

## Workshop

**Energy infrastructure  
resilience in response  
to war and other hazards**

23–26 September 2024

Rzeszów, Poland

# Design of the Consortium on International Network of Virtual Training Center development and implementation



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Science for Peace and Security (2024)

Energy infrastructure resilience in response to war and other hazards

Advanced Research Workshop (ARW) supported by NATO

POLAND, Rzeszów, 24.09.2024



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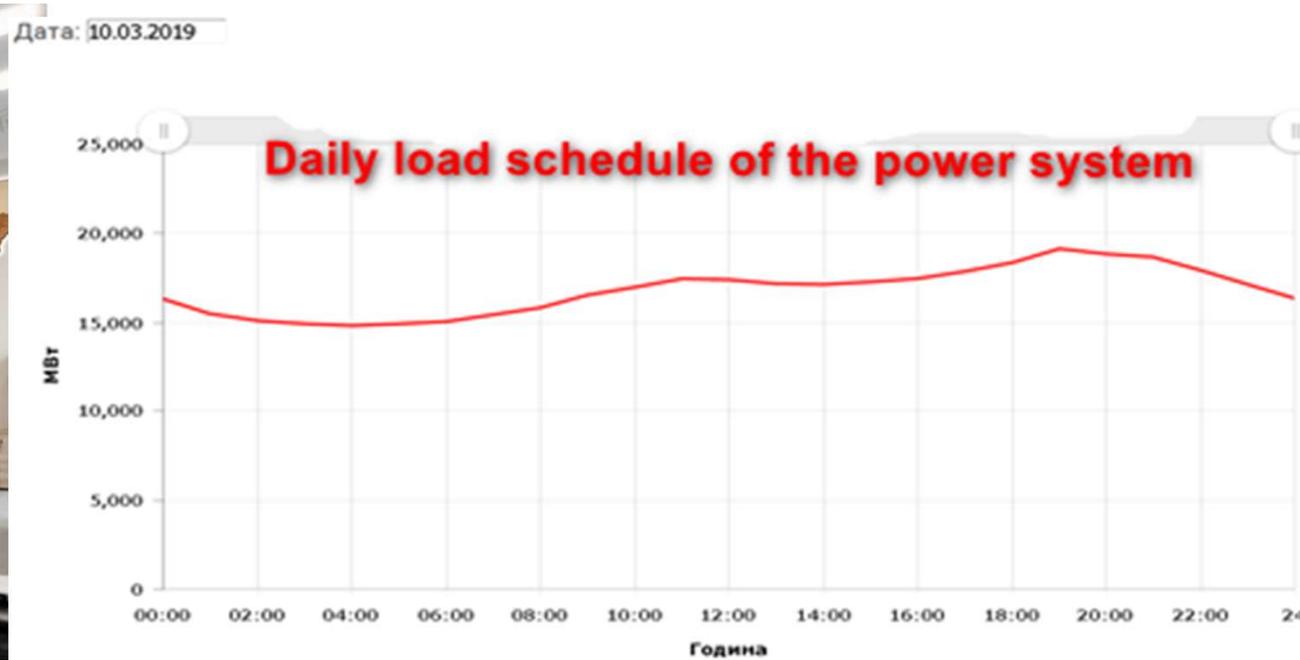
## ***The main goals of the presentation:***

- *To discuss the scientific and technological worldwide problems and challenges in modeling Virtual Training Centers (VTC)*
- *To suggest the best ways of creation, research directions, and development of the International Network of Virtual Training Center*

## Global changes, challenges, and problems in the energy sector

1. Intensive use of RES and decarbonization of the energy sector when there is a need for a structural change in energy production and consumption technology (equipment is worn out)
2. No global systemic studies of optimal resource allocation in interacting ecosystems (energy, economic, social, etc.) exist.
3. Intensive development and use of AI (Quantum computers, Blockchain, Distance learning, Crypto, etc.), Cloud Calculation, Digital twins, Virtual Technologies, ESS, Modern Education technologies, Stable Development of the economy's branches, etc.
4. More and more achievements in these fields of investigation lead to scientific research becoming increasingly complicated.
5. The time spent learning and using new technologies is critically increasing.

# Example of supervisory control system and electricity market



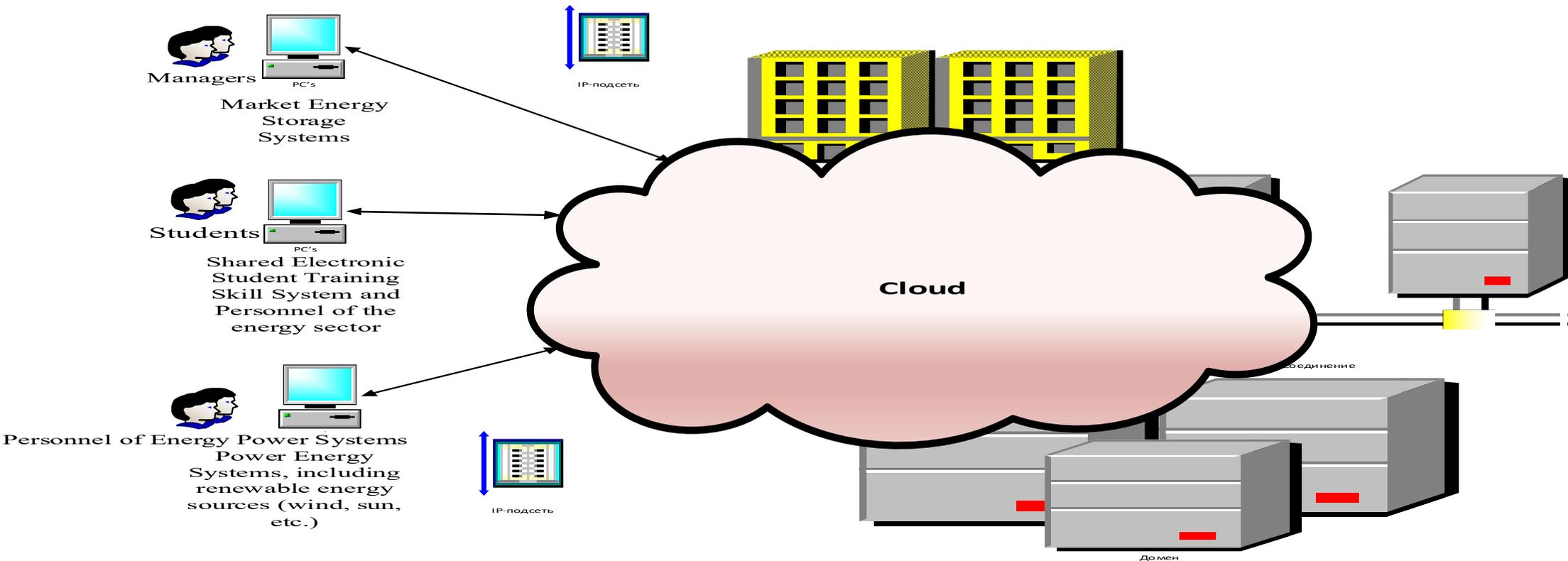
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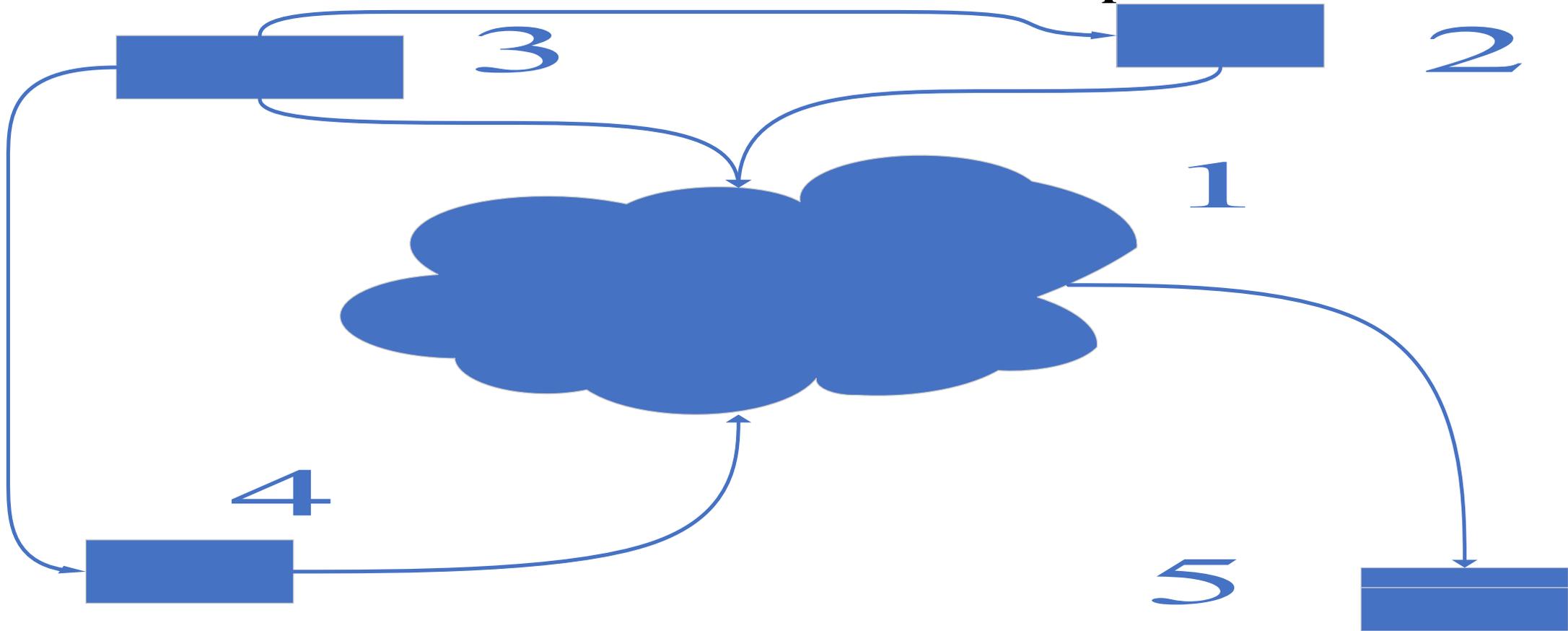
A shared VTC model includes a real-time database (PostgreSQL/Oracle) and an e-learning system (Moodle) in the cloud for modeling power systems.



## Structure of Real-Time United Virtual Model

No.	Name of artificial system	Parameters	Short Description
1.	<b>Power Energy Systems, including renewable energy sources (wind, sun, etc.)</b>	Nodes, Branches, Topology of the electrical network, power flows, voltages, currents, etc.	$[S_s]^T = [I_s]^T [\bar{U}_s]_d$ where $[\bar{U}_s]_d$ - diagonal matrix of conjugate voltages vectors of nodes; $[I_s]^T$ - transposed column vector of node currents
2	<b>Market Energy Storage Systems</b>	Prices, Power, Energy Resources, etc.	$i_s = \sum_{f=1}^k Y_{sf} \cdot (\dot{U}_f - \dot{U}_s)$ , where $Y_{sf}$ - complex conductance of adjacent branch
3.	<b>Shared Electronic Student Training Skill System and Personnel of the energy sector</b>	Competences, skills, knowledge, etc.	Bloom's taxonomy, System of rules IF (...) THEN (...);
4.	<b>The energy supply of Railway transport</b>	voltages, currents, power flows, quality, etc.	System of rules IF (...) THEN (...);
5.	<b>The energy supply of Agriculture</b>	voltages, currents, power flows, energy's quality, etc.	System of rules IF (...) THEN (...);

## Virtual Model as a Graph



# Web-based operational switching simulators with knowledge and skills monitoring and full-featured mode simulators

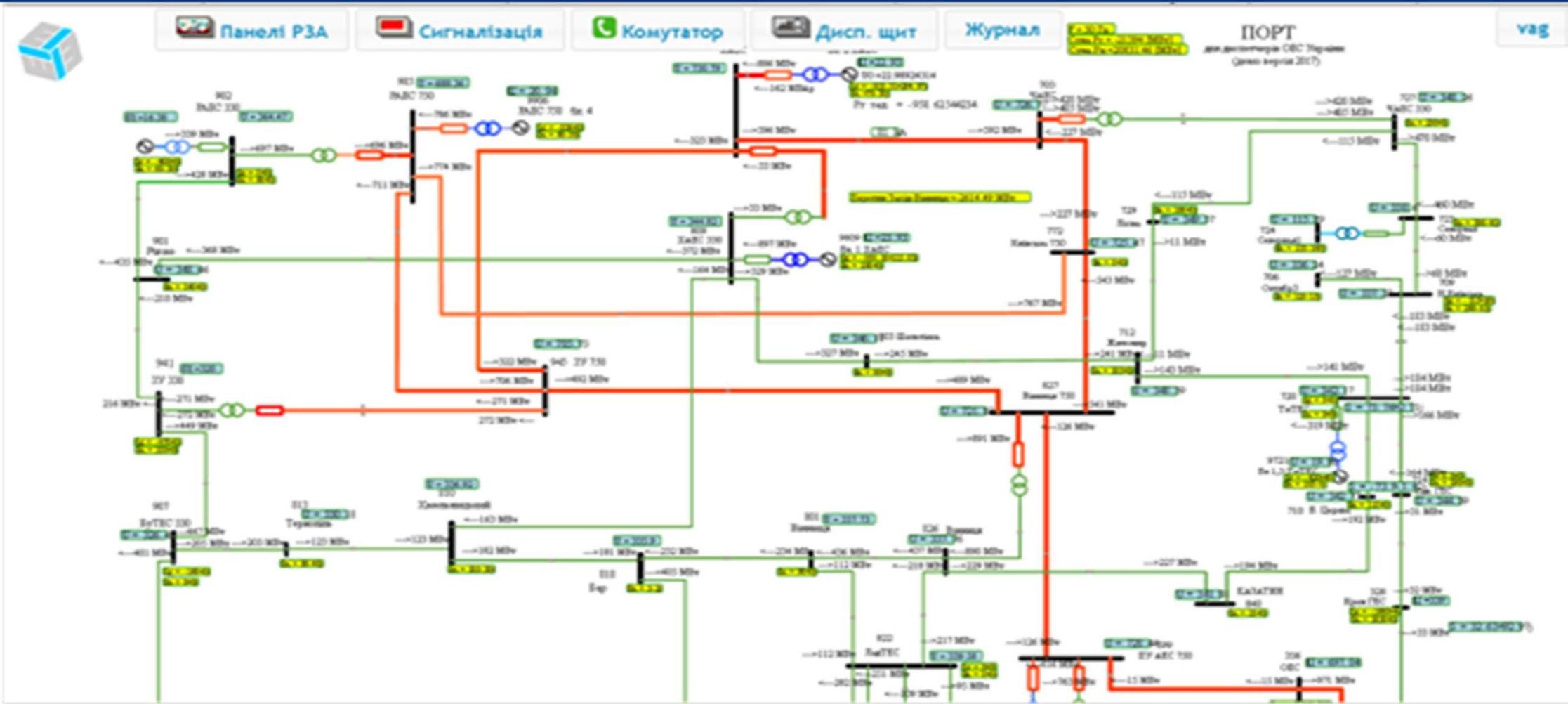
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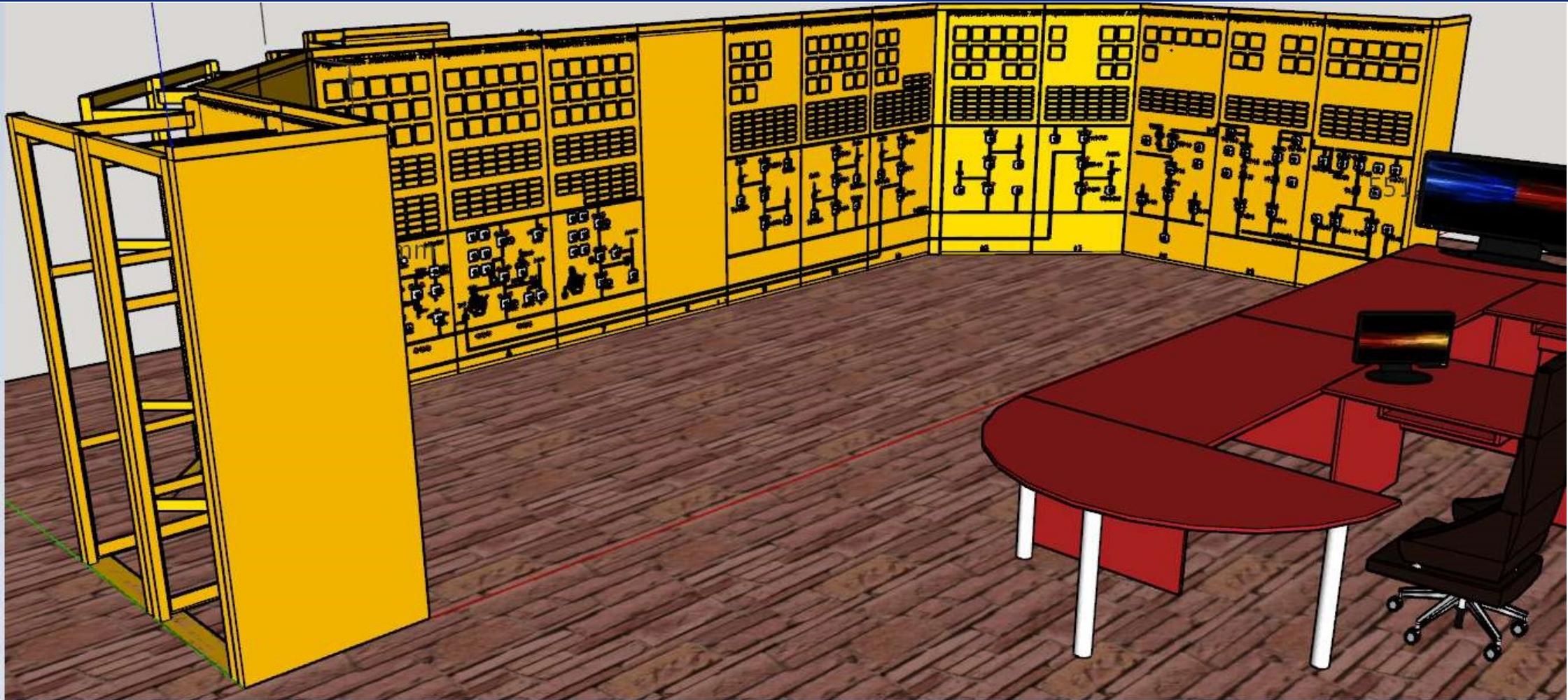
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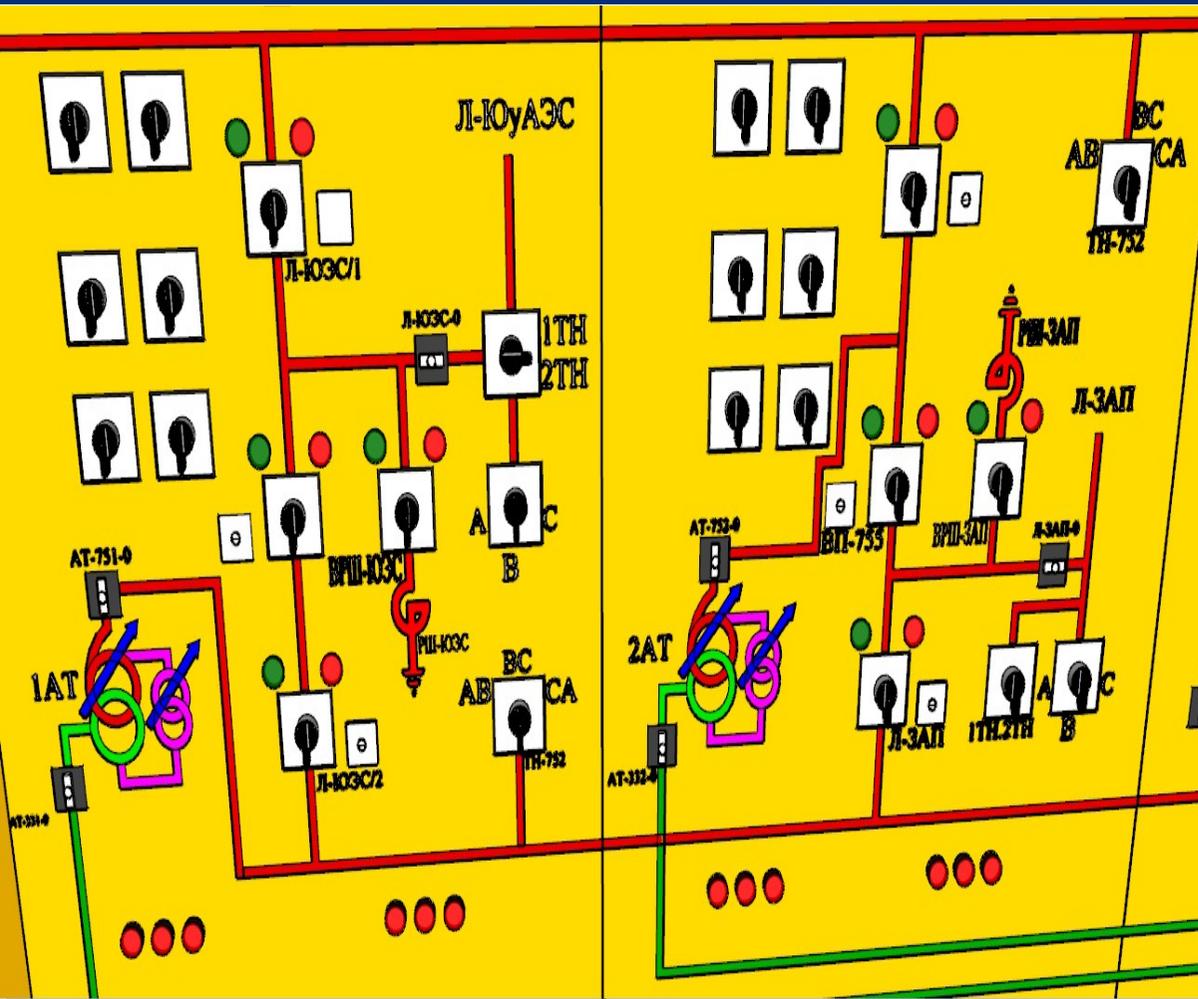
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Презентация: Front\_page\_01.jpg

LTI\_2015\_bbb

Клaviши быстрого доступа ?

НВ ТОВ "Infotex"

РУ | EN | UK

ФОРМУВАННЯ ТА ПІДТРИМКА НАВИКІВ ЛІКВІДАЦІ СИСТЕМНИХ АВАРІЙ ЗА ДОПОМОГОЮ ВІРТУАЛЬНОЇ МОДЕЛІ ОЕС УКРАЇНИ  
Національна енергетична компанія "Укренерго"

Опис і настанови

УМОВИ ПОКАЗАННЯ:

- ▲ - 4000 мВ
- - 1500 мВ
- - 400-200 мВ
- - 200 мВ
- - 200 мВ

Чат

Все | Настройки

19:26

Welcome to "LTI\_2015\_bbb"!

This meeting is being recorded

To understand how BigBlueButton works see our [tutorial videos](#).

To join the audio bridge click the headset icon (upper-left hand corner). **Please use a headset to avoid causing noise for others.**

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Отправить

Веб-камеры

Viktor Gurieiev

**VIKTOR GURIEIEV, Academician of the Academy of Technological Sciences of Ukraine, Doctor Habilitatus of Technical Sciences**



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## The main principles of the functioning of VM

1. It is possible to participate in e-learning education and anti-damage training for the staff of ES, nuclear, thermal, RES, hydropower plants, and other power companies, and it is allowed without restrictions.
2. Separate databases and application servers, including virtual ones, are distributed randomly and in different locations.
3. Such a structured computer network allows adequate and quick simulation of various emergency regimes in parallel working EES.
4. A distributed database system and application servers VM integrates into a global network and connects to the Internet

## Scope of research

1. The main types of energy sources in electric power systems. The role and place of energy storage systems
2. New models and software for research and analysis of the energy system
3. Fundamentals of creating a new continuous education and personnel training system using full-featured simulators
4. Market of energy storage systems and its components

Author(s)  
Title



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## Needed resources for each Virtual Training Center

1. We need a friendly team of talented researchers with the obligatory involvement of bachelor's, master's, and graduate students inclined toward scientific activity
2. We need three (3) HP power servers of the newest type and corresponding permission to create a cloud structure
3. Large Shared Screen (2x6m) or more
4. Computer class for 10 ... 15 seats

## Expected science and educational results

1. Enable world-class research and create a modern system for training students and personnel globally (formation and control of key competencies).
2. Licensed simulator training and developing new electronic training technologies.
3. Individual guidance to training, knowledge control, and personnel training.
4. We offer laboratory work, webinars on various topics, and learning technologies, available 24/7 to accommodate diverse schedules.
5. Preparing dispatchers of the highest qualification and molding elite dispatchers for activity in creating the electricity market.
6. Create corresponding Bachelor's and Magister's degree programs that are world-class.

# Questions?

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