

Problems of personnel training for power utilities and ways of their solution

V.Y. Putilov, I.V. Putilova, E.A. Malikova, National Research University "MPEI", Moscow, Russia

INTRODUCTION

In the Russian Federation according to the Law "On higher and postgraduate professional education" in 2015 in the majority of universities a transfer to the two-level system of higher professional education will be completed by the example of the European "Bologna" one with the Bachelor's and Master's degrees, but no engineers will be graduated.

In the transition period after starting reformation of the higher educational system in the Russian universities the following training levels took place:

- bachelor is a qualification, assigned to individuals, who learnt the correspondent educational programs of higher education. Duration of study under the Bachelor's program is 4 years.
- engineer is a higher education professional in the sciences, who has the right to be admitted to the first positions in organizations and enterprises with the specific type of economic activity. The training duration period is 5,5 years.
- master is a higher education professional in the sciences. This level allows both to hold different managing positions in companies and to conduct research work. The training duration period is 6 years.

PROBLEMS OF PERSONNEL TRAINING BEING FACED NOW

At the end of 1980-ies - beginning of 2000-ies the analysis of personnel training arranged for the power engineering sector is presented in [1]. At present as for the qualification of the personnel of power companies being the result of reforming the Russian educational system and restructuring the JSC "RAO UES of Russia" (simply defined as actual liquidation of the managing structure of the industry) the current situation is a consequence of two major problems:

1. Low efficiency of the state cooperation, on one side, and the fuel and energy complex, housing and public utilities and other branches of economy, on the other side, in the field of graduates training for their work at power enterprises;
2. Higher professional education status not meeting the modern requirements because of low funding of state universities since 1990-ies and of mass academic decline of the applicants.

Brief characteristics of cooperation efficiency between the state and the fuel and energy complex, housing and public utilities and other branches of economy in the field of graduates training for their work at power engineering enterprises

The results of cooperation between the state and different branches of economy relating to the training of professionals in power engineering:

- uncertainty of the required amount of graduates of the major profile specialties for power engineering companies with the significant state participation (JSC "Inter

RAO EES", "Gazprom energoholding" ltd, JSC "Rusgidro", JSC "FSK EES" and JSC "MRSK") and as a result the incomprehensibility of meeting the state plan of the students' acceptance for the base energy specialties to the actual demand for specialists of these utilities;

- uncertainty of the required amount of professionals in the major profile specialties for power engineering companies with the private capital, and as a result, it is impossible to foresee and plan the students' acceptance for paid education in regions of location of power companies;
- absence of requirements, developed by power companies under the guidance of the Ministry of Power and agreed with the Ministry of Science and Education, relating to qualification of graduates in power engineering in a form of the State Educational Standards.

Today such cooperation resulted in occurring the spontaneous process of professionals training in the field of power engineering. The Ministry of Power and the Ministry of Science and Education are the main state regulators in the sphere of professionals training for the power sector. They can't say anything distinct about the required amounts and qualifications of graduates. It is fair to mention that in 1980-ies in the Ministry of Higher Education Institutions and the Ministry of Power of the USSR they didn't know as well, which and how many professionals are needed for the power sector, and the plan of the specialists production was formed according to the gained level.

Consequences of low funding of state universities and academic decline of applicants

Low funding of the state universities since the beginning of 1990-ies of the 20th century is the consequence of misunderstanding and actual ignoring the role and place of scientific and educational establishments in sustainable development of the society, both by state power representatives and business.

Ideology of the major owners and managers of power engineering companies in relation to science and educational system in the field of power engineering is built according to the terms being very simple and intelligible for them: our children will be taught abroad, and relating to science - universities should conduct research at their own expense.

Low funding for universities since the early 1990s has led to the fact that the average age of lecturers of the most leading technical universities teaching the professionals in power engineering, is about 56 years and has steadily increased. 70% of teachers are older than 50 years, which is very alarming symptom. The age gap between generations of teachers may lead to the fact that in the coming years there will be nobody to teach basic power engineering disciplines at the appropriate level. Excluding postgraduates the picture looks even sadder, and the average age of teachers will exceed 60 years. The low level of salaries for the main activities of the teacher that is teaching the students, is the reason to consider this profession to be not prestigious (full pay with all the surcharges of the profes-

sor, Dr. Sci. is 18 thous. rub., associate professor, Ph.D. - 14 thous. rub.).

Average age of research employees of universities, being potential lecturers, is 48 years. Educational and scientific laboratory and experimental base outdated morally and physically. In the post-perestroika period funding of pilot and applied research both from the side of Ministry of Science and Education, and electric power industry was sharply cut. This has led to the decline of the experimental base and cut of the salary of scientific and academic staff.

Before early 1990s in the leading technical universities of Russia a lot of students were involved in research, and the experimental basis was used for the educational purposes as well. This allows not only to produce graduates - engineers with the corresponding level of technical and technological skills, but also to train research employees and teachers, both for reproduction of the teaching staff of universities, and for renewal of research staff of industrial research and project institutions. But all this remained in past. The absence of significant scope of contracts with power companies since the mid 1990s for the design of new technologies of production, transportation and distribution of electrical and thermal energy and extremely low amount of state financing of the researches led to degradation of the educational and scientific experimental basis in universities and to the sharp outflow of high-qualified lecturers and scientists of the universities.

It should be mentioned that creation of Federal and National research universities, as well as realization of the Skolkovo project recently have changed the situation in some way, but in general it doesn't much.

A process of creation of the actualized courseware is also directly dependent on the level of funding. Since early 2000s due to cooperation of MPEI employees with JSC "RAO EES Russia" there was a boom in publishing of scientific and technical, reference and educational literature, which reflects the modern level of equipment and technologies in the field of power engineering. After JSC "RAO EES Russia" stopped its activity only JSC "FSK EES" after a small break continued to finance the development and publishing the mentioned literature needed for the preparation, improvement of professional skills and professional retraining of experts of power grid of Russia.

Besides, most of the Russian universities can't duly renew and update courseware, considering regional features of power sector and specific features of the university because of the lack of funding. One of the special aspects of implementing the projects in the field of creation and publishing the scientific, technical and educational literature is its their low commercial attractiveness because of its low single edition (in the best way it is up to some thousands of books). The availability of such literature for universities can be increased in case its design, edition and publishing of the first edition are financed by the industry. In this case the cost of realization of next editions can be significantly reduced for universities.

Academic decline of applicants

Enrollment in recent years of the students in universities under the Unified State Exam results led to the admission of students, most of them unprepared for the successful studying under the university programs. This is noticeable in extremely low level of knowledge of students, especially of 2009-2010 admission. In some groups, at senior courses less than 10 students are being studied, master-

ing the curriculum with great difficulty. One gets the impression that the existing school system of education having the test system for checking the knowledge does not encourage the development of pupils' and students' thinking. Transfer to the two-level system of education (Bachelor and Master) further dramatizes the situation. As a result of these reforms, the power sector will get the drop-outs with the degree of a bachelor, whose qualifications unlikely suits power utilities. According to the plan of higher education reforming, the training under the master's program will continue on a budgetary basis for not more than 20% of the total number of admitted students.

TRAINING, PROFESSIONAL DEVELOPMENT AND PROFESSIONAL RETRAINING OF EXPERTS IN THE RUSSIAN UNIVERSITIES

In the state educational institutions of higher professional education of Russia (SEI HPE) the training is provided in accordance with the state educational standards of higher professional education and other relevant normative acts approved by the Ministry of Education of the Russian Federation. In parallel with SEI HPE the training is also conducted in private institutions of higher education (PIHE). Requirements of the State Standard are mandatory for SEI HPE and PIHE (hereinafter universities) that are accredited by the relevant state bodies and have the right to issue the documents of higher education of the established pattern to graduates.

Successful training of the specialists in power engineering is unlikely possible in PIHE because the majority of these universities have no schools of scientists as well as scientific and teaching personnel in the field of power engineering, scientific and educational experimental facilities and teaching materials for engineering training.

Training of graduates in power engineering is provided mainly in the following SEI HPE:

1. National Research University "Moscow Power Engineering Institute" (MPEI);
2. Ivanovo State Power Engineering University (ISPEU);
3. Kazan State Power Engineering Institute (KSPEI);
4. National Research University "Irkutsk State Technical University";
5. Amursk State University (AmSU, Blagoveschensk);
6. Far East State Technical University (FESTU, Vladivostok);
7. Krasnoyarsk State Technical University (KSTU, Krasnoyarsk);
8. Novosibirsk State Technical University (NSTU);
9. Samara State Technical University (SamSTU);
10. Saratov State Technical University (SSTU);
11. National Research University "Saint-Petersburg State Polytechnic University" (SpbSTU);
12. National Research University "Tomsk polytechnic university" (TPU);
13. Ural State Technical University (UFU, Yekaterinburg);
14. South-Russian State Technical University (SRSTU, Novocherkassk).
15. National Research University "South-Ural State University" (SUSU, Chelyabinsk).

There is a form of targeted training provided in some universities for power engineers on the basis of power

company contracts, but there are no published justified numbers of postgraduates-contractors. It is realized on the basis of standard educational programs.

To resolve the practical problems of the targeted training of graduates in system of the Ministry of Education and Science it is necessary to address the following main tasks:

- define a need in graduates for power engineering industry;
- form real requirements of power engineering industry to the trained graduates;
- define basic educational institutions, which have in maximum equipped educational-methodological complexes and laboratory-experimental basis ready to train graduates with the minimum excess;
- include necessary changes in the state educational standards;
- proceed to training of graduates;
- one can foresee that the first graduates, which will be trained under these programs of targeted training, will appear in 8-10 years after the beginning of practical resolution of all the tasks.

Besides, universities provide training of Masters and post-graduates planned for the work at university departments or in other enterprises of power engineering industry of different forms of ownership. Such training is provided for the interests of reproduction of scientific and educational personnel at the presence of contracts to realize fundamental or pilot research works financed by the state budget or due to contracts with power companies to solve specific industrial problems or to train the qualified staff for them. One should mention that Masters and post-graduates are trained according to individual educational plans, and it requires significant excesses.

Though a number of the trained graduates is not obviously enough for power companies of Russia, to hold the corresponding engineering positions of all levels, the graduates with diplomas of higher or specialized secondary but non profiled education are hired. It's quite frequently occurs when teachers, lawyers, economists etc. hold the positions requiring power engineering background. In practice such specialists, working as operational and management personnel, can cause the incorrect actions due to misunderstanding of technological processes they manage under different personal life circumstances.

The situation with insufficient amount of the qualified engineering personnel of all levels needed for power companies is worsened owing to the outflow of high-qualified specialists by reasons of low salaries and by the necessity to operate power equipment being out of date morally and physically. Along with this, there is the outflow of staff at the introduction of new technologies and equipment at the power companies, when previously trained staff has not enough knowledge and practical skill to work at. Such situation is destructive. If the specialist has not the systematic profile education and doesn't understand the productive technology, then he won't be able to manage this production properly. It's necessary to provide improvement of professional skills and/or professional retraining of such specialist. So in large companies (or universities) it is necessary to create a constantly operating system of professional development and retraining of specialists.

Programs of professional development of specialists

for power companies are aimed, firstly, at the staff with basic power engineering education or significant practical period of work. Programs of professional retraining of specialists for power companies are aimed at specialists having no basic power engineering education. After successful completion of professional retraining the specialists get the state diploma, which gives the right to practice a profession according to the area of education.

Listeners who successfully complete the training program depending on duration of the educational program get the following documents:

- 6 to 72 class hours — the Certificate of educational institution of short-term professional development;
- 72 to 100 class hours — the state Certificate of short-term professional development;
- 100 to 500 class hours — the state Certificate of professional development;
- 500 to 1000 class hours — the state Diploma of professional retraining, giving the right to practice a profession according to the program of professional retraining (under these programs specialists having high and special secondary education can be trained);
- 1000 to 2000 class hours — the state Diploma of professional retraining of the Engineer's, Specialist's or Manager's degree (sometimes it is called as the diploma of a second higher education; under these programs only specialists with a higher education can be trained).

One should mention that some educational institutions to attract students very often misinform them by statements that throughout the year of education in form of evening or part-time training they will get a diploma of a second higher education. In the correspondence with the state educational standards it is possible only at the long-term training of two-four years of duration, at absolute observance of other requirements.

In a number of Russian institutions at departments and in centres of professional development and retraining, key power engineering personnel is trained under different programs of additional education.

ON THE COMPLIANCE OF QUALIFICATION OF PERSONNEL FROM POWER COMPANIES AND SPECIALIZED ORGANIZATIONS WITH THE CURRENT REQUIREMENTS

About the reason of creation and activity of the Centre "Ecology in power engineering" of MPEI

In 1997 a Center for improvement of professional skill and professional retraining "Ecology in Power Engineering" (CPPEE MPEI) has been established in MPEI. The base department is Boiler Plants and Ecology in Power Engineering Department. CPPEE MPEI is a structural subdivision of Department of professional skill improvement of the MPEI teachers and experts and works on the basis of the accreditation documents and license of the MPEI.

The main reason of CPPEE MPEI creation was to eliminate the non-compliance of qualification of the managing and engineering personnel of power companies, design and other specialized organizations of the energy sector to the regularly changing requirements for application of environmental technologies, taking into account the state-of-the-art world experience. The consequence of this

was either the resistance to include the tasks for development and introduction of the modern environmental technologies in the industry R&D plans and/or the use of positive results of the tested R&D in the projects on TPP technical re-equipment or a lack of understanding of the operating personnel, how to use new techniques and technologies, already introduced at the power plant. A pleasant exception made few TPPs, where activity on collecting and analyzing the information on application of nature protection technologies in power engineering was systematically arranged. At introduction of new techniques and technologies MPEI employees in some form conducted the studies with the operational personnel. Due to all this, MPEI management decided to establish CPPEE MPEI.

Since 1998 in CPPEE MPEI under different programs of additional education 940 specialists of key power engineering specialties have been trained. Duration of training programs varies from 18 to 475 class hours and duration of retraining programs makes about 510 class hours. If necessary, in addition to the state educational documents listeners also get Knowledge Assessment Certificates on Regulations and Rules of the Electric Power Sector Worker, Labor Protection Knowledge Assessment Certificates or Knowledge Assessment Certificates on Basic Fire Safety. These Certificates were issued by Rostekhnadzor authorities. As a result of CPPEE MPEI work during 1998-2012, 675 employees of power utilities and specialized organizations have been trained and 265 – retrained.

Specific features realizing professional retraining programs in CPPEE MPEI in the areas of Heat Power Engineering (Thermal Power Plants) and Electric Power Engineering (Electric Power Plants and Electrical energy Systems and Networks) with a total training duration of about 1000 hours, including minimum 510 class hours are the following:

- Customer formulates the desired theme of the thesis, the implementation of which allows the listener to deal with one of the issues that are relevant to his power company, and to use this knowledge in his future work;
- during the first session, each participant works on the thesis according to recommendation of the Customer; the thesis supervisor appointed will accompany the listener during the entire training period, and he will also participate in determining the course projects;
- during training, each listener performs term projects included in the thesis, and studies the specific question, which is the quintessence of the diploma. The three main parts of the thesis are linked and form an integrated whole thesis that allows the listener to get a holistic view of the object of study;
- the listener who successfully defended his thesis in front of the National Certification Commission receives a state diploma of vocational retraining, giving the right to practise a profession in accordance with the retraining program;
- the training form is full-part-time with the inclusion of distant forms of training (class hours during 9 weeks with a breakaway of the production works: 1 - 3 sessions during two weeks and session 4 during three weeks, 5 days for consulting on Saturdays between the sessions, unsupervised study between the sessions);
- training starts at the end of September - beginning of October and ends at the end of May - beginning of June;

- lectures and practical classes are held in the specialized class room, equipped with the multimedia complex with Internet; laboratory classes are held in laboratories of profile MPEI departments and educational-experimental MPEI CHPP;
- specialists having higher and special secondary education can be trained under professional retraining program.

Despite of the fact that CPPEE MPEI work is certainly useful, it doesn't solve the problem of compliance of qualification of personnel for the power sector as a whole and also in the field of nature protection technologies in the Russian power engineering with its huge territory to the modern requirements.

Situation with the courseware in the field of nature protection technologies

In accordance with the state educational standard, the training center should have the necessary education materials for the curriculum. Necessary courseware has been developed, but there were no up-to-date printing editions in the field of nature protection technologies for the moment of CPPEE MPEI creation.

In 2003 MPEI Publishing House issued the manual "Ecology in power engineering" [2], intended for implementation of advanced training and professional training programs in the field of ecology in power engineering of the personnel from enterprises and organizations of RAO "UES of Russia", Fuel and Energy Complex, Municipal and Community Services and other sectors and agencies. The basis for the training manual made education materials, developed by the leading Russian experts - CPPEE MPEI teachers during 1998-2003 for programs of training and professional retraining of personnel from utilities of RAO "UES of Russia" and other economic sectors on the specialties "Thermal power plants", "Electric power systems and networks" and "Electric power plants". In 2007 the informational collection "State-of-the-art nature protection technologies in electric power engineering" [3] has been issued. It contains information on the modern domestic and foreign nature protection technologies in eclectic power sector applied for reduction of the man-made impact on environment caused by enterprises producing, transporting and distributing electric and thermal energy.

One should mention that some special issues relating to ecology of power engineering are included in other printed editions, but [2] and [3] contain the whole complex of aspects concerning all the directions of nature protection activity of power companies, having no analogs in the world.

What are the ways of creating an effective system of professional development and professional retraining of specialists in Russian universities?

Arrangement of professional development of personnel

Depending on the problems to address, the Customer chooses the short-term or the long-term program of professional development of specialists.

The thematic example of effective short-term professional development of specialists is the conducting or participating in international Russian or foreign scientific seminars or conferences where special issues of power

production are highlighted (ashes, noise, combined cycle gas turbine units, tax legislation and etc.). For example, during 2007 - 2012 Information and Analytical Centre "Ecology in power engineering" (IACEE MPEI) conducted four International Scientific and Practical Workshops "Ashes from TTPs - removal, transport, processing, storage". In October 2010 together with the Polish CCP Union there was for first time in the world I International workshop "A practice of implementing technologies for use of ash and slag from power generation" held in Poland. The aim of the workshop was to introduce large-scale technologies of beneficial coal ash utilization applied in the industry in the territory of Poland. Releases and materials of the workshops are placed at the site <http://osi.ecopower.ru> and they help the representatives of corresponding Russian and foreign companies and enterprises to examine new developments and get information on the projects being prepared for implementation. Participation in such scientific and technical events allows with minimum expenditures to get up-to-date structural information on the problems and ways of addressing the actual issues in sphere of power production in different countries all over the world.

Of course, there could be other programs of short-term professional development of specialists, but the Customer should exactly see the targeted audience and tasks to be completed being a result of the programs implementation. According to our opinion, professional development of specialists in the field of power generation having non-core education and lasting less than 100 hours is waste of financial resources and working hours of employees. To improve professional skills one need to possess the skills. It is impossible to explain the specific features of power station operation to employees, who are not familiar with Rankine cycle, Ohm's laws and other founders of power industry.

Long-term professional development of specialists having non-core education is provided for specialists of economic, legal and other non productive departments of power companies to study elementary basis of power production. It is necessary to increase the efficiency of power companies as a whole, and also to eliminate conflicts between employees of productive and non-productive subdivisions of power companies, which appear because of the lack of elementary knowledge in the field of power generation they have. By our experience duration of the professional development programs should be 110-120 hours. According to the curriculum of the programs, it's not required to prepare and defend the thesis. To check the assimilation of knowledge it's sufficient to pass examinations.

Long-term professional development of specialists having core education is intended to acquire the necessary competence by engineering and technical employees, introducing new equipment and technologies in power companies, and also developing and realizing the plans for modernization/reconstruction of power company production departments. Development of base teaching materials for the long-term professional development of specialists, in our opinion, will take to one year depending on the tasks set. Duration of professional development programs can be different, but to achieve the desired efficiency it should be about 160 class hours. The curriculum of these programs should include the preparation and defense of thesis targeted at practical resolution of some problem in

the field of power generation or ecology of power engineering, which is the most actual for the organization, where the listener works.

Professional training and retraining of specialists

The most effective directions of profile specialists training are development and realization of additional education programs for core training and professional retraining. In the correspondence with the state educational standard there are three basic forms possible: master courses, postgraduate studies and professional retraining of specialists, working in power companies, but having non-core education.

Master courses. Training process under this form begins at the last (fourth) year of the bachelor's study under the core speciality. During this period the bachelor conducts the final work, connected with the subject of the planned master's thesis. Thus, professional retraining is combined with the basic education. During postgraduate studies there is a target preparation of the future expert in the field of ash and slag handling. At the same time along with studies in CPPEE MPEI future masters are involved in performance of works under contracts with power companies, paying for their education. Total duration of preparation of such an expert makes three years (1 + 2 considering the last year of bachelor's study). So during the period of training under master courses, a targeted preparation of a future specialist under one of the tasks of the training direction is provided. At the same time along with training at the University Department or in the Centre of Training and Retraining (structural subdivision of the University) future holders of the master's degree take part in scientific and technical projects under the contracts with power companies, paying for their training. During the training under master's program the student works about 30% of his time for the Customer under supervision of the teacher to resolve the actual problem of the power company that allows the Customer to form the opinion about the future employee and to define his workplace after graduating from the master courses. Master courses allow to get a specialist, more or less prepared for the practical work who was before the holder of bachelor's degree, i.e. half-educated person. Total duration of training of the specialist is three years: 1 (last year of study under bachelor's program) + 2 (master courses).

Postgraduate study. It is a form of preparation of highly skilled experts under the system: "Bachelor's programme→Master's programme→Postgraduate studies". During postgraduate studies a future expert most of his time (50% and more) is involved in activity on performance of works under contracts with power companies, paying for his postgraduate study. Total duration of professional retraining of such an expert makes seven years: 1 (last year of study under bachelor's program) + 2 (master courses) + 4 (postgraduate study).

Professional retraining. According to our data there are a lot of power engineers working at power companies, who don't have necessary core power engineering education. Minimum duration period of effective professional retraining of such specialists should be about 507-519 class hours, which is possible at full-part-time form of study applying distance elements of learning. In this case the total duration of off-job training of the listener will be

only two months. According to our experience of implementation of professional retraining programs of specialists, the intensive training, organized in CPPEE MPEI since 2001, allows listeners to get the necessary knowledge for successful work under the corresponding direction of professional retraining. Evening-time education is also possible, but the duration period of professional retraining program won't be less than two years. Besides, the quality of education will be inevitably lower, because the listeners, having worked a whole working day, can't fruitfully participate in the educational process. One should also mention that a break in training during summer period absolutely unsettles the listener out of the educational process. For these reasons the authors refused from the evening-time education. We begin classes under professional retraining programs at the end of September - beginning of October and finish the educational process at the end of May - beginning of June.

SOME ESSENTIAL CONDITIONS TO SUPPLY POWER SAFETY OF RUSSIA AND POWER PRODUCTION EFFICIENCY

Addressing the issues relating to power safety of Russia and power generation efficiency, it is required to know more about power production technologies and be skilled in implementing ecological and economic assessment of investment projects of power companies modernization. For that purpose the corresponding core training of managers of power companies and engineering staff of all levels is needed and it can be provided only if there is a clear understanding of the following basic questions by owners and managers of power holdings and companies:

- a role and a place of universities to address the issues relating to power production [4];
- without involving universities in completing actual scientific projects, it is impossible not only to increase the efficiency and stability of power company operation, but also to provide effective staff preparation in universities under different core and additional educational programs according to the state-of-the-art requirements;
- necessity of development and realization of prospective program of preparation, professional training and professional retraining of power engineers under core specialties;
- economic feasibility of targeted training of specialists under contracts with universities;
- necessity of creation and update of electronic information resources of the open access for solving different problems relating to power industry development and ecology of power engineering;
- necessity of holding and active participation in the International Scientific and Practical Conferences and Workshop in the field of the best available and prospective technologies in power industry;
- use of systematic informing through the printing and electronic mass media about the problems and achievements of each power engineering company in the field of power generation.

In 2010-2011 according to the Program of MPEI Development, Information and Analytical Centre "Ecology of power engineering" MPEI (IACEPE MPEI) developed the electronic constantly updated system of the open access

"The Best Available and Perspective Nature Protection Technologies in the Russian Power Industry". The System was financed from the state budget. It has both versions – the Russian and the English (<http://osi.ecopower.ru> [5]). It should be mentioned that the section "Ash handling" of the System is a part of the *World-wide Coal Combustion Products Network* (www.wwccpn.org).

Informational basis of the System are results of the system researches on various aspects of ecological problems in power engineering, information collection "State-of-the-art nature protection technologies in power industry", Russian and foreign legal, normative and technical documents, proceeding of international scientific and technical conferences, reports of power companies relating to nature protection activity and publications in printed and electronic mass media.

The System plays the important role in providing the effective functioning of power industry, namely:

- promotes in Russia the world's best technologies in the field of ecology in power engineering;
- provides the information base while constructing new facilities and modernizing the operating utilities;
- results in sharp cutting the cost of information provision of utilities production activities;
- allows to significantly reduce the risks of financing the development of already known technical solutions or implementation of technologies in the field of energy production that are not the best;
- improves the quality of training, advanced training and retraining of specialists in the field of design, construction and operation of electric utilities, as well as protection of the environment;
- promotes information exchange in the field of nature protection technologies and equipment in power engineering between professionals around the world;
- promotes the formation of an objective image of Russia in the field of environmental protection in the electric power industry.

CONCLUSION

1. In the nearest future the level of graduates training will be declined independently from the volume of funding by the state and industries of the fuel-and-energy complex. It should take 8-10 years from the start of substantial financing of universities to get high qualified scientific and pedagogical staff trained, to rebuild educational and scientific experimental basis with the aim of mass increase in postgraduates training level. If it does not happen in 2-3 years, then most scientific schools will be closed by the reason of their extinction, and we can only dream about power safety of Russia because it's impossible to provide it with non-qualified power engineers.

2. To have graduates of the required level, power companies need to conclude contracts with universities under targeted master and other programs to overcome negative consequences of bachelor's program.

3. Involving universities in implementation of actual scientific and technical projects allows not only to increase the efficiency and stability of power companies operation, but also to provide more effective training of

staff in universities under different core and additional education programs.

4. To guarantee sustainable development and prevent the losses due to wrong operation of the non-qualified staff, power utilities should always provide training, professional development and professional retraining of the staff.

5. Without financing the development and publishing of scientific, technical, reference and teaching literature, as well as without creation and maintenance of updated information electronic systems of the open access, it's impossible to create the information platform in the field of the best available and perspective technologies in power industry to guarantee the power safety of Russia.

REFERENCES

1. **Путилов В.Я.** В энергетике должны работать специалисты // Рынок электротехники. - 2006. - №2.
2. **Экология энергетики:** учеб. пособие / Под общ. ред.

В.Я. Путилова. М.: Издательство МЭИ, 2003. 716 с.

3. **Современные** природоохранные технологии в электроэнергетике: Информационный сборник / В.В. Абрамов и др.; под общей ред. В.Я. Путилова. — М.: Издательский дом МЭИ, 2007 — 388 с.: ил.

4. **Путилов В.Я., Путилова И.В., Маликова Е.А.** Роль и место научно-образовательных учреждений в решении проблемы обращения с золошлаками энергетики в России / Материалы IV Международного научно-практического семинара «Золошлаки ТЭС: удаление, транспорт, переработка, складирование». Москва, 19-20 апреля 2012 г. — М.: Издательский дом МЭИ. — с. 39-47.

5. **Информационная** электронная постоянно обновляемая система открытого доступа «Наилучшие доступные и перспективные природоохранные технологии в энергетике России», <http://osi.ecorpower.ru>.

Putilov V.Y., Putilova I.V., Malikova E.A. Problems of personnel training for power utilities and ways of their solution, Energy saving and water treatment, №1, 2013, p. 52-60.