level of the task being solved, which is quite difficult for a qualified assessment, made it possible to avoid significant influence of other points of view on organizing and conducting a competition for the electrification of *KhLP*, except as technically competent. That is, the organizers of this tender managed to exclude the possibility of consideration by the Board of JSC *RLMS* of any other projects except for the five firms officially admitted to the tender, despite the fact that, as the chronology of the relevant correspondence of JSC *RLMS* with other companies shows, attempts to start the course of events in a different way were made. However, only three companies: *Oerlikon*, *Siemens & Halske* and *AEG*, took full part in the competition, providing both detailed designs and reasonable cost estimates for products, materials and works. Although, it must be admitted that the preparation time for the competition was very short (one month), as a result of which costs estimates for the electrification of *KhLP* presented by *Lahmeyer* and *Hillairet* turned out to be incomplete, and *Hillairet's* project, moreover, turned out to be completed only in general terms (SAKhR: 1895m, 1896a). That is, initially only *Siemens & Halske*, which received information on the planned

³ Which was mentioned at the beginning of the article.

electrification of the JSC *RLMS* plant in Kharkiv long before the announcement of the competition in volumes sufficient to draw up the relevant preliminary design and estimates, had a guaranteed opportunity to provide design and estimate documentation of the required completeness within the deadlines established by the competition and quality. To do this, she only had to make changes according to the terms of reference of JSC *RLMS* in the existing calculations, and not start the design again, like all the other electrical companies participating in the tender.

In other words, the fact that *Oerlikon* and *AEG*, which are in much worse conditions than *Siemens & Halske*, nevertheless managed to properly prepare for the tender for the electrification of *KhLP*, indicates the high scientific and technical potential of these two companies, however, which was ignored by the Board of JSC *RLMS* during the competition itself. Thus, we have every reason to believe that not only the preparation for tender, but also the tender for the electrification of *KhLP* itself was held by the Board of JSC *RLMS* somewhat biased in favor of *Siemens & Halske*. So, for example, the total cost of electrification of the plant, proposed by *Oerlikon*, was only 1% higher than the cost proposed by *Siemens & Halske* [tab. 1], however, *Oerlikon* guaranteed the efficiency of the entire system of 75.27% versus 74% for *Siemens & Halske* (SAKhR, 1896c). That is, in case of winning the *Oerlikon* tender, having paid money to this company 1% more than *Siemens & Halske* disposably, JSC *RLMS* received 1.27% more useful capacity on the entire life of the *KhLP* electric power system. Nonetheless, the contract with *Oerlikon* was recognized as unprofitable, since, according to the conclusion of L. V. Sventorzhetsky in the project of this company, the efficiency loss in electrical wiring was 9% versus 3% for *Siemens & Halske*, and the overall high efficiency was achieved due to the high efficiency of the electric machines used (SAKhR, 1896d). Meanwhile, from an economic point of view, to assess the profitability of operating a production power supply system, its overall efficiency is important, and not its discrete value for individual elements of this system. Although, of course, from the technical side, the lower efficiency of the conductive elements in the *KhLP* electrification project presented by *Oerlikon* made it problematic a possible future increase in the power supply capacity of the plant on the existing electrical wiring due to a progressive drop in efficiency in this case, or even physical its inability to bear the applied load at a whole. However, on the other hand, *AEG*'s proposal, based on the preventive power reserve of the enterprise's power supply system [as we see in tab. 1], also did not find support from the Board of JSC *RLMS*, despite the fact that, in terms of a unit of capacity, the total cost of electrification of *KhLP*, proposed by *AEG*, amounted to 149 rubles. 68 kops. for 1 hp against 152 rubles. 78 kops. for 1 hp from *Siemens & Halske* [or 2% less]. That is, the management of JSC *RLMS* during the tender did not took into account [or took into account selectively] a possible increase in electricity consumption by its plant in the medium term, which makes the feasibility study of *Oerlikon*'s refusal to electrify *KhLP* very doubtful.

Table 1. Key indicators of cost estimates for *KhLP* electrification projects presented by competing firms [compiled according to: (SAKhR: 1896b, 1896c)].

Name of the firm-contractor	Power of an electric station (hp)	Total cost of electrification of <i>KhLP</i> (rub.)		Comments
		Originally stated	Changed during the competition	
<i>Hillairet</i>	900	94 726,00	94 726,00	The project is presented only in general terms; the estimate is given without taking into account the cost of delivery of components and their installation
<i>AEG</i>	1 200	197 856,04	179 610,00	In the project, instead of generators with a total capacity of 900 hp, generators with a total capacity of 1,200 hp are included, and the cross-sections of the wires of the power grid are not indicated.
<i>Siemens & Halske</i>	900	154 730,00	137 500,00	Without comments
<i>Oerlikon</i>	900	138 874,00	138 874,00	Project and estimate are not detailed enough
<i>Lahmeyer</i>	900	132 054,00	132 054,00	The estimate does not take into account materials that the company was supposed to purchase in Russia

Moreover, a similar refusal to *AEG* is also puzzling, since just replacing the power generating unit proposed by this company with a unit of the same capacity as that of *Siemens & Halske* or *Oerlikon* could reduce the final cost of electrification of *KhLP* under the *AEG* project at least to the cost proposed by *Siemens & Halske*, with

an efficiency equal to the guaranteed *Oerlikon* and keeping of electrical wiring, allowed without any significant loss in it, the efficiency of the system as a whole, if necessary, to increase the power of the latter by a third. In spite of all the above, the Board of JSC *RLMS* did not proposed *AEG* to revise its project in the direction of reducing the power generating unit, which, in principle, would not have taken many times for the company's engineers, given that they completed the full project in month. Moreover, the design competition was held on January 19, 1896, when the snowy and frosty winter in Kharkov forced the suspension of all construction work at the *KhLP* until the end of April of this year, and the design of the power station by the architect of the plant A.I. von Goghen was carried out almost last, which, however, was due to the objective necessity of the initial design of production areas (SAKhR: 1896e, 1896f).

Thus, there is every reason to believe that the victory of *Siemens & Halske* in the tender for the electrification of *KhLP* was not due to the technical and economic advantages of the corresponding project presented by this company over the projects of its competitors, although its high scientific and technical level cannot be denied. The presence of other reasons for this victory allows us to consider both the previously indicated facts regarding the leakage of confidential profile information from the Board of JSC *RLMS* in favor of *Siemens & Halske*, and the fact sanctioned by the Board a personal meeting of its Chairman Viktor Mikhailovich Ivanov (1846–1919) with a representative of *Siemens & Halske* in St. Petersburg, which took place approximately 10 days before the tender, at which, as follows from the minutes of the Board meeting, there was a discussion about reducing the originally announced by *Siemens & Halske* cost of electrification of *KhLP* (SAKhR, 1896b). It is embarrassing as that the meeting was initiated by this representative, both that all such discussions with representatives of other firms participating in the competition were carried out by correspondence. Personal meetings on business matters with the management of the Board of JSC *RLMS* were not initiated either by the Board itself or by other competing companies, despite the presence of their authorized representative offices in St. Petersburg [at least, there are no corresponding mentions in the documents of JSC *RLMS*]. This exclusion in relations with the contestants, made for *Siemens & Halske*, chronologically coincides with the beginning of preparations for the creation of JSC *Russian Electrotechnical Plants Siemens & Halske* [Highly approved in 1898] with the proposed construction of a parent enterprise in St. Petersburg and a network of small electrical plants, the geographical location of which was to correspond as closely as possible to the centers of the areas of greatest consumption of *Siemens Corporation* products and services. The rest of the tender participants, at the time of its holding, did not raise the issue of creating their own plants on the territory of the Russian Empire, while the plant of another division of *Siemens Corporation* – *Siemens-Schuckertwerke* had been operating in St. Petersburg already for more than 40 years, which made intentions in 1895 regarding the creation of the above joint-stock company entirely real. Taking into account the “protectionist policy” being pursued by the tsarist government at the same time, as well as the fact that high-ranking government officials were present among the

leadership of the Board of the JSC *RLMS* [such as, for example, an official for special assignments under the Minister of the Imperial Court N. N. Koksharov was one of the directors of the Management Board and General V.M. Ivanov was its Chairman], and the fact that both profile experts of JSC *RLMS*: and A. A. Voronov, and L. V. Sventorzhetsky were real state servants [and the latter, moreover, an officer], we get a reason to make an assumption about a more meaningful conversation between the Chairman of the Board of JSC *RLMS* and a representative of *Siemens & Halske* than was displayed in the minutes, and which was carried out taking into account the state interests of the Russian Empire. And the incompleteness of information about it in the protocol wording, in this case, may well be due to the need to keep the competitive secret of its counterparties, especially since the process of creating *Siemens & Halske Russian Electrotechnical Plants* JSC at the time of the tender was in the phase when the corresponding the decision by the management of *Siemens Corporation* had already been made, but its implementation is still being prepared.

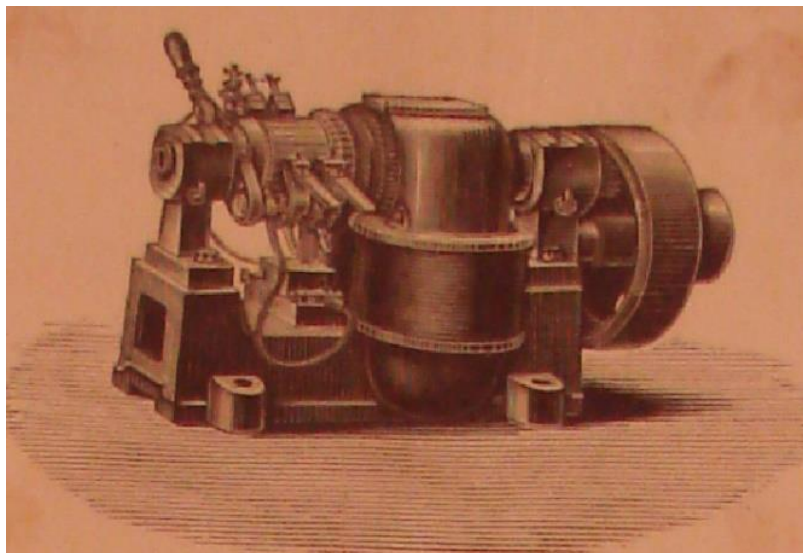


Figure 5. Siemens N-type electric motors with power from 1 hp to 60.5 hp, installed since 1896 for metal-cutting machines manufactured by KhLP (SAKhR, 1896k).

That is, we can say that the victory of *Siemens & Halske* in the tender for the electrification of *KhLP*, with rather dubious technical and economic advantages of the project presented by it, could with a high degree of probability be the result of strategic agreements between this company and JSC *RLMS* about the further cooperation in context of the “protectionism policy” pursued in the country, what kept secret from *Siemens*’s competitors. We find indirect confirmation of this in almost simultaneously with this victory [a month later] the emergence in JSC *RPMO* of a project to organize a joint production of electric locomotives with *Siemens & Halske* at the same *KhLP*, however, not implemented both due to a lack of free production capacities at the plant, and because of the small current demand for them in the domestic market of the empire (SAKhR, 1896g). However, the fact that this project of the AO *RLMS* was considered

seriously is evidenced by the fact that from May 1896 L. V. Sventorzhetsky as Society's expert had on a three-month trip abroad in order to get acquainted with the practice of electric locomotive construction at foreign electrical plants (SAKhR, 1896h). Also, an indirect confirmation of the existence of strategic agreements on further cooperation between *Siemens & Halske* and JSC *RLMS* even before the tender for the electrification of the *KhLP* was held is that, starting from December 1, 1896 [that is, even before the completion constructing works on the plant] machine tools according to the drawings of *Usines Bouheu*, those that manufactured with an individual electric drive, was equipped with electrical equipment exclusively by *Siemens & Halske*, and not by specified in the original technical documentation - for the most part by French electrical companies (SAKhR: 1896j, 1897c). At the same time, the discount in the price for this electrical equipment, provided by *Siemens & Halske* to JSC *RLMS*, ranged from 15% to 20% of its minimum price in free sale on the domestic market of the Russian Empire (SAKhR, 1897c).

Discussion.

The statements given in the presented material are largely based on assumptions, which is due both to the small number of documents that have survived today in Ukraine regarding the issue under consideration, and the practice of verbal agreements inherent in business on the most confidential aspects of partnerships. However, all the assumptions are made on the basis of the imperatives of the theory and practice of mechanical engineering technology, as well as the theoretical foundations of electrical engineering, applied in accordance with the principles of historicism, which allows us to consider the presented historical picture of the organization of the preparation of the *KhLP* electrification process at the stage of creating the plant as an objective picture at a whole. At the same time, the authors admit the possibility of further identification of additional historical facts that specify the role of individual individuals or legal entities in solving the issue considered in this article – both already known and newly established. Also, taking into account the volume and geography of the corresponding correspondence of the JSC *RLMS*, the authors do not exclude the entry into scientific circulation of new documents on the topic they studied. However, the probability that the information contained in these documents in its general meaning will contradict the already established one remains extremely low, if only because of the limits of the semantic variability of the information necessary for JSC *RLMS* on the organizational preparation of the *KhLP* electrification process, which have already been finally clarified, and examples filling in the information field in which are already given.

Conclusions.

The electrification of the *KhLP* became a significant event that determined the further path of development of the industry not only in the Ukrainian territories of Tsarist Russia, and not only in the empire as a whole, but also in Ukraine and the Soviet Union, because that choice of the scheme for organizing production processes, which

was made due to objective and subjective circumstances in its implementation has been made for the first time within the territorial boundaries under consideration, and subsequently was used massively and constantly [albeit with varying degrees of success], despite the changes in socio-economic relations and political-social structures that took place within them. Thus, the experience of electrification of the *KhLP* is successful, which, considering it as a major innovative event, allows us to once again be convinced of the unambiguous effectiveness of such events only when they are carried out simultaneously with the introduction of a set of other innovations that make it possible to use the most of the advantages to be acquired. At the same time, the organizational preparation for the electrification of *KhLP* had certain nuances that led to both positive and negative consequences for the further operation of the enterprise, including in terms of establishing the practice of making compromise decisions by the relevant management on issues that were controversial only due to technical incompetence leading staff. Thus, due to lobbying by one part of the Board members of the JSC *RLMS* of the interests of only one participant in the tender for the electrification of *KhLP* – *Siemens & Halske* and the technical incompetence of its other part, the applied electrification scheme of the enterprise under study turned out to be not the cheapest in execution and obsolete already at the time implementation, which later led to its radical alteration at an already operating plant. However, on the other hand, cooperation between JSC *RLMS* and *Siemens & Halske* has become one of the factors contributing to the development of the electrical industry in the country, moreover, on the basis of scientific and technical experience and material resources of one of the world's best manufacturers of electrical equipment. In addition, this manifestation of the “protectionist policy” served as one of the brightest examples for other leading world manufacturers of electrical engineering in terms of demonstrating the opportunities that open up for them in the market of the Russian Empire if enterprises of the corresponding profile are organized in it.

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Conflicts of interest.

The authors declare no conflict of interest.

References

- Alexandrov, A. G., et al. (1957). *Istoriya energeticheskoy tekhniki SSSR*. [History of power engineering of the USSR]. In 4 volumes. Belkind, L. D., et al. (Eds). Vol. 2. : *Elektrotekhnika – Electrical engineering*. Moscow, Leningrad: The State energy publishing house [in Russian].
- Annienkov, I. (2014). *Obsiah vykorystannia elektrychnykh mashyn na promyslovykh pidpriemstvakh Slobozhanshchyny naprykintsi XIX st.* [The scale of the use of

- electrical machines at industrial enterprises in the Sloboda region at the end of the 19th century]. *Visnyk Natsionalnoho Tekhnichnoho Universytetu "KhPI". Seriya: Istorii Nauky i Tekhnyky – Bulletin of the National Technical University "KhPI". Series: History of Science and Technology*, (59), 3–10 [in Ukrainian].
- Annikenkov, I. (2020). Cooperation with AEG in 1925–1928 as the first form of scientific-technical borrowings in the electric machine-building industry of the Ukrainian SSR. *History of Science and Technology*, 10(1(16)), 34–49. [https://doi.org/10.32703/2415-7422-2020-10-1\(16\)](https://doi.org/10.32703/2415-7422-2020-10-1(16))
- Annikenkova, N. (2014). Vyrobnystvo verstatnoho obladnannia na Kharkivskomu zavodi Rosiiskoho parovozobudivnoho i mekhanichnoho tovarystva (kinets XIX – pochatok XX st.) [Manufacture of machinery equipment at the Kharkov Locomotive Plant of the Russian society and mechanical (end of XIX – early XX century)]. *Visnyk Natsionalnoho Tekhnichnoho Universytetu "KhPI". Seriya: Istorii Nauky i Tekhnyky – Bulletin of the National Technical University "KhPI". Series: History of Science and Technology*, (59), 10–18 [in Ukrainian].
- Atmakin, M. (1936). Osobennosti amerikanskogo stankostroeniya [Features of the American machine tool industry]. *Vestnik metallopromyshlennosti – The metal industry herald*, 2, 96–104 [in Russian]
- Davydova, L. G. (1966). *Ispolzovanie elektricheskoy energii v promyshlennosti Rossii. (Istoricheskiy ocherk) [The use of electrical energy in the industry of Russia. (Historical essay)]*. Moscow: Nauka [in Russian]
- Diakova, O. V. (2018). Ekonomichniy ta sotsialnyi stan robitnykiv Kharkivskoho parovozobudivnoho zavodu na rubezhi XIX–XX st. [The economic and social situation of workers of the Kharkov Locomotive Plant at the turn of the XIX–XX centuries]. *Istoriia ta Heohrafiia – History and Geography*, (53), 91–96. <https://doi.org/10.5281/zenodo.400761> [in Ukrainian].
- l'Auxois Morvan. (2023). *Les inventeurs et industriels: Philippe Bouhey (Paris 1836 – Montzeron, 1899)*. Retrieved from <https://www.pah-auxois.fr/les-celebrites-de-lauxois-morvan/les-inventeurs-et-industriels/> [in French].
- Livshic, S. (1929). Odinochnyj i gruppovoj privod stankov v mehanicheskikh masterskikh [Single and group drive of machine tools in mechanical workshops]. *Izvestiia Gosudarstvennogo elektrotehnicheskogo tresta – The State Electrotechnical Trust herald*, 12, 252–268 [in Russian]
- Ministry of Finance & Ministry of Trade and Industry of the Russian Empire. (1911). *Spisok fabrik i zavodov Rossii na 1910 g. [List of factories and plants in Russia in 1910]*. Moscow, St. Petersburg, Warsaw: Trading house L. and E. Metzel & Co [in Russian]
- Orlov, P. A., Budagov, S. G. (1894). *Ukazatel fabrik i zavodov Evropeyskoy Rossii: materialyi dlya fabrichno-zavodskoy statistiki. [Index of factories and plants in European Russia: materials for factory statistics]*. St. Petersburg: Kirshbaum typography [in Russian]

- Radoguz, S., Zaitsev, R., Gutnyk, M. & Tverytnykova, O. (2019, July). The development of researches in the electrical engineering field in Kharkiv Practical Technological Institute. The personalities. In *2019 IEEE 2nd Ukraine Conference on Electrical and Computer Engineering (UKRCON)* (pp. 1260–1264). <https://doi.org/10.1109/UKRCON.2019.8879924>
- Sorochynska, O. L. (2013). Vnesok Kharkivskoho parovozobudivnoho zavodu v rozvytok parovozobudivnoi haluzi na Ukraini. [Contribution of the Kharkiv parovozobudivnyj plant to development of locomotive construction industry on territory of Ukraine]. *History of Science and Technology*, 3(3), 111–120. Retrieved from <https://www.hst-journal.com/index.php/hst/article/view/353> [in Ukrainian].
- Sorochynska, O. L. (2015a). Analiz diialnosti vitchyznianskykh inzheneriv u haluzi parovozobuduvannia [Activity analysis of home engineers in locomotive construction industry]. *Zaporizhzhia Historical Review*, 2(44), 257–259. Retrieved from <https://istznu.org/index.php/journal/article/view/1040> [in Ukrainian].
- Sorochynska, O.L. (2015b). Analiz sotsialno-politychnykh prychyn rozvytku parovozobuduvannia na terytorii Ukrainy [Analysis of the socio-political causes of steam locomotive on the territory of Ukraine]. *History of Science and Technology*, 5(6), 86–93. Retrieved from <https://www.hst-journal.com/index.php/hst/article/view/66> [in Ukrainian].
- Strelko, O., Berdnychenko, Yu., Khromova, O. I., Spys, O. (2022). Background of creation, further development, and establishment of Kharkiv Locomotive Plant. *History of science and technology*, 12(2), 367–387. <https://doi.org/10.32703/2415-7422-2022-12-2>
- Suvorin, A. S. (Ed). (1895). *Vsya Rossiya: russkaya kniga promyshlennosti, trgovli, selskogo hozyaystva i administratsii*. [All Russia: Russian book of industry, trade, agriculture and administration]. (Vol. 2). St. Petersburg: Typography of the Panteleev brothers [in Russian].
- The State Archive of Kharkiv Region. (1895a). File [F]. 930, Description [D]. 1, Case [C]. 4, Ss. [Sheets] 12–16f.v [overleaf], dt. 13. October. 1895. *Protokol zasedaniya Pravleniya RPMO No.4* [Minutes of the meeting of the Board of the RLMS № 4] [in Russian].
- The State Archive of Kharkiv Region. (1895b). F. 930, D. 1, C. 4, Ss. 24–28f.v, dt. 01. December. 1895. *Protokol zasedaniya Pravleniya RPMO № 9* [Minutes of the meeting of the Board of the RLMS No. 9] [in Russian].
- The State Archive of Kharkiv Region. (1895c). F. 930, D. 1, C. 4, Ss. 7–11f.v, dt. 25. September. 1895. *Protokol zasedaniya Pravleniya RPMO № 3* [Minutes of the meeting of the Board of the RLMS No. 3] [in Russian].
- The State Archive of Kharkiv Region. (1895d). F. 930, D. 1, C. 4, Ss. 3–6f.v, dt. 13. September. 1895. *Protokol zasedaniya Pravleniya RPMO № 2* [Minutes of the meeting of the Board of the RLMS No. 2] [in Russian].

- The State Archive of Kharkiv Region. (1895e). F. 930, D. 2, C. 12, S. 1, dt. 24. July. 1895. *Pismo № 01734 predstavitelia firmy Siemens & Galske v S.-Peterburge chlenu Pravleniia AO RPMO A.Ya. Prohorovu* [Letter No. 01734 from the representative of the company Siemens & Halske in St. Petersburg to the member of the Board of JSC RLMS A.Ya. Prokhorov. [in Russian].
- The State Archive of Kharkiv Region. (1895f). F. 930, D. 2, C. 12, Ss. 8–8f.v, dt. 26. November. 1895. *Pismo № 236 predstavitelia firmy Genri Smit i Ko v Kieve Pravleniyu AO RPMO* [Letter No. 236 from the representative of Henry Smith & Co. in Kyiv to the Board of JSC RLMS] [in Russian].
- The State Archive of Kharkiv Region. (1895g). F. 930, D. 2, C. 12, Ss. 2–3f.v, dt. 19. November. 1895. *Pismo № 8908 predstavitelia firmy Siemens & Galske v S.-Peterburge v Pravleniie AO RPMO* [Letter No. 8908 from the representative of the company Siemens & Halske in St. Petersburg to the Board of JSC RLMS] [in Russian].
- The State Archive of Kharkiv Region. (1895h). F. 930, D. 1, C. 4, Ss. 118–118f.v, dt. 30. November. 1895. *Protokol soveschaniya o vybore sistemy elektricheskoy peredachi na HPZ* [Minutes of the meeting on the selection of an electrical transmission system at KhPZ] [in Russian].
- The State Archive of Kharkiv Region. (1895j). F. 930, D. 2, C. 12, Ss. 14–14f.v, dt. 06. December. 1895. *Pismo L.V. Sventorzhetskogo Predsedateliu Pravleniia AO RPMO V.M. Ivanovu* [The letter by L. V. Sventorzhetsky to the Chairman of the Board of JSC RLMS V. M. Ivanov] [in Russian].
- The State Archive of Kharkiv Region. (1895k). F. 930, D. 1, C. 4, Ss. 119–121f.v, dt. 29. November. 1895. *Pismo N.N. Koksharova Predsedatelyu Pravleniya AO RPMO V.M. Ivanovu* [The letter by N. N. Koksharov to the Chairman of the Board of the JSC RLMS V. M. Ivanov] [in Russian].
- The State Archive of Kharkiv Region. (1895l). F. 930, D. 2, C. 12, Ss. 51–52, dt. 28. December. 1895. *Pismo № 387 administratsii Maschinenbau Schwartzkopf v Pravlenie RPMO* [Letter No. 387 from the administration of Maschinenbau Schwartzkopf to the Board of the RLMS] [in Russian].
- The State Archive of Kharkiv Region. (1895m). F. 930, D. 1, C. 4, Ss. 29–32f.v, dt. 15. December. 1895. *Protokol zasedaniya Pravleniya RPMO № 10* [Minutes of the meeting of the Board of the RLMS No. 10] [in Russian].
- The State Archive of Kharkiv Region. (1896a). F. 930, D. 1, C. 4, Ss. 33–35f.v, dt. 05. January. 1896. *Protokol zasedaniya Pravleniya RPMO № 11* [Minutes of the meeting of the Board of the RLMS No. 11] [in Russian].
- The State Archive of Kharkiv Region. (1896b). F. 930, D. 1, C. 4, Ss. 36–37f.v, dt. 12. January. 1896. *Protokol zasedaniya Pravleniya RPMO № 12* [Minutes of the meeting of the Board of the RLMS No. 12] [in Russian].
- The State Archive of Kharkiv Region. (1896c). F. 930, D. 1, C. 4, S. 127, dt. 05. January. 1896. *Sravnitel'naya tablitsa osnovnyh pokazateley smet na ustroystvo elektricheskogo osvescheniya i peredachi sily na zavode RPMO v*

- Harkove, predstavlenykh firmami-konkursantami (podgotovlena L.V. Sventorzhetskim) [Comparative table of the main indicators of estimates for the installation of electric lighting and power transmission at the plant of the RLMS in Kharkov, presented by the firms participating in the competition (prepared by L.V. Sventorzhetsky)] [in Russian].*
- The State Archive of Kharkiv Region. (1896d). F. 930, D. 1, C. 4, S. 126, dt. 05. January. 1896. *Poyasnitelnaya zapiska L.V. Sventorzhetskogo s zamechaniyami k konkursnym proektam elektrifikatsii HPZ [Explanatory note by L.V. Sventorzhetsky with comments on the competitive projects for the electrification of KhPZ] [in Russian].*
- The State Archive of Kharkiv Region. (1896e). F. 930, D. 1, C. 4, Ss. 38–38f.v, dt. 19. January. 1896. *Protokol zasedaniya Pravleniya RPMO № 13 [Minutes of the meeting of the Board of the RLMS No. 13] [in Russian].*
- The State Archive of Kharkiv Region. (1896f). F. 930, D. 1, C. 4, Ss. 46–47f.v, dt. 05. April. 1896. *Protokol zasedaniya Pravleniya RPMO № 17 [Minutes of the meeting of the Board of the RLMS No. 17] [in Russian].*
- The State Archive of Kharkiv Region. (1896g). F. 930, D. 1, C. 4, Ss. 42–43f.v, dt. 23. February. 1896. *Protokol zasedaniya Pravleniya RPMO № 15 [Minutes of the meeting of the Board of the RLMS No. 15] [in Russian].*
- The State Archive of Kharkiv Region. (1896h). F. 930, D. 1, C. 4, Ss. 54–56f.v, dt. 31. May. 1896. *Protokol zasedaniya Pravleniya RPMO № 20 [Minutes of the meeting of the Board of the RLMS No. 20] [in Russian].*
- The State Archive of Kharkiv Region. (1896j). F. 930, D. 1, C. 7, Ss. 36–37, dt. 14. December. 1896. *Otchet Pravleniia RPMO obschemu sobraniiu aktsionerov [Report of the Board of the RLMS to the General Meeting of Shareholders] [in Russian].*
- The State Archive of Kharkiv Region. (1896k). F. 930, D. 2, C. 12, Ss. 118–119, dt. January. 1896. *Spetsifikatsiya na elektrodvigateli tipa «N», postavlyaemyie Siemens i Galske dlya ustanovki na metallorezhushee oborudovanie proizvodstva KhPZ [Specification for N-type electric motors supplied by Siemens and Halske for installation on metal-cutting equipment manufactured by KhLP] [in Russian].*
- The State Archive of Kharkiv Region. (1897a). F. 930, D. 1, C. 57, Ss. 40–43, dt. 01. June. 1897. *Spravka zavodoupravleniya HPZ o nachale ego deyatel'nosti [Reference of the KhPZ factory management office on the beginning of its activities] [in Russian].*
- The State Archive of Kharkiv Region. (1897b). F. 930, D. 1, C. 8, Ss. 16–17f.v, dt. 11. December. 1897. *Protokol zasedaniya Pravleniya RPMO № 47 [Minutes of the meeting of the Board of the RLMS No. 47] [in Russian].*
- The State Archive of Kharkiv Region. (1897c). F. 930, D. 1, C. 8, Ss. 1–3, dt. 24. July. 1897. *Protokol zasedaniya Pravleniya RPMO № 40 [Minutes of the meeting of the Board of the RLMS No. 40] [in Russian].*

- The State Archive of Kharkiv Region. (1916). F. 349, D. 1, C. 49, 76 ss., dt. 1908–1916. Katalog i smety elektroenergeticheskogo oborudovaniya, realizuemogo i obsluzhivaemogo VEK [Catalog and costings of electric power equipment sold and maintained by VEC] [in Russian, German & English].
- The Times. (1936). Alfred George de Glehn: Obituary, London of 11 June 1936, p. 18.
- Voskresenskij, A.A. (1958). *Revolucionnaya bor'ba rabochih har'kovskogo parovozostroitel'nogo zavoda, (1895–1917): Kratkij istoricheskij ocherk* [The revolutionary struggle of the workers of the Kharkov locomotive plant, (1895–1917): A brief historical essay]. Kharkov: Publishing House of the Kharkov State University [in Russian].

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Нюанси організаційної підготовки електрифікації Харківського заводу Російського паровозобудівного і механічного товариства (1895–1896 гг.)

Анотація. *Перехід до електромеханічного приводу устаткування став новою віхою в індустріалізації, що привела до значного: зростання продуктивності праці та зниження енергоємності виробничих процесів. Але на українських землях Російської імперії дана інновація до середини 1890-х років не впроваджувалася, і лише саме з того часу процес електрифікації виробництва на українських підприємствах отримав свій розвиток, проте при цьому на них зберігався й паромеханічний привод обладнання. Харківський завод Акціонерного товариства «Російське паровозобудівне і механічне товариство» став першим підприємством не лише в українських губерніях Російської імперії, але й у всій країні, на якому було застосовано виключно електромеханічний привод усього устаткування. Зважаючи на даний пріоритет, організаційна підготовка процесу електрифікації цього підприємства також стала першим у країні досвідом впровадження такої інновації, порівняний бодай лише з досвідом переходу з механічного на паромеханічний привод, який, однак, у Російській імперії не був досліджений. При цьому, рівень технічної компетенції частини керівництва Акціонерного товариства «Російське паровозобудівне і механічне товариство» був недостатньо високим для того, щоб надавати адекватну техніко-економічну оцінку відповідним інноваціям. Через це організаційна підготовка електрифікації Харківського заводу означеного Товариства проводилася без яких-небудь чітких методологічних підходів, яка у дискусії щодо*

схеми електрифікації підприємства привела до заміни питання вибору оптимального варіанту з ефективних питань вибору оптимального з дешевих. В результаті, експертами Товариства було розроблено технічне завдання на компромісний варіант проєкту електрифікації, суть якого полягала у встановленні відносно нового за технічним рівнем електрообладнання, що експлуатувався по вже застарілій схемі, це робило даний варіант електрифікації ані ефективним ані дешевим, але політично проблемним для усього керівництва Товариства. Досягти очікуваної вигоди від електрифікації заводу в результаті вдалося не від запровадження обраної схеми її проведення, а шляхом укладання стратегічних домовленостей із компанією Siemens & Halske, згідно з якими Правління Товариства забезпечило їй перемогу в конкурсі на електрифікацію свого підприємства за прийнятною ціною, а Siemens & Halske, в свою чергу, в подальшому постачало свою продукцію із значними знижками.

Ключові слова: електропривод; електромеханіка; індустріалізація; інновації; машинобудування; виробничі процеси

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