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ASSESSMENT REPORT

of the Master degree programme Power Plant Engineering at Peter the Great Saint Petersburg Polytechnic University, Russian Federation

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Foundation under public law
M 7, 9a-10, 68161 Mannheim; Germany
www.evalag.de

Content

Peter the Great Saint Petersburg Polytechnic University (SPbPU) commissioned **evalag** and the National Centre for Public Accreditation (NCPA) with the external evaluation of the 2nd cycle Master's degree programme Power Plant Engineering at SPbPU in Russia. The programme evaluation was carried out by an international expert panel who assessed the study programme (SP) according to the Guidelines for joint International Accreditation, which comply with current Russian legislation in the sphere of education, German legislation and the main principles and documents of the Bologna process as well as the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) and the Federal State Educational Standards (FSES) in the Russian Federation (RF).

SPbPU's internalisation strategy and the popularity of the SP among international students set the demand for the international accreditation with the objective to evaluate and recognise the high quality of Higher Education (HE) and to state the conformity of the SP to the standards and criteria for international programme accreditation established jointly by **evalag** and NCPA.

It is intended to enhance the competitiveness of the offered SP of the globally recognised Federal State Autonomous Educational Institution (FSAEI) of HE Peter the Great Saint Petersburg Polytechnic University by accrediting the programme and awarding **evalag**'s international quality label to the SP.

1. Peter the Great Saint Petersburg Polytechnic University

Upon the decision by government regulation, the Polytechnic Institute in Saint Petersburg was founded in 1899. Initially, it aimed at training highly qualified engineers and economists so that within the institute, electro-technical, metallurgical, shipbuilding and economics departments started to operate. The Institute of Energy and Transport System (IE&TS), which carries out the SP Power Plant Engineering, covers two study areas: electro-mechanical and power machinery. The power machinery division was formed on the basis of the Faculty of Power Engineering founded in 1934. The Polytechnic Institute became subordinate to the Ministry of Higher Education in 1946, which offered the institute the opportunity to develop its own academic programmes and curricula. From the 1950s, it became open to international students. Since 2010, SPbPU is a National Research University with a polytechnic stream and leading educational facilities in the field of applied physics and mathematics, industrial engineering, chemical engineering, aerospace engineering and many other academic disciplines. Today, the multidisciplinary university of Russian polytechnic education and research hosts the Central Research & Development Institute of Robotics and Engineering Cybernetics, which is one of the most significant scientific centres in Russia.

As a state-licensed higher education institution, SPbPU offers full-time Bachelor's degrees (1st cycle) and Master's degrees (2nd cycle) directed towards academic activity as well as postgraduate (PhD) degrees (3rd cycle) in certain fields including double degree PhD programmes. Furthermore, SPbPU provides a variety of short-term programmes covering different subjects, among them Russian Studies and Russian Language programmes, internships and two tailor-made programmes Culture Studies and Doing Business in Russia as well as exchange programmes in English, in which students from more than one hundred countries participate. Besides, secondary vocational education and international summer and winter schools are regularly taking place.

Today, SPbPU trains specialists in 57 Bachelor degree programmes and 170 Master degree programmes, 90 PhD programmes and doctorate programmes. In addition,

there are a number of non-degree and more than one hundred international educational programmes (EP) including 20 Bachelor's and Master's degree programmes and 31 double degree programmes, most of which are taught in English. According to the Academic Ranking of World Universities-European Standard ARES, SPbPU is one of the three top Russian universities and is ranked first among Technical Universities.

At the moment, there are 30,197 students enrolled at SPbPU, among them 4,995 international students. Thirteen institutes of various professional streams and 43 research and educational centres belong to the university. SPbPU has more than 300 partner universities and 90 partner companies in 68 countries.[1]

Main academic units of the university are:

- Institute of Energy and Transport Systems (IE&TS)
- Institute of Humanities (IH)
- Institute of Civil Engineering (ICE)
- Institute of Physics, Nanotechnologies and Telecommunications (IPN&T)
- Institute of Military Technical Education and Security (IMTES)
- Institute of Further Education (IFE)
- Institute of Computer Science and Technology (ICS&T)
- Institute of International Educational Programmes (IIEP)
- Institute of Metallurgy, Mechanical Engineering and Transport (IMME&T)
- Institute of Advanced Production Technologies (IAPT)
- Institute of Applied Mathematics and Mechanics (IAMM)
- Institute of Physical Education, Sport and Tourism (IPES&T)
- Institute of Industrial Management, Economics and Trade (IIME&T)

The leading instructors of the following departments of the IE&TS participate in the SP Power Plant Engineering:

- Nuclear and Heat Power Engineering
- Turbines, Hydromachines and Aircraft Engines
- Thermophysics of Power Units
- Compressor, Vacuum and Refrigeration Equipment
- Electrical Power Engineering and Equipment

from the departments of the IAMM:

- Theoretical Mechanics
- Fluid Dynamics, Combustion and Heat Transfer

from the department of the ICE:

- Construction of Unique Buildings and Structures

and from the department of the IIME&T:

- Entrepreneurship and Commerce

[1] A list of all partner companies is available under: http://www.spbstu-eng.ru/index.php5?module=menu&class=menuMap&id=146 (27.04.2017).

International Master's degree programmes of the IE&TS are:

- Power Plant Engineering
- Electrical Power Engineering
- Energy Technology

These SPs can optionally be studied as double degree programmes. Power Plant Engineering has become a basis for opening the double degree programme with Lappeenranta University of Technology (LUT) in Finland, where students can study one or two terms abroad. This option has the advantage of an excellent prospective to get international experience of joint scientific research and collaboration with overseas researchers.

Russian Bachelor's and Master's programmes of the IE&TS are:

- Heat and Power Engineering
- Electrical and Electrical Power Engineering
- Power-machine Engineering
- Technological Machinery and Equipment
- Motor Transport and Technology Systems
- Nuclear Power and Thermal Physics

The main goal of SPbPU is the modernisation of the university and development of a new generation university, integrating multidisciplinary scientific research and metabranch technology with the purpose of increasing the competitiveness of the national economy and carrying out theoretical and applied scientific research at an international level. After becoming a national research university, SPbPU implemented a Strategic Development Programme meeting the national policy tasks of forming the innovation economy of knowledge in Russia for 2010-2019. Besides, SPbPU participates in various federal programmes, such as the Federal Target Programme, and programmes of the Russian Foundation for Basic Research and Russian Science Foundation.

In 2010, the Joint Science and Technology Institute was founded, which includes the following innovative research institutions:

- Research Institute of Materials and Technologies
- Research Institute of Energy, Resources Saving and Environmental Technologies
- Research Institute of Nano-biotechnologies
- Research Institute of Electronic Systems
- Research Institute Mathematical Modeling and Intelligent Control Systems
- Research Institute of Machine-Building Technologies (MashTeh)

2. Power Plant Engineering (M. Sc. in Engineering)

The SP was created in 2014 for international students and is fully taught in English. Currently, there are twenty-five students enrolled in the SP, two of them in the double degree programme with LUT. In 2016, an agreement was reached with Ecole National Superieure Des Mines' D'Albi-Carmaux in France on a double degree programme, in

which one student from France is trained in the EP for two years. At the moment, eleven students are enrolled in the first year of study among them one student from Russia and ten international students coming from France, India, Italy, Iran, Ecuador, Columbia and Singapore. In the second year, there are fourteen students enrolled in the SP, among them five Russian students and nine international students from Egypt, Iraq, Columbia, Pakistan, Mexico and China.

The competencies of the SP consider the existing FSES HE by major 13.04.01 Heat Power Engineering and Thermal Engineering (Master's level) approved by the Ministry of Education and Science of the RF as of 21st November 2014, N1499 as well as the ESG. SPbPU and its partners, as part of the EU project Erasmus+ Online Quality Assurance of Educational Programmes (EQUASP), have developed Standards and Guidelines for Internal Quality Assurance of EPs, approved by the Russian Ministry of Education and Science. It is intended to harmonise national and European standards in order to ensure the quality of EPs and the use of standards designed to ensure the quality of EPs in Russian universities.

Apart from that, the National Qualification Framework (NQF) of the RF has been developed based on the Cooperation Agreement of the Ministry of Education and Science of the RF and the Russian Union of Industrialists and Entrepreneurs given the experience of the European Qualification Framework, national frameworks of the countries participating in Bologna and Copenhagen processes. This NQF is designed for various groups of users (associations of employers, educational government bodies, enterprises, educational organisations, etc.) and makes it possible to form a common development strategy of the labour market and education system. It is based on the principles common for the similar framework structures of the EU and other countries.

The SP comprises a wide range of power engineering subjects aimed at theoretical and practical training. A Master's degree enables graduates to work as specialists and managers in their field of study in state and non-state organisations in Russia as well as abroad. Upon graduation, students will have gained proficiency in the modern energy sector in the field of design, operation and engineering of thermal power plants. They are capable of working on advanced production lines combining research and business activities, solving advanced manufacturing tasks and can adapt themselves quickly to the real economy. They may start with entry-level positions, which often deal with maintenance and repair of plant equipment, and further can be promoted to senior managerial positions or to continue their studies in doctoral programmes. According to statistics, the employment rate upon graduating is 100% to date.

The programme is offered in full-time study mode with a duration of two years. The total credit point number is 120 ECTS. Five students have completed training and defended their Master's theses successfully to date.

Cost of education sum up to 190,000 RUB (~3,052.62 EURO) for Russian students and 280,000 RUB (~4,498.60 EURO) for foreigners per academic year.

3. Evaluation and Accreditation Process

The programme evaluation was carried out with a peer review based on a self-evaluation report (according to the Methodology for Evaluation of Higher Education SPs and **evalag**'s as well as NCPA's key principles and criteria catalogue) provided by SPbPU, a site visit and subsequent assessment report of the international expert panel and the accreditation decision by **evalag**'s Accreditation Commission as well as NCPA's National Accreditation Board.

For conducting the international accreditation of the SP, the independent external evaluation panel was formed consisting of two Russian experts enlisted by NCPA (an expert representing the RF academic community and a student representing the RF student community) as well as two German experts (an expert representing the international academic community, and an expert representing the international employer community) enlisted by **evalag**.

Experts from the academic community:

- Prof. Dr. Dmitry Ivanov holds the review chair of the expert group. He is Professor in the Department of General Physics and Nuclear Fusion at the Thermal and Atomic Power Institute of the Moscow Power Engineering Institute (National Research University).
- Prof. Dr. Andrea Luke functions as deputy review chair of the expert group. After finishing her PhD and Habilitation in Mechanical Engineering and working as a full professor and researcher at Hannover University, she is now full Professor for Thermodynamics at Kassel University (Germany). She is a member of the International Centre for Heat and Mass Transfer and of the German Association for Refrigeration and Climate Engineering as well as a member of the Directory of the International Institute of Refrigeration Expertise and editor-in-chief of the Journal of Heat and Mass Transfer. The focus of her academic interests and publications lies in multiphase flow, the structure of evaporator surfaces and in heat and mass transfer.

Expert from the international employer community:

- Qualified Engineer, Martina Pösl, holds a degree in Mechanical Engineering and is a certified International Welding Engineer. Before becoming a risk consultant and loss investigation expert at Allianz Global Corporate & Specialty SE in Munich, she worked as a power plant engineer at GDF Suez Energie Deutschland GmbH in Germany.

Expert from the student community:

- Sergey Muraveynikov, 1st year post-graduate student at the Department of Thermophysics and Theoretical Heat Engineering at Saint Petersburg National Research University of Information Technologies, Mechanics and Optics.

The site visit took place on 10th to 12th April, 2017 at SPbPU in Russia. During the site visit, the expert team met with the members of SPbPU rectorate, heads of departments, academic and administrative staff, graduates and students. They visited the library, seminar rooms and laboratories used by the students of the programme.

The expert team produced an assessment report of the programme with an accreditation recommendation, which was submitted to **evalag**'s Accreditation Commission, who took the final accreditation decision on June 26th and 27th, 2017 and NCPA's Accreditation Board, whose decision was taken on June 29th, 2017.

Amanda Zeitz coordinated the accreditation from the side of **evalag** and experienced extraordinary support from the deputy head of the accreditation office of NCPA, Oksana Matveeva.

The following assessment report is structured along the six standards and criteria of the joint international accreditation of **evalag** and NCPA. Each chapter starts with a description of the current status regarding the criterion based on the information in the self-evaluation report of SPbPU and the information gathered during the site visit. On

this basis, the expert team assesses the criterion and finally lists recommendations for further improvement.

4. Programme Assessment

4.1 Programme Profile

Current situation

The self-evaluation report describes the qualification objectives and intended learning outcomes of the SP and links them to the curriculum. The programme is aimed at the development of Master's students' personal qualities, general cultural and general professional competencies as well as the formation of professional skills required for highly qualified specialists solving problems in the field of design, installation and operation of energy objects (thermal power plants). It enables graduates to work in academic, scientific and professional fields.

In accordance with the EP Graduates Requirements, denoted in the FSES HE, the qualification objectives of the EP are the following:

- Formation of project design skills in the field of heat power engineering and thermal engineering.
- Formation of research skills in the field of heat power engineering and thermal engineering.
- Formation of skills in organisation and management activities at energy industry enterprises.
- Formation of skills in production and technology activities at energy industry enterprises.
- Formation of skills in competent presentation of research and technology information, both orally and in writing, in particular skills in a foreign language.
- Formation of teaching skills, readiness for further education.

General cultural competencies:

- Skills of abstract thinking, summarising, analysing, managing and forecasting.
- Ability to act in non-standard situations, take responsibility for decisions made.
- Ability of self-development, self-realisation, using creative potential.

General professional competencies:

- Ability to formulate goals and objectives of the study, to identify priorities for the tasks, to select and create evaluation criteria.
- Ability to apply modern methods of research, evaluate and present the results of the work performed.
- Ability to use a foreign language in a professional field.
- Capability of the analysis, evaluation and implementation of the state-of-the-art technical solutions aimed at improving the energy efficiency of power plants.
- Capability to simulate and analyse the operation of power plants with the use of up-to-date sophisticated software.

Professional competencies:

- Ability to formulate the task for the development of design solutions related to the modernisation of technological equipment, measures to improve performance, increase environmental safety, resource saving.
- Ability to carry out technical calculations for projects, feasibility and value analysis of efficiency of design solutions using application software for calculating the parameters and select the serial and the development of new energy, heat engineering and thermal technological equipment.
- Ability to develop measures to improve the production technology.
- Readiness to ensure smooth operation, proper operation, repair and modernisation of the energy, heat engineering and thermal technological equipment, automation and protection of electric and thermal networks, gas pipelines and air ducts.
- Ability to evaluate the needs of production in fuel and energy resources, to justify measures on energy saving, to develop norms of consumption, to calculate production energy needs.
- Readiness to apply the methods and means of the automated process control systems in power, heat engineering and heat technologies.
- Ability to plan and set objectives of the study, to choose the methods of experimental work, interpret and present the results of research in the form of reports, essays, scientific publications and public discussions.
- Readiness to led a team of executors, decision-making, determining the order of work.
- Ability to develop measures for the prevention workplace injuries, occupational diseases, the prevention of environmental violations.
- Readiness to organise work of supervision during the manufacture, installation, maintenance, testing and commissioning of products and objects.
- Readiness for pedagogical activity in the field of professional training.

The expected learning outcomes formulated in terms of competencies of graduates are relevant to the requirements of the FSES of HE in the major and the profile of training, professional standards and the needs of the labour market as well as requirements of international standards. When developing the EP, the learning objectives and outcomes, SPbPU relied on international experience: meetings were held with the coordinators of educational programmes at partner universities abroad in order to determine the requirements for the SP already at its stage of development to ensure its maximum effectiveness and relevance on the international market of educational services. Regarding the further development of the SP, the interests of employers are taken into consideration. Control over compliance with academic and professional national standards and educational policy is systematically done by the Directorate of Main EPs and the Academic Council of the institute as well as by the tutor and academic advisor of the SP at the programme level. In case new requirements appear, they are discussed at the meeting of the department and after that the Teaching and Methodological Council of the IE&TS approves the relevant changes in the SP.

Qualifications and practical work experience of the academic staff of the SP correspond to the profile and goals of the programme. The teaching staff covers all areas and disciplines of the SP.

The SP's objectives and intended learning outcomes are publicly accessible on the university's website.

Assessment

Responding to the need of society, the labour market and the feedback from employers, the SP is, according to the self-evaluation report and conversations on site with the programme directors and managers, continuously developed and updated. The professional orientation of the programme is set out and both academic and professional requirements of graduates in the field of thermal engineering are met. The learning outcomes of the programme as well as the course level are consistent with the university-type studies.

In the view of the experts, some parts of the programme profile are very well described and partly, the learning outcomes are very specified and well-defined, e.g. regarding management courses, whereas other parts are not detailed enough. The SP's profile should be sharpened and the learning outcomes should be described more precisely in the module handbooks with a clear differentiation to other programmes within the institute.

Apart from that, the experts believe that the titles of the modules in the module handbook do not exactly describe the contents of the lectures and seminars. Thus, the titles of all modules should be more concrete to better match the content of the single lectures and seminars. Furthermore, pursuant to the expert panel, responsibilities for the different modules and disciplines do not become clear within the module handbook. Responsibilities and teachers' names should be clearly stated in the module handbook for all classes.

Moreover, the experts express the need for a more actively promotion of the SP, also online. In fact, students are informed about the learning outcomes in the course descriptions, which are publicly accessible on the website of SPbPU. Nevertheless, the visibility of the learning outcomes on the website of the university should be increased as per the opinion of the experts.

From the experts' vantage point, the objectives and strategic goals of SPbPU comply with the objectives of the SP. The staff of the faculty with academic degrees involved in the programmes' delivery is qualified with necessary skills and work experience conforming to the profile and goals of the SP. The intended learning outcomes correspond to the level of the awarded qualification.

SPbPU intends to attract more students from western countries with their international programmes, which is highly appreciated by the expert panel. The Specialisation of SPbPU in core competencies in the field of thermal engineering is a successful way to attract more (international) students from Europe and western countries.

With regard to the standards, it is also referred to the presentation of the study programme in the following sections.

Recommendations

R1 The profile of the study programme should be sharpened and the learning outcomes should be described more precisely in the module handbook with a clear differentiation to other programmes within the institute. The same concerns the titles of all modules. They should be more concrete to better match the content of the single lectures and seminars.

R2 Responsibilities, requirements and teachers' names should be clearly stated in the module handbook for all classes.

R3 The study programme should be more actively promoted by the university with an increased international online visibility. Additionally, the visibility of the learning outcomes should be increased on the website of the university.

4.2 Curriculum

Current situation

The curriculum and course contents are described in the self-evaluation report and – more detailed regarding content and working methods – in the syllabi as well as the programme description. Besides, the working plan contains the schedule of academic process.

A wide range of power engineering subjects aimed at theoretical and practical training is included in the curriculum. It covers four main study areas comprising modules in energy technology, electric power engineering, civil engineering, and economics and management. Aside from scientific and research work, a pedagogic practice and one-day excursions to the energy companies are part of the SP.

The entire study period of two years is divided into four terms. There are examination sessions at the end of terms followed by vacations. The courses can be divided into several parts. Basic components include, amongst others, international standards of production management, modelling of process engineering, modern energy technologies and modes of operation of thermal power plants. English for Technical Communication is mandatory in the first term.

The share of electives is 26.4% of the variable part of the curriculum consisting of four sections the student must choose from. Apart from that, additional voluntary elective disciplines are offered to students who are interested in. The university invites scientists and teachers for giving open lectures or courses of lectures or workshops. These disciplines are not included in the document issued upon graduation, but are of an academic nature and are aimed at expanding the horizons of the students as well as obtaining information directly from scientists researching specific subjects at the international level. In addition, there are voluntary summer and winter schools in Power Engineering held by the IE&TS.

A Master thesis, comprising 30 credits, on the basis of research work is compulsory in the fourth term. Every year, the companies interested in the graduates of the EP send official requests to SPbPU with the themes of diploma projects companies are interested in. Every student may choose one theme for his/her Master's thesis, which is written under supervision of an employee from SPbPU and, if applicable, the company's representative. Thus, the student is integrated into the industry already at the phase of learning. Students are involved in research work and acquire the skills and competencies, which will later on allow them to do research independently and manage teams of scientists. As part of the practical training, students can participate in internships during the second semester. Additionally, one-day excursions allow students to gain insights into potential real-life work settings. Some competencies (teamwork skills, planning and organisation of research activity, feasibility study, heat engineering computations, analysis and registration of the obtained results, report-making, publication of results, improvement of foreign language skills due to work with foreign literature, etc.) are acquired and improved in research practical training both at the graduate department and in partner organisations. This way, acquisition of skills takes place in

the environment maximally similar to that of the future professional activity, which helps the graduates to adapt quickly to the employment conditions.

Students also make presentations at the annual scientific practical conference “A Week of Science in SPbPU” with international participation. Afterwards, a collected volume with abstracts is published and the best presentations are published in the peer-reviewed journal “Scientific and Technical Journal of SPbPU”. Teachers’ research studies and results are reflected within the educational process. Together with their academic advisors, teachers of the programme, students carry out research projects that can also be used as a basis for their Master’s thesis.

Weekly classes of the Russian SPbPU teachers are given on business days and Saturdays. Classes given by foreign teachers take place in the format of modular intensive classes with a duration of one or two weeks. Regular classes are held 3-4 times a week and various training methods are conducted: lectures and seminars, case studies, practical studies connected with the subject of lectures, applied research projects, written assignments, practical preparation and practice, self-study and preparation for the exam. Employed students can use distance courses developed for some subjects based on the platform Moodle and get additional consultations from teachers.

The SP is continuously modernised and upgraded. Annual updates of the curriculum take place and if necessary, corrections related to new scientific and performance results are made. The curriculum and especially modules concerning professional training are annually corrected on basis of the feedback given by employers. Management courses are developed and implemented with the participation of specialists of companies.

One RF credit is equal to one ECTS credit. The scope of the programme is 120 credits. One credit point adopted in the Russian educational institution equals one unit labour intensity of study and other activities of the educational programme or curriculum equivalent to 36 academic hours, with one hour comprising 45 minutes. According to the students, the workload of the SP is reasonable.

	Course or discipline	**Workload/ academic hours**	**Credit**	**Form of classes, workload, academic hours**	**Form and semester of attestation**
B1.B Basic component					
B1.**B**.1	English for Technical Communication	108	3.0	Semester 1: Practical classes – 36 h; Semester 2: Practical classes – 36 h; Independent work – 9 h	semester 1 – control test, academic assessment; semester 2 – control test, exam
B1.**B**.2	History and Philosophy of Science	54	1.5	Practical classes – 36 h; Independent work – 18 h	semester 2 – academic assessment

B1.**B**.3	International Standards of Production Management	90	2.5	Practical classes – 36 h; Independent work – 27 h	semester 3 academic assessment, exam
B1.**B**.4	Modelling of Process Engineering	90	2.5	Practical classes – 36 h; Independent work – 18 h	semester 1 – exam
B1.**B**.5	Modern Energy Technologies	90	2.5	Practical classes – 36 h; Independent work – 18 h	semester 2 – exam
B1.**B**.6	Energy Efficiency and Energy Saving in Industry	90	2.5	Practical classes – 18 h; Independent work – 45 h	semester 3 – report, academic assessment, exam
B1.**B**.7	Modes of Operation of Thermal Power Plants	90	2.5	Lectures – 18 h; Practical classes – 18 h; Independent work – 27 h	semester 3 – course paper, exam
B1.V Elective component					
B1.V.OD Compulsory Disciplines					
B1.V.OD.1	Innovation Management in Industry	108	3.0	Practical classes – 36 h; Independent work – 45 h	semester 3 – control test, course paper, exam
B1.V.OD.2	Power Machines Turbines	126	3.5	Lectures – 18 h; Practical classes – 36 h; Independent work – 36 h	semester 1 – academic assessment, exam
B1.V.OD.3	Combined Cycle Power Plants	108	3.0	Lectures – 18 h; Practical classes – 18 h; Independent work – 72 h	semester 3 – academic assessment
B1.V.OD.4	Numerical Methods in Heat and Mass Transfer	126	3.5	Lectures – 18 h; Practical classes – 54 h; Independent work – 18 h	semester 1 – computational graphics, academic assessment, exam
B1.V.OD.5	Steam Boilers	126	3.5	Practical classes – 36 h; Independent work – 54 h	semester 1 – course paper, exam

B1.V.OD.6	Pump Equipment of Power Plants	72	2.0	Practical classes – 36 h; Independent work – 36 h	semester 2 – course paper, academic assessment
B1.V.OD.7	Thermal Power Plants	108	3.0	Practical classes – 36 h; Independent work – 36 h	semester 2 – course paper, exam
B1.V.OD.8	Energy Efficient HVAC Systems	72	2.0	Practical classes – 36 h; Independent work – 36 h	semester 2 – academic assessment
B1.V.OD.9	Electrical Machines	90	2.5	Lectures – 18 h; Practical classes – 18 h; Independent work – 54 h	semester 1 – academic assessment
B1.V.OD.10	Mathematical Physics	90	2.5	Lectures – 18 h; Practical classes – 36 h; Independent work – 36 h	semester 1 – academic assessment
B1.V.OD.11	Waste Heat Recovery Techniques	126	3.5	Lectures – 18 h; Practical classes – 36 h; Independent work – 45 h	semester 3 – academic assessment
B1.V.DV Elective disciplines:					
B1.V.DV1					
1	Energy Efficient Buildings and Structures	90	2.5	Lectures – 18 h; Practical classes – 18 h; Independent work – 54 h	semester 2 – academic assessment
2	Energy Audit of Buildings and Construction	90	2.5	Lectures – 18 h; Practical classes – 18 h; Independent work – 54 h	semester 2 – academic assessment
	Total	90	2.5	Lectures – 18 h; Practical classes – 18 h; Independent work – 54 h	
B1.V.DV2					
1	Renewable Energy: Resources and Technologies	108	3.0	Practical classes – 36 h; Independent work – 72 h	semester 2 – computational graphics, academic assessment

2	Modern Problems of Science and Industry in Energy Sector	108	3.0	Practical classes – 36 h; Independent work – 72 h	semester 2 – computational graphics, academic assessment
	Total	108	3.0	Practical classes – 36 h; Independent work – 72 h	
B1.V.DV3					
1	Network Problems and Electrical Systems Technology	54	1.5	Lectures – 18 h; Laboratory works – 18 h; Independent work – 18 h	semester 3 – academic assessment
2	High Voltage Technique	54	1.5	Lectures – 18 h; Laboratory works – 18 h; Independent work – 18 h	semester 3 – academic assessment
	Total	54	1.5	Lectures – 18 h; Laboratory works – 18 h; Independent work – 18 h	
B1.V.DV4					
1	Modern Energy Problems	162	4.5	Practical classes – 36 h; Independent work – 90 h	semester 2 – exam
2	Bioenergy Technology Solutions	162	4.5	Practical classes – 36 h; Independent work – 90 h	semester 2 – exam
	Total	162	4.5	Practical classes – 36 h; Independent work – 90 h	
B2. Practice					
B2.U	Educational Practice	54	1.5	1 week	semester 4 – academic assessment
B2.N	Scientific and Research Work	846	23.5	semester 9 – 5 weeks; semester A – 3 weeks; semester B – 6 weeks	semester 1, 2, 3 – academic assessment
B2.P.1	Professional Practice (Internship in Industry)	216	6.0	semester A – 3 weeks; semester C – 1 week	semester 2 – exam; semester 4 – academic assessment
B2.P.2	Scientific and Research Practice	594	16.5	11 weeks	semester 4 – academic

					assessment
B2.P.3	Pre-diploma Practice	162	4.5	3 weeks	semester 4 – exam
B3. State final examination					
B3	State Final Examination	270	7.5		State exam, Master's thesis defense – semester 4
	Total hours of Master's special training	4320	120.0		
FTD. Additional Elective Courses					
FTD.1	Computer Technologies in Science and Industry	72	2.0	Practical classes – 36 h; Independent work – 36 h	semester 1 – academic assessment
FTD.2	Theory of Hydrostatic Machines	72	2.0	Lectures – 18 h; Practical classes – 18 h; Independent work – 36 h	semester 1 – academic assessment
FTD.3	Modelling of Vaporization Processes	72	2.0	Lectures – 18 h; Practical classes – 18 h; Independent work – 9 h	semester 2 – exam
FTD.4	Energy Systems Engineering	36	1.0	Practical classes – 36 h	semester 2 – academic assessment with a grade
FTD.5	Turbine-Driven Compressors	108	3.0	Lectures – 18 h; Practical classes – 36 h; Independent work – 27 h	semester 3 – exam
	Total hours of Master's special training (with additional elective courses)	4680	130,0		
Courses (modules) – 2 178 hours (60,5 ECTS) Educational Practice – 54 hours (1,5 ECTS) Scientific and Research Work – 846 hours (23,5 ECTS) Professional Practice – 216 hours (6 ECTS) Scientific and Research Practice – 594 hours (16,5 ECTS) Pre-diploma Practice – 162 hours (4,5 ECTS) State Final Examination – 270 hours (7,5 ECTS)				List of abbreviations: B1. – courses (modules) B1.B – courses of basic component B1.V – courses of elective component B1.V.OD – compulsory courses of elective component B1.V.DV – elective courses of elective component B2. – practice B2.U – educational practice B2.P – professional practice B2.N – research work B3. – state final examination	

Table 1: Contents and structure of the curriculum by the IEP «Power Plant Engineering», self-evaluation report, annex 4, p. 2-7.

Assessment

The courses of the SP cover relevant contents and competencies to meet the SP's objectives and prepare graduates for their professional tasks with a great specialisation in the field of power plant engineering. Current developments in the field are reflected. From the experts' standpoint, the curriculum has a logical structure and a clear subsequence of the disciplines. Subjects and course units are spread evenly.

Within the curriculum, there are very specific classes with narrowly defined focuses in a specific field of study. According to the experts, the programme is not fundamental enough content-wise because crucial fundamental topics in the field of mechanical process and thermal engineering to enable the students to participate in advanced classes and for transfer thinking are missing. This is especially important for students who pursue an academic career. On site, experts learned that almost all students entering the SP have a B. Sc. degree in a different field of study, not specifically in power plant engineering and energy efficiency. Although many of the students have gained work experience upon graduation of their first cycle degree, students and lecturers likewise state that the different educational backgrounds are a big challenge since it makes it difficult for students to keep on track in classes. On the one hand, this leads students to quickly connect and help each other within their community to better cope with the learning content. On the other hand, students would like to have more support from the university and additional fundamental classes to get all of them to the same level in spite of the make-up sessions for some topics and courses, which are sometimes offered for students who fall behind. Therefore, the experts strongly recommend to integrate a broader scope of fundamental courses into the curriculum in order to fill knowledge gaps, especially in thermodynamics, fluid dynamics, physics and mechanical engineering concepts. In the wake of this, mentoring carried out by teaching staff to support students should also be improved.

During the site visit, the experts gained the impression that colleagues are not kept informed about the other classes within the SP. There should be a greater transparency among teachers of classes taught by their colleagues and more interfaces.

There are several barriers getting international students in Russian companies. For one thing, students have language problems since English is not spoken in all companies, and for another thing, because of industrial secrets. Professors and university staff speak English very well but Russian companies do not, which makes it difficult for international students to enter the Russian job market. Thus, the experts underscore the importance of a Russian language course, which should be mandatory for international students in the first term.

Pursuant to the students as well as to the experts, experimental lab work is limited or even missing in the curriculum and also in practice and practical work is mostly considered to be simulation works. As the experimental research component is a major element for acquiring the necessary knowledge during Master's training, the experts express their strong view to incorporate obligatory experimental practical laboratory classes to an adequate extent into the curriculum for all students, and especially for students who do not have the opportunity to work in the industry.

Since all courses (except for electives) are fixed within the curriculum, in the view of the experts, students should be given the opportunity to create an individual study plan. Furthermore, the university should implement additional voluntary advanced classes, especially for students who would like to pursue an academic career.

The experts appreciate the variety of learning methods used in the curriculum, and particularly the application of state-of-the-art software in part as well as the target-oriented work in a team in the frame of this programme.

Students' workload is consistent with the number of credits allocated to the respective component. The requirements for the content and structure of the Master's thesis are defined by SPbPU. During the site visit, the experts examined several Master's theses of students, of which many showed a narrative or descriptive approach. Therefore, the expert panel encourages the institute to provide all Master's thesises with a more scientific approach.

Recommendations

R4 A broader scope of fundamental courses, especially in thermodynamics, fluid-dynamics, heat-mass exchange, physics and mechanical engineering concepts should be integrated into the curriculum in order to fill knowledge gaps of students with different bachelor background learning experience.

R5 There should be a greater transparency among teachers of classes taught by their colleagues and more interfaces, especially between visiting lecturers, because teachers from different universities do not have contact to each other within the learning process.

R6 A Russian language course should be mandatory for international students in the first term.

R7 An increased extent of obligatory experimental practical laboratory classes should be included into the curriculum for all students, and especially for students who do not have the opportunity to work in the industry.

R8 Students should be given the opportunity to create an individual study plan. It is necessary to extend the number of selective courses and enhance possibilities for students to choose these courses.

R9 Additional voluntary advanced classes should be offered, especially for students pursuing an academic career.

R10 Students' Master's theses should be based on scientific approaches opposed to narrative or descriptive ones.

4.3 Student Assessment

Current situation

Assessment of the quality of Master's training includes routine assessment, interim assessment and final state attestation. The achieved learning outcomes are assessed at the end of every semester via exams taken by students. Some disciplines of the curriculum have interim assessment in the form of tests measuring performance. Various forms of assessment are applicable to the students: exams with examination papers in oral and written form, control tests, individual and group presentations, tests with multiple choice questions and question/answer tests, case studies, oral presentations, course projects, course papers, etc. Oral forms of assessment are applied at lectures or practical classes before laboratory projects. Written forms of control are essays, exams, tests and reports on laboratory projects and on practical training as well as research work. Performance results at the end of semesters and formative attestation indicators are regularly discussed at the meetings of the department.

No more than ten exams and twelve academic assessments (pass-or-fail exams) are taken over one academic year. This number does not include attestations in additional

elective disciplines, academic assessments in practical training and course projects (papers). The number of exams in every examination session does not exceed five, and the number of academic assessments per semester must not be more than six.

By a joint decree of the Ministry of Public Health and for Public Education, students have to meet certain health criteria in order to study within this SP, which is why it is not possible to enter the SP for students with physical disabilities. For students with medical certificates or other good reasons, the exam session can be prolonged. Classes may be transferred to the academic building of the IIEP, which is equipped with all necessary facilities to provide access for citizens with mobility impairments.

The assessment system adopted in SPbPU is a five-mark grading system from two to five. For international students who study within an academic mobility programme, the teacher gives a mark according to the five-mark grading system and duplicates this mark in the ECTS system (A-F), which is represented in the transcript of records. The assessment criteria are transparent and available online.

SPbPU implements the following grading systems:

Numerical system	Numerical system (descriptively)	Merit-based system	Pass/Fail system	Grades
5	Excellent	86 – 100%	Passed	A
4	Good	71 – 85%	Passed	B
3	Satisfactory	55 – 70%	Passed	C-D
2	Fail	0 – 54%	Failed	F

Table 2: Grading System (Source: Department of External Affairs).

The Master's thesis is aimed to show the level of professional and general educational competence of a graduate in the relevant Master's programme, the ability to learn and generalise literature sources in the relevant field of knowledge, the ability to carry out independent scientific research and to independently justify the conclusions. It must be a complete scientific research paper, which contains solution to a theoretical or practical problem. The theme must be topical, corresponding to the current state of scientific, process and technology development by the graduate major. The chosen theme and the academic advisor are to be approved by the rector. The thesis is defended publicly at a meeting of the State Examination Board (SEB), whose major objective is to ensure professional objective assessment of scientific knowledge and practical skills.

Final assessment (defence of the Master project) is aimed at evaluating the learning outcomes as a whole as well as all universal and professional competencies acquired by the student. The procedure for the state final attestation is approved by the order of the RF Ministry of Education and Sciences N636 as of 29.06.2015. State Final Certification (SFC) of the learners takes the form of a state exam and defence of the final qualification work. State exams are written exams taken in several disciplines of the EP with definitive significance for the professional activity of the graduates. After successful completion, a higher education and qualification document in the format approved by the Ministry of Education and Science of the RF is obtained by the student. An appeal commission has been set up for appeal procedures.

Assessment

The experts consider the examination procedure at SPbPU as well-thought out. Good in-house regulations define current, intermediate and final assessment forms. Orders and regulations established assure a common operating procedure in terms of frequency and the evaluation system for the ongoing monitoring of the students' progress as well as the course examinations during the SP. These are carried out in accordance with the curriculum. The assessment scope and requirements with regard to the intended learning outcomes are appropriate. Assessment tools are continuously developed and approved by the university. Crucial boards are existent, which leads experts to believe that objective and independent assessment of competencies is assured.

From the students' vantage point, the grading and assessment criteria are transparent and the volume and requirements for assessment are adequate. Nevertheless, in the view of the experts, the visibility of the examination system and assessment criteria should be expanded. Apart from that, a clear responsibility for the methodology of the assessment should be designated.

Students' examination schedules are available no later than ten days before the examination period starts. They are available on the information stand and sent to all students and teachers by e-mail.

Regulations for students in special circumstances as well as disabled students are documented in the self-evaluation report.

Recommendations

R11 The visibility of the examination system and assessment criteria should be expanded and the attestation as well as assessment regulations should be made available for international students in the English language.

R12 A clear responsibility for the methodology of 5-point assessment and its compliance with the ECTS assessment system should be designated.

4.4 Organisation of the Study Programme

Current situation

The university functions within the structure of the Ministry of Education and Science and enjoys academic autonomy, which means that all principal decisions regarding the university operation are made by an Academic Council. This body is responsible for defining basic directions of educational processes and research. It also approves the university budget and makes important administrative decisions. Official regulations for document recognition in the enrolment process of international students are set in place, even though they may take time. Irrespective of that, students can be enrolled in the SP after the semester has already started without any disadvantages due to the good support system of the university.

Entry requirements for the SP are a Bachelor's degree diploma in a relevant area (Energy Technology, Mechanical Engineering, Power Engineering, Electrical Engineering or an equivalent degree according to the educational system of the respective country) with a transcript of records. Candidates must have basic knowledge in thermodynamics, theory of heat and mass transfer, theory of turbomachines and hydromachines, combustion theory and must be sufficiently skilled in languages, i.e. English language proficiency B+ (CEFR B2). Taking a multidisciplinary entrance exam in heat power en-

gineering and an interview in English with a programme coordinator (also online) is further required. For entering the double degree programme, extra requirements at the partner university are necessary: applicants should have an English language test with the minimum score: Academic TOEFL 65 iBT or 513 PBT, Academic IELTS 5.5, PTE Academic 46, Cambridge CAE or CPE level C.

In order to participate in the budget competition of Russian applicants, Russian students must pass an entrance exam for the state-budget funded form of education in the format of a written test by major Heat Power Engineering and Thermal Engineering. For excellent students, grants are given by national and international employers, if they are actively operating on the Russian market. At SPbPU, the largest enrolment is on the basis of state subsidies. Information for Russian and international students is provided in both languages at the official website of SPbPU.

The International Academic Mobility Department is a structural unit of SPbPU aimed at administrational support and development of academic exchanges between SPbPU and foreign partner universities in accordance with the Lisbon Declaration and the Bologna Process based on bilateral agreements on exchange – among them joint degree programmes, integrated programmes, projects and programmes initiated and financed by national agencies and services of academic mobility of foreign countries. In total, SPbPU has agreements on scientific and academic cooperation with more than 250 foreign universities from 50 countries. In 2015, SPbPU became a member of eight ERASMUS+ projects. Academic students' semester mobility at foreign universities is supported by the federal academic excellence programme 5-100-2020 of the RF Ministry of Education and by foreign scholarship programmes, such as FIRST, DAAD and ERASMUS+.

SPbPU welcomes international students providing free short-term education for those of them coming from partner universities in the framework of academic mobility agreements. Outgoing students are selected on the base of their academic results and language proficiency. The need for legalisation of documents on foreign education is stipulated in the Federal Law as of 29.12.2012 N273-FZ On Education in the RF and the Federal Law On Science and State Scientific and Technical Policy as of 23.08.1996 N127-FZ. Since 2013, SPbPU has the right to independently recognise foreign education and qualification according to the procedure it has established in order to organise admission for education at SPbPU. Teachers also participate in the academic mobility programmes, give lectures at foreign universities and have a chance to exchange experience with foreign colleagues, e.g. at the City University London, University of Applied Sciences Upper Austria, Zhejiang University, LUT and others. Foreign visiting professors and guest speakers are also regularly coming to SPbPU.

Within the framework of international cooperation, they carry out joint research projects with the involvement of industry, joint publications in international editions, joint workshops and conferences as well as joint R&D centres and labs involving global companies. Key partners include Leibniz Universität Hannover, Universität Stuttgart, TU München, Graz University of Technology in Austria, Paris Tech, Politecnico di Milano, Mc Gill University in Canada, Georgia Institute of Technology in the USA and others. Additionally, SPbPU has signed agreements on cooperation with leading Russian companies and corporations – Rosatom, Gazprom, RusHydro, AvtoVAZ, ALROSA, FGC UES, State Corporation Russian Technologies, Rosneft, Energia, United Shipbuilding Corporation, Kamaz, Power Machines LMZ etc. and collaborates with more than 90 international companies, such as Motorola, Microsoft, AT&T, Siemens, Apple Macintosh, Schlumberger and others.

The Supply Centre for International Activity was established in 2008 within the implementation of SPbPU's Innovation Educational Programme. The Centre consolidates in-

tellectual, methodology and technical resources, providing information, regulatory and marketing support for international scientific and educational activities of faculties and other SPbPU units. Besides, the International Educational Projects Office provides consulting, organisational and informational support for international educational projects and programmes to academic and administrative staff and students of the university.

The SP has a scientific advisor responsible for academic advising of the programme and two coordinators liable for organisational and information support. One of them is in direct contact with the students, arranges extra-curricular events and facilitates their adaptation in Russia and cross-cultural communication. The programme tutor also supports international students and gives classes in Russian and Russian culture. Moreover, students may request help at the International Education Office, the Centre for Expertise of Foreign Educational Documents, the Foreign Student Department as well as the Passport and Visa Department.

Assessment

The study process of the programme is assessed as well organised, balanced and adequate to achieve the intended learning outcomes by the experts. The enrolment process is going smoothly. Nevertheless, the expert recommend to state publicly that official regulations for document recognition in the enrolment process of international students can take time. Because of the heterogeneity of the levels of the entrance qualification, the minimum entrance level should be adjusted to have a similar level of fundamental knowledge among students entering the Master programme. In addition to that, the entrance tests should focus on fundamental knowledge of thermal engineering in order to avoid repetition of fundamentals in their master classes. Although the contents are covered in the module handbooks, the expert team believes that the programme coordinators should more clearly state what is expected from the students' right from the beginning of study.

Students on site confirmed their satisfaction with their study situation and appreciate the support services offered. Particularly positively mentioned was the very close and easy contact with their lecturers and supervisors. Students stressed the pleasant exchange of ideas and the very good English language skills of staff and teachers.

The expert panel is impressed that within two years, the university has invited a bunch of foreign professors specialised in the field of study to teach within the SP. However, in the opinion of the experts, it is advisable to extend the stay of foreign visiting professors at SPbPU in order to guarantee professorial mentoring for the students during the whole semester after participating in intensive courses.

The expert group values the good cooperation with different national and international companies as well as the experience in industry of the majority of staff and their research for industry orders. However, none of the students in the SP is currently employed by a company. According to the students, it is upon their own initiatives to have a practical internship within a company. As declared by the programme management, industrial placement for international students is not always possible in Russian power industry companies due to the full or partial prohibition of industrial placement or employment of foreign citizens and sometimes due to a language barrier. This contrasts with the excellent collaborations between the industry and SPbPU established for Russian students, which is why international students are not as regularly and quickly absorbed by the Russian labour market as Russian students. So, only a small amount of scientific research in the international SP is carried out jointly with foreign partners although cooperations are installed. Notwithstanding, the expert panel strongly recom-

mends to help international students getting employed within international companies in Russia while studying and actively create opportunities for international students working in scientific cooperations in order to improve their employment opportunities as well as to assure research based teaching in a real work setting.

The SP gives students the opportunity to study in an international and multinational academic environment, to be involved in extracurricular activities at the university and unique opportunities for international academic mobility the experts as well as the students are very delighted about. Besides, the availability of short-term programmes in power engineering in the format of winter and summer schools are excellent. In the view of the experts, students' opportunities to participate in mobility programmes, especially the joint programme with LUT, are important steps to connect with western universities.

Students' opportunities to publish articles in the university journal and to present results at university internal conferences is very much esteemed by the expert panel as well as projects done in the FabLab. Additionally, the internal exchange and collaboration between the departments of the university is very good in the view of the experts.

Since the SP is only offered in full-time study mode, the experts stimulate the possibility of part-time studies. Moreover, for international students, the organisation chart of the management and organisation structure of the institute should be translated into English as it is only available in Russian.

Recommendations

R13 It should be stated publicly that official regulations for document recognition in the enrolment process of international students can take time.

R14 The minimum entrance level of students' knowledge should be identified and adjusted to have a similar level of fundamental knowledge among students entering the Master programme and it should clearly be stated what is expected from the students' right from the beginning of study.

R15 The entrance tests should focus on fundamental knowledge of thermal engineering in order to avoid repetition in students' Master classes.

R16 The stay of visiting professors at SPbPU should be extended and long-term visiting lecturers from European universities should be invited in order to guarantee intensified professorial mentoring and face-to-face interaction between teachers and students during the whole semester.

R17 The institute should help international students getting employed within international companies in Russia while studying and actively create opportunities for international students working in scientific cooperations.

R18 For international students, the organisation chart of the management and organisation structure of the institute should be translated into English.

4.5 Resources

Current situation

At SPbPU, there are more than 2,500 lecturers, professors and international faculty members. Twenty-four teachers regularly participate in the SP with sixteen of them being among the IE&TS teachers, five foreign visiting professors of the IE&TS, and each

one teacher of the ICE, IIMET and IAM&M. International visiting professors from LUT, Leibniz University of Hannover, University of Genova and Brandenburg University of Technology Cottbus-Senftenberg are involved on a regular basis to implement the SP as well as representatives of Saint Petersburg energy complex who are invited. Sixteen out of nineteen Russian professors working at SPbPU are full-time employees, foreign researchers and teachers are hired under a contract of work and labour. 75% of the teaching staff hold a PhD or Doctor of Sciences degree. Some teachers who have no post graduate degree participate in the programme since they are experts in the field of the discipline they teach and have practical experience in the production industry. The academic and examination workload is distributed evenly among teachers. The SP has its own competent English teachers with international English teaching certificates, who had teaching experience in several countries. The employment procedure is publicly available.

University teachers have to improve their skills at least once every three years within professional development courses including a course on methods of teaching in English. They regularly exchange experience with foreign colleagues and have voluntary further training in partner universities. Teachers annually participate in Russian and foreign conferences and fairs. Methods of teaching and conducting research are analysed once a year at the department as well as seminars to discuss teaching experiences as well as the prospects for development of the disciplines in the context of the current situation in the relevant scientific field and requirements of the employers.

A major component of the mechanism ensuring acquisition of the necessary knowledge as part of the Master's education is a scientific research component. Each year, SPbPU holds more than thirty international scientific conferences and publishes textbooks monographs and a number of scientific periodical publications. There are a number of International R&D Centres, which were established in cooperation with international companies for developing joint R&D projects, such as Polytechnic National Instruments, Philips-Research and Development Laboratory, Polytechnic-SAP, Russian-Chinese Research Laboratory and others.

Classroom facilities comprise seven lecture rooms of the IE&TS with twenty-five seats each, two classrooms with thirty seats and two computer classrooms, one of the Nuclear and Heat Power Engineering Department and one of the Thermophysics of Power Units Department. Computer classrooms are equipped with all necessary licensed software and have fifteen seats.

The structural units of SPbPU include ten academic institutes, 120 R&D laboratories, 43 research and educational centres, the Supercomputer Centre, Polytechnicheskiy Research and Technology Park, the Natural Science Lyceum, University Polytechnic College, Nuclear Energy Institute in Sosnovy Bor and Centres for Continuing Education and Professional Development. The scientific and research laboratory Industrial Heat Power System is based on the Department of Nuclear and Thermal Power, where successful developments within all the newer areas of the energy market take place.

Software complexes ZuluThermo, ZuluHydro, United Cycle, Ansys are given. It has all necessary licenses including the license of Financial Services Board (FSB) allowing to work with the state secret, as well as the certificate of Self-Regulating Organisation" (SRO). From the technical point of view, the laboratory is completely supplied with a new highly effective computer hardware and software. Also in the arsenal are measurement instruments – thermal imagers, measuring instruments of density of thermal streams and temperature, thermohygrometers, anemometers, gas analysers, 3D printer ect. At the moment, there are more than 50 executed schemes of heat supply, water supply and drainage schemes of city settlements, such as Ozersk and Petrozavodsk.

An increasing demand falls on programmes of complex development, 3D-modeling and production of models of power objects.

FabLab Polytech is part of the Centre for Scientific and Technical Creativity of Youth (SCY) of SPbPU. It is an open and free workspace with CNC-machines for students aiming at the provision of students with the opportunity to realise their technical and creative ideas. Areas of activities include robotic engineering, 2D and 3D simulation, 3D scanning and printing, electronic devices programming and design. An expansion of laboratories is planned within the near future.

The university provides a wide range of social, cultural and recreational facilities for students and staff. The infrastructural units include the fundamental library, exhibition complex, the publishing house, sport and recreation complex, university accommodation complex with twenty-three dormitories, northern and southern vacation camps, students' clubs, a medical complex, scientists' club in Lesnoy as well as canteens and cafes. Furthermore, there are a theatre and various musical and performance groups.

The Fundamental Library of Polytechnic University is one of the largest scientific and technological libraries in Russia, and rates among the three best libraries in Saint Petersburg. The library possesses a collection of more than 4,000,000 volumes. This rich collection comprises books in Russian and in fourteen languages with titles in every branch of science, technology and commerce. A valuable stock of scientific periodicals is available and complete sets of journals and magazines covering periods of many years. The library information services are developed and supported by the Open Library System Centre. Within the e-library, students have access to 60,000 documents, access to electronic resources of the Publishing houses (Elsevier, Academic Press, etc.), to the databases UMI, Code, VINITI (Russian Institute of Scientific and Technical Information) etc. and to electronic resources all over the world. Despite external resources and databases, resources from partner libraries, e.g. the National German Library of Science & Technology, can be used. Those books that are in most demand are held separately in spacious reading rooms. There are more than 1000 working places located within the library, among them 150 computer working places. Wifi is accessible across the campus. The library continues to add volumes to its collection by subscription and through book exchange. The library is accessible for readers with disabilities and library stuff guarantees special support for disabled students.

The financial position of SPbPU is described in detail in the self-documentation and annexes. Financing the SP has been secured by a variety of sources: federal budget funds, funds of the Ministry of Education and Science of the RF, funds obtained from business activities of the university and financial means by grants and competitions, funds of the academic excellence programme 5-100-2020 as well as financing of visiting professors by EU capabilities as well as tuition fees of students. Within this multichannel financing of the SP, employers also co-finance programmes.

Assessment

During the site visit, the expert team could explore the classrooms and laboratories of the department as well as the library. Resource endowments and their deployment sustain student-centred teaching and core activities. An up-to-date media equipment is in some of the facilities. The experts are convinced that the university urgently needs support from the industry to have better experimental laboratories. The IE&TS should make sure to receive sponsorship from companies to equip adequately their labs in order to sufficiently reach the objectives of the SP and ensure good working conditions as well as to enable students to gain experience in best practice examples.

Classrooms are of adequate size to create a good learning environment considering the current number of enrolled students. Students emphasised that the new dormitories are very comfortable, which has brought the experts to believe that lodging is no problem, due to the good supply of student housing by SPbPU.

As regards the library, the experts found that all important standard literature and scientific literature on key topics of the SP are available. The library is very well equipped and especially noteworthy is the excellently English speaking staff. Besides, the e-infrastructure of research communication is very well set in place. All students have access to the library and many publications are available in several languages, i.e. English and Russian. Furthermore, access to major international databases is given. The numerous services of the library, from which both students and teachers benefit, is very much appreciated by the experts.

The teaching staff qualification fits the profile and goals of the programme. Strategies and processes for staff recruiting are in stock. The expert team highly values the staffs' international teaching and professional experiences. 35 % of the SP is taught by visiting professors. Core components of the SP (steam boilers, power machines, turbines, heat and mass transfer, thermal power plants) should be given by in-house professors and lecturers on a regular basis so that they can be approached by the students any time. More teaching staff with a comprehensive research background should be recruited as well as more researchers with a background in industry, especially in technical terms (as opposed to management skills) to increase research based teaching. Moreover, further educational training for teaching staff should be increased with regard to didactics and pedagogical qualities. Apart from that, the process of development for teaching staff should be formalised also when it comes to research.

Financial management and funding is regarded as professional and multichannel funding as exemplary in the opinion of the experts. Funding is sufficiently and the financial situation of students is good. SPbPU has developed good fund raising activities and pursues to increase them.

All in all, resources are comprehensive to fulfil the mission of the institute.

Recommendations

R19 The institute should make sure to receive sponsorship from companies to adequately equip their laboratories with modern infrastructure.

R20 More teaching staff with a comprehensive research background should be recruited as well as more researchers with a background in industry, especially in technical terms.

R21 Further educational training for teaching staff should be increased with regard to didactics and pedagogical qualities.

R22 The process of recruitment and development for teaching staff should be formalised with regard to research. It is necessary to involve teachers more in the research work, thus increasing the number of publications, particularly joint publications prepared with representatives of industry.

4.6 Quality Assurance

Current situation

According to the Law on Education of the RF, quality control is performed by governmental authorities specially assigned to this task and belonging to an executive branch. Certification of the quality management system (QMS) of the FSAEI of HE SPbPU is currently valid for educational activities in accordance with the area of licensing and accreditation, scientific activities and innovation projects according to the profile of the university. The QMS in application to the EPs of Additional Professional Education was certified for the first time in 2007, in application to scientific research activities in 2012. At the moment, the certificate on fulfilment of requirements of GOST[2] ISO 9001-2008[3] by the Management System of SPbPU is in force, issued on 31st March 2016 by the certification body of the Russian Register Association. On December 1st, 2015, Russia was officially presented in the European Quality Assurance Register. Decisions taken by the accreditation bodies listed in the register are recognised internationally. Among technical universities, SPbPU was the first higher education institution that successfully underwent such an accreditation.

Monitoring of processes is carried out annually in frames of the procedure of internal audits of the university's QMS, which is certified on the correspondence to ISO 9001 requirements. Based on the results of audits, corrective actions are employed, which brings about continuous improvements of processes. Regulatory documentation is monitored by the SP's staff.

The concept of quality assurance of SPbPU's EPs is reflected in its Quality Assurance Policy, developed and approved as part of the certified management system of the university. The programme and all teaching and methodological materials were approved by the Council of the IE&TS, then by the Teaching and Methodological Council and the Academic Council of SPbPU. The SP is revised and corrected annually given the scientific achievements and topicality of the discipline taking into account the FSES, professional standards and feedback from students, alumni, teachers and employers. Feedback tools include questionnaires and surveys, monitoring of the labour market and cooperation of the institute with employers in the sphere of power engineering. Students' experience abroad is also taken into account. Annual updates of the EP and the teaching staff are made based on this feedback. Results are compared to the programme learning outcome assessments by years and then conclusions and managerial decisions are made. One of the SP's advisors is responsible of quality improvement of the EP. Together with the coordinators of the EP, he meets representatives of employers in the middle of every year to find out if the companies are satisfied with the graduates of the EP, to discuss the needs of the industry for the graduates and to define new areas. They develop a mutual strategy to achieve professional learning outcomes required by the company. Statistical data are collected and evaluated on the university's own portal umu.stu.neva.ru.

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[2] In Russia, there are several types of technical standards: national standards (GOST R), interstate standards (GOST) and other standards (OST, TU, etc.). The national and interstate standards have designations GOST R (or GOST) plus a numeric designator consisting of a serial number and a year the standard becomes effective. GOST is an acronym for "gosudarstvennyy standart", which means "state standard". At present, the collection of GOST standards includes over 20,000 titles used extensively in conformity assessment activities in 12 countries (https://runorm.com/gost-gost-r-standards, 24.04.2017).

[3] The certificate ISO 9001 defines minimum requirements for quality management systems that must be implemented by the institution certified.

Assessment

In the view of the experts, a systematic and methodologically sophisticated approach of quality management is visible. The experts certify that SPbPU has developed and implemented a comprehensive quality assurance concept of the SP, which is interconnected with the quality assurance system of the institution. The QMS is of systematic character and effectively assures the quality of the SP.

The institute's quality assurance policy reflects the relationship between research and learning and teaching. It takes into account the national context in which the institution operates as well as the institutional context and its strategic approach. The policy translates into practice through a variety of internal quality assurance processes, e. g. elements of an independent evaluation system as far as student knowledge and content is concerned.

Mechanisms for closing quality feedback loops are established and regular feedback cycles are set in place. Within the institute, survey results are regularly discussed and improvements are initiated based on them. The self-evaluation report and the discussions during the site visit showed that data and developments are differentiated and self-critically analysed. Different stakeholders are involved in the quality assurance processes and the QMS also implies the involvement of students in the assurance of quality of training. On site, students confirmed that they feel their complaints are taken seriously and changes are made for the upcoming semester. Nevertheless, according to the experts, it is necessary to develop a more effective teacher-student feedback system. The experts highlight the orientation on the changing demands of the labour market. Changes in the labour market, expectations of employers and students are analysed on department and institute level. In the view of the experts, on the basis of the available database of alumni and employers, it is necessary to develop a system of regular feedback on the advantages and disadvantages of the study programme, its relevance and compliance with the labour functions, the alumni has to fulfil in the workplace.

Recommendations

R23 It is necessary to develop an effective teacher-student feedback system.

R24 On the basis of the available database of alumni and employers, it is necessary to develop a system of regular feedback on the advantages and disadvantages of the study programme, its relevance and compliance with the labour functions, the alumni has to fulfil in the workplace.

5. Overall Assessment

The experts would like to express their appreciation for the open and respectful communication culture, the pleasant working environment and the significant high commitment and dedication for continuous development and innovation of the university's rectorate, administration, programme representatives, teachers and students.

The content and structure of the SP are coherent and convincing with a sound basis of scientific and pedagogical-didactic high quality. SPbPU provides a profound education and prepares its students very well for future professions in their field of study.

Especially noteworthy is the demand for the SP in the labour market. The experts were impressed by the high number of cooperations between SPbPU and partner universities as well as national and international companies, especially European ones. These networks, particularly with the industry, should henceforth be fully exploited. The development of joint scientific research of Russian and European scientists is very well established at SPbPU. Highly remarkable is the well trained international personnel who makes it possible to cover a wide-range of research activities. Teachers of the SP are actively involved in research activities at the university and visiting professors from leading European universities are available. The opportunity of the double degree with LUT and agreements on academic exchange with other partner universities guarantee a high level of academic mobility, which should be further developed and continued in the future. During the site visit, students commended on the mixed nationality composition of the students and teachers, which allows realising a cross-cultural environment and makes it possible to work in an international environment. One of the major strengths of the programme is the focus on quality and internationalisation. The experts encourage SPbPU to further promote international programmes. Pursuing the further development and modernisation of SPbPU, the university has good future prospects based on the competitiveness and reputation of the programme in the international market of educational programmes.

The experts agree that the SP complies with the European requirements and meets the evaluation criteria of the joint international accreditation of **evalag** and NCPA. Therefore, they recommend the programme for accreditation and for awarding the **evalag** label for international programme accreditation. In addition to that, they recommend that SPbPU will consider and implement the recommendations in this report to further improve the programme.

The expert panel wishes the representatives of SPbPU all the best for the future development of the SP.

6. Statement of the University

POLYTECH
Peter the Great
St.Petersburg Polytechnic
University

Polytechnicheskaya str., 29
St. Petersburg
195251 Russia
www.sbppu-eng.ru

Ph.: +7 812 534-1001
+7 812 534-1002
Fax: +7 812 534-1365
e-mail: director@ipts.spbstu.ru

To whom it may concern

INSTITUTE OF ENERGY AND TRANSPORT SYSTEMS

Statement of the University

The Institute of Energy and Transport Systems expresses its gratitude to the expert group for their expert report on the international accreditation of the study programme «Power Plant Engineering», delivered by the Federal State Autonomous Institution of Higher Education «Peter the Great St. Petersburg Polytechnic University».

No factual errors have been revealed in the report.

We would like to express once again our gratitude to the expert group, German accreditation agency evalag and national accreditation agency NCPA for the large scope of highly professional work on preparing and drawing up the expert report on evaluation and accreditation of the study programme «Power Plant Engineering» of the field of study «Heat Power Engineering and Thermal Engineering» (13.04.01).

Director of the IE&TS

Nikolay A. Zabelin

Stamp

7. Recommendations (summarised)

Programme Profile

R1 The profile of the study programme should be sharpened and the learning outcomes should be described more precisely in the module handbooks with a clear differentiation to other programmes within the institute. The same holds the titles of all module handbook. They should be more concrete to better match the content of the single lectures and seminars.

R2 Responsibilities, requirements and teachers' names should be clearly stated in the module handbook for all classes.

R3 The study programme should be more actively promoted by the university with an increased international online visibility. Additionally, the visibility of the learning outcomes should be increased on the website of the university.

Curriculum

R4 A broader scope of fundamental courses, especially in thermodynamics, fluid-dynamics, heat-mass exchange, physics and mechanical engineering concepts, should be integrated into the curriculum in order to fill knowledge gaps of students with different bachelor background learning experience.

R5 There should be a greater transparency among teachers of classes taught by their colleagues and more interfaces, especially between visiting lecturers, because teachers from different universities do not have contact to each other within the learning process.

R6 A Russian language course should be mandatory for international students in the first term.

R7 An increased extent of obligatory experimental practical laboratory classes should be included into the curriculum for all students, and especially for students who do not have the opportunity to work in the industry.

R8 Students should be given the opportunity to create an individual study plan. It is necessary to extend the number of selective courses and enhance possibilities for students to choose these courses.

R9 Additional voluntary advanced classes should be offered, especially for students pursuing an academic career.

R10 Students' Master's theses should be based on scientific approaches opposed to narrative or descriptive ones.

Student Assessment

R11 The visibility of the examination system and assessment criteria should be expanded and the attestation as well as assessment regulations should be made available for international students in the English language.

R12 A clear responsibility for the methodology of 5-point assessment and its com plicance with the ECTS assessment system should be designated.

Organisation of the Study Programme

R13 It should be stated publicly that official regulations for document recognition in the enrolment process of international students can take time.

R14 The minimum entrance level of students' knowledge should be identified and adjusted to have a similar level of fundamental knowledge among students entering the Master programme and it should clearly be stated what is expected from the students' right from the beginning of study.

R15 The entrance tests should focus on fundamental knowledge of thermal engineering in order to avoid repetition in students' Master classes.

R16 The stay of visiting professors at SPbPU should be extended and long-term visiting lecturers from European universities should be invited in order to guarantee intensified professorial mentoring and face-to-face interaction between teachers and students during the whole semester.

R17 The institute should help international students getting employed within international companies in Russia while studying and actively create opportunities for international students working in scientific cooperations.

R18 For international students, the organisation chart of the management and organisation structure of the institute should be translated into English.

Resources

R19 The institute should make sure to receive sponsorship from companies to adequately equip their laboratories with modern infrastructure.

R20 More teaching staff with a comprehensive research background should be recruited as well as more researchers with a background in industry, especially in technical terms.

R21 Further educational training for teaching staff should be increased with regard to didactics and pedagogical qualities.

R22 The process of development for teaching staff should be formalised with regard to research. It is necessary to involve teachers more in the research work, thus, increasing the number of publications, particularly joint publications prepared with representatives of industry.

Quality Assurance

R23 It is necessary to develop an effective teacher-student feedback system.

R24 On the basis of the available database of alumni and employers it is necessary to develop a system of regular feedback on the advantages and disadvantages of the study programme, its relevance and compliance with the labour functions, the alumni has to fulfil in the workplace.

8. Decision of the evalag Accreditation Commission and NCPA Accreditation Commission

The accreditation commissions of NCPA and **evalag** accredited jointly the Master's programme Power Plant Engineering of Peter the Great Saint Petersburg Polytechnic University. The **evalag** Accreditation Commission awarded the **evalag** label for international programme accreditation on 27th June 2017, the NCPA Accreditation Commission awarded the NCPA label on 29th June 2017. The accreditation is valid **from 1st July, 2017 until 30th June, 2023**.

To further improve the programme the accreditation commission affirms the recommendations given by the expert team.

Programme Profile

R1 The profile of the study programme should be sharpened and the learning outcomes should be described more precisely in the module handbook with a clear differentiation to other programmes within the institute. The same holds for the titles of all modules. They should be more concrete to better match the content of the individual lectures and seminars.

R2 Responsibilities, requirements and teachers' names should be clearly stated in the module handbook for all classes.

R3 The study programme should be more actively promoted by the university with an increased international online visibility. Additionally, the visibility of the learning outcomes should be increased on the website of the university.

Curriculum

R4 A broader scope of fundamental courses, especially in thermodynamics, fluid-dynamics, heat-mass exchange, physics and mechanical engineering concepts should be integrated into the curriculum in order to fill knowledge gaps of students with different bachelor background learning experience.

R5 There should be a greater transparency among teachers about class content, especially involving visiting lecturers. Teachers from different universities should have contact to each other within the programme.

R6 A Russian language course should be mandatory for international students in the first term.

R7 An increased extent of obligatory experimental practical laboratory classes should be included into the curriculum for all students, and especially for students who do not have the opportunity to work in the industry.

R8 Students should be given the opportunity to create an individual study plan. It is necessary to expand the number of selective courses and enhance possibilities for students to choose these courses.

R9 Additional voluntary advanced classes should be offered, especially for students pursuing an academic career.

R10 Students' Master theses should be based on scientific approaches as opposed to narrative or descriptive ones.

Student Assessment

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Organisation of the study programme

R13 It should be stated publicly that official regulations for document recognition in the enrolment process of international students can take time.

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R15 The entrance tests should focus on fundamental knowledge of thermal engineering in order to avoid repetition in students' Master classes.

R16 The stay of visiting professors at SPbPU should be extended and long-term visiting lecturers from European universities should be invited in order to guarantee intensified professional mentoring and face-to-face interaction between teachers and students during the whole semester.

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R18 For international students, the organisation chart of the management and organisation structure of the institute should be translated into English.

Resources

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R20 More teaching staff with a comprehensive research background should be recruited as well as more researchers with a background in industry, especially in technical fields.

R21 Further educational training for teaching staff should be increased with regard to didactics and pedagogical qualities.

R22 The process of development for teaching staff should be formalised with regard to research. It is necessary to involve teachers more in the research work, thus increasing the number of publications, particularly joint publications prepared with representatives of industry.

Quality Assurance

R23 It is necessary to develop an effective teacher-student feedback system.

R24 On the basis of the available database of alumni and employers, it is necessary to develop a system of regular feedback on the advantages and disad-

vantages of the study programme, its relevance and compliance with the labour functions, which the alumni have to fulfil in their workplace.

9. Scale of Assessment Parameters and Evaluation Marks

Mark	Evaluation	Description
1	Unsatisfactory	The subfield under evaluation fails to ensure study quality on the basis of the criterion under consideration. It requires substantial correction; irregularities must be eliminated.
2	Satisfactory	The subfield under evaluation meets the requirements and provides a sufficient quality of studies at basic academic standards. Improvements should/must be made and recommendations should be implemented.
3	Good	The subfield under evaluation has been well-defined and is systemically developed on the basis of the criterion under consideration. The core activities are provided at high academic standard and ensure good quality of studies.
4	Very good	The subfield under evaluation is perfectly defined and very well developed on the basis of the criterion under consideration. The core activities are provided at very high academic standard and ensures an exceptionally good quality of studies.

No	Standards	Evaluation Marks given by the experts
1	Programme profile	3
2	Curriculum design	3
3	Student assessment	3
4	Organisation of the study programme	3
5	Resources	3
6	Quality assurance	3
	Total Maximum score: 24	18

Annexes

Annex 1: Standards and Criteria of International Accreditation of Study Programmes and Questionnaire

Standard 1: Programme Profile

Criteria for assessment of a study programme	Issues for consideration
1.1 Correspondence of the objectives of the study programme to the profile and strategic goals of the HEI	What are the objectives of the study programme? What are qualification goals of the study programme and how do they fit to the HEI profile? How well are objectives and qualification goals of the study programme documented? How does the programme fit in the context of the other programmes provided by the faculty/teaching unit?
1.2 Definition of the intended learning outcomes of the programme and their accessibility	Are the intended learning outcomes of the programme well defined and publicly accessible?
1.3. Correspondence of the intended learning outcomes to the level of awarded qualification	Do the learning outcomes correspond to the type and level of qualification provided by the programme? How does the institution assure that the programme complies with internationally accepted standards?
1.4. Consideration of academic and professional requirements (standards), public needs and the demands of the labour market in the intended learning outcomes	How are learning outcomes based on the requirements of the Federal State Educational Standards, professional requirements (if applicable) to Bachelor, Master and Specialist Degree programme graduates; on public needs and the needs of the labour market? How do they contribute to the employability of the graduates? How is the analysis of changing labour market requirements conducted? What are the main employment possibilities of the graduates? How did the institution assess employment possibilities for the graduates? How do the expected learning outcomes contribute to the employability of the graduates?
1.5. Relation of the study programme to research (provision of scientific methods in theory and practice, research based teaching)	Is there an institutional policy related to research and research based teaching? Are the outcomes of research work used in teaching?
1.6. Compliance of the programme's profile with internationally accepted standards	Do the programmes profile and goals comply with internationally accepted standards?
1.7. The international dimension of the programme	Is there international dimension in the programme? What does it involve (student and stuff exchange programmes, foreign students, international component in the curriculum, etc.)?

1.8. Correspondence (adequacy) of the teaching staff's qualifications to the profile and objectives of the programme	Do the qualifications of the teaching staff, academic degrees and titles and/or work experience correspond to the profile and goals of the programme? Do the teaching staff cover all areas and disciplines of the study programme? Is the number of employed staff sufficient for the academic objectives? Are the teachers able to manage the necessary work load?

Standard 2: Curriculum

Criteria for assessment of a study programme	Issues for consideration
2.1 Structuring of the programme and ways of achieving intended learning outcomes	How do contents, structure, and teaching and learning methods meet the learning outcomes of the programme? How are they integrated in the study plan?
2.2 Mechanisms for providing knowledge in the corresponding discipline in the framework of the delivered programme. Application of scientific methods in the delivery of the programme	How does the programme provide the necessary knowledge and methodological expertise of the relevant discipline(s)? What are the main teaching and research methods used in the delivery of the programme? Why have these methods been chosen? How does the curriculum reflect the state of the art in the discipline?
2.3 Organisation of learning experience with the account of the diversity of students and their needs and appropriate student-centered teaching. Encouraging students to take an active role in creating the learning process	Is there a possibility of creating individual learning paths (if applicable)? At what point in the curriculum can students take choices (electives, tracks, etc.)? How are needs of a diverse student population (such as mature, part-time, employed and international students as well as students with disabilities and students in difficult life situations) taken into account?

Standard 3: Student Assessment

Criteria for assessment of a study programme	Issues for consideration
3.1 Organisation of assessment of intended learning outcomes	How is the assessment of intended learning outcomes organised? Is there an adequate system of student assessment? Is this system in line with the intended learning outcomes? Does the study programme participate in any kind of independent procedure of learning outcomes assessment? Does the study programme participate in this kind of procedures on a regular basis or occasionally?

3.2 The adequacy of the amount and requirements of assessments with regard to the intended learning outcomes	Are the amount and requirements of assessments adequate with regard to the intended learning outcomes?
3.3 The correspondence of the requirements of the thesis to the level of the degree	Do the requirements of the thesis reflect the level of the degree? What kind of thesis and final examinations are necessary? What kind of topics are covered by the thesis? How do teaching staff supervise the thesis?
3.4 Transparency and consistency of assessment criteria	What are the assessment criteria and are they transparent and used consistently? Are the documents regulating assessment procedures of knowledge/competencies of students published? Is this information accessible?
3.5 Adequacy of the qualifications of the staff undertaking assessments	Are the teachers undertaking assessment adequately qualified?
3.6 Availability of examination regulations	How is the examination procedure regulated? What different types of examinations are used? How many examinations exist within one module, within one semester, within the entire programme? Are students informed about assessment procedures, examinations, tests and other types of control? How do examination results contribute to the final degree? Is there an affective appeals system? How are students' complaints addressed? How does the examination system assess the intended learning outcomes of the study programme and the modules?
3.7 Availability of clear and objective regulations for student absence, illness and other mitigating circumstances	What kind of regulations for student absence, illness and other mitigating circumstances exist in the examination regulations? Are these regulations transparent and accessible to students? How are needs of part-time, employed students, etc. taken into account?

Standard 4: Organisation of the Study Programme

Criteria for assessment of a study programme	Issues for consideration
4.1 Appropriateness of entry qualifications	What are the entry qualifications of the programme? How are these qualifications defined and how are they connected to the learning outcomes? How is the selection/admission process organised? How is it documented? Where are admission rules and rules for transfer of students from other educational institutions published?

4.2 Regulations for the recognition of qualifications (i.e. Lisbon Convention)	What are the regulations for the recognition of prior learning? How is it documented and where are these documents published? Are graduates issued a Diploma Supplement? Does the programme cooperate with other educational institutions and national recognition centres with a view to ensuring coherent recognition of qualifications across the country?
4.3 Organisation of the study process and achievement of intended learning outcomes. Consideration of the diversity of students and their needs	How is the study process organised (types of classes, group sizes, relation between classes, homework, self-learning time, etc.)? Does the organisation of the study process allow the programme to be carried out in such a way that the intended learning outcomes will be achieved? Does the organisation of the study process also take the diversity of students and their needs into account? How does the programme take into account the needs of disabled students, as well as students in difficult life situations (students that have children, migrants, international students); students with different abilities; students with different level of academic achievements?
4.4 Management of the study programme (roles and responsibilities)	How is the programme management organised? Who has which responsibilities in the management of the programme?
4.5 Adequacy of the workload of the programme with respect to the necessity to reach the intended learning outcomes in the scheduled time frame	What is the student workload of the programme? How is the workload distributed across semesters and within one semester? How does the institution assure that the workload is manageable for the students? Is the workload of the programme adequate with respect to the necessity to reach the intended learning outcomes in the scheduled time frame?
4.6 Organisation of the student life cycle (i.e. all (organisational) relationships between the student and the institution from enrolment to graduation)	How is the student life cycle organised (from enrolment to graduation)?
4.7 Student support system (care services and student advisory services)	What student care services and student advisory services does the institution provide on the institutional and on the programme level? How effectively are these services organised? Is there a regular monitoring of student opinion on the issues of conditions and organisation of the study process, student support and advisory services? How is student academic mobility supported?
4.8 Cooperation with internal and external partners	Does the programme cooperate with other internal and external partners? Which parts of the programme are provided by partners? How does the programme assure that the partners provide their services at high quality?

Standard 5: Resources

Criteria for assessment of a study programme	Issues for consideration
5.1 Sustainability of funding and financial management	What financial resources does the programme dispose of? Which are the funding sources (tuition fees, university funding, direct government funding, third party funding, etc.)? How does the institution assure the financial sustainability of the programme? How does the programme deploy its resources to reach the programme's objectives? Are the financial resources sufficient to provide quality delivery of the programme? Is there a long term plan for financing the educational institution?
5.2 Adequacy of the number and qualification of academic staff (full-time and part-time) to ensure intended learning outcomes	Is the number and qualifications of the academic staff (full-time and part-time) adequate to ensure intended learning outcomes? What is the ratio between full time and part time academic staff? Are the teachers involved in research? Do they carry out methodological work? Do they participate in conferences and exhibitions?
5.3 Availability of strategies and processes for the staff recruiting and staff development	What are the strategies and processes for (full time) staff recruiting? How does the institution recruit part time staff? Which possibilities for staff development (especially development in teaching and learning methodologies) does the institution provide? How does the teaching staff use these possibilities?
5.4 Availability, sufficiency and quality of facilities and equipment for the provision of the programme (library, laboratories, teaching rooms, IT equipment)	Do the amount and quality of facilities and equipment allow the provision of the programme (library, laboratories, teaching rooms, IT equipment)? Does the provision with material and technical recourses allow the study programme to be delivered in accordance with the requirements of the curriculum? Are there enough computers and other technical equipment? Are up-to-date methods and teaching aids used in the study process (information resources and data bases, to include electronic multimedia resources)? What resources does the library provide for the programme? How accessible is the library? Are learning and teaching materials accessible for students' independent work?
5.5 Sufficiency and quality of the resources provided to reach the objectives of the programme	Are the amount and quality of the resources provided adequate to reach the objectives of the programme? How does the programme deploy its resources (financial and non-financial) to reach the programme objectives?

Standard 6: Quality Assurance

Criteria for assessment of a study programme	Issues for consideration
6.1 Design, approval and implementation of the programme; monitoring procedures	How does the institution develop, approve and implement the study programme? What are the mechanisms for its reviewing and improving? How is information on the management of the programme collected and analysed? What data does the programme collect and how are these data used for quality enhancement? - profile of the student population; - student progression, success and drop-out rates; - students' satisfaction with their programmes; - learning resources and student support available; - employability and career paths of graduates; - satisfaction of the staff with the working conditions, resources, etc. What are the procedures for reviewing and updating the curriculum with the account of the latest achievements of science and technology? How often is the programme reviewed?
6.2 Availability of a quality assurance concept of the programme and how it is connected to the quality assurance system of the institution	What is the quality concept of the programme and how is it connected to the quality assurance system of the institution?
6.3 Quality assurance processes and instruments of the programme	What are the quality assurance processes and instruments of the programme?
6.4 Effectiveness, regularity and systematic character of the quality assurance system	Does the programme use quality assurance regularly and systematically for quality enhancement? What are the objectives for the programme in quality assurance how does the institution monitor the achievement of the objectives
6.5 Availability of mechanisms for closing quality feedback loops	Are there effective mechanisms for rectifying shortcomings identified by the inner quality assurance system? How does the programme demonstrate that quality feedback loops are closed? How effective are they?
6.6 Collecting, analysis and use of data by the persons responsible for implementing the programme	How are the responsibilities for quality assurance distributed among programme staff and between levels (institution, faculty, programme)? How systematically and effectively do the persons responsible for the programme collect, analyse and use relevant information How have the results of quality assurance monitoring and periodic review contributed to the enhancement of the programme?

6.7 Involvement of stakeholders (students, teachers, administration, external experts, alumni, employers) in quality assurance	How does the institution involve stakeholders (students, teachers, administration, external experts, alumni, employers) in quality assurance?
6.8 Availability of procedures and relevant information for informing current and prospective students about the programme	Is the information about the study programme accessible to all stakeholders (applicants and their parents, students, teachers, employers, etc.)? How regularly does the programme monitor and update the published information? Is the information published on the website complete and accurate? Such as: - curriculum, - admission requirements, - intended learning outcomes, - awarded qualifications, - teaching and learning methods, assessment procedures, - academic progression, - research programmes and achievements

Annex 2: Requirements for experts

The expert panel will consist of four members who are unbiased. The majority of the panel members will have substantial expertise in the management of higher education institutions. Experience with international higher education systems is also a necessary requirement. Two experts will be from higher education institutions with leadership experience. One student will also be member of the panel. Upon request of the university, the size of the expert panel may be increased.

In order to make unbiased assessments, peer reviewers need to be, and need to be seen to be, free from conflicts of interest. This requires all professional and private relations with the evaluated institution to be disclosed in order to remove any doubts about the reviewer's assessment of the institution. Possible conflicts of interest are:

- employment as professor, teacher, researcher or guest scholar at SPbPU within the last five years;
- doctoral or post-doctoral studies at SPbPU within the last five years;
- family ties, personal connections or conflicts with staff members at SPbPU;
- current common research or other intensive contacts with SPbPU;
- direct academic competition with reviewers own projects;
- student/teacher relationship with staff members at SPbPU dating back less than five years;
- professional dependency within the last three years;
- participation in mutual review procedures within the last five years[4];

[4] Participation in mutual review procedures does not necessarily lead to a conflict of interest. This needs to be checked on a case to case basis.

- current application procedures or appointment negotiations with SPbPU;
- membership in commissions, councils or boards of SPbPU;
- individual or common economic interests.

Annex 3: Site visit schedule

Time	Event	Participants	Place
April 10th, Monday			
During the day	Experts' arrival to St.Petersburg, Transfer to the "Dostoevsky" Hotel (19, Vladimirsky prospect)		
17.00 — 18.30	Internal preparatory meeting of the expert team. Training.		Conference-hall "Dostoevsky" Hotel
20.00	Dinner (for foreign experts)		The Hotel cafe
April 11th, Tuesday			
8.20	Meeting in the Hotel hall (for foreign experts) Transfer to SPbPU.		"Dostoevsky" Hotel (19, Vladimirsky prospect)
8.45	Arrival to SPbPU		16th Academic Building (28a, Grazhdansky prospect)
09.00 — 10.30	**Internal meeting of expert team**	Expert team	Room 220
10.30 — 11.30	**General meeting of the University heads, heads of departments and Expert team**	Rector, Vice-rectors, Heads of the depart-ments, Expert team	Room 220
11.30 – 12.00	Document review. Expert evaluation of the graduation thesis works.	Expert team	Room 217
12.00 – 13.30	Lunch	Expert team	University canteen
13.30 – 13.45	Visits to the lecture and computer rooms		29, Gzhatskaya
13.45 – 13.50	Transfer to the SPbPU Main Building		29, Politekhnich-eskaya
13.50 — 14.15	**Visit to the Library Com-plex**	Expert team	The Main Building Library

Time	Event	Participants	Place
14.15 – 14.20	Cross-walk to the Institute of Energy and Transport Systems		Main Building (29, Politekhnich-eskaya)
14.20 — 15.15	**Meeting with Institute Director and Deputy Heads**	Institute Director, Deputy Heads, Expert team	Room 261
15.15 — 15.30	Coffee-break		Room 261
15.30 — 16.30	**Meeting with the program manager, teaching and administrative staff**	Head of the Department, program manager, program coordinator, Expert team	Room 261
16.30 — 17.30	**Tour through the Academic Building: visits to the main rooms, labs, equipment review**	Expert team	Mechanical Academic Building, “Turbines, Hydro Machines and Aircraft Engines” Department and Lab; 4th Academic Building, ”Thermophysics of Power Units” Department and Lab
17.30 — 18.00	**Meeting with employers and alumni**	Employers, Alumni, Expert team	Room 313
18.00 — 18.15	Internal EEC meeting	Expert team	Room 211
18.20	Transfer to the Hotel		
20.00	Dinner at the Hotel (for foreign experts)		The Hotel cafe
April 12th, Wednesday			
08.30	Meeting in the Hotel hall (for foreign experts). Transfer to SPbPU.		“Dostoevsky” Hotel
08.50	Arrival to SPbPU		16th Academic Building (28a, Grazhdansky prospect)
09.00 — 09.15	Internal meeting of expert team	Expert team	Room 217

Time	Event	Participants	Place
09.15 — 10.15	**Meeting with students**	Students, Expert team	Room 220
10.15 — 10.30	Coffee-break	Expert team	Room 220
10.30 — 12.00	**Meeting with teaching staff**	Teaching staff, Expert team	Room 220
12.00 — 12.45	Extra meeting (upon request)	Expert team	Room 220
12.45 — 14.00	Lunch		University canteen
14.10 — 16.00	**Internal meeting of expert team. Assessment form completing, work with the report. Preparation of oral report.**	Expert team	Room 217
16.00 — 17.00	**Feedback to program management. Final meeting of expert teams with University representatives**	University representatives, Expert team	Room 220
17.00 — 17.30	Free communication with the experts		Room 220
17.40	Transfer to the Hotel		
20.00	Dinner at the Hotel (for foreign experts)		

Annex 4: Profiles of expert panel members

Prof. Dr. Dmitry Ivanov (Russia)

Dmitry Ivanov holds the review chair of the expert group. He is Professor in the Department of General Physics and Nuclear Fusion at the Thermal and Atomic Power Institute of the Moscow Power Engineering Institute (National Research University).

Prof. Dr. Andrea Luke (Germany)

Andrea Luke functions as deputy review chair of the expert group. After finishing her PhD in machine engineering and working as a researcher at Hannover University, she is now Professor for Thermodynamics at Kassel University (Germany). She is a member of the International Centre for Heat and Mass Transfer and of the German Association for Refrigeration and Climate Engineering as well as a member of the Directory of the International Institute of Refrigeration Expertise and editor of the Journal of Heat and Mass Transfer. The focus of her academic interests and publications lies in the structure of evaporator surfaces and in heat transformation.

Dipl.-Ing. Martina Pösl (Germany)

As qualified Engineer, Martina Pösl holds a degree in Mechanical Engineering and is a certified International Welding Engineer. Before becoming a risk consultant and loss investigation expert at Allianz Global Corporate & Specialty SE in Munich, she worked as a power plant engineer at GDF Suez Energie Deutschland GmbH in Germany.

Sergey Muraveynikov (Russia)

Sergey Muraveynikov is a 1st year Master student at the Department of Thermophysics and Theoretical Heat Engineering at Saint Petersburg National Research University of Information Technologies, Mechanics and Optics.