

STEAM GENERATOR BUILDING DEPARTMENT OF NTU “KHPI”

Short history:

- ❖ First course of steam boilers was lectured in 1888
- ❖ Department was established in 1938 as Steam boilers building department
- ❖ Implementation of nuclear energy for steam generating expand area of interest of department at same time, which is reflected in the modern title of department
- ❖ Processes, constructions, mechanics of structures and materials damage of different steam generating installations, including steam boilers, nuclear reactors and its steam generators, are interesting for ours department

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Branches for bachelors and masters:

- ❖ Power generating technologies and installations
- ❖ Automation and computer –informational technologies in power engineering

Branches for PhD:

- ❖ Nuclear power

SHORT DESCRIPTION OF THE PROPOSED SCIENTIFIC PROJECT FOR COOPERATION

Project title:

**DEVELOPMENT OF APPROACHES, MODELS AND METHODS
TO STUDY THE PROCESSES AND EQUIPMENT ELEMENTS
TO FIND IMPROVE OPPORTUNITIES OF OPERATION EFFICIENCY
AND ENVIRONMENTAL SAFETY OF THERMAL AND NUCLEAR POWER
INSTALLATIONS**

Main purpose of the project :

Consideration of emergent properties for more accurate prediction of reliability indexes and optimization of equipment operating modes to increase the average operating efficiency and environmental safety of heat and nuclear power installations



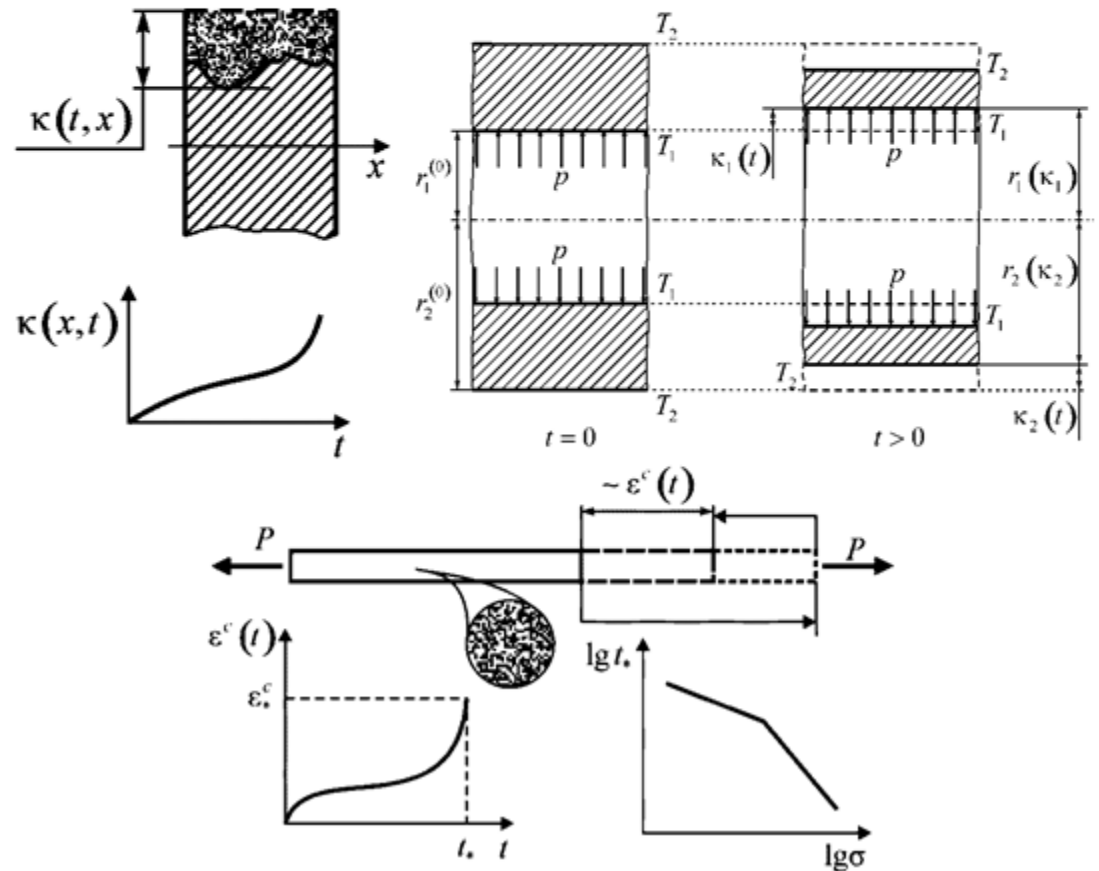
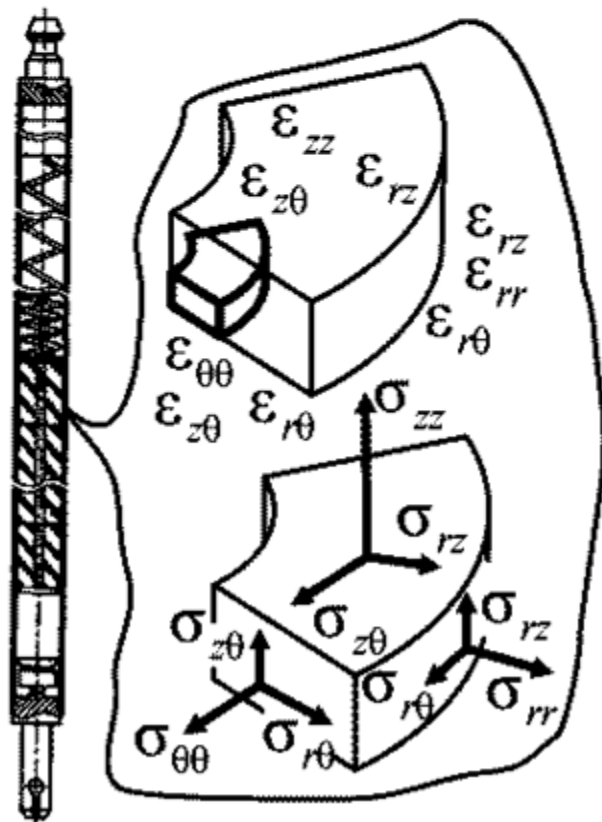
MAIN ASSIGNMENTS OF THE PROPOSED SCIENTIFIC PROJECT FOR COOPERATION

- ❖ Interdisciplinary analysis of typical processes, structures, materials and modes of operation of thermal and nuclear power installations based on the joint consideration of the thermodynamics, heat and mass transfer, gas-hydrodynamics, deformation, strength and fracture of materials
- ❖ The development of simulation models and computer modeling of processes, structures, materials and modes of operation to identify possible emergent properties and assess their impact on the reliability of the equipment of thermal and nuclear power installations
- ❖ Life time management of the equipment to increase the average operating efficiency and ecological safety of thermal and nuclear power installations, taking into account the possible emergent properties and their impact on the reliability of the equipment



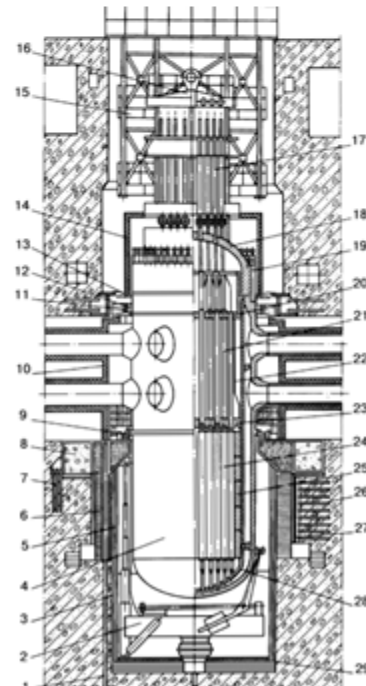
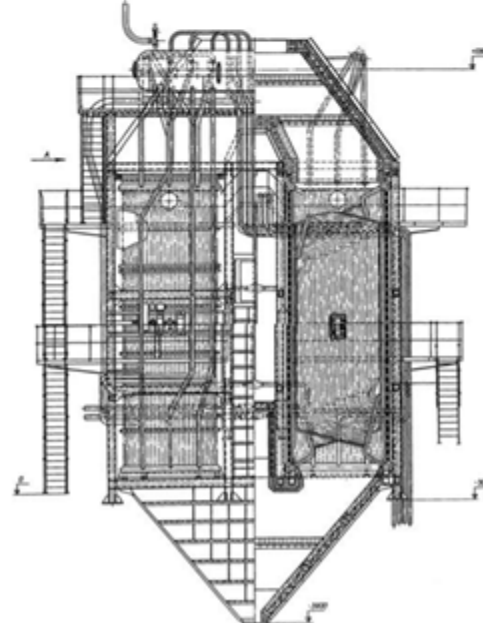
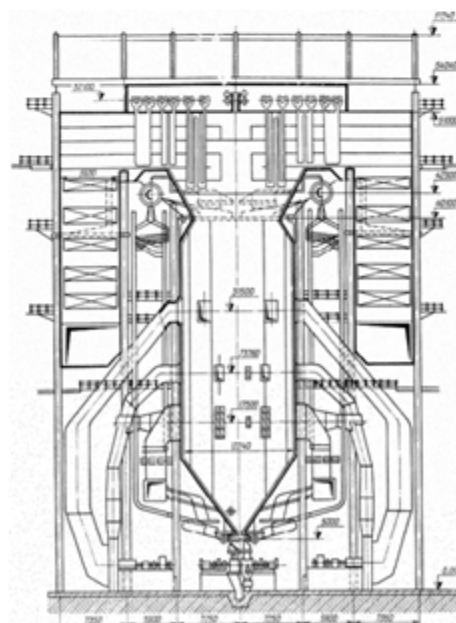
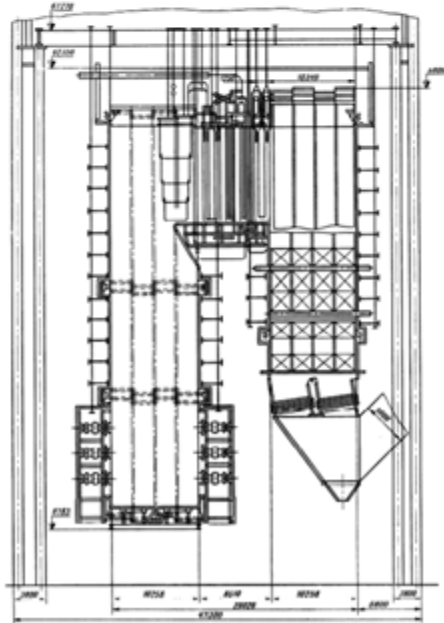
SCIENTIFIC NOVELTY OF THE PROPOSED SCIENTIFIC PROJECT FOR COOPERATION

- ❖ Accounting for the effects of possible emergent properties on the life time management of equipment elements more accurate evaluation of reliability
- ❖ Development of theoretical foundations for increasing average operational efficiency and ecological safety of thermal and nuclear power installations on the basis of the accounting of influence of emergent properties on the reliability equipment elements



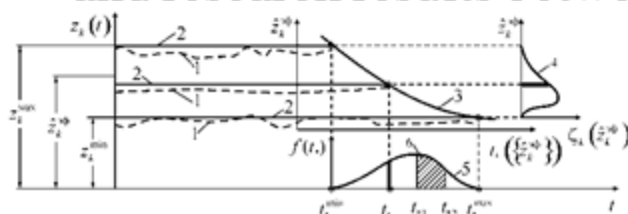
THE PRACTICAL VALUE OF THE PROPOSED SCIENTIFIC PROJECT FOR COOPERATION

- ❖ The possibility of using the results for improve the average operational efficiency of the thermal and nuclear power plants, petrochemical and metallurgical industries, heating networks
- ❖ The possibility of using the results for the design and expert assessment of thermal and nuclear power installations
- ❖ The strengthening of scientific contacts and increase mobility of professorial staff, research staff and students
- ❖ Publication of the results in the rating of scientific international journals and discussions at international scientific conferences



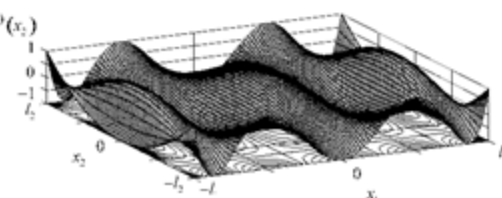
RESEARCH METHODS

- ❖ **Interdisciplinary researches** which cover fuel combustion and nuclear fission processes, heat and mass transfer, deformation and fracture of structural materials and structural elements of thermal and nuclear power plants
- ❖ **Simulated modelling**, which includes the construction of mathematical models in the form of boundary and initial-boundary value problems and numerical methods
- ❖ **Computer modelling** of processes in thermal and nuclear power plants using the original specially designed application software
- ❖ **Methods of mathematical statistics** for processing of available statistical data on equipment failures of existing thermal and nuclear power plants
- ❖ **Standard numerical methods** for solving boundary value problems, the integration of systems of ordinary differential equations, calculating the integrals, solving systems of linear algebraic equations, find the stationary values
- ❖ **Object-oriented and modular programming** to develop original software applications necessary for computer modeling of processes in thermal and nuclear power plants in conducting computational experiments
- ❖ **Internet-technologies** for communications and exchanging of scientific information and research results between researchers from Ukraine and the EU countries



$$A^{(1)}(\mathbf{u}^{(1)}; \mathbf{u}^{(2)}) = \mathbf{f}^{(1)}(\mathbf{v}) \quad \forall \mathbf{x} \in \Omega, \quad L^{(1)}(\mathbf{u}^{(1)}; \mathbf{u}^{(2)}) = \mathbf{p}^{(1)}(\mathbf{v}) \quad \forall \mathbf{x} \in \Gamma \quad \psi^{(1)}(x_1) \cdot \psi^{(1)}(x_2)$$

$$\begin{cases} \frac{\partial \mathbf{u}^{(2)}}{\partial t} + A^{(2)}(\mathbf{u}^{(2)}; \mathbf{u}^{(1)}; \mathbf{v}) = \mathbf{f}^{(2)}(\mathbf{u}^{(2)}; \mathbf{u}^{(1)}; \mathbf{v}) \quad \forall \mathbf{x} \in \Omega \\ \mathbf{u}^{(2)}(\mathbf{x}, 0) = \mathbf{u}_0^{(2)}(\mathbf{x}) \quad \forall \mathbf{x} \in \Omega, \quad L^{(2)}(\mathbf{u}^{(2)}; \mathbf{u}^{(1)}; \mathbf{v}) = \mathbf{p}^{(2)}(\mathbf{v}) \quad \forall \mathbf{x} \in \Gamma \end{cases}$$



EXPECTED SCIENTIFIC RESULTS

- ❖ Determination of the relation between the processes of energy generation in various types of fuel (burning, nuclear fission, etc.), heat and mass transfer (heat and steam generation based on the accumulation of sediments, etc.) and reliability indexes (probability of failure, resource, etc.) of the main equipment (heat exchanger pipes, etc.) thermal and nuclear power installations
- ❖ Determination of the possible emergent properties and assess their impact on the reliability of the equipment of thermal and nuclear power installations
- ❖ Determination of the relation between life time of the equipment elements and the operation modes of thermal and nuclear power installations
- ❖ Determination of the possible emergent properties in thermal and nuclear power installations and assess their impact on the reliability of the equipment elements such as heat exchanges pipes and fuel element cladding
- ❖ The mathematical models and of processes, structures, materials and modes of operation to identify possible emergent properties and assess their impact on the reliability of the equipment of thermal and nuclear power installations
- ❖ Development of numerical methods and technics to solve the system of related boundary and initial-boundary value problems, which simulate the equipment elements and technological processes in thermal and nuclear power installations
- ❖ Computer technologies development for programming implementations of the proposed numerical methods and technics to solve researched problems
- ❖ Publishing papers, monographs, participation in international conferences by the professors and scientific staffs as well as students of bachelor, masters and PhD