Methodological possibilities for the solution of new tasks for "Thermophysics of Power Units" Department of SPbPU

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Abstract. "Thermophysics of Power Units" Department is based on pre existed "Thermodynamics and Heat Transfer" and “Reactors and Boilers” Departments. The main goal of the new department (in addition to training students in basic courses of Thermodynamics, Heat and Mass Transfer, Fluid Mechanics, Metrology and Thermal Measurement) has become a new master's profile "Thermal Engineering, Energy Audit and Energy Service". It required radical restructuring of the whole educational process, and in the first place – its material resources and equipment. Over the last two years "Heat and Mass Transfer" lab and "Wind tunnel" lab are upgraded, and "Metrology and Thermophysical Measurement" lab is newly created. Tutorials of new generation are changing significantly the structure of our main courses. The members of our scientific group (2 – 6 year students) actively engaged in the work process. Now we hope to see the best of them among our future postgraduates.

1. Introduction
Major changes taking place in Russian higher education. That have affected all aspects of universities life, including radical restructuring of existing long-time structure of faculties and departments. In particular, the merger of Power Plant Engineering and Electrical Engineering Faculties of Peter the Great St. Petersburg Polytechnic University has given birth to Institute of Energy and Transport Systems. In 2015, the changes affected the departments of new Institute: "Thermodynamics and Heat Transfer" and "Reactors and Boilers" Departments were jointed. The process went delicately, but it gave substantially new results, that is why its progress can be of interest to our colleagues.

2. Association of departments: contradictions and challenges
The Departments jointed by administrative decision had a long history, well-deserved reputation and established traditions.

"Thermodynamics and Heat Transfer" Department was engaged in the training of students (in the first place – for Power Engineering Faculty) in such basic courses as Thermodynamics, Heat Transfer, Fluid Mechanics, Metrology and Thermophysical Measurement. In addition, there were delivered master classes; for the most part, they were bound with numerical simulation of heat transfer and fluid dynamics in power units. There were also classes of "Non-Equilibrium Thermodynamics", "Vehicle Aerodynamics", etc. Scientific work was built within the same branches: the main areas were heat transfer, fluid dynamics, thermal measurement. Since the 2000 year resource base of the Department significantly developed, both research and study laboratories were updated.
"Reactors and Boilers" Department was the issuing of: preparing a group master degree in fossil-fueled feed boilers and a group of specialists in nuclear reactors. The boiler branch was bound, in the first place, with the low-temperature vortex technology of fuel combustion created in the Department under the guidance of Professor V. V. Pomerantsev over 40 years ago and greatly developed by his disciples. The reactor branch was headed for many years by Professor A. Ya. Blagoveschenskiy, a prominent expert on the problems of auto-circulation of heat-transfer agent in nuclear reactor. With all the glorious history of the Department, in recent decades, the scale of its research has considerably decreased, and its resource base declined.

The merger could give both departments a new impetus, but for some subjective reasons, it went hard and unproductive. By the time it fails coincided with a marked study workload and staff reduction. It became clear that the training of “boilermakers” has almost no resource and methodic base, and the “reactor branch” should be better lead by the department of the appropriate profile. Now we are finishing teaching of “boilers branch” students, and “reactor branch” is given to "Nuclear and Thermal Energy” Department.

Our Department got the name of "Thermophysics of Power Units". The question about the new masters’ profile sharply arose. The specialty should satisfy the existing needs and the level of skills should meet modern requirements.

Now we are currently preparing documents to open such profile of masters’ preparation as "Thermal Engineering, Energy Audit and Energy Service". This way is difficult, it requires a large and rapid restructuring of the whole educational process and, primarily, its resource base.

3. Modernization of the labs

Our "Thermodynamics", "Heat Transfer", "Fluid Mechanics" labs are mostly corresponding to modern requirements. They are well equipped, all study works are provided with methodic manuals. In 2016, "Numerical Simulation of Hydrodynamics and Heat Transfer" lab was equipped with new computers and an interactive blackboard. At the same time, setups and study works on thermal measurement to the time of the merger of the departments came to a complete mismatch era behind, at least half a century.

Worse still, the metrological part of the works was interpreted for obsolete standards: all of them required to estimate the error, while in 2012 in Russia, according to the new standards (same with international) [1] the uncertainty is the subject of assessment.

In 2017 the Department has build modern laboratory "Metrology and Thermophysical Measurement" (figure 1), equipped with multi-functional setups and a complex for metrological calibration of thermocouples and resistance thermometers which has all appropriate certificates. "Metrology of Thermophysical Measurement" study guide was also written and published [2].
There are new setups in our "Heat Transfer" lab. In study works devoted to regular regime of heat transfer, film boiling and condensation the data of physical experiments are processing and presenting by personal computers.

Research and study "Wind Tunnel" lab (figure 2) received a new thermal imaging equipment and complex analog-to-digital data processing of the last generation produced by "National Instruments" company. We use its possibilities in scientific and educational processes as well.

Our research labs are also updated. The setup for electric-spark cutting is introduced and widely used in the manufacture of unique gradient heat flux sensors. The new setups for the study of heat transfer during condensation, thermal monitoring in diesel engines were created. Our mechanical workshop is located in the new areas. This part of the transformation was possible after the repair of basements done by the authors (with the invaluable assistance of our “scientific circle students”).

4. Creation of “Energy Audit and Energy Service” lab

This lab (figure 3) has appeared quite recently; until it is equipped with three wall-setups ("Ventilation", "Boiler Plant", "Heating Systems") and is used in pilot mode. In further the number of setups will increase to 8 – 10; it will be a base for qualitative training of future masters.

There is also a complete computer classroom (figure 4). Plan TES-ing a combination of numerical and physical modeling of processes in power plants: only it will allow to produce a complete and sought-after professionals of the new profile.
5. Manpower training
The Department basic staff consists now of 7 lecturers, and we involve to classes 3 “outer” lecturers more as hourly workers. The need for fresh forces is acute, and the only way to satisfy it to prepare our own personnel. We are actively involving to research studies and re-equipment of the Department our “scientific circle students” whose total number has reached 14 now. It gives the choice of further ways both students and supervisors: we are planning to take 1 – 2 postgraduates a year. They will be "our people" in the broadest sense of the word; some judgments of youth are presented in the paper [3].

6. Conclusion
“Thermophysics of Power Units” Department of SPbPU overcomes some difficulties and now ready to achieve new challenges in education and scientific research.

7. References
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