



Reform of power engineering specialists training in higher education institutions of Ukraine

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**First SEERC Power Conference
CIGRE
ACADEMIC FORUM**

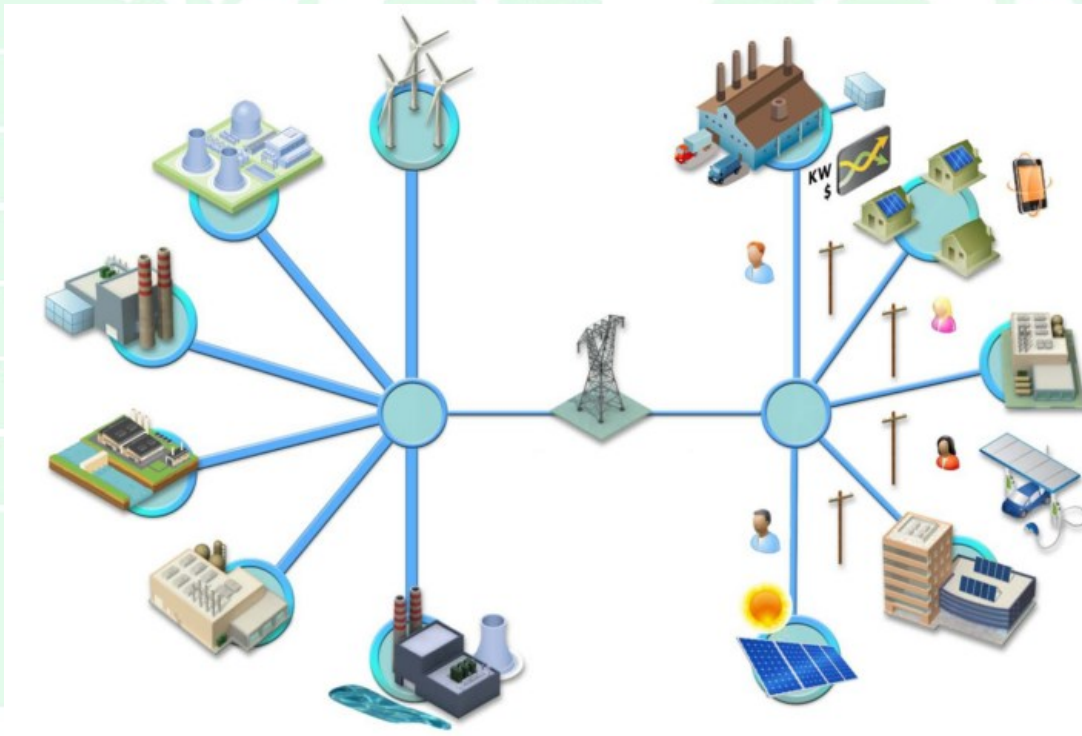
7- 9 june 2016 , Portoroz, Slovenia





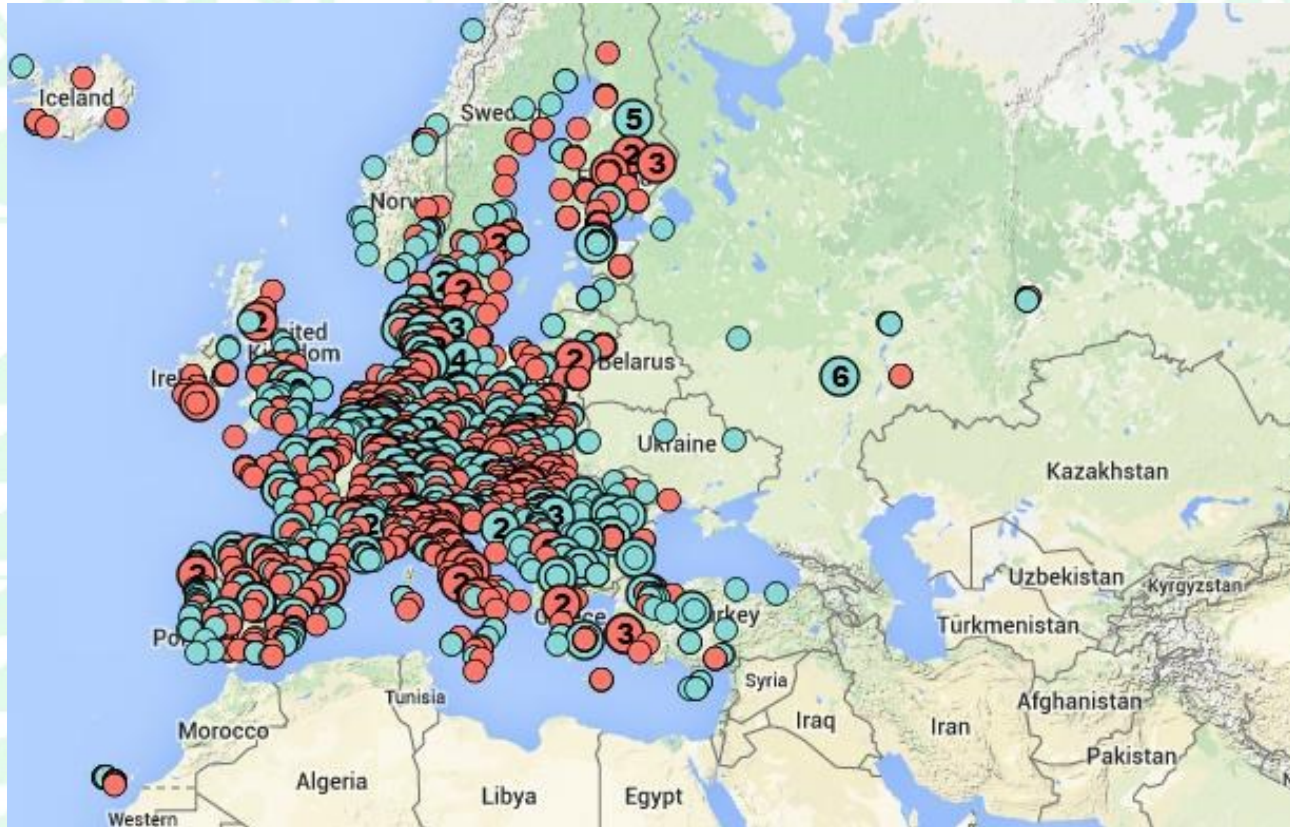
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So we can see another component of electric power engineering – the inclusive energy saving and energy efficiency advancement in all elements and processes of the power system.





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Now, the modern tendency in Europe is integration of Innovative Clusters.

In the clusters, up-to-date quality standards are defined and adopted . This approach includes requirements for high quality of education.



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High-power combined-cycle plants with enhanced thermal power efficiency of up to 60-65% have become available. The unit capacity of turbo- and hydroelectric generators increased, and their design and operating procedures improved .

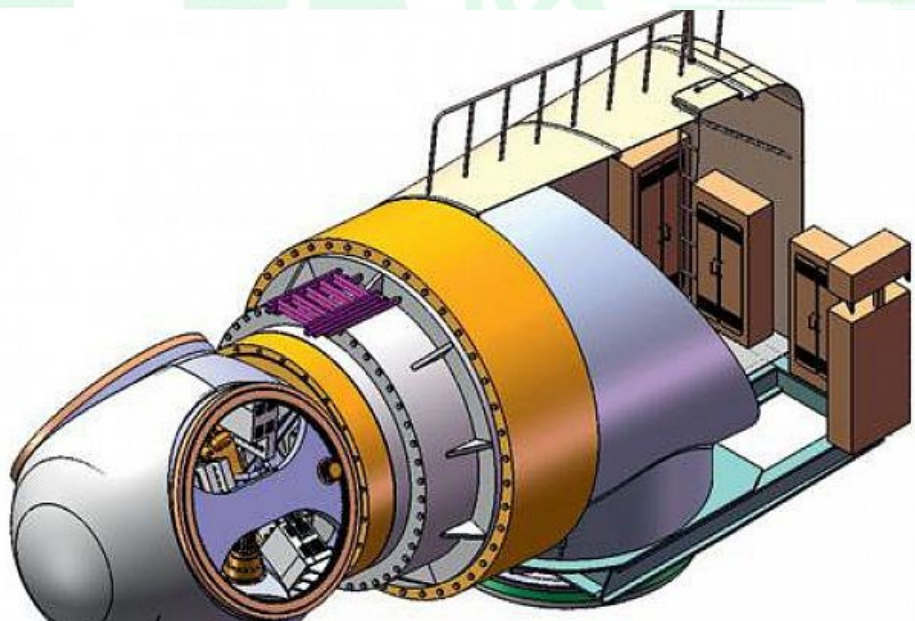




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- Asynchronized synchronous generators,
- Air-cooled synchronous generators,
- Large asynchronous generators and DC generators





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The number of pumped storage power plants that solve very important problems in large power systems significantly increased. Operating modes of their reversible hydroelectric units improved.





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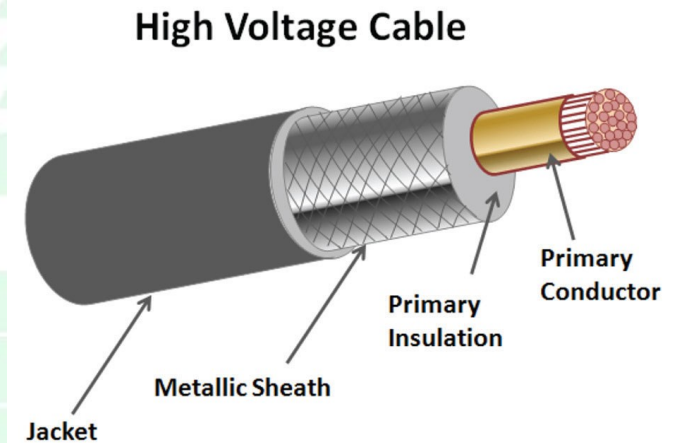
Now capacity of wind and solar power stations reaches hundreds of megawatts.





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Gas-insulated high-power lines and high-voltage cables with cross-linked polyethylene insulation and with fiber-optic inserts have become widely spread. As rigid buses, aluminum alloys buses are used. Their mechanical strength substantially exceeds that of conventional aluminum buses.





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- Vacuum and SF6 circuit breakers,
- Gas insulated switchgear (GIS),
- SF6 measuring current and voltage transformers,
- Semiconductor surge arresters and others.





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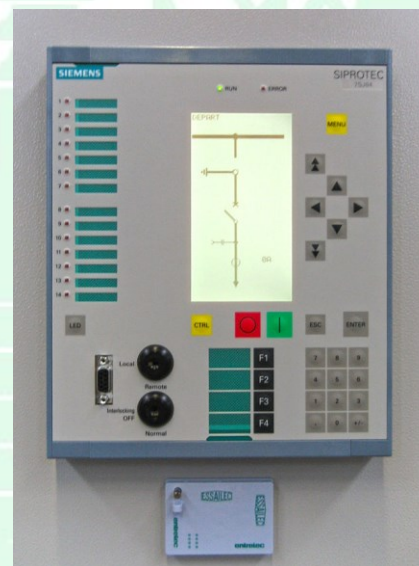
There are now installed dry and SF6 transformers, flexible-magnetic-core transformers with low no-load loss, on-line diagnostic systems which significantly increase the reliability and simplify the operation.





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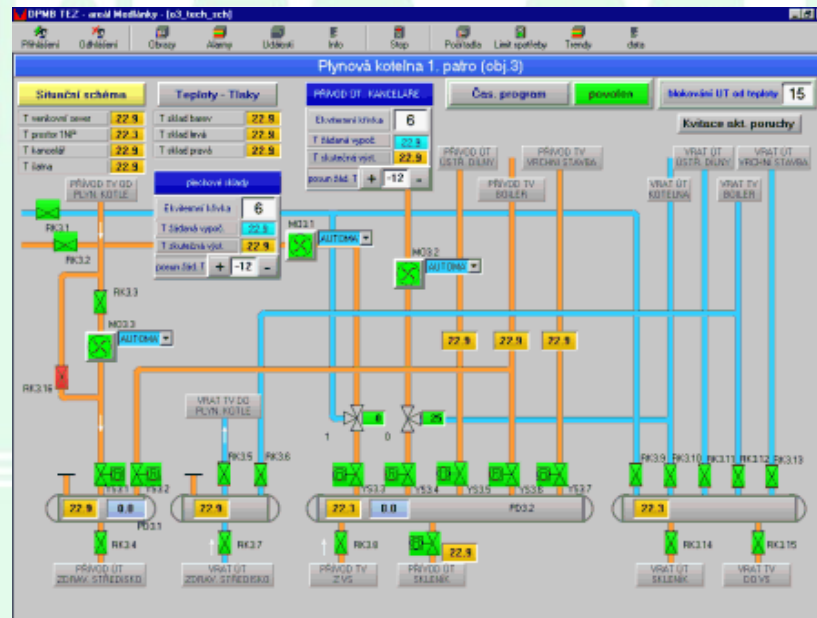
- Electromagnetic and electromechanical relays of the old generation have been replaced by "smart" microprocessor-based protective relays
- New digital devices which accurately maintain increased number of required parameters are now available.





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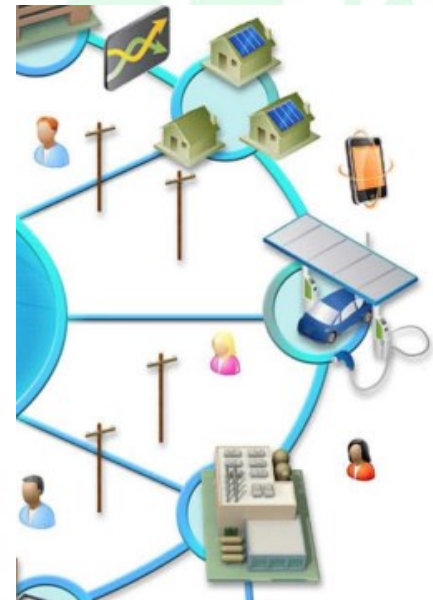
Energy-efficient control systems for drives of auxiliary electric mechanism in station and substation are also developed





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Electricity consumers become active participants of the power system operation.
Some of them act as consumers-regulators and help balance distribution grid modes and contribute to the system frequency and active power control.





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I should also mention wholesale electricity market with its important regulating role and its action on economic indicators and technical policy in the industry.



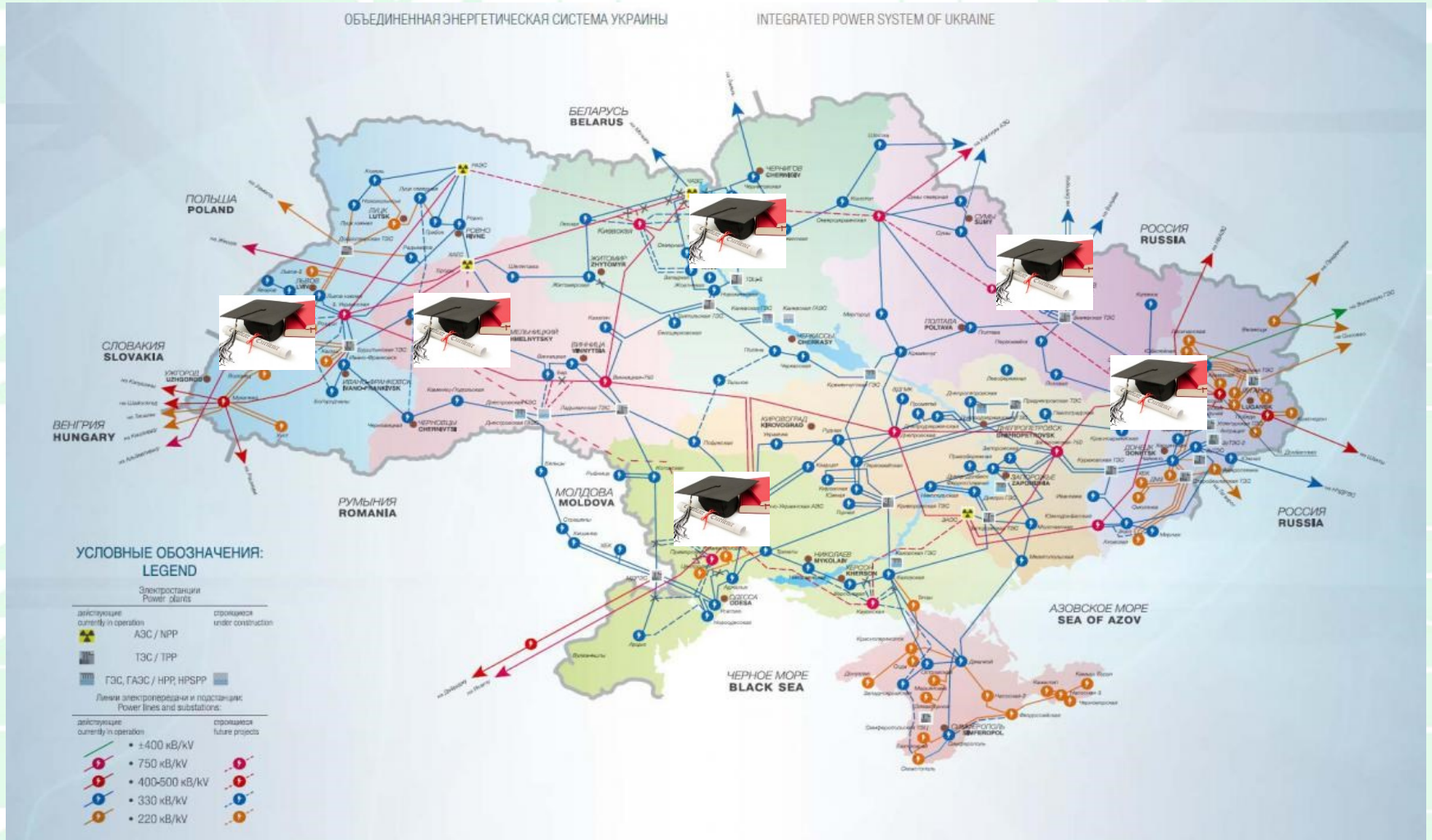


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- National Technical University of Ukraine "Kyiv Polytechnic Institute";
- National Technical University "Kharkiv Polytechnic Institute";
- National Technical University "Lviv Polytechnic";
- Odessa National Polytechnic University;
- Vinnytsia National Polytechnic University;
- Donetsk National Technical University.



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Every year about 500 students (on the whole) are enrolled to electric power engineering specialties in these universities.

Up to 2016, the professional training has been based on a three-step program: **Bachelor - Specialist – Master**. Since 2017, a two-step training, **Bachelor – Master**

In this respect, our old motto of specialists training, **“Knowledge – Skills – Practical Experience”** is being replaced by a conceptually new competencies-oriented approach to training.



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- These specialists must have all necessary competencies which are specified by employers and the main industry trends.
- These specialists must be capable of further self-education.





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Transition from the existing three-step higher education professional training to the European two-step education result in reduction of the excessive number of niche specialties.





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Due to the difference between our educational system and the wider European system, it is difficult for university graduates to find a job in the contemporary labor market conditions. Besides, it complicates their post-degree training or retraining at a new workplace.





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- Electric Stations;**
- Electric Systems and Networks;**
- Electricity Generation and Distribution Control Systems;**
- Electrical Power Supply Systems;**
- Lighting Engineering and Light Sources;**
- High-Voltage Engineering and Electrophysics;**
- Energy Management;**
- Unconventional and Renewable Energy Sources;**
- Electrical Machines and Apparatus;**
- Automated Electromechanical Systems and Electric Drive;**
- Electric Transport;**
- Transport Electrical Systems and Complexes.**



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But now in Ukraine we adopted, a new list of specialties.

-The number of specialties has decreased almost twice.

-Specialties related to electricity are classified as Electrical Engineering.

- All the above-mentioned specialties are united into one specialty with classification number **141 – Electric Power Engineering, Electrical Engineering and Electromechanics.**



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The bachelor-level training in this specialty is based on a competency orientation principle. We have defined a set of mandatory requirements for implementation of bachelor programs in the field of Electrical Engineering.





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The Bachelor-Level Program in specialty 142 provides a regulatory 4-year study with full-time volume of 240 credits of European Credits Transfer System (ECTS) for intramural education (1 credit corresponds to 30 hours of study).





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The program focuses on definite competencies according to directions of the bachelor's professional activity. The main of directions are

- **production processes,**
- **organization and management,**
- **project designing,**
- **assembly and adjustment,**
- **service and operation**





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- Humanitarian and socio-economic training cycle (10-15%);
- Fundamental mathematical and natural scientific training cycle (15 - 20%);
- Professional training cycle (45-50%);
- Optional disciplines cycle (25%).





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The general component of the professional training in the specialty includes compulsory academic courses for all bachelor-level students.





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The compulsory general part involves practical training of future specialists, diploma designing, and graduation certification.

The optional disciplines cycle comprises mainly specialty-oriented courses for future training in the master-level program. There are also available optional courses of other cycles according to individual education plans.





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All Bachelor's competencies and Master's competencies are specified in agreement between universities and employers. They become an integral part of educational programs and the Standard of Higher Education for graduates in this specialty.





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Code	Content
BLO	<u>The basic program learning outcomes (BLO)</u>
BLO-1	Knowledge and understanding of the basic definitions and laws of electrical engineering, the theory of electric and magnetic circuits, methods of DC/AC circuits analysis for steady-state and transient conditions
BLO -2	Knowledge and understanding of the fundamentals of material science and technology of construction materials, electrical insulating materials as components of electrical and power equipment

PLO	<u>Professional program learning outcomes for Electric Stations specialization (PLO)</u>
PLO -1	Knowledge and understanding of connection circuits and operational principles of the main electrical equipment of power stations and substations, circuits and high-voltage facilities of power systems and grids
PLO -2	Knowledge and understanding of methods of steady-state and dynamic stability analysis for various operational modes of power stations and substations



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Master's programs focus on niche specializations which are defined by the universities within the specialty of Electric Power Engineering, Electrical Engineering and Electromechanics.





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The list of these specializations corresponds to the nomenclature of jobs and positions in power industry and covers the mentioned basic processes and tendencies in power systems:

- **Electric Stations,**
- **Power Systems and Networks,**
- **Electricity Generation and Distribution Control Systems,**
- **Unconventional Energy Sources,**
- **High-Voltage Engineering and Electrophysics,**
- **Energy Management and Energy-Efficient Technologies, and others.**



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We have no strict requirements for development of master's curricula. The content and the volume of the compulsory component covers up to 25% of the total credits. The curriculum increases the volume of optional courses which form individual educational plans of the students. It helps more flexibly react to labor market conditions and take into account specific character of the students' future work.





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Term of study at the master's level is 2 years. The total volume is 120 ECTS credits. Many of the basic principles of masters' training are the same as those of the bachelors'. We also pay special attention to research activity of the masters during the training period and defense of graduate thesis which is considered as a graduation certification.





Chernobyl Nuclear Power Station (Ukraine)

Fukushima Nuclear Power Station (Japan)



Sayano-Shushenskaya
Hydropower Plant (Russia)





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We suppose that responsibility of specialists for their actions must be trained at university. Accordingly, Electric Stations Department of NTU “KPI” has developed and delivers students a course on Fundamentals of Energy and Environmental Safety and Professional Responsibility. Employers say that university graduates who took this course quickly adapt to power production conditions and have a more responsible and reasonable approach to making managerial and operational decisions.



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The above-described approaches to compiling bachelor's and master's educational programs and specialists training at university were initially discussed widely at numerous meetings with alumni and via inquiry of graduates and employers. They went through a thorough theoretical study in specialized departments and were presented in publications



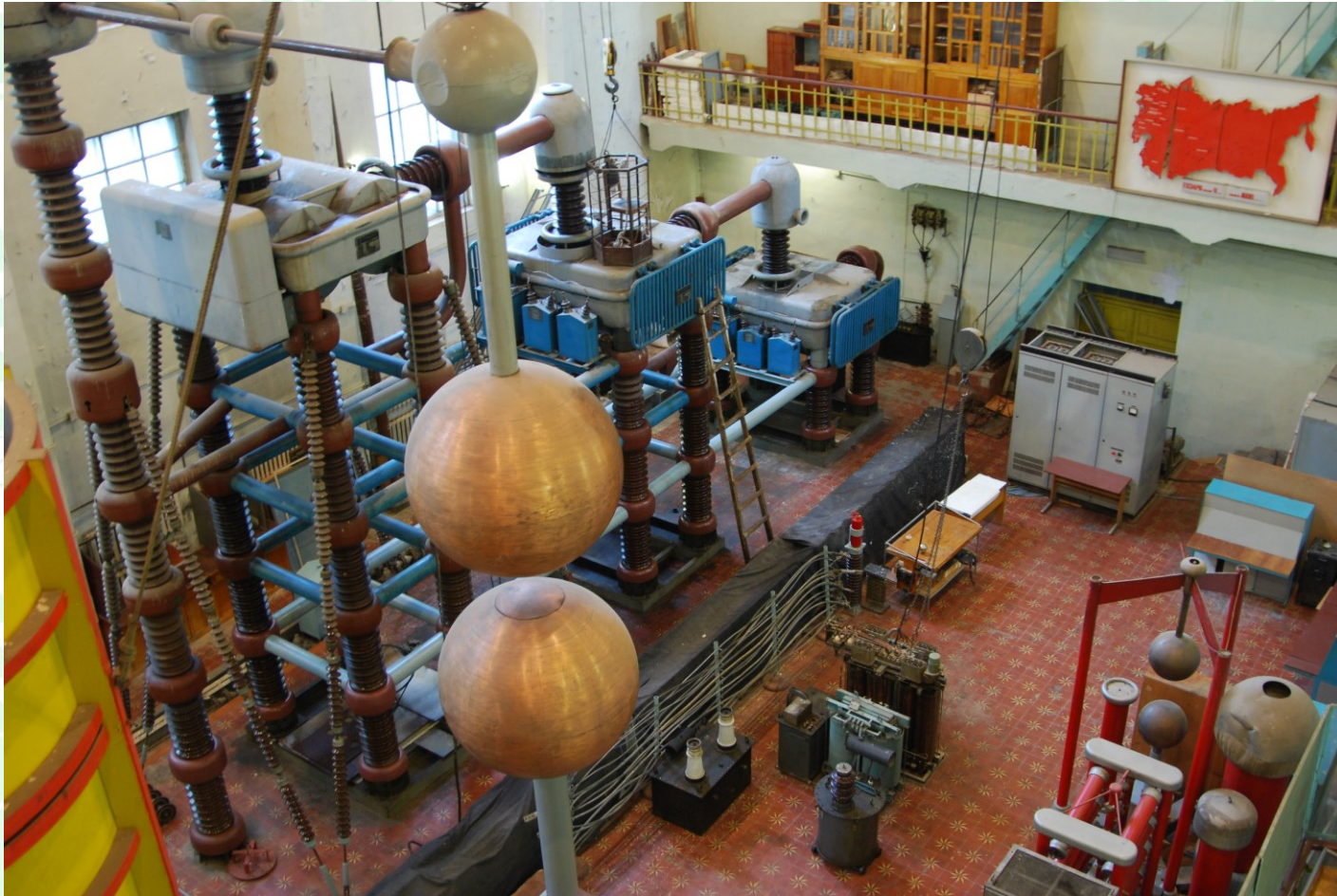


National Technical University "Kharkiv Polytechnic Institute" is the oldest polytechnic university in Ukraine. It was founded in 1885 and has been training power engineers for 85 years. Over this period, about 9000 specialists have been trained.



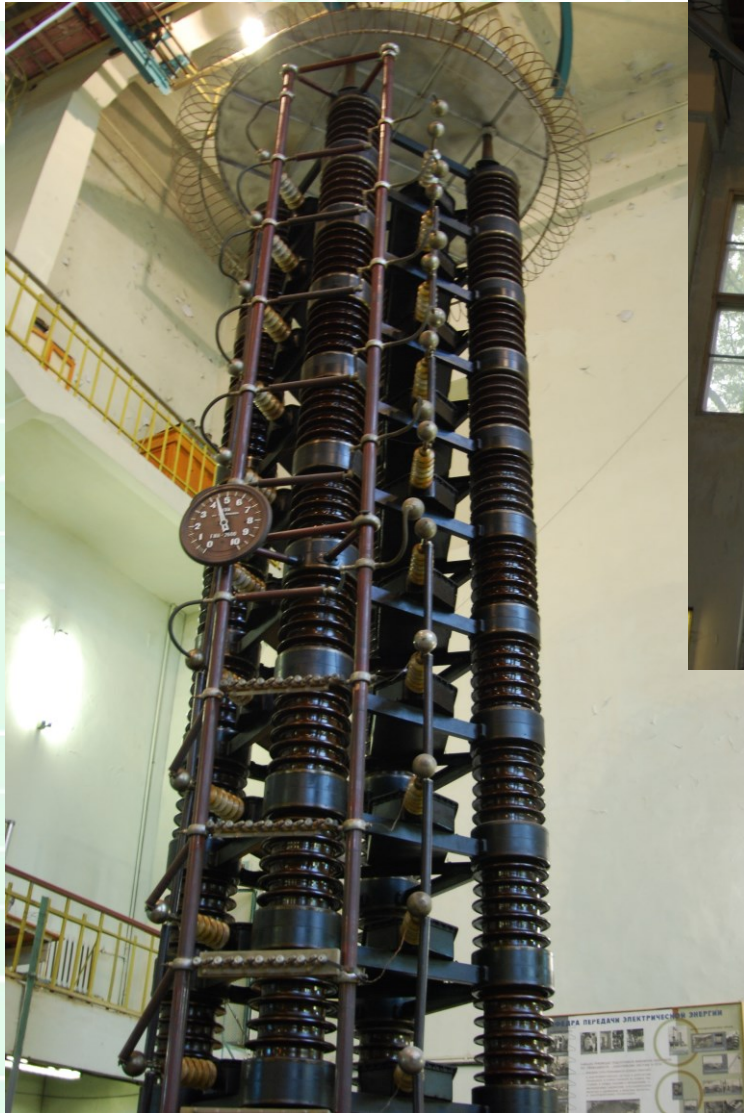


The University has unique technical facilities including a high-voltage laboratory hall with the possibility of obtaining 1,000,000 V AC





and 2,000,000 V DC



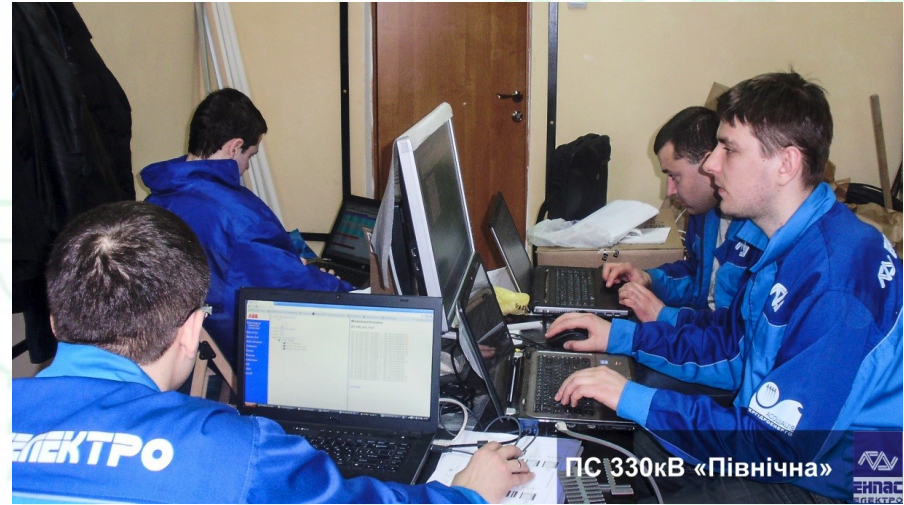
The University has wide connections with many energy companies and organizations as well as designers and manufacturers of electrical and power equipment, such as Turboatom, Electroyazhmash, ABB, Schneider Electric, Siemens, etc.



Holidays star of student's life in our Universities



CIGRE, 2015



THANK YOU FOR
ATTENTION!