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**POWER EFFICIENCY LABORATORY AT THE NPUA
INSTITUTE OF POWER AND ELECTRICAL ENGINEERING.
CONCEPTION**

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A conception of a power efficiency laboratory is proposed whose establishment is envisaged at the Institute of Power and Electrical Engineering of National Polytechnic University of Armenia. The conception is developed in the frames of the project of the Federal Ministry of Education and Scientific Investigations of Germany, SYNERGIA. The laboratory will be equipped with technological installations, devices, and equipment so that lectures and laboratory activities on power efficiency, practical seminars, and scientific investigations should be organized and conducted. In the discussions on developing the Economic Education Institute of Carl von Ossietzky University of Oldenburg, Yerevan State University, National Polytechnic University of Armenia and the Federal Technological Centre of Electrical Engineering and Information Engineering have taken part.

Keywords: power efficiency, laboratory, technological installations, “smart home”, academic studies, qualification improvement, re-training of specialists, scientific investigations.

Introduction. The Economic Education Institute of Carl von Ossietzky University of Oldenburg (IOB), Yerevan State University (YSU), National Polytechnic University of Armenia (NPUA) have jointly implemented the project SYNERGIA financed by the Federal Ministry of Education and Science of Germany for about two years [1]. The participants of the project have carried out investigations on the problems of power efficiency, paying special attention to the issue on power efficiency in the private sectors of Armenia and Germany [2,3]. In September, 2016, the final seminar-conference of the project SYNERGIA was held [4], during which, the investigation results of the project participants were discussed, in particular, the conception of the power efficiency laboratory.

The goal of this conception is the establishment of a Laboratory at the Institute of Power and Electrical Engineering (IPEE) of NPUA. The representative specialists of the IOB, YSU, NPUA, as well as the Federal Technological Centre of Electrical Engineering and Information Engineering (BFE, Oldenburg, Germany) took part in the discussion on the conception development.

Statement of the reaserch. The Laboratory will be situated at the address: #105, Teryan Str., Building 2, Yerevan, Armenia. The Institute of Power and Electrical Engineering has allocated a space for the Laboratory whose plan is introduced in Fig. 1. The area consists of two rooms – a large room and a smaller one -47,31 and 22,23 *sq.m.* respectively. The large room – auditorium - is envisaged for conducting academic lessons: lectures, practical and laboratory lessons, academic and scientific seminars, etc. Here, in particular, desks and chairs, as well as laboratory academic stands, an interactive monitor – board, a projector, and a computer for 20...24 persons will be placed. Demonstrative stands with material samples, devices, apparatuses applied in power efficiency technologies will be installed on the walls. In the smaller room of the Laboratory, technological equipment and devices will be placed.

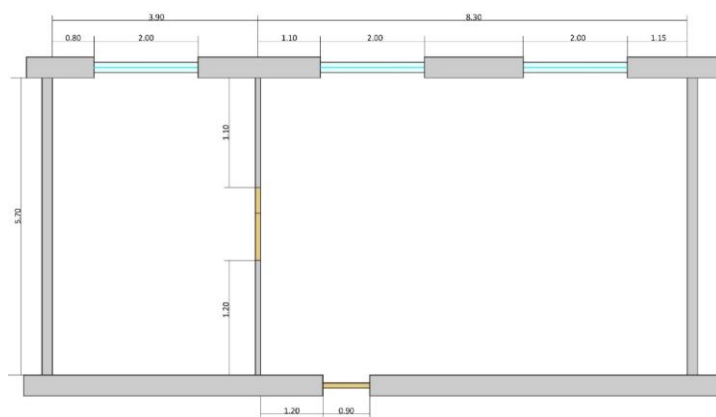


Fig. 1

The establishment of the Laboratory at the IPEE is urgent, as that institute trains Bachelors and Masters of Engineering in many specialties of Power and Electrical Engineering. Post-graduate students are also trained at the Institute. The total number of the students of the IPEE is about 800. All the students of the Institute study the issues on power efficiency one way or another. Power efficiency technologies are paid a special attention in the courses taught to the students, studying by the speciality “Power-saving Technologies and Power Management”. A new speciality, namely “Alternative Energetics” will be introduced at the Institute beginning from the academic year 2017-2018. The issues concerning the power efficiency will occupy a significant part in the disciplinary courses of the students, being trained by that speciality.

Analysis. The (IPEE) new laboratory will be used for academic and research purposes. It will be equipped by technological installations, devices, equipment, and furniture so that it should be possible to conduct lectures and laboratory works on

power efficiency, as well as organize demonstrative practical seminars and carry out investigations.

For academic purposes, in accordance with the curricula and programmes of the University, the following types of lessons will be held for the students at the laboratory:

- lectures;
- practical lessons;
- laboratory lessons,
- scientific seminars.

Lessons for the qualification improvement of both the lecturers of the University and the re-training the specialists of different enterprises and institutions will be conducted.

For that purpose, special academic programmes will be developed. The qualification improvement of the teachers will be carried out by the order of the University, while the re-training of the specialists - by both the order of institutions and enterprises and the individual initiative of the specialists.

In the laboratory, the Graduate and Post-graduate students of the University will carry out investigations on the issues of power efficiency and power-saving. In particular, they will study the characteristics and operation modes of the laboratory equipment and installations.

The technological installations, devices, and equipment can be conventionally divided into two groups:

1. The equipment, providing the power supply of the laboratory.
2. The equipment, providing the efficient power consumption.

The first group will include:

- a. the solar photovoltaic plant of small power (installed outside the laboratory);
- b. the solar thermal plant (installed outside the laboratory);
- c. the wind generator (installed outside the laboratory);
- d. the accumulator with an inverter system;
- e. the geothermal thermocompressor.

The laboratory will be supplied with electric power by both accumulators whose output voltage will be transformed into 220 V of alternating current through an inverter, and the network. The accumulator will be charged by a solar plant and by a wind generator. The whole power-saving system of the laboratory is regulated by an automated system regulating the operation modes of power sources based on the conditions of power efficiency.

The second group will include the installations and devices, regulating the operation modes of the cooling-heating, lighting, and other systems, as well as

various sensors. All the equipment, including the operation of the thermocompressor, providing the laboratory with heat energy, will be regulated with the automatic system “smart home”.

For the purpose of comparative analysis, another – alternative academic laboratory with a similar area, height, location of windows, etc, not having special systems of power supply, power saving, and power efficiency may be established at the IPEE. By contrasting the data obtained by the sensors installed in two laboratories, it will be possible to determine to what extent the systems and the equipment installed in the laboratories are efficient.

As an example, let us consider several important systems, subsystems, and functions of the laboratory (according to the BFE’s specialist Dipl.-Eng. Raimund Wiesmann recommendations):

1. Illumination shading usage of daylight:
 - the system of permanent control of the room lighting;
 - the system of adding artificial light to the daylight;
 - automated lighting;
 - automated control system for the sunlight access;
 - application of external vertical metallic jalousie;
 - correction of shading;
 - dusk switching;
 - protection from bad weather.
2. Automatic control systems of microclimate in the premises:
 - selection of the energetic level of the space;
 - window control;
 - determination of the required indices;
 - temperature adjustment;
 - fan control systems;
 - adjustment of the air quality in the room;
 - automatic heat regulation, etc.
3. Determining the number of people in the room.
4. Switchings of the energetic level of the room for changing the microclimate.
5. The window control system and the possibility of complete switching off the air conditioner at the drop of the air temperature outside.
6. A system of protection from bad weather, application of external panels and jalousie, adjustment of shading and the automatic heat regulator.
7. Installations of independent systems for power recording, etc.

As a good example for establishing and equipping the Laboratory, as well as organizing the academic process can serve the effectively acting similar academic classrooms at BFE in Oldenburg whose academic stands are shown in Fig. 2.



Fig. 2

Conclusion. The concept of the Laboratory of Power Efficiency is developed supported by the specialists of NPUA, IOB, BFE, and YSU taking into consideration the experience of NPUA in establishing academic and research laboratories, as well as taking into account the technological equipment and the experience of efficient maintenance of similar functioning classrooms of BFE.

At implementing the given conception, an up-to-date laboratory of power efficiency will function in the IPEE, equipped with necessary facilities and installations, regulated by an automatic system “smart home” supporting the process of training specialists and improving the quality of education.

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**ԷՆԵՐԳԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅԱՆ ԼԱԲՈՐԱՏՈՐԻԱ ՀԱՊՀ
ԷՆԵՐԳԵՏԻԿԱՅԻ ԵՎ ԷԼԵԿՏՐԱՏԵԽՆԻԿԱՅԻ ԻՆՍՏԻՏՈՒՏՈՒՄ. ՀԱՅԵՑԱԿԱՐԳ**

Ա.Խ. Գրիգորյան

Առաջարկվում է էներգաարդյունավետության լաբորատորիայի հայեցակարգ, որը նախատեսվում է ստեղծել Հայաստանի ազգային պոլիտեխնիկական համալսարանի էներգետիկայի և էլեկտրատեխնիկայի ինստիտուտում: Հայեցակարգը մշակվել է Գերմանիայի կրթության և գիտական հետազոտությունների դաշնային նախարարության SYNERGIA նախագծի շրջանակներում: Լաբորատորիան տեխնոլոգիական տեղակայանքներով, սարքերով և սարքավորումներով կահավորված կլինի այնպես, որ հնարավոր լինի անցկացնել էներգաարդյունավետության խնդիրներին նվիրված դասախոսություններ ու լաբորատոր պարասպունքներ, կազմակերպել գործնական սեմինարներ, կատարել գիտական հետազոտություններ: Հայեցակարգի մշակման շուրջ քննարկումներին մասնակցել են Օլդենբուրգի համալսարանի Կարլ Ֆոն Օսեցկու անվան համալսարանի տնտեսագիտական կրթության ինստիտուտի, Երևանի պետական համալսարանի, Հայաստանի ազգային պոլիտեխնիկական համալսարանի և էլեկտրատեխնիկայի ու տեղեկատվական տեխնիկայի դաշնային տեխնոլոգիական կենտրոնի (ք. Օլդենբուրգ, Գերմանիա) մասնագետները:

Առանցքային բաներ. էներգաարդյունավետություն, լաբորատորիա, տեխնոլոգիական սարքավորումներ, «խելոք տուն», ուսումնական պարասպունքներ, որակավորման բարձրացում, մասնագետների վերապատրաստում, գիտական հետազոտություններ:

**ЛАБОРАТОРИЯ ЭНЕРГЕТИЧЕСКОЙ ЭФФЕКТИВНОСТИ
В ИНСТИТУТЕ ЭНЕРГЕТИКИ И ЭЛЕКТРОТЕХНИКИ НПУА:
КОНЦЕПЦИЯ**

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Ключевые слова: энергетическая эффективность, лаборатория, технологическое оборудование, "умный дом", учебные занятия, повышение квалификации, переподготовка специалистов, научные исследования.