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RISK MANAGEMENT MODEL FOR THE SELECTION OF MANUFACTURERS OF PLASMA EQUIPMENT FOR POWER SYSTEMS

МОДЕЛЬ УПРАВЛІННЯ РИЗИКАМИ ВИБОРУ ВИРОБНИКІВ ПЛАЗМОВОГО ОБЛАДНАННЯ ДЛЯ ЕНЕРГЕТИЧНИХ СИСТЕМ

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Abstract. The article presents analysis of previous studies which defines the aspects of selection of technical equipment manufacturers. The available criteria for the manufacturer assessment are rendered. The study implements the practices for the selection of plasma equipment manufacturers at the execution of various projects. There has been developed a model for managing the risks arising at the selection of plasma equipment manufacturers in the projects aimed at creation of plasma-chemical elements. The article then considers the major blocks of the risk management model for the selection of plasma equipment manufacturers within the projects aimed at creation of plasma-chemical elements. There are provided the criteria for the selection of plasma equipment manufacturers that can be used by the project team. The most probable indicators of plasma systems used to select potential manufacturers are defined. The study also considers the main steps of testing the manufacturer's qualification prior to establishment of a contract. At last, the criteria for assessment of plasma equipment manufacturers are proposed.

Keywords: plasma-chemical elements; plasma equipment manufacturers; risk management; manufacturer assessment criteria.

Анотація. Представлено аналіз попередніх досліджень, що визначає аспекти вибору виробників технічного обладнання. Проаналізовано критерії оцінки виробників обладнання, що використовуються в літературі. Застосовано практики вибору виробників плазмового обладнання під час виконання різноманітних проектів. Розроблено модель управління ризиками, які виникають у процесі вибору виробників плазмового обладнання в проектах зі створення ПХЕ. Розглянуто основні блоки моделі управління ризиками вибору виробників плазмового обладнання під час реалізації проектів зі створення ПХЕ. Наведено критерії вибору виробників плазмового обладнання, які можуть використовуватися командою проекту. Визначено найбільш вірогідні показники плазмових систем для вибору потенційних виробників. Охарактеризовано основні кроки перевірки кваліфікації виробника до укладання з ним контракту. Запропоновано критерії оцінки виробників плазмового обладнання.

Ключові слова: плазмохімічні елементи; виробники плазмового обладнання; управління ризиками; критерії оцінки виробників.

Аннотация. Представлен анализ предыдущих исследований, который определяет критерии выбора производителей технического оборудования. Проанализированы критерии оценки производителей оборудования, применяемые в литературе. Использованы практики выбора производителей плазменного оборудования при выполнении различных проектов. Разработана модель управления рисками, которые возникают при выборе производителей плазменного оборудования в проектах по созданию ПХЭ. Рассмотрены основные блоки модели управления рисками выбора производителей плазменного оборудования при реализации проектов по созданию ПХЭ. Приведены критерии выбора производителей плазменного оборудования, которые могут использоваться командой проекта. Определены наиболее вероятные показатели плазменных систем для выбора потенциальных производителей. Охарактеризованы основные шаги проверки квалификации производителя до заключения с ним контракта. Предложены критерии оценки производителей плазменного оборудования.

Ключевые слова: плазмохимические элементы; производители плазменного оборудования; управление рисками; критерии оценки производителей.

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Problem statement. Modern sea and river ports should operate with due account for the conditions for preservation of ecosystems and maintenance of the appropriate quality of the environment. To tackle the set of environmental issues associated with the development of a port, it is desirable to form a comprehensive ecological infrastructure with the use of mobile complexes for the collection, treatment and disposal of various types of waste, as well as sediments in treatment facilities. Application of advanced plasma-chemical technologies is one of the most promising options for building environmentally friendly power systems [1, 4].

Projects on the creation of plasma-chemical elements (PCE) for power systems require specific types of equipment with a particular level of application. These projects face a huge number of risks that need to be identified and analyzed at the stage of project initiation, assessed cumulatively, prevented, eliminated or reduced at the next stages of the life cycle.

Effective management of the selection of plasma equipment manufacturers is an important task in the PCE creation projects. The choice of the plasma equipment manufacturer defines the effectiveness of the mission and objectives of the PCE creation project, which makes the task of its scientific substantiation relevant and practically significant.

Latest research and publications analysis. Projects on the creation of PCE for power systems [1, 4, 5] predominantly involve a wide range of plasma equipment manufacturers. At that, unfavorable manifestations of the risk factors associated with the selection of plasma equipment manufacturers may lead to an increase in the expenditures on the whole project and time of its execution, deterioration of quality, and further decline of the basic economic indicators.

It should be noted that the generalized criteria for the selection of manufacturers of technical equipment for various purposes are rendered in the papers published by a number of authors. Table 1 presents their summary.

In fact, the publications on the selection of equipment manufacturers indicate that at present, there is a wide variety of criteria common for different industries, as shown in Table 2.

Such assessment criteria as product price formation, cost of sub-components, cost-effectiveness and indirect costs all enable allocating various amounts of total expenditure for the purchase of technical equipment. Similarly, such assessment criteria as the equipment exportability and customs duties address the situation with geographically distant manufacturer and customer in the context of international projects.

When determining the scale of the manufacturer's product, the project team (PT) should take into account such criteria as manufacturing of high-quality equipment, no deviations during inspection, and the diversity of the product range. Assessment of the prospect of order fulfillment for a project on the development of technical systems should involve such criteria as quality management, availability of inspection permits, warranty service, self-regulation, compliance with procedural and safety requirements, availability of a conflict resolution system, and a proper time of order execution [18]

Furthermore, such criteria as reliable delivery, response flexibility, accuracy of calculations, equipment design, work experience, and order confirmation also regard the options of the equipment purchase. Procedural compliance, certification and standards, and compliance with regulatory requirements should be assessed by the PT as well. A prospective strategic analysis of technical equipment manufacturers suggests considering such assessment criteria as intellectual property rights, research and development, and innovations, all aimed at progressive improvement. The criteria of IT standards, data administration, and availability of electronic transactions are all associated with the capabilities of information systems management. In order to meet a project customer's specific requirements and expectations, the PT must take into account cultural orientation, manufacturer's obligations, confidentiality of relations, previous business records, scope of discounts, mutual agreements, and fulfillment of contractual obligations. In addition, the criteria of organizational culture, personnel's qualification and education, as well as design capability all focus on the human resources available to the equipment manufacturer within their organization.

Table 1. Criteria for the selection of technical equipment manufacturers

Authors	Criteria for the selection of equipment manufacturers
[15]	Technical criteria Economic criteria Contractual obligations Logistics
[12]	Technical criteria
[13]	Technical aspects Economic aspects Strategic aspects
[17]	Manufacturing standards Cost of ownership Operational costs Equipment specifications
[9]	Cost criteria Operational requirements Technical requirements
[16]	Cost Technical characteristics Safety Enterprise policy State of the market Environmental restrictions
[11]	Cost criteria Technical effectiveness criteria

Table 2. Criteria for the assessment of equipment manufacturers [18, 19]

Criteria for the assessment of equipment manufacturers		
Manufacturing of high-quality equipment	Reliable delivery	Guarantees
Equipment exportability	Sufficient solvency of the manufacturer	Intellectual property rights
Equipment cost	Production opportunities	Technical capabilities
Labor relations	Reputation	Financial position on the market
Application of modern market systems for management, labor organization and efficient resource use	Service quality	At least one-year experience
No bankruptcy procedure	Cultural affiliation	No communication barriers
Geographical location of the manufacturer	Reference to exchange rates	Customized discounts
No trade restrictions	Service	Confirmation of orders
Business initiative	Fulfillment of contractual obligations	Possibility of conducting electronic transactions
Compliance with legislation of the registration country	Technical, engineering and production capacity	Availability of an information system for communication and order processing
No deviation during inspection	Accurate billing	Provision with stable orders
Proper time of execution of the order	Customs duties	Response flexibility
Innovations	Wide range of products	Compliance with safety requirements
Experience	Confidentiality of relations	Conflict resolution systems
Effective quality control system	IT standards	Cost reducibility
Research and development	Organizational culture	Availability of certificates and licenses
Sub-component price formation	Compliance control	Self-regulation
Data administration	Proper level of personnel's education	Proper level of personnel's qualification
Electronic data exchange	Comprehensive approach to detection and resolution of a customer's issues	Procedural compliance

Unfortunately, specialized publications hardly provide any risk management models and criteria for the selection of plasma equipment manufacturers.

THE ARTICLE AIM is to develop the criteria and models for managing the risks accompanying the selection of advanced plasma equipment manufacturers during implementation of the projects on creation of PCE for power systems.

Basic material. The problem of the selection of plasma equipment manufacturers covers the issues of search for partners and creation of a bank of identified manufacturers of plasma equipment of various purposes. Identification and formation of a strategic partnership with the most effective manufacturers should be integrated into the process of managing PCE creation projects in order to meet their mission, goals and objectives, that is, to reduce financial expenses, provide continuous improvement of product quality aimed at minimizing operational defects, increase flexibility at satisfaction of customer needs, and reduce the execution time at different stages of the project's life cycle [18].

Thus, the main purpose of the selection of plasma equipment manufacturers is to meet the goals and objectives of the PCE creation project, that is, to achieve higher quality and efficiency of various plasma elements for power systems (for instance, plasma igniters, plasma-fuel injection nozzles, plasma generators of hydrogen-containing gas, their feeders, etc.), higher operational flexibility and more sustainable economic positions.

As a result of theoretical studies and analysis of the experience in selecting plasma equipment manufacturers in the course of implementing various projects at the Admiral Makarov National University of Shipbuilding [3], the American company Applied Plasma Technology, LLC [8], the International Plasma Technology Center [14], and the Research Institute of Experimental and Theoretical Physics at the Kazakh National University [2], there has been developed a risk management model for the selection of plasma equipment manufacturers when implementing the PCE creation projects (see Fig. 1).

This model includes the following main blocks: formation of a set of requirements for the manufacturer, formation of a set of constraints and criteria for the selection of the manufacturer, development of a template for the selection of the manufacturer, verification of the criteria for the selection of the manufacturer, identification of alternative manufacturers and their hierarchy, assessment and final analysis of manufacturers, and archiving.

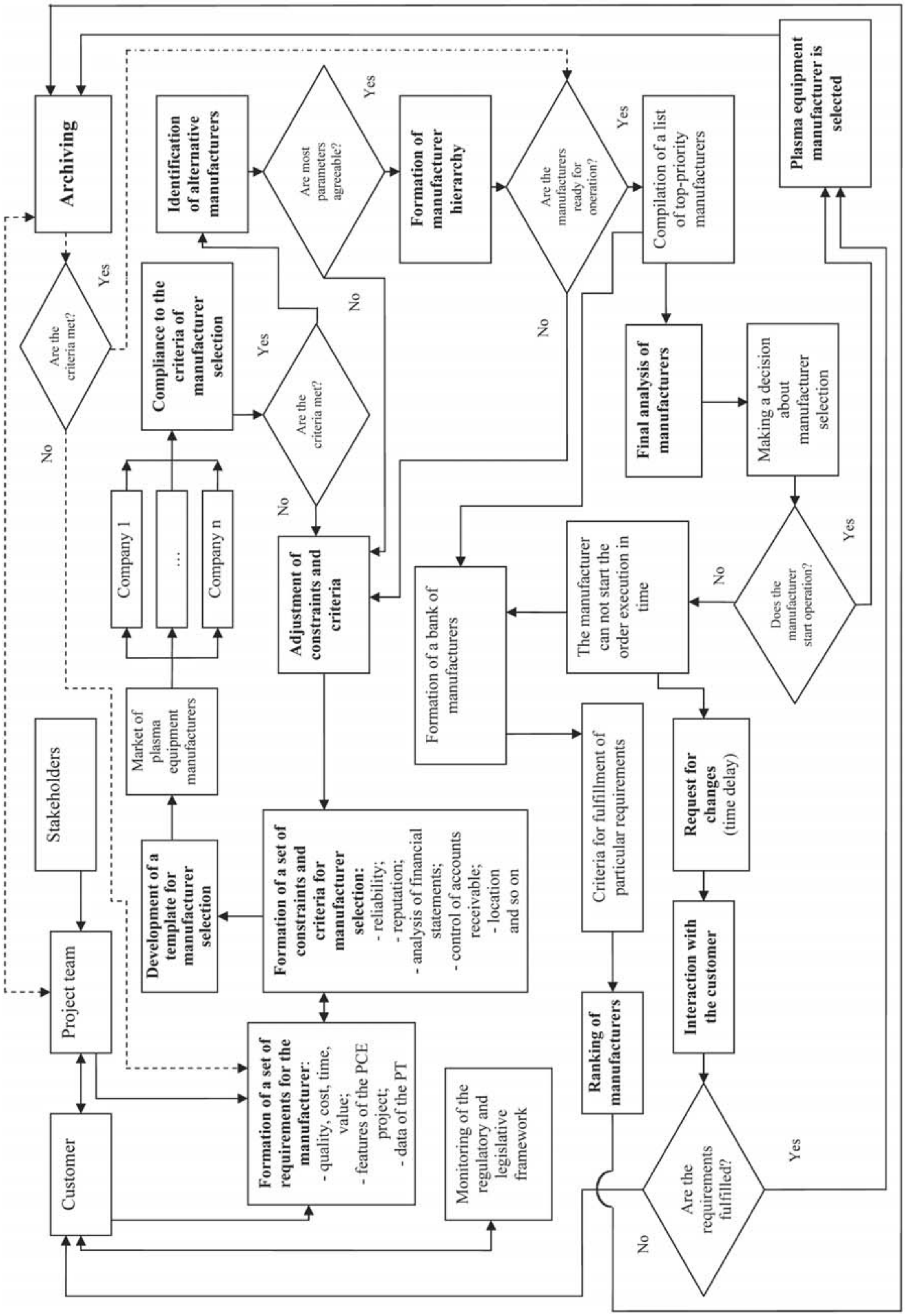

Fig. 1. Risk management model for the selection of plasma equipment manufacturers

The proposed model is based on the set of constraints defined with account for the customer's requirements, regulatory and legislative framework, special features of the PCE creation project, possible proposals of the project team, as well as the set of criteria for selecting the plasma equipment manufacturer.

Generally speaking, the set of customer requirements may include performance indicators, cost, composition, domain, and experience of operation, PT's focus on innovations, and feedback on its work. In turn, the set of legislative and regulatory constraints comprise the PT's legal status, relevant permits and licenses, and qualifications of the PT's members.

Let us consider the main components of the developed model in more detail. First, the team of the PCE creation project addresses its archive in order to search for the plasma equipment manufacturers available on the international market (shown with dotted line in Fig. 1). The archive contains the following information about plasma equipment manufacturers:

1. Company name: ______________
2. Experience in international innovation projects: ______________ years
3. How long has the company been on the market?
   – less than 5 years;
   – from 6 to 10 years;
   – from 11 to 20 years;
   – more than 20 years.
4. How many employees are there in the company?
   – less than 10;
   – 11 – 50;
   – 51 – 100;
   – more than 100.
5. Equipment manufactured for project purposes: ______________________________
6. Equipment price: ______________
7. Time of execution of the order: ______________

Besides, the PT should use other criteria for selecting companies available in the archive (see Table 3). It is proposed to take expert assessment as a basis, with low rating being 10 to 39 points, medium being 40 to 69 points, and high rating being 70 to 100 points.

If the archived company meets the specified criteria, the PT contacts this manufacturer with a request for readiness; if it does not, the procedure of selection of the plasma equipment manufacturer starts from the very beginning.

Selection of the plasma equipment manufacturer is a process during which the project team identifies, assesses and offers selected companies to the customer. It is performed through forming a set of requirements for the manufacturer of plasma equipment of the required type and capacity. From the customer's point of view, the most important requirements include the cost and efficiency of the equipment, timeframe available for its manufacturing, and value (i.e. the commitment based on the project's mission, which is to be completed within the agreed time period, resources and operating conditions).

Beyond that, this stage should take into account the special features of the PCE creation projects. The most essential ones are as follows [1]: substantial complexity of the organizational systems of knowledge-based industries where the projects are implemented; considerable uncertainty in the state of the projects and a high probability of risks due to the factors that can not be provided for in the

Table 3. Criteria for the selection of plasma equipment manufacturers

Criteria	Rating
Manufacturer's qualification and current market position	≥ 70
Financial and business parameters of the manufacturer	≥ 50
Possibilities of manufacturing the PCE of various capacity	≥ 70
Possibilities of manufacturing various types of low-temperature plasma generators	≥ 70
Possibilities of manufacturing the PCE power supply units of required capacity	≥ 70
Reliability and efficiency of the plasma equipment to be manufactured, level of customer service	≥ 70
Ecological parameters of the PCE	≥ 70
Cost of manufacturing and testing of plasma devices	≥ 40
Available timeframe for the manufacturing of plasma devices	≥ 40
Previous experience in plasma engineering, fulfillment of contractual obligations	≥ 50
Design team able to develop and upgrade plasma system elements	≥ 70
Experimental stands and other equipment to adjust plasma devices for power systems	≥ 70
Interoperability, integrability with other necessary equipment	≥ 50
Applied data management technologies, software and information processing	≥ 50
Support provided by the manufacturer during equipment commissioning and operation	≥ 50
Costs and options for maintenance, upgrade and adaptation to the changing legal environment	≥ 50
Possibilities of localization in case of multinational, global companies	≥ 40
Tailored solutions for specific countries in particular business spheres	≥ 40
Business transparency	≥ 50

process of management; uniqueness and a high cost of the production and intellectual assets involved; problems of resource management for international projects.

After the formation of the set of requirements for plasma equipment manufacturers, the team working on the PCE creation project proceeds to establishing a set of constraints and criteria for the selection of the plasma equipment manufacturer.

Since the assessment criteria are quite diverse, it is important for the project team to identify the most probable indicators of plasma products and prioritize them judging from their actual suitability for the objectives of the PCE creation project. As an example, Table 4 shows the indicators of plasma systems that are used to select potential manufacturers.

In order to avoid the grave consequences of the plasma equipment manufacturers failing to fulfill their obligations, the team working on the PCE creation project must check the manufacturer's qualifications before concluding a contract. The main objective of this procedure is to reduce the probability of untimely delivery or delivery of inappropriate (defective) equipment. Another objective is to make sure that the manufacturer will be a responsible partner in the business relations with the customer.

The following major steps are proposed for this purpose [10].

Table 4. Most probable (favorable) indicators of plasma systems

Plasma-chemical system type	Range of indicators of plasma systems
Plasma ignition system for gas turbine engines (GTE)	1. Electric-arc plasma generator. 2. Thermal (*a*) or non-equilibrium (*b*) plasma. 3. Power of up to 2 kW for (*a*) and up to 300 W for (*b*). 4. Arc current of up to 6 A for (*a*) and up to 300 mA for (*b*). 5. Plasma torch efficiency of 0.6 – 0.8. 6. Power supply efficiency of 0.5 – 0.7. 7. Arc voltage of up to 300 V for (*a*) and up to 10 kV for (*b*). 8. Electrode service life of up to 3000 uses 60 – 120 seconds long. 9. Ignition reliability of 100 %.
System for plasma-chemical intensification of hydrocarbon fuel combustion for ship and stationary GTE	1. Electric-arc plasma generator. 2. Thermal (*a*) or non-equilibrium (*b*) plasma. 3. Power of up to 5 kW for (*a*) and up to 800 W for (*b*). 4. Arc current of up to 10 A for (*a*) and up to 500 mA for (*b*). 5. Plasma torch efficiency of 0.7 – 0.85. 6. Power supply efficiency of 0.7 – 0.9. 7. Arc voltage of up to 280 V for (*a*) and up to 15 kV for (*b*). 8. Electrode service life of up to 2000 hours, easily replaceable. 9. Fuel combustion efficiency increased by 1 – 3 % at the partial load modes. 10. Nitrogen oxide emissions decreased by 15 – 20 % at the rated mode.
Plasma system for the processing of liquid waste and sewage sludge	1. Induction (radiofrequency) plasma generator. 2. Thermal plasma. 3. Power of up to 75 kW. 4. Arc current of up to 300 A. 5. Plasma torch efficiency of 0.9 – 0.95. 6. Power supply efficiency of 0.6 – 0.85. 7. Service life limited by the service life of power supply elements (up to 3000 hours). 8. Specific power consumption: 0.4 – 1.0 kWh/(kg of waste).
System for plasma activation and gasification of low-grade coal	1. Induction (radiofrequency) plasma generator. 2. Thermal plasma. 3. Power of up to 500 kW. 4. Arc current of up to 400 A. 5. Plasma torch efficiency of 0.9 – 0.95. 6. Power supply efficiency of 0.6 – 0.85. 7. Service life limited by the service life of power supply elements (up to 3000 hours). 8. Specific power consumption: 0.4 – 1.3 kWh/(kg of coal).
System for plasma ignition and maintenance of pulverized coal mixture combustion	1. Electric-arc plasma generator. 2. Thermal plasma. 3. Power of up to 200 kW. 4. Arc current of up to 250 A. 5. Plasma torch efficiency of 0.65 – 0.8. 6. Power supply efficiency of 0.85 – 0.87. 7. Electrode service life of up to 1500 hours. 8. Specific power consumption: 0.05 – 0.4 kWh/(kg of coal) for plasma ignition and 0.5 – 1.5 kWh/(kg of coal) for plasma gasification.

Inquiry checks. The PT can contact the manufacturer's previous customers and inquire about the performance of the plasma devices supplied, compliance with the terms of the contracts concluded, occurrence of logistics issues, etc.

Financial position check. The PT should use manufacturer ratings to determine the financial position and potential financial viability of a particular manufacturer in the short and medium term. For example, a large debt might imply a probability of the manufacturer's going bankrupt before fulfilling the contract obligations.

Additional production opportunities. The manufacturer's ability to increase the quantity of products within a short time is an essential factor, as the customer may be uncertain about the exact quantity of plasma equipment that is established by the contract. This is especially true for long-term contracts, when the demand for a product can be strongly tied to unexpected market events. In such a case, there should be an opportunity to organize overtime or shift work.

Equipment quality check. The PT should require the equipment manufacturers to have ISO 9000 certificates (or other of that kind), which would attest to the manufacturer's providing all the necessary procedures and documentation for continuous compliance with quality standards.

Compliance with technical specifications. The team working on the PCE creation project has to ascertain the manufacturer's potential. In certain scenarios, this can be done through ordering samples of the manufacturer's products and checking them for compliance with the customer's requirements, visiting production facilities and conducting their audit.

The plasma equipment manufacturers that meet the qualification requirements of the customer and are eligible for the contract are included to the bank of manufacturers formed by the PT. If the customer employs short-term contracts and often purchases the same equipment, it makes sense to create a hierarchy of pre-qualified manufacturers that are to compete for these contracts. The use of the manufacturer database allows developing standardized contracts and conditions for the qualified manufacturers, thereby optimizing management of the risks associated with the lack of plasma equipment manufacturers.

After forming the set of constraints and criteria for the selection of the plasma equipment manufacturer, the team responsible for the PCE creation project develops a template for the selection procedure.

Being based on the set of constraints, this model suggests developing a special template that provides for the search for plasma equipment manufacturers that meet the selection criteria. It should be noted that the project team may sum up the feedback on particular cycles of the selection of plasma equipment manufacturers to offer a reference template [7] which would take into account all the available templates for different conditions of the selection of manufacturers.

The next step is to enter the market of plasma equipment manufacturers with relevant inquiries to companies about their products or services.

An information request is issued when the PT seeks information on the options and opportunities available to meet customer needs. Typical points include products and services that can be potentially provided, features that distinguish a particular manufacturer from others in the plasma equipment market, and so on.

A proposal request applies when the project team has a set of requirements for the efficiency and quality of products. For example, the PT may describe equipment of a certain capacity, environmental effect and service life without indicating the type of plasma-chemical system. The manufacturers respond to this request with detailed information on how they will meet the requirements and specify the price of such a product.

After analyzing the proposed price, the PT may reconsider the customer requirements and/or agree on the exact conditions with the manufacturer. Thus, this process is typically iterative and suitable for the purchase of non-standard or complex equipment, which requires the manufacturer to perform appropriate expert evaluation.

Afterwards, the PT working on the PCE creation project examines the criteria for the selection of the plasma equipment manufacturer to define the parameters for manufacturer assessment. As already mentioned, cost, efficiency, reliability and time of manufacturing are the main customer requirements for plasma equipment manufacturers. However, the project team should also employ such additional criteria as production capacity and flexibility, technical capabilities, information and communication systems, financial position, innovation and R&D, quality system, management and organization system, personnel training and development system, location, reputation, guarantees, and business activity. The most recent criteria include environmental and social responsibility, awareness of security, internal political stability, cultural affiliation with the customer's organization, and the risk of terrorism.

In the event of non-compliance with the criteria for the selection of the plasma equipment manufacturer, the constraints and criteria are to be adjusted and the selection procedure starts from the very beginning. If the selection criteria correspond to the above set of constraints and criteria, the PT working on the PCE creation project starts formulating the manufacturer alternatives.

If the project team finds most of the parameters inappropriate, the constraints and criteria are updated again. Otherwise, it is possible to establish a manufacturer hierarchy. For this purpose, it is necessary to identify strategically important manufacturers and conduct their multicriteria assessment [6]. Table 5 lists the criteria which can be applied for this procedure.

Depending on the ratings and context of plasma equipment manufacturers, it is recommended to divide them into unreliable, backup, reliable, and strategic ones. At that, the priority must be given to the two latter groups.

The maximum number of points a potential plasma equipment manufacturer can get is equal to 80. When forming the hierarchy of manufacturers, the PT should assume that strategic manufacturers are to receive no less than 50 points. At that, the following basic limitations should be taken into account: the quality of plasma equipment can not be scored lower than 7 points, and the reliability of plasma equipment should be equal to 8 points or above.

If several manufacturers have the same number of points, the PT establishes the most important assessment criterion. For example, the price of equipment will be considered the most important factor when the budget is limited; when it is sufficient, the reliability of plasma equipment (number of cycles in the plasma ignition sys-

Table 5. Criteria for the final assessment of plasma equipment manufacturers

Criterion	Range of values
Price	
very high	1 – 2
high	3 – 4
agreeable	5 – 6
quite low	7 – 8
low	9 – 10
Flexibility of price policy	
low	1 – 3
average	4 – 7
high	8 – 10
Experience of the plasma equipment manufacturer	
less than 5 years	1 – 3
6 – 10 years	4 – 6
11 – 20 years	7 – 8
more than 20 years	9 – 10
Quality of plasma equipment	
low	1 – 3
satisfactory	4 – 6
good	7 – 8
high	9 – 10
Reliability of plasma equipment	
low	1 – 3
satisfactory	4 – 5
agreeable	6 – 7
high	8 – 10
Production facilities	
not available	0
expandable	1 – 5
available	6 – 10
Business activity of the plasma equipment manufacturer	
low	1 – 2
lower than average	3 – 4
average	5
higher than average	6 – 8
high	9 – 10
Rate of execution	
low	1 – 3
satisfactory	4 – 6
agreeable	7 – 8
high	9 – 10

tem, service life of the system's PCE and power supply, etc.) is to be first accounted for.

When appropriate weighted scores are estimated and plasma equipment manufacturers are ready to start executing the order, the project team compiles a list of top-priority manufacturers and forms a bank of backup manufacturers.

One should keep in mind that the ranking of manufacturers is fairly simple when the manufacturer's proposals are differentiated by a single criterion, such as price. Meanwhile, it becomes quite difficult when a number of criteria are to be taken into account during assessment. For example, if the PT assesses both the cost and time of order execution, it should find a compromise between these two criteria and determine what would be best for the customer: a high cost and a short time of execution, or vice versa.

Next, the PT responsible for the PCE creation project conducts a final analysis of the plasma equipment manufacturers. As a rule, it involves interacts with those manufacturers that have passed the qualification check. At this stage, the PT may also reconsider the complex and subjective criteria for the assessment of plasma equipment manufacturers.

Having performed the final analysis, the PT makes the decision on the choice of the plasma equipment manufacturer. Then it directly contacts the selected manufacturer with a proposal to start executing the order. Thereat, the PT may regard the manufacturer's potential in terms of non-price factors, such as its reputation and the experience in plasma chemical engineering.

In case the manufacturer and the customer are located in different countries/regions, the project stakeholders are particularly vulnerable to the risks associated with increased transportation costs.

If the manufacturer meets all the criteria and constraints and starts executing the order, the process of data archiving takes place.

Otherwise, i.e. if the manufacturer can not start execution in time (for example, because of other orders or force-majeure circumstances), the PT working on the PCE creation project logs its data to the bank of backup manufacturers and informs the customer about the delay. If the customer agrees to postpone the order, the plasma equipment manufacturer is being confirmed and then archived.

In accordance with the proposed model, the customer and stakeholders may refuse to postpone implementation of the project or selection of the plasma equipment manufacturer from the backup bank. In this case, the customer is informed about the impossibility of selecting a manufacturer, and the entire selection procedure is repeated under the new conditions of the project's dynamic environment.

The proposed risk management model for the selection of plasma equipment manufacturers allows formalizing the selection procedure, automating the process of decision making for the purposes of the PCE creation project, and substantially reducing the risks of improper decisions.

CONCLUSIONS. 1. The article proposes criteria for the selection of plasma system manufacturers, which should be taken into account in the course of production of plasma-chemical systems of various purpose. It will accelerate the identification of top-priority manufacturers.

2. The developed risk management model for the selection of plasma equipment manufacturers provides an increased efficiency of implementation of the projects on creation of the PCE for power systems through formalizing the procedure of selecting the optimal manufacturer.

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