

JOINT-STOCK COMPANY
«KYIV RESEARCH AND DESIGN INSTITUTE

«ENERGOPROJECT»

ETP
КИЕВ

www.kiep.kiev.ua

**Joint-Stock Company
«Kyiv Research and Design Institute
«Energoproject»
counts its history since 1933**

Joint Stock company “Kyiv Research and Design Institute “Energoproject” (JSC KIEP) has always been a leader in Ukraine in development of nuclear, thermal and renewable energy projects, and in other fields of industrial and civil engineering.











More than 80 thermal and nuclear power plants have been constructed by the KIEP projects worldwide.

The Main Directions of the Activity

- Implementation the comprehensive engineering, design and research works in the field of energy sector of the industry and in other branches of industrial and civil engineering
- Design supervision at stage of the energy facilities construction
- Scientific and technical support of the energy facilities construction
- Engineering support for the energy facilities at stage of the operation
- Development of feasibility studies for power industry objects
- Development of analytical studies, national strategies, programs and concepts in the field of energy industry
- Development of regulations in the field of energy industry
- Inspection and assessment of technical conditions of the energy facilities
- Performance of the General Designer functions for the power energy objects and facilities
- Scientific, technical and design activity for modernization, renovation, reconstruction and life-time extension of the nuclear and thermal power plants
- Development of programs, projects and detail design documentation for the decommissioning of NPP units
- Performance of environmental impact assessments, including a comprehensive environmental protection solutions
- Development of the feasibility studies for the energy objects construction sites selection
- Performance of Consulting Engineer and the Client's Technical Agent's functions

KIEP has been designing nuclear power facilities over 40 years






Main Nuclear Power Plants Designed by KIEP

| Country | Name of NPP | Quantity of Units and Capacity (MW) | KIEP Responsibility |
|---|-------------------------------------|-------------------------------------|--|
|  | Hungary NPP Paks | 4x VVER-440 2x VVER-1000 (B-320) | General Designer |
|  | Bulgaria NPP Belene | 2x VVER-1000 (B-320) | General Designer |
|  | Bulgaria NPP Belene | 2x VVER-1000 (B-466) | Developer of Design and Detailed documentation of the Turbine Building |
|  | Russia Balakovo NPP | 2x VVER-1000 | General Designer |
|  | Russia Kostroma NPP | 2x RBMK-1500 | Designer of the Turbine Building |
|  | Russia Beloyarsk NPP | 1x BH-800 1x BH-1200 | Designer of the Turbine Building |
|  | Russia Kalinin NPP | 1x VVER-1000 | Designer of the Turbine Building |
|  | Russia VVER-TOI | 1x VVER-1200 | Designer of the Turbine Building |
|  | Russia Siberian Chemical Combine | BREST-OD-300 | Developer of the pre-design of Turbine Building |
|  | India NPP Kudankulam | 2x VVER-1000 | Developer of Technical specifications for the reactor installation and Technical specifications for NPP Design |



NPP Paks

Main Nuclear PowerPlants Designed by KIEP

| Country | Name of NPP | Quantity of Units and Capacity (MW) | KIEP Responsibility |
|---|----------------------|-------------------------------------|--|
|  | Moldovan NPP | 4x VVER-1000 (B-320) | Development of the Feasibility Study and NPP site selection |
|  | Ignalina NPP | 2xRBMK-1500 | Designer of the Turbine Building |
|  | Belarusian NPP | 2xVVER-1200 (NPP-2006) | Development of the Feasibility Study and NPP site selection |
|  | NPP Ninh Thuan-1 | 4xVVER-1200 (NPP-2006) | Development of the Feasibility Study and NPP site selection |
|  | Chigirinskaya NPP | 4x VVER-1000 (B-320) | General Designer |
| | Rivne NPP | 2xVVER-440 2xVVER-1000 | General Designer |
| | Khmelnitsky NPP | 2xVVER-1000 (B-320) 2xVVER-1000 | General Designer |
| | Zaporizhzhya NPP | Zaporizhzhya NPP | Responsibly Designer of safety enhancement measures |
| | South-Ukrainian NPP | South-Ukrainian NPP | Responsibly Designer of safety enhancement measures |
| | Chernobyl NPP | 3xRBMK-1000 | General Designer since 1987. Designer of the NPP decommissioning Project including EIA report development for the decommissioning |



Chernobyl NPP

Design of the NPP with Modern Reactor Installations of New Generation «3+»

NPP NINH THUAN 1 in Vietnam

The site for the construction of the NPP Ninh Thuan 1 is located 300 km North-East of Ho Chi Minh City (Vietnam). The prevailing climate conditions of the area are determined by tropical monsoons.

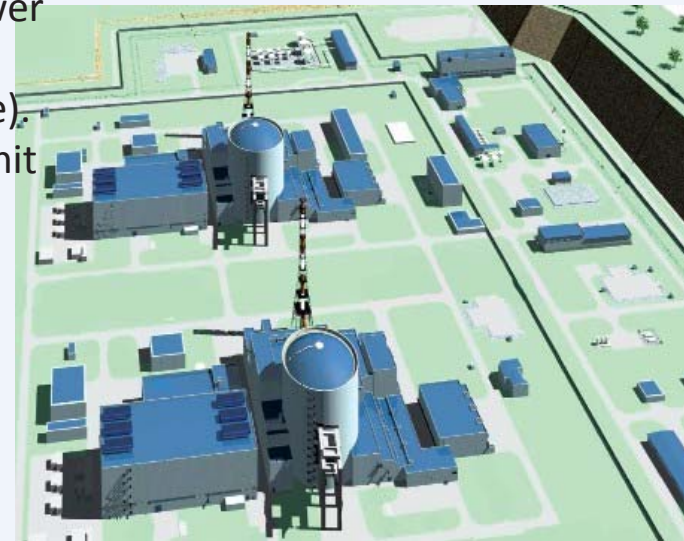
The NPP Ninh Thuan 1 consists of two VVER-1200 power units (1st construction stage), with the possibility of further extension to four units (2nd construction stage).

The electric capacity of each unit is 1200 MW. Each unit is designed to generate electricity in base load mode.

The unit will consist of a reactor installation with water-cooled power reactor (VVER) and a turbine plant. The NPP is designed as a two-loop steam cycle plant.

The life cycle of the NPP main equipment is 50 years.

Refueling is performed once a year.



Main Facilities Designed by KIEP in NuclearField

| Country | Name of Object | Name of Facility | KIEP Responsibility |
|---------|---------------------------------|--|---|
| Ukraine | Chernobyl NPP | Liquid Radwaste Treatment Plant | General Designer, since 1987 |
| Ukraine | Chernobyl NPP | Industrial Complex for Solid Radwaste Management | Local Designer in partnership with NUKEM, Germany |
| Ukraine | Chernobyl NPP | Facility for removal of trans-uranium elements and organics from process water and liquid Radwaste | Local Designer in partnership with NUKEM, Germany |
| Ukraine | Chernobyl NPP | Object «Shelter» | General Designer (operation support, New Safe Confinement enclosure perimeter) |
| Ukraine | Chernobyl NPP | New Safe Confinement (NSC) | Main Ukrainian Designer in partnership with consortium NOVARKA, France |
| Ukraine | Chernobyl NPP | Interim Storage Facility for Spent Nuclear Fuel (ISF-2) | General Designer in partnership with Holtec, USA (Holtec spent fuel storage technology application) |
| Ukraine | Chernobyl NPP | Units 1-3 Final decommissioning and conservation project | General Designer and EIA report developer |
| Ukraine | Exclusion zone of Chernobyl NPP | Centralized Storage Facility for Spent Nuclear Fuel of Ukrainian NPPs | General Designer in partnership with Holtec, USA (Holtec spent fuel storage technology application) |
| Ukraine | Exclusion zone of Chernobyl NPP | «Vektor» Industrial Complex. Technological Building for Radwaste Treatment | Local Designer in partnership with EMPRESARIOS AGRUPADOS, Spain |



Spent Nuclear Fuel Storage at Chernobyl NPP for RBMK fuel



Industrial Complex for Solid Radwaste Management at Chernobyl NPP

EXTENSION OF NUCLEAR POWER PLANTS' OPERATION LIFETIME

- Performing surveys to determine the technical state of Power Unit structures, systems, equipment and components.
- Qualifying Power Unit equipment and components for extreme conditions and extreme environmental influences, including seismic impacts.
- Developing design documentation for reconstruction of the Power Unit associated with operation lifetime extension.
- Developing periodic "Safety Analysis Report", taking into account technical factors, qualification and the completed reconstruction work at the Power Unit.
- Providing support to Operator organizations in obtaining operating licenses from Regulatory Authority to extend the service life of the Power Unit.

Ukraine NPP Power Units scheduled for operation lifetime extension

| NPP Power Units | Service lifetime extension |
|--------------------------|-----------------------------------|
| Rivne NPP – 1,2 | 20 years |
| Rivne NPP – 3 | 20 years |
| Zaporizhia NPP -1,2 | 10 years |
| South-Ukrainian NPP -1,2 | 10 years |

Centralized Storage Facility for Spent Nuclear Fuel in Ukraine

- The modern worldwide proven spent nuclear fuel storage technologies are used in Centralized Storage Facility for Spent Nuclear Fuel (CSFSF) Design.
- CSFSF is a state nuclear facility designed by KIEP for the storage of spent nuclear fuel generated at Ukrainian nuclear power plants with reactor types VVER -1000 and VVER-440.
- The CSFSF site is located in the Chernobyl Exclusion Zone, the area that has been radioactively contaminated at the Chernobyl NPP accident.
- The dry storage technology is used for storage of the spent nuclear fuel with application of the Holtec International (USA) double-barrier sealing system design.
- The CSFSF design service life is 100 years.

CSFSF total capacity is 458 storage containers type HI-STORM 190 UA that can hold 16529 spent nuclear fuel assemblies, including:

388 storage containers type HI-STORM 190 UA, where 12010 VVER-1000 spent nuclear fuel assemblies are stored into multi-purpose containers MPC - 31 type

70 storage containers type HI-STORM 190 UA where 4519 VVER-440 spent nuclear fuel assemblies are stored into multi-purpose containers MPC - 85 type



KIEP's Activity at SSE «Chernobyl NPP» and Chernobyl NPP Exclusion Zone

Since 1987 till now KIEP as a General Designer for the Chernobyl NPP performed works to enhance safety of the Chernobyl NPP reactor units 1 and 3 at the stage of their operation. After the resolution by Ukraine government on early decommissioning of unit 3 and the final closure of the Chernobyl NPP the KIEP launched a variety of Chernobyl NPP decommissioning activities.

General Designer Activities Associated with Design and Engineering Support of the SSE «Chernobyl NPP» Decommissioning

- Development of the National Strategy and Program of the Chernobyl NPP decommissioning
- Jointly with NUKEM (Germany) development and providing an engineering support for the Industrial Complex for Solid Radwaste Management (ICSRM) Project
- Jointly with Holtec International (USA) development and providing an engineering support for the Interim Storage Facility-2 (ISF-2) Project;
- Development of the Design of Interim Storage Facility -1 (ISF-1) reconstruction;
- Development of the final Design for Liquid Radioactive Waste Treatment Plant (LRWTP)
- Jointly with NUKEM (Germany) development of the Design of the Industrial Facility for Removal of Trans-uranium Elements and Organics from Process Water and Liquid Radioactive Waste at ChNPP
- Development of the Chernobyl NPP power units 1-3 decommissioning strategy and program
- Develop of the Chernobyl NPP power units 1-3 decommissioning strategy at the stage of "Final shutdown and conservation"
- Feasibility Study for construction of additional RAW management facilities at Chernobyl NPP decommissioning
- Feasibility Study for optimization of the Chernobyl NPP infrastructure at the decommissioning stage

Design and Engineering Support for the Object «Shelter» at Chernobyl NPP

- Activity in various «Shelter Implementation Plan» (SIP) projects for the Object «Shelter» from 1998 to present
- As one of KSK Consortium (Ukraine) members, KIEP in cooperation with Morrison Knudsen (USA) and BNFL (UK) developed the Object «Shelter» Safety Measures Program within the SIP framework
- As one of KSK Consortium (Ukraine) members, KIEP in cooperation with EDF (France), Battelle and Bechtel (USA) developed the conceptual design-feasibility study for the New Safe Confinement (NSC) at the Object «Shelter»
- As one of KSK Consortium (Ukraine) members, KIEP developed working (detailed) design and provided engineering support for the implementation of the «Stabilization of the Object «Shelter» building structures» project
- As one of KSK Consortium (Ukraine) members, KIEP fulfilled functions of the Client's Engineer under SIP PMU projects
- KIEP developed the design, technical documentation and provided engineering support for the implementation of a New Ventilation Stack (NVS) project at the ChNPP Power Unit 4 (Object «Shelter»)
- As one of KSK Consortium (Ukraine) members, KIEP developed design and provided engineering support for the implementation of NSC Enclosing Perimeter project at the Object «Shelter»

Activity for the Chernobyl NPP Exclusion Zone Projects

- Development of the «Concept of the Exclusion Zone» in cooperation with the Ukrainian Academy of Sciences
- Development of the Design of the 1-st construction stage of the «Radioactive Waste Disposal Complex» («Vector») for low and intermediate Radwaste
- In cooperation with Empresarios agrupados company (Spain) development of the Design of Process Building with selection of technologies for low and intermediate
- Participation in activity of the research and technological committee in frame of State Administration for Exclusion zone of Ukraine

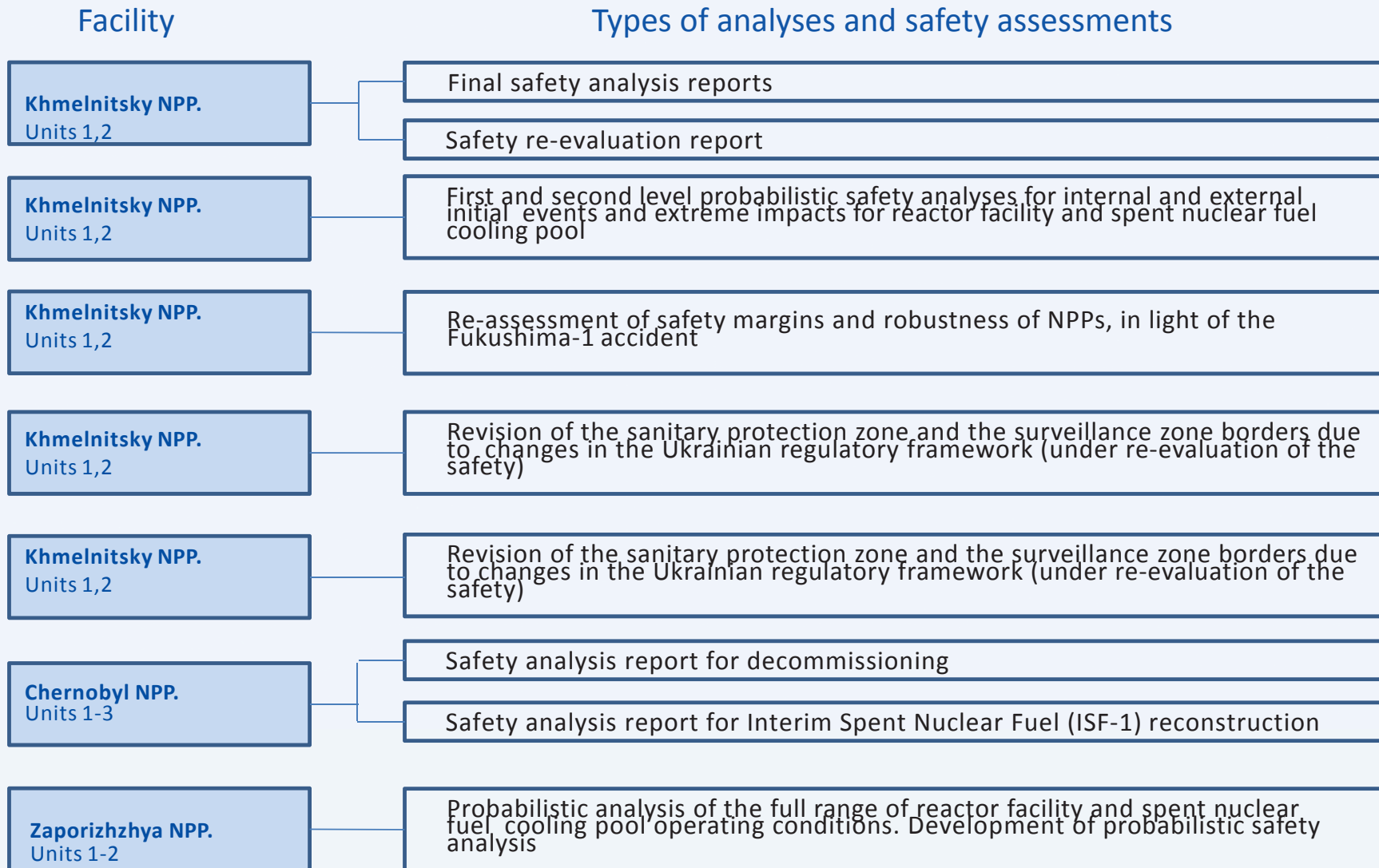
Activity for the New Safe Confinement (NSC) Project

Since 2009 the KIEP as the Main Ukrainian Designer in cooperation with NOVARKA Consortium (France) is provided an activity for the Project of the construction of the NSC over the Object «Shelter», including:

- Development of the Licensing Package (LP-5) «Main structure and main cranes system» and provided support for the Contractor in the process of licensing LP-5 with the state authorities of Ukraine
- Development of the Licensing Package (LP-6) «Shelter structure with life support systems and necessary infrastructure» and provided support for the Contractor in the process of licensing LP-6 with the state authorities of Ukraine
- Development of the Licensing Package (LP-3) «Foundations of NSC Arch erection and transfer zones» and provided support for the Contractor in the process of licensing LP-3 with the state authorities of Ukraine
- Development the working documentation for foundations in the assembly, transfer and service zones, including all necessary justification calculations
- Design supervision activity for construction of foundations in the assembly, transfer and service NSC zones
- Engineering support for the Contractor by performing the structural calculations, developing the technical solutions and preparing design documentation for the
- construction of the Arch and the NSC auxiliary facilities' infrastructure
- Development of the design documentation and performing design supervision of the NSC Enclosing Perimeter construction



Activity for the Nuclear and Radiation Safety Analysis and Assessments at Ukrainian NPPs



Activity for the Nuclear and Radiation Safety Analysis and Assessments at Ukrainian NPPs

| Facility | Types of analyses and safety assessments |
|-------------------------|--|
| Rivne NPP. Units 1-4 | <ul style="list-style-type: none"> Final safety analysis reports for units 3 and 4 Safety re-evaluation report for units 1 and 2 Safety analysis report for the RAW treatment plant |
| Rivne NPP. Units 1-4 | First and second level probabilistic safety analyses for internal and external initial events and extreme impacts for reactor facility and spent nuclear fuel cooling pool |
| Rivne NPP. Units 1-4 | Analysis of design and beyond design basis accidents |
| Rivne NPP. Unit 1 | Development of severe accident management guide |
| Rivne NPP. Unit 1 | Determination of the hydrogen concentration at severe accidents |
| Rivne NPP. Unit 1 | Calculated justification of forced pressure reduction system in containment for beyond design basis accidents associated with severe core damage |
| Rivne NPP. Units 1-4 | Re-assessment of safety margins and robustness of NPPs, in light of the Fukushima-1 accident |
| Rivne NPP. Units 1-4 | Revision of the sanitary protection zone and the surveillance zone borders due to changes in the Ukrainian regulatory framework (under re-evaluation of the safety) |

KIEP Scientific and Research Activities in Energy Field

| Activity | KIEP Responsibility |
|---|---|
| Energy Strategy of Ukraine till 2030 | Development of the Section «Nuclear Energy» |
| Ukraine Strategy of spent nuclear fuel management | Contractor for the development of the Strategy |
| National Program for decommissioning of the Chernobyl NPP | Contractor for the development of the Program |
| The Strategy of RAW management in Ukraine | Development of the Section «Radioactive Waste Management of the Ukrainian NPPs» |
| The Chernobyl NPP Decommissioning Concept | Contractor for the development of the Cadastre |
| SSE NAEC «Energoatom» regulatory document. Content and composition of the NPP units decommissioning project | Contractor for the development of the Cadastre |
| Cadastre of Ukrainian NPP sites | Contractor for the development of the Cadastre |
| Regulatory Authority's nuclear and radiation safety regulations | Participation in the development, review, expert examination |
| Fire safety regulations | Participation in the development, review, expert examination |
| Participation in interdepartmental working groups, including international ones on activities associated with the nuclear fuel and radioactive waste management | Participation in the working groups |
| Technical specifications for the supply of equipment for the RAW treatment plants | Contractor for the development of the Specifications |

The KIEP Organizational Structure Provides for Comprehensive Development of Scientific, Technological and Design Documentation

The KIEP structure includes

Administration
and management units

Design
departments

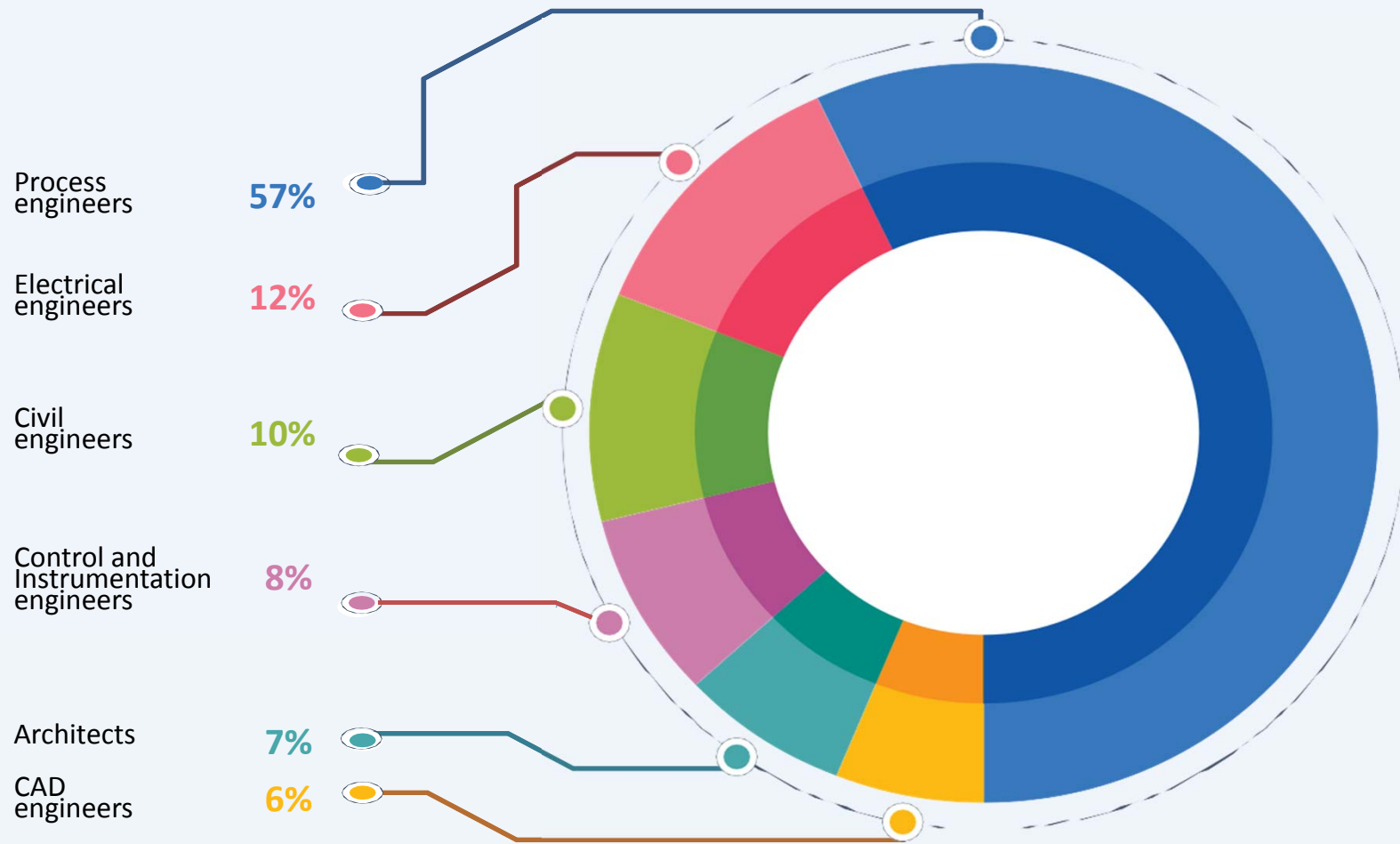
Supporting
departments

Design departments are developed comprehensive design documentation for nuclear and thermal power stations, industrial complexes, residential and civil construction projects.

- Chief Design Engineers (Project Managers) department
- Design Technical Support Department
- Quality and Personnel Management Department
- Main Department for design of nuclear and thermal power facilities
- Nuclear and Radiation Safety Assessment Department
- Radioactive Waste and Water Treatment Department
- Electrical Engineering Department
- Department of Automated Control Systems design

- Department of Reinforced Concrete Structures design
 - Department of Metal Structures design
 - Architectural Department
 - Heating and Ventilation Department
 - Water Supply Department
 - Computer-Aided Design Department
 - Comprehensive Computer-Aided Design Support Department
- Supporting departments support the activity of the administrative and management units and design departments.

Personnel specialization structure



To Prepare Design Documentation and Provide Engineering Services at a High Quality Level KIEP Applies:

- Significant experience and high professional qualification of KIEP engineers and technical personnel
- Advanced design technologies and licensed software Certified quality management system
- Experience of international cooperation in the energy sector

KIEP Activities are Based on the Following Documents:

- License for design activities
- License for design, assembly and maintenance of fire protection equipment
- License for topographic, geodetic and cartographic works
- Special permits to carry out activities on the territory of the Chernobyl NPP Exclusion Zone.



Certification experts KIEP

In accordance with the Ukrainian legislation KIEP experts have a personal qualification certificates for the following design activities:

- Architectural and layout design
- Development of civil and public buildings design documentation
- Engineering and construction design, including
 - work to ensure the mechanical resistance and stability of structures
 - fire safety
 - life and human health safety
 - environmental and operational safety, noise protection requirements
 - energy saving
 - cost estimate documentation
- Engineering and structural design of roads
- Technical inspection of buildings and structures.



KIEP Multidisciplinary Activities are Supported by a Variety of Modern Software

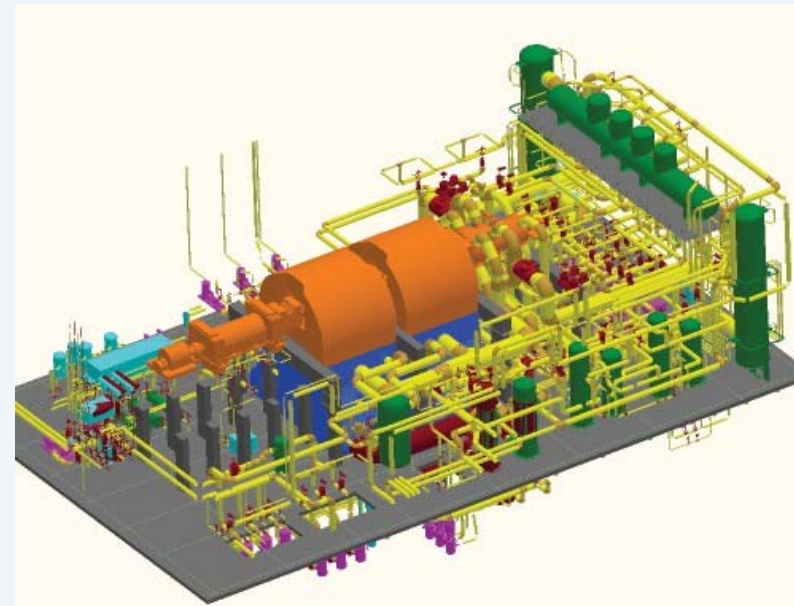
The main tools of computer-aided design in KIEP are the advanced CAD technologies based on a single data center of 3D model of design objects.

3D design technologies **Smart Plant Enterprise (Intergraph)** and **PDMS (AVEVA)** are currently applied by KIEP for Projects development.

AutoCAD Revit Architecture Suite and **AutoCAD Revit Structure Suite** are used by KIEP to design buildings (architecture, structures).

KIEP is capable to solve a wide range of computing tasks in line with the modern requirements:

- The finite element software **SCAD, Lira, ANSYS, SYSTUS** are used for structural calculations
- **START, ASTRA** and **Hydraulic** are used to calculate pipeline systems
- **PROJECT EXPERT, ALT INVEST** are used to calculate the economic efficiency parameters of projects

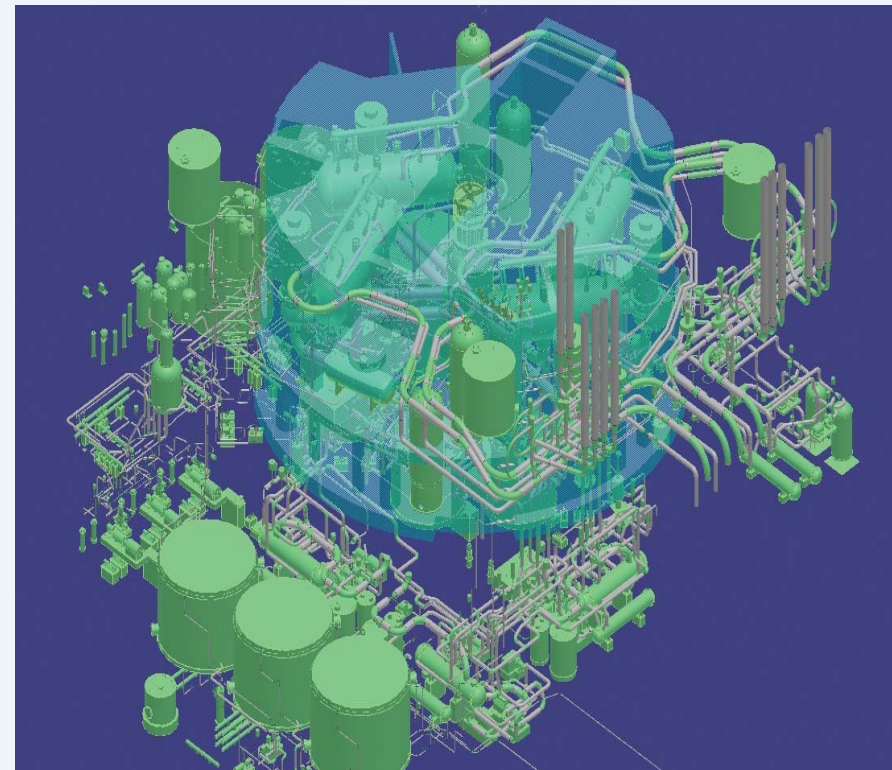


Software testing the safety of nuclear facilities

Along with general computing tasks KIEP has qualified professionals and software to perform specific computations related to the specifics of nuclear energy.

This software includes:

- **RELAP, ATHLET, CATHARE**: for analysis of thermal-hydraulic transients in nuclear installations
- **CONTAIN, MELCOR**: for analysis of accidents inside the NPP containment
- **RISK SPECTRUM, SAPHIRE**: for probabilistic safety analysis
- **RASCAL, PANDORA, COSYMA, GENII**: for radiation calculations, including environmental impact calculations
- **MCNP 6, MCNPX, SCALE 6.2, Microshield** : for radiation protection and nuclear systems criticality calculations



KIEP Quality Management System

KIEP Quality Management System established since 1996. The high quality of the KIEP design documentation and engineering services is based on:

- Continuous improvement of the Quality Management System as required by standard ISO 9000
- Products compliance with established requirements and customer expectations due to performance of work in a timely manner and maintaining accurate and complete records of client requests
- Training and encouraging personnel to produce high-quality products
- Identification and analysis of arising discrepancies and taking preventive measures to avoid them in future
- Assigning responsibility for product quality to KIEP top management

In 2001, the KIEP Quality Management System was certified for compliance with ISO 9001 requirements by the:

- UkrSEPRO system
- «Bureau Veritas International» in Ukraine

Since 2001, the KIEP Quality Management System has re-confirmed its compliance with ISO 9001 requirements.

In February 2016, the KIEP Quality Management System was re-certified for compliance with ISO 9001:2008 requirements by the “Bureau Veritas Certification” in Ukraine.

The effectiveness of KIEP Quality Management System was confirmed by numerous audits by certified European and U.S. auditors.



Partnership

The objective of developing scientific, technical and design documentation that arise to solve complex challenges, is usually achieved by collective effort of the leading research and educational institutions.

In this field, KIEP maintains working relations with more than 30 research institutes.

For many years, KIEP has been collaborating with well-known Ukrainian and foreign companies: **SE NAEK «Energoatom», SEE "Chernobyl NPP" (Ukraine), «Empresarios Agrupados» (Spain), Framatom-AREVA and EDF (France), NUKEM (Germany), NNC (UK), «Westinghouse», Bechtel, Battel, PNNL and ANL , Holtech International (USA).**

KIEP is a member of the «Ukrainian Association of Excellence and Quality», the collective member of the Academy of Construction of Ukraine, collective member of the «Ukrainian Nuclear Society».

Today, KIEP has become one of the recognized and well-reputed leaders in the design of energy facilities and in the energy sector as a whole, actively participating in the development and implementation of the national electric power industry strategies and programs.

Since the Date of Establishment till Present the KIEP Adhere to the Principles of:

- ✔ Strict and timely compliance with the obligations it has assumed
- ✔ Strict compliance with applicable laws and regulations
- ✔ Rapid response to and satisfaction of customer needs
- ✔ Taking technical decisions on appropriate level
- ✔ Using advanced design technologies
- ✔ Implementing flexible pricing policy
- ✔ Continuous training of personnel
- ✔ Respect of confidentiality and non-disclosure principles
- ✔ Support to Customer at all stages of the facility's life cycle
- ✔ Compliance with the principles of the national anti-corruption program

**KIEP Considers the Maximum Customer Satisfaction
as an Absolute Priority for Its Activity**

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