PUBLIC REPORT OF
JSC ATOMSTROYEXPORT
2011

Approved By The Decision Of The Annual General
Shareholders’ Meeting As Of 29.06.2012.
Preliminarily Approved By The Decision Of The Board
Of Directors As Of 29.05.2012.

V.I. Limarenko
Director Of JSC NIAEP,
Management Company
Of JSC Atomstroyexport

M.Y. Samotsvetova
Chief Accountant
Of JSC Atomstroyexport
State Corporation Rosatom is currently implementing a full scale program for construction of nuclear power plants in the territory of the Russian Federation, guaranteed by the federal budget. The full-scale program for construction of NPPs in other countries is also being implemented.

Analyzing the results of JSC Atomstroyexport activity, the leading engineering company for construction of NPPs abroad under State Corporation Rosatom, we can acknowledge that in 2011 the Company has shown adherence to a principle of the guaranteed performance of obligations to customers and growth of a portfolio of orders.

Tianwan NPS in China, the first-ever nuclear power plant with safety systems of new generation shows reliable operation.

Projects for construction of the nuclear power plants in Iran and India are coming to the end.

In the reporting year hot test of Kudankulam NPP unit 1 was completed with success. After resumption of the works interrupted as a result of blockade of access of the personnel to Kudankulam NPP site, implementation of the Agreement between the Government of the Russian Federation and the Government of the Republic of India on cooperation in construction of the additional power units on the same site and construction of nuclear power plants based on the Russian design at new sites in India have continued anew.

JSC Atomstroyexport has carried out its obligations to the customer on construction of Belene NPP in Bulgaria. It is very important, that the Company’s portfolio includes a project with unique options which corresponds to the European Utility Requirements (EUR) for construction of nuclear power plants with light-water reactors, IAEA recommendations and international safety requirements. This project corresponds to the requirements for new generation of nuclear power plants of class III +.

Despite of tragical events in Japan, the results of the fiscal year testify that the Company not only has kept its portfolio of the international orders, but also continues strengthening the positions in the world market of NPP construction. In the long-term forecast till 2025 JSC Atomstroyexport plans to construct several tens of new nuclear power plants in India, China, Turkey, Armenia, Jordan, Ukraine, Czech Republic, Belarus, Kazakhstan, Vietnam, Slovakia, Hungary, Bangladesh, Argentina, the Republic of South Africa, Brazil. The governments of the given countries applied for continuation of realization of national programs for development of nuclear power engineering and
support of projects for construction of new nuclear power plants.

In 2011 the general contract for construction of Tianwan NPS units 3 and 4 has come into force. In May 2011 JSC Atomstroyexport signed the first contract with the Turkish Contractor within the limits of realization of the project for construction of Akkuyu nuclear power plant in the Republic of Turkey. The branch of JSC Atomstroyexport was entered in the trade register of legal entities of Turkey. The experience gained by Russia at realization of the project for construction of the nuclear power plant in Turkey on BOO (Build-Own-Operate) business model can be extended subsequently to other projects in the developing countries.

In the reporting year the intergovernmental agreement on granting the state credit for construction of the first Vietnamese nuclear power plant based on the Russian technology was signed. Simultaneously the intergovernmental agreement on construction of the Center of nuclear science and technologies in Vietnam was signed.

The Company has considerably strengthened its positions in the market of the CIS countries. In 2011 the intergovernmental cooperation agreement for construction of NPP consisting of two 1200 MWt units in the territory of Belorussia was signed, as well as the contract agreement. The contract agreement on development of the design of reactor installations for units 3 and 4 of Khmelnitsk NPP was signed.

The intergovernmental agreement with the Republic of Kazakhstan on cooperation in the design and construction of a nuclear power plant with VVER-300 reactor was prepared. The negotiations with the Armenian side were held and the functions of JSC Atomstroyexport were specified both as the general contractor and designer of a new power unit in the Republic of Armenia.

In 2011 JSC Atomstroyexport successfully finished preparation of the bid for construction of a nuclear power plant in Jordan and sent it to the customer. Also in 2011 the Company, being a member of the Consortium MIR.1200, passed a stage of preliminary qualification in the tender for completion of Temelin NPP units 3, 4 and in October, 2011 the Consortium received the bidding documentation for this project.

At participation of JSC Atomstroyexport the draft Memorandum of mutual understanding between State Corporation Rosatom and Egyptian Atomic Energy Authority (EAEA) on development and the subsequent realization of the program of complex inspection of research reactor ET-RR-1 in Inshas was prepared and approved by the Egyptian side. JSC Atomstroyexport in 2012 plans to participate in the forthcoming tender for construction of the first Egyptian NPP. Now all the planned activities related to operation in the energy market of Egypt are postponed until internal political conditions in the country are stabilized and the Egyptian government takes an official decision on realization of the national nuclear program.

In 2011 experts of JSC Atomstroyexport took part in foreign activities of State Corporation Rosatom, having provided support in promotion of the Russian nuclear technologies in the foreign markets and having shown a high level of professionalism.

Key directions in strategy of development of perspective projects of JSC Atomstroyexport are defined by the initiatives of State Corporation Rosatom. Ambitious strategy of development of State Corporation corresponds with administrative association of NIAEP and ASE. Appearance of the large financially optimized structure shall boost a role of State Corporation Rosatom in the foreign markets.

Alexander Lokshin,
Chairman of Board of Directors
of JSC Atomstroyexport
Joint-Stock Company Atomstroyexport, an engineering company of State Corporation Rosatom, constructing nuclear power plants abroad, in 2011 has kept its positions in key directions of development. NPP construction projects in the Islamic Republic of Iran and India are coming to the end. Despite tragic events at the Japanese nuclear power plant Fukushima-1, JSC Atomstroyexport has confirmed its competence in construction of safe nuclear power plants, and today the portfolio of Rosatom international orders is the most significant one among the participants of the NPP global construction market. All main foreign customers of Russian NPP power units have kept their policy relative to development of the nuclear engineering, and some of them including the Republic of Turkey, the Socialist Republic of Vietnam and others have strengthened in their commitment to cooperate with the nuclear industry of Russia. According to their firm belief, the accident at the Fukushima-1 NPP has not only revealed the problems in the world nuclear industry, but has also proved that Russian nuclear power plants are the safest ones as of today.

The reporting period was especially important for the Company from the viewpoint of transition to the final stage in implementation of foreign projects on construction of nuclear power plants, contracts thereon have been concluded in the beginning of the nineties of the XX century – during hard times of Russian economic reforms and stagnation of the nuclear industry all over the world.

In 2011 the works at the first power unit of Bushehr NPP (the Islamic Republic of Iran) were completed at the reactor physical start-up stage, the works at the power start-up sub-stage were also completed. The first kilowatts of electricity generated by Bushehr NPP were provided to the power grid of Iran.

In March 2012 the works of Russian personnel at the Kudankulam NPP site (the Republic of India) interrupted in October 2011 due to blocking the personnel access to the site, were resumed. After the equipment inspection and implementation of all necessary works, the first power unit of the largest nuclear power plant in India will be ready for loading the fuel – and the guarantee thereto is successful testing performed within the reported period.

Tianwan NPS demonstrates reliable operation. It is the biggest nuclear power plant in the Republic of China and the first nuclear power plant in the world with safety systems of new generation. JSC ASE was a general contractor in construction of the abovemen-

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Dear shareholders, colleagues and partners!

Since 02.04.2012 the powers of the sole executive body (President) of JSC ASE have been assigned to the management company – JSC NIAEP. The detailed information is given in Section 1.3 “Company Management”.

ADDRESS OF DIRECTOR OF NIAEP, MANAGEMENT COMPANY OF JSC ASE
tioned NPS on a turn-key basis. According to leading world experts, Tianwan NPS is one of the most reliable and safe operating nuclear power plants. Thus, the scheduled preventive maintenance of the second power unit in 2011 was completed for 39.2 days. This became a record relative to the period of similar works at VVER-1000 reactors in the world.

In the reporting period the Company implemented the contract signed on the 27th of September 2010 between JSC ASE and the Chinese customer – Jiangsu Nuclear Power Corporation (JNPC) – the contract for development of the technical design for Tianwan NPS second phase. The Company continued the works relative to the ditch and foundation slabs of the third and fourth units. The first concrete for the nuclear island of the third power unit is planned for December 20, 2012.

The status of the leading engineering company in nuclear construction abroad allows JSC Atomstroyexport to use its accumulated potential for implementation of Russian power projects including those relative to construction and modernization of thermal power generating plants. Significant success has also been achieved in this sphere.

On June 26th, 2011 a commissioning ceremony of a new steam-gas power unit of 400 MWt capacity (SGU-410) took place in the town of Nevinnomyssk, Stavropol Region. On August 12th, 2011 a solemn opening of Saint-Petersburg complex of protective facilities (CPF) from flooding took place. In November 2011 the Company received an official letter from CPF Directorate with gratitude to JSC ASE for qualitative performance of the works under the project of CPF construction, the letter also informed that the dyke had saved Saint-Petersburg from flooding which could cause 1.3 billion rubles damage to the city. The works on construction of the first phase of Yuzhnowaisk power complex GRES-2 in the Chelyabinsk Region were continued.

In 2011 the process of the administrative merger of two largest engineering companies of State Corporation Rosatom, JSC NIAEP and JSC ASE, began. The purpose of the merger is further enhancement of management efficiency and expansion of the companies’ competence. In 2012 JSC NIAEP was assigned the management company of JSC ASE. The structure of NIAEP and ASE merged company is a network of offices for management of projects on power plants construction. These are – Design Office in Nizhny Novgorod managing the construction of power units at Kalinin, Rostov and Nizhny Novgorod nuclear plants; design office in Moscow responsible for construction of power plants abroad – in China, India, Turkey, Vietnam; design office in Saint-Petersburg in charge of power units at Baltic NPP and Belarusian NPP. Besides, the merged company has more than ten representative offices in Europe and Asia. The number of employees working in the merged companies since January 1, 2012 is about four thousand people, and with subsidiaries – about seven thousand employees.

As a result of the merger, JSC ASE gets up-to-date advantages of multi-D engineering, JSC NIAEP expands geography and scope of activity, as well as enters the foreign markets. The merger of JSC NIAEP and JSC ASE will create a synergetic effect and will enable the increase in their competitiveness. As a whole, the Group of companies will get an excellent advantage in duplicating projects of nuclear power plant construction all over the world.

By the present, the joint order portfolio of the merged company includes about 30 nuclear power units and three power units of GRES, SNF and RAW treatment facilities. The forecasts relative to the dynamics of growth in the order portfolio are positive. Therefore, the Group of companies in prospective will become the world’s largest supplier of nuclear services that designs and constructs nuclear power plants on a turn-key basis, contributing significantly into the era of new energetics all over the world.

Valery I. Limarenko, Director of NIAEP, Management Company of JSC Atomstroyexport
DESCRIPTION OF KEY ACTIVITIES OF JSC ATOMSTROYEXPORT

Table 0.1.
KEY PARAMETERS INDICATING ACTIVITY IN 2009-2011

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of measurement</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Plants constructed within reporting period</td>
<td>Pcs.</td>
<td>10</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Number of employees (including freelancers)</td>
<td>persons</td>
<td>1446</td>
<td>1664</td>
<td>1590</td>
</tr>
</tbody>
</table>

SCHEDULE OF MILESTONES

Table 0.2.
MILESTONES

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-th February</td>
<td>JSC Atomstroyexport organized seminar in the Republic of Bulgaria to discuss execution of construction works at Belene NPP Site.</td>
</tr>
<tr>
<td>8-th February</td>
<td>Testing of integrity and density of the containment of Kudankulam NPP, Unit 1 finished successfully.</td>
</tr>
<tr>
<td>9-th February</td>
<td>Contract was signed between NNEGC Energoatom and JSC Atomstroyexport for construction of Unit 3 and 4, Khmelnitskiy Nuclear Power Plant.</td>
</tr>
<tr>
<td>15-th February</td>
<td>Official start of project on implementation of system for management of projects of JSC Atomstroyexport.</td>
</tr>
<tr>
<td>15-th March</td>
<td>Agreement was signed between the government of Russian Federation and the Republic of Belarus on cooperation in construction of two NPP Units, 1200 MW each at the territory of the Republic of Belarus.</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>20-th April</td>
<td>International Consortium MIR.1200 consisting of Skoda JS a.s., JSC Atomstroyexport and Development and Design Office Gidropress signed an Agreement on cooperation with the Academy of Mines under Ostrava Technical University.</td>
</tr>
<tr>
<td>20-th May</td>
<td>JSC ASE signed first contract with Turkish Contractor ENVY Energy and Environmental Investments Inc. in the framework of the project for construction of Akkuyu NPP.</td>
</tr>
<tr>
<td>24-th May</td>
<td>JSCASE and JNPC signed a contract for rendering services related to study of possibility to prolong inter-repair period of systems, equipment, primary and secondary circuit pipelines of Tianwan NPS. This is due to intention of the Chinese Side to extend the period of operation of Tianwan NPS from 12 to 18 months.</td>
</tr>
<tr>
<td>1-st June</td>
<td>Beginning of the stage, called power start-up of Bushehr NPP.</td>
</tr>
<tr>
<td>30-th June</td>
<td>JSC ASE submitted Technical Offer for construction of NPP in Jordan to the Customer–Nuclear Power Committee of Jordan (NPCJ).</td>
</tr>
<tr>
<td>15-th July</td>
<td>Grand ceremony, dedicated to commissioning of new 410 MW Combined Cycle Plant (HRSG-410) at Nevinnomyssk GRES.</td>
</tr>
<tr>
<td>12-th August</td>
<td>Grand opening of protective structures (KZS) in Saint-Petersburg (protection from flooding).</td>
</tr>
<tr>
<td>19-th August</td>
<td>General Contract between JSC ASE an JNPC for construction of Unit 3 &amp; 4, Tianwan NPS in China came into force.</td>
</tr>
<tr>
<td>3-rd September</td>
<td>Grand ceremony, dedicated to power start-up of Bushehr NPP in Islamic Republic of Iran.</td>
</tr>
<tr>
<td>6 –th September</td>
<td>Main stages of Hot operational testing at Kudankulam NPP Unit 1 were completed.</td>
</tr>
<tr>
<td>15-th September</td>
<td>JSC ASE together with leading companies at the world NPP construction market announced acceptance of key principles of work, considering modern international experience in export of nuclear power plants.</td>
</tr>
<tr>
<td>30-th September</td>
<td>JSC ASE and NEK (Bulgaria) signed Addendum 14 to the Contract for construction of Belene NPP, extending Contract validity period up to March 31, 2012.</td>
</tr>
<tr>
<td>30 -th September</td>
<td>Construction of fire fighting system of Shelter at Chernobyl NPP finished. The works were performed by the Consortium Shelter (JSC ASE-leader, JSC UkraineEnergoMontazh).</td>
</tr>
<tr>
<td>3-rd October</td>
<td>JSC Atomstroyexport branch in Turkey is included in trade register of legal entities of the Republic of Turkey.</td>
</tr>
<tr>
<td>11 –th October</td>
<td>JSC ASE and Direction for construction of Nuclear Power Plants (The Republic of Belarus) signed Contract Agreement for construction of Unit 1 and 2 in the Republic of Belarus.</td>
</tr>
<tr>
<td>2-nd November</td>
<td>Intergovernmental Agreement on cooperation in construction of Ruppur Nuclear Power Plant at the territory of People’s Republic of Bangladesh was signed.</td>
</tr>
<tr>
<td>7-th November</td>
<td>Valery Limarenko, Director of JSC NIAEP, was temporary appointed as President of JSC Atomstroyexport.</td>
</tr>
</tbody>
</table>
21-st November

In Hanoi (Socialistic Republic of Vietnam), an Intergovernmental Agreement on granting State Credit for construction of the first NPP in Vietnam was signed. This NPP shall be constructed based on Russian design. JSC Atomstroyexport is the General Contractor. Intergovernmental Agreement was signed for construction of Centre for Nuclear Science and Technology in Vietnam including installation of research reactor, research and development laboratory, equipment and infrastructure for ensuring safe functioning of this Centre. JSC Atomstroyexport is the General Contractor.

22-nd December

Sergey Kirienko, General Director of State Corporation Rosatom submitted State and industry-specific rewards to JSC ASE experts.

REWARDS

Table 0.3.
REWARDS GRANTED FOR THE REPORTING PERIOD

| Certificates: |
| Certificate Best Employer from SuperJob.ru portal |

Certificates obtained at Forums and Exhibitions:

| International Forum Fuel and Energy Companies of Ukraine: present and future, Kiev, Ukraine |
| International Forum and Exhibition Atomexpo-Belarus, Minsk, Belarus |
| 10-th International Exhibition EXPO Russia -Jordan, Amman, Jordan |
| International Forum Atomexpo 2011, Moscow, Russia |
| Exhibition and Conference Nuclear Power in India, Mumbai, India |
| 5-th International Forum and Exhibition Atomexpo-2011, Moscow, Russia |
| 11-th International Exhibition and Conference on power engineering and environment protection ICCI 2011, Istanbul, Turkey. |
| Exhibition with participation of companies, operating in nuclear field Atomex-Europe, Prague, Czech Republic |
| Central Forum and Exhibitions with participation of companies, operating in nuclear field Atomex 2011, Moscow, Russia |
DIPLOMA
ATOMSTROYLEXPORT, JSC
10th ANNIVERSARY EXHIBITION
EXPO-RUSSIA JORDAN
7-9 March 2011 Amman

SACRADOR
NAGI AL-KABARI
Chairman
Jordan Chamber of Commerce

DAVID VARTANOV
Chairman of Organizing Committee "Expo-Russia"


ДИПЛОМ
Атомэкспорт

Награждается

ЗА УЧАСТИЕ В ВЫСТАВКЕ
III МЕЖДУНАРОДНОГО ФОРУМА ПОСТАВЩИКОВ АТОМНОЙ ОТРАСЛИ
"АТОМЭКС-2011"

II МЕЖДУНАРОДНЫЙ ФОРУМ ПОСТАВЩИКОВ АТОМНОЙ ОТРАСЛИ
"АТОМЭКС-2011"
6-8 декабря 2011 года • Москва, Центр Международной Торговли

INDIA NUCLEAR ENERGY 2011
Energy Security for the Future...

29 Sep. - 1 Oct. 2011, BEC, Mumbai

ATOMSTROYLEXPORT JSC
We gratefully acknowledge your participation at India Nuclear Energy and T&D India 2011
2. Providing Safe NPP Construction

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2. Providing Safe NPP Construction

The compliance of JSC ASE activity with the highest international requirements and standards of nuclear, radiation and environmental safety is ensured due to:

- availability of integrated management system;
- compliance of the projects with the requirements of IAEA, EUR, WENRA and foreign customers on NPP safety and safety of other engineering facilities;
- evolution development of NPP projects with VVER type reactors;
- analysis of the stability of NPPs which have been built and are being built abroad in accordance with the Russian VVER NPP designs.

2.1. Integrated Management System

The decision about the establishment of the integrated management system (IMS) was taken in 2008. Legal and normative requirements valid in the nuclear industry were taken into account during its development. Thus, the IMS constitutes a single framework for the implementation of organizational measures and processes of various aspects of JSC Atomstroyexport, including safety, health, environmental protection, personnel protection, quality and economic aspects.

The integrated management system includes:

- Quality management system (refer to Section 4.2 “Quality management”);
- Environmental management system (refer to Section 4.7 “Environmental impact”);
- Labor safety management system (refer to Section 4.1.2 “Personnel management”).


The IMS embraces not only the Company, but also its customers, suppliers and contractors in order to ensure the highest possible level of safety during the construction of NPPs and other engineering facilities (refer to Section 4.2. “Quality management”).

To ensure the functioning and improvement of the IMS, 18 internal system audits, 29 evaluation audits and 13 scheduled audits of the suppliers were carried out in 2011.
In 2011 the Company successfully completed the second supervision audit of the IMS. The results of the supervision audit carried out by the certification organ “Bureau Veritas Certification” confirm that the integrated management system applied during the construction, reconstruction and modernization of nuclear power plants, nuclear facilities, heat and power engineering facilities, hydro-protective facilities, civil and erection works, commissioning works, commissioning, warranty operation, foreign customer’s personnel training and the necessary export and import operations, has been implemented and is operating successfully. The auditors have pointed out that the IMS strong points are the JSC ASE management leadership, experience in the implementation of projects, introduction and use of process automatic control systems and allocation of financial resources for labor safety measures, protection of environment, comprehensive approach for the confirmation of competence of the employed personnel, planning and organization of the works related to personnel qualification enhancement. Among the strong points mentioned by the auditors are the well-developed IMS documentation, monitoring by ASE of the markets and the civil and erection works completed by subcontractors. The auditors also pointed out that the IMS, which was developed taking into account the recommendation of the latest IAEA documents, successfully resolves the tasks facing the nuclear industry. The validity of IMS certification has been confirmed up to 2012.

In January 2012 JSC Slovenske Elektrarne successfully completed an audit of JSC ASE with the purpose of confirming the accreditation of JSC ASE in the list of suppliers. The auditors pointed out that the results of the completed audit make it possible to prolong the accreditation of the Company with the highest rating. Among the strong points the auditors mentioned the well documented system and pointed out that compared to the previous audit by JSC Slovenske Elektrarne in 2008 the amount of the developed normative documents had increased by over 5%.

In accordance with the decision of the Company management, a re-certification audit of the IMS group of companies is planned in May 2012 (JSC ASE, the Moscow branch of JSC NIAEP and the Moscow representative office of JSC NIAEP) on the basis of the IMS valid in JSC ASE complying with the requirements of international standards ISO 9001:2008, 14001:2004 and OHSAS 18001:2007.

2.2. Compliance Of Designs With The Requirements Of IAEA, EUR, WENRA And Foreign Customers

NPP of the Russian design constructed by JSC ASE comply with the requirements of international organizations and specific foreign customers, namely:
- they are stable against internal and external impacts (plane crush, explosion, tornado, etc.);
- they have the necessary resources to withstand the loads during safe shutdown earthquakes with magnitude over 8;
- they provide effective protection from common cause failures due to the accepted approach envisaging reservation and variability;
- they are stable against complete blackout due to passive safety system in each fundamental safety function.
2.2. Compliance Of Designs With The Requirements Of IAEA, EUR, WENRA And Foreign Customers

Table 2.2.1.
LEVELS OF IMPACT AGAINST WHICH THE NPPS ARE STABLE

<table>
<thead>
<tr>
<th>Impact Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock wave</td>
<td>Front pressure 30 KPa</td>
</tr>
<tr>
<td>Plane crash</td>
<td>Weighing 400 tons, speed 200</td>
</tr>
<tr>
<td>Snow and ice load</td>
<td>Peak (extreme) snow load accepted in the design is 4.1 kPa</td>
</tr>
<tr>
<td>Tornados</td>
<td>Wind design velocity 5 m/s</td>
</tr>
<tr>
<td>Floods</td>
<td>Probability level &gt;0.01</td>
</tr>
<tr>
<td>Seismic impacts</td>
<td>SSE – magnitude 8 according to MSK-64</td>
</tr>
</tbody>
</table>

2.3. ASE Design Development With VVER Type Reactors

Table 2.3.1.
COMPARATIVE PROPERTIES OF THE MAIN PROJECTS WHERE NPPS ARE BUILT

<table>
<thead>
<tr>
<th>NPP - 91</th>
<th>NPP-92</th>
<th>NPP-2006</th>
<th>NPP VVER TOI</th>
<th>AP-1000 (Westinghouse)</th>
<th>EPR-1600 (Areva)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implemented at TNPS in China units 1 and 2</td>
<td>Being implemented at stage 1 of Kudankulam NPP</td>
<td>Negotiations about implementation in Belorussia are being held</td>
<td>Nizhny Novgorod NPP is being designed</td>
<td>Being implemented in China</td>
<td>Being implemented in France, Finland, China</td>
</tr>
<tr>
<td>NPP - 91</td>
<td>NPP-92</td>
<td>NPP-2006</td>
<td>NPP VVER TOI</td>
<td>AP-1000 (Westinghouse)</td>
<td>EPR-1600 (Areva)</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>----------</td>
<td>--------------</td>
<td>-------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>4 safety channels</td>
<td>4 safety channels, active + passive safety systems</td>
<td>2 channels of active safety devices with internal control</td>
<td>2 channels of active safety devices with internal control</td>
<td>Passive safety systems</td>
<td>4 safety channels, 2 channels of heat removal</td>
</tr>
<tr>
<td>Melt localization device</td>
<td>Melt localization device</td>
<td>Melt localization device</td>
<td>Melt localization device</td>
<td>Interaction of the core melt with concrete is excluded due to its retention in the reactor vessel, the reactor is flooded with water from outside to cool the vessel</td>
<td>No data</td>
</tr>
<tr>
<td>Double containment</td>
<td>Double containment with the passive system of ventilation and filtration in the annulus, passive system of hydrogen removal</td>
<td>Double containment with ventilated clearance</td>
<td>Double containment with ventilated clearance</td>
<td>Steel containment and external concrete containment with ventilation channel meant for access of air from the environment to steel containment for cooling</td>
<td>Cylindrical pre-stressed containment with metal coating and external reinforced concrete containment</td>
</tr>
<tr>
<td>Life of the main equipment up to 50 years</td>
<td>Life of the main equipment up to 60 years</td>
<td>Life of the main equipment up to 60 years</td>
<td>Life of the main equipment up to 60 years</td>
<td>No data</td>
<td>Life of the main equipment up to 60 years</td>
</tr>
<tr>
<td>Independence from external power supply 24 hours</td>
<td>Independence from external power supply 24 hours</td>
<td>Independence from external power supply 72 hours</td>
<td>Independence from external power supply 72 hours</td>
<td>Independence from external power supply 72 hours</td>
<td>No data</td>
</tr>
</tbody>
</table>
2.3.1. “NPP-91” CONCEPT

Concept “NPP-91” is evolutionary development of standard NPP with VVER-1000 type reactor. Back in 1977 the development of new NPP design was started together with the Company’s partners and contractors – JSC SPbAEP, JSC OKB Gidropress and Finnish Company Imatran Voima International Ltd (currently – Fortum Engineering Ltd). The prototype was the design with serial VVER-100 type reactor (B-320). As a result, reactor design VVER-000 (B-428) was created, under which two power units of Tianwan NPS (TNPS) have been constructed in China.

RUSSIA’S EXPERIENCE OF NPP CONSTRUCTION IN SEISMIC REGIONS

The Russian nuclear industry has advanced technologies of seismic protection of industrial facilities, including construction of seismically isolated foundations and floors in buildings. Many factors are taken into account during the selection of the site: seismic properties, water reservoirs, possible tsunami wave height, wind direction, plane corridors, proximity of gas pipelines and dangerous industrial facilities and residential towns. Plant designs developed by Soviet specialists for Cuba and Libya were intended for safety shutdown earthquakes whose probability is 1/10000 years with the magnitude up to 9 according to MSK-64 scale.

The TNPS project achieved significant enhancement of safety and improvement of technical and economic parameters in the NPP design with VVER-1000 reactor (B-428) compared to the serial design, due to the following:

- improvement of nuclear-physical properties of the core;
- supplementing the principle “defense in depth” with new elements, including the use of double containment of the reactor compartment;
- ensuring guaranteed negative values of the reactivity coefficients;
- use of 4-channel principle of safety systems reservation;
- use of new systems of control and diagnosis of equipment;
- introduction, for the first time in the world nuclear industry, of device for the localization of the core melt – “core catcher”;
- digital I&C systems;
- reduced number of pumps, valves, etc.
- increased seismic stability.
SAFETY SYSTEMS OF TIANWAN NPS

The function of heat removal from the containment is performed by the containment sprinkler system. The efficiency of the system makes it possible to ensure that the normative values for the exhausts and contents of radioactive substances in the environment will not be exceeded during design basis accidents.

The emergency core cooling system is designed for cooling the reactor core during loss of coolant accidents, it consists of:

- emergency high pressure sprinkler system;
- emergency core cooling system, passive part;
- emergency low pressure sprinkler system;
- emergency boron injection system.

- Residual heat removal system removes residual heat emissions and cools the reactor during normal operational plant shutdowns, violation of normal operation and accidents.
- The system of emergency feed water is designed for supplying water to the steam generator during violation of normal operation and design basis accidents when the water supply from the main and the auxiliary system is impossible.
- Overpressure protection system is designed for the protection of the primary circuit and steam generators from overpressure by means of protective valves of pressure compensator and steam generators.
- Emergency gas removal system is designed for the removal of steam-gas medium from the primary circuit during accidents related to the exposure of the reactor core and occurrence of steam zirconium reaction, as well as drop of pressure in the primary circuit.
- Reliable power supply system.
- Intermediate cooling circuit ensures the cooling of reactor plant equipment, its auxiliary systems and safety systems in normal operational conditions, violation of normal operation and during design basis accidents. The system provides a barrier between auxiliary systems containing radioactivity and the system of process water for essential loads.
- The system of process water for essential loads removes heat from the system of essential loads cooling and transfers it to the ultimate heat sink in all NPP operational modes.
- Filtering safety systems – systems of localization of radioactive substances which can be emitted into the environment of process rooms during expected deviations from normal operation and accidents, are included in the design, with the purpose of reducing emergency exhausts into the environment and uncontrolled proliferation throughout the power plant.
- Melt localization device.
- Other systems ensuring NPP safe operation.

MELT LOCALIZATION DEVICE (“CORE CATCHER”) IS A NEW EPOCH IN THE SAFETY OF NUCLEAR REACTORS

The device for keeping the melt in the concrete cavity of the reactor vessel was implemented for the first time in the world by Russian nuclear specialists at Tianwan NPS. It provides protection of the foundation plate of the reactor building from melting through during severe accidents with the destruction of the core and the reactor vessel and it retains the melt and solid fragments of the
destroyed core, the reactor vessel parts and reactor internals. The melt is localized and cooled within the sub-reactor room of the concrete cavity for an indefinite time. The protection of the foundation plate and the concrete reactor cavity walls is carried out by water cooled heat exchangers. The catcher significantly enhances the safety of the facility in case of hydrogen emissions. The catcher design has successfully undergone expertise by Russian and Chinese authorities, it was approved by Finnish experts from Fortum Engineering and by a special IAEA commission.

2.3.2. BUSHEHR NPP (ISLAMIC REPUBLIC OF IRAN)

The unique properties of Bushehr NPP project (please refer to section 4.3) determines its special place in the evolution of ASE projects with VVER. Bushehr NPP is the first Russian project with four safety channels and additional hydroaccumulators of the emergency core cooling system for beyond design basis accidents.

2.3.3. “NPP-92” CONCEPT

The project is fully compliant with the requirements of modern normative and technical documents of the Russian Federation, IAEA, it has been certified in terms of its compliance with the European Utility Requirements (EUR) applied to NPP constructed after 2000. The project uses new reactor plants B-412 (Kudankulam NPP in India) and B-466 (Belene NPP in Bulgaria).

The main design peculiarities are as follows:
- modernized reactor plant VVER-1000 with enhanced safety level due to the use of combined safety systems with active and passive channels;
- principle of defense in depth – the system of four barriers against the emission of ionizing radiation and radioactive substances into the environment, five levels of technical and organization measures for the protection of these barriers and their efficiency prevents accidents and ensures the management of beyond design basis accidents localizing radioactivity inside the containment;
- high availability of systems of diagnosis which allow the operational and repair personnel of the plant reacting in advance to symptoms of equipment deviation from normal operation;
- ensuring protection from inter-site impacts (fire, flood, steam and water streams, flying objects, rupture of pipelines in the NPP rooms);
- ensuring protection from external impacts of natural and industrial character typical for the NPP site (earthquake, tornado, high and low temperature, shock wave with front pressure up to 30 kPa, accidents of air, land and water transport).
Different principles of systems and elements used for the performance of the main safety function totally excludes the possibility of default of safety functions due to common cause failures which are the main contributors to the probability of severe accidents at NPP units with VVER and significantly reduce the probability of human factor in these accidents.

The following aims have been achieved:
- low sensitivity to power cuts;
- it is not necessary to urgently evacuate the population during accidents;
- it is possible to trace the load and to maneuver;
- new level of safety culture at all the stages of the plant life from foundation laying to decommissioning.

**SAFETY SYSTEMS OF KUDANKULAM NPP (REPUBLIC OF INDIA)**

The peculiarity of the project is the implementation, apart from traditional active safety systems, of a number of technical solutions based on “passive” principles which in accordance with the accepted criterion bring the project close to the fourth generation projects in
terms of its nuclear safety. Double localizing and protective containment, passive heat removal system from the reactor plant, core catcher, passive high pressure boron injection system, additional accumulators providing passive long-time supply of borated water to the reactor, the system of annulus passive filtration, closed scoop of technical water intake for the NPP which is in fact a breakthrough – all these properties provide an unprecedented design level of nuclear and environmental safety of the constructed NPP. The core damage frequency in Kudankulam NPP project is $6.99 \times 10^{-08}$ which is significantly less than the target value of $1.0 \times 10^{-05}$ in accordance with the requirements of the Russian and international safety standards.

SAFETY SYSTEMS OF BELENE NPP (REPUBLIC OF BULGARIA)

Belene NPP design is characterized by a unique combination of active and passive safety systems which ensure a higher level of NPP protection compared to the one implemented in the world projects. It ensures higher technical and economic parameters due to reduction of idle periods, increase of the life of main equipment up to 60 years and increase of the load factor up to 90%.

The main peculiarities of the project:
- The impact of a large commercial plane crush weighing up to 400 tons on the containment has been taken into account;
- It has been suggested to use advanced referential technologies of solid and liquid radioactive waste treatment using plasma furnace and to use double-purpose transportation and packing container developed by GNS, modified for Belene NPP fuel;  
  - It has been planned to modernize the melt localization device considering the nuclear fuel of Belene NPP and increased seismic stability;
  - Maximal acceleration 0.334g has been taken into account (under the 12 score MSK-64 scale it corresponds to 8-9);
- Storage concept of spent nuclear fuel up to 60 years has been developed.
- A peculiarity of Belene NPP project is multi-lateral analysis and a wide expertise of the design, including:
2.3.4. “NPP-2006” CONCEPT

The project enjoys the advantages of all the previous projects, it complies with the requirements of the normative documents of RF, recommendations of IAEA and has been certified by European Utility Requirements (EUR).

The design envisages active and passive safety systems, it uses an improved reactor control and protection system, the number of regulating elements of the control and protection system has been increased up to 121, it has a modern system of control and diagnosis of reactor plant. The safety systems consist of four fully independent channels. The safety channels are separated from each other by fireproof physical barriers along the whole border of the channel, including communications between the buildings. No direct connections between different safety channels are admitted. Physical protection of the safety channels from unauthorized personnel access is envisaged. The design envisages engineering measures of severe beyond design basis accidents management, and the plant’s independence from power supply sources is provided for 72 hours.

Environmental factors had priority importance during the development of the design. The reactor life is up to 60 years with the possibility of its extension and capital repairs once in every 8–10 years.

Concept “NPP-2006” is applied in NPP in the Republic of Belarus and in the design suggested for the completion of Temelin NPP in the Check Republic. The designs comply with the specific requirements of the customer, including those to seismic protection and process automatic control system.

2.3.5. VVER-TOI CONCEPT

JSC ASE, jointly with JSC Rosenergoatom Concern, are co-customers for the development of the evolutionary design VVER-TOI. General designer is JSC Atomenergoproekt (Moscow).

Technical issues during the development of VVER-TOI design have been reviewed in the reported year, including the safety issues.

In December 2012 VVER-TOI design will be ready for certification by IAEA and EUR.
Due to the accident at Fukushima-1 NPP (Japan) in March 2011 and growing concern about NPP safety, JSC ASE has organized work related to additional assessment of safety of the constructed NPPs and NPPs under construction. The completed analyses have shown that modern Russian NPP projects already have a potential which makes it possible for them to comply with international or national requirements to safety in case of making the latter more stringent.

STRESS-TEST AND PARTNER’S AUDIT OF TIANWAN NPS (PEOPLE’S REPUBLIC OF CHINA)

STRESS-TEST

The Chinese leadership promptly reacted to the tragic events in Japan. Council of State of People’s Republic of China has taken a decision to suspend issuing licenses for the construction of new nuclear power plants and to have a comprehensive audit of all the power plants under construction and operational, in terms of their safety. In mid April 2011 an inspection group was established which included representatives of National Nuclear Safety Administration and Seismological Bureau of China which started the inspection of safety of all the power plants in the country which are under construction and operation.

The main parameters of the stress-test

On 4-6 May 2011 the state comprehensive inspection of nuclear safety, the group of comprehensive inspection of civil nuclear facilities safety with the experts from NNSA, Department of State Power and State Seismological Bureau visited the Tianwan NPS site.

Among other things, they evaluated the input data and possibilities for the protection of the nuclear facility against flood, evaluated the input data in case of earthquake and the nuclear facility seismic stability, inspected the fire extinguishing system of the nuclear plant, analyzed and evaluated an accident with complete power cut-off, efficiency of the system of radiation monitoring and emergency response system.

Proposals and measures carried out upon the results of the stress-test

According to the conclusions of the state commission, the plant’s own safety, the modern level of design and operation at units 1 and 2 of Tianwan NPS are the most advanced among the nuclear power plants in China. The power plant
corresponds to all the requirements of the current norms and standards of nuclear safety and IEAE guides.

In 2011 four correcting measures were taken, among them inspections of the doors, windows, ventilation channels, cable penetrations and process pipelines channels in terms of their tightness, an anti-accident plan for the protection against flood was developed, including measures to protect important buildings from flooding.

TECHNICAL SUPPORT MISSIONS CARRIED OUT AT TIANWAN NPS

On 10–12 May 2011 the Moscow WANO center, jointly with the Paris Centre and the London WANO Coordination Center, under request of Tianwan NPS, held a technical support mission related to “Supervision over the execution of activities”. The purpose of the mission was to teach the Tianwan NPS personnel methodology of supervision over the execution of works. In the course of the mission the participants discussed the following issues: standards and expectation, culture of trust in the company, personnel behavior, monitoring and training, delegation, analysis and trends.

On 14–18 November 2011 the WANO Moscow Center carried out a technical support mission at Tianwan NPS related to the operation of the core components and regulating elements drives at Tianwan NPS and that of NPPs in Russia, Ukraine and Bulgaria.

During the four years of operation of Tianwan NPS, the design stationary parameters of the fuel cycle have been achieved. Experts of NPP submitted information about the operation of regulating elements drives of the control and protection system, the observed changes of the fuel parameters during the extension of its operation in the core. The Chinese experts intend to transfer the operation of the power units into the mode of 18-month fuel cycle and to increase the electric power of each unit up to 110%. The joint analysis of the submitted information made it possible to evaluate the actual condition of the fuel and the system of regulating elements of the control and protection system, to determine the measures which should be carried out to successfully reach the identified aims. The recommendations of the experts have been submitted to Tianwan NPS as part of the final report on the technical support mission.

STRESS-TEST AND PARTNER’S AUDIT OF BUSHEHR NPP (ISLAMIC REPUBLIC OF IRAN)

STRESS-TEST

Main parameters of the stress-test

In the course of the comprehensive inspection of the power plant its seismic stability, conditions of NPP location, hydrogen explosion protection, radiation safety, consequences of beyond design basis accidents were analyzed.

Proposals and measures held upon the results of the stress-test

“Report on analysis of NPP Bushehr safety during extreme external impacts” has been developed. On the basis of the “Report” a “List of measures on Bushehr NPP project” was developed taking into account the events at Fukushima NPP. A program of anti-accident training of Bushehr NPP personnel was developed for the scenario of complete power cut of the power plant like at the Fukushima NPP.
PARTNER’S AUDIT AND TECHNICAL SUPPORT MISSION AT BUSHEHR NPP

On 10–23 November 2011 the international team of WANO experts including representatives of France, Belgium, Ukraine, Russia, Armenia, Hungary (the Paris and the Moscow WANO centre) held a pre-commissioning inspection of Bushehr NPP. The team was headed by Jean-Marie Badgio (WANO Coordination Centre in London). The purpose of the inspection was to compare the level of the power plant operation with the WANO standards by means of a profound analysis of the main industrial aims (organization of the works, administration, management, repair, engineering support, personnel training, fire safety, emergency preparedness, etc.).

In accordance with the conclusions of WANO, Bushehr NPP has done profound work in terms of the organization and management of NPP activities in order to bring its condition in compliance with the project requirements; operational procedures have been developed, as well as schedules of work completion and inspections, routes and forms of inspection of important valves have been developed in order to improve the quality of operation. The WANO experts have identified some areas for improvement of industrial activity where organizational and technical corrective measures are being currently implemented.

On 28 - 30 November the Moscow WANO centre carried out a technical support mission on “Chemical and metal corrosion of equipment and pipelines in the tropical conditions climate, methods of maintenance and corrosion fight”.

Upon the results of the NPP visit and the submitted information, the experts, jointly with NPP specialists, have prepared recommendations on pipelines metal and equipment control which will be considered in the course of further operation of Bushehr NPP.

STRESS-TEST AND PARTNER’S AUDIT OF KUDANKULAM NPP (REPUBLIC OF INDIA)

STRESS-TEST

Main parameters of the stress-test

The approach used during the consideration of possible accident scenarios envisaged a combination of several additional initial events of beyond design basis accidents. The considered initial events included those which are the consequences of extreme external impacts accompanied by complete failure of all the alternative power sources (NPP power cut-off with failure of all design diesel-generator units) and/or loss of final heat sink for emergency heat removal from the reactor core and cooling of safety system equipment). Among the extreme external impacts are earthquakes, tsunamis, floods, fires and other natural and industrial impacts.
The following main safety functions were analyzed: reactor emergency shutdown and its retention in sub-critical condition, emergency heat removal from the reactor, emergency heat removal from fuel pond, maintaining radioactive substances within the established limits (ensuring the integrity of the containment).

Proposals and measures taken upon the results of the stress-test

The design bases of overcoming the beyond design basis accidents were confirmed upon the results of the analysis, the customer was offered measures of Kudankulam NPP safety enhancement for beyond design events. The customer completed the analysis and prepared proposals on different ways of safety enhancement, including the following: ensuring the possibility of water supply from alternative sources located outside the reactor building (apart from those which are envisaged in the design), use of mobile pumping equipment and alternative sources of power supply for the pumping equipment, etc. Currently the customer is developing specific decisions on technical issues and the timeframe of the implementation of the above mentioned proposals.

PRE-COMMISSIONING PARTNER’S AUDIT AT KUDANKULAM NPP

On 3–16 September 2011 a pre-commissioning inspection of the first power unit of Kudankulam NPP was held. The purpose of the inspection was to evaluate the plant’s readiness for a safe commissioning and operation of the new power unit.

The partner’s inspection team included 14 experts from 8 countries representing three regional WANO centers and WANO coordination center in London.

At the final meeting the experts submitted to the power plant management areas for improvement identified in the course of the inspection.

STRESS-TEST OF BELENE NPP (REPUBLIC OF BULGARIA)

JSC ASE, Natsionalna Elektricheska Kompania (NEK) and Architect-Engineer – international company Worley Parsons have prepared report “Stress-tests of European NPPs after the events at Fukushima”. This is a unique assessment of an NPP safety as it represents a stress-test of a design and not of an operating plant. It was carried out upon request of the Bulgarian side. The basis of the report preparation were Technical Design, Intermediate Safety Analysis Report (ISAR), Probability Safety Analysis (PSA) of Belene NPP in terms of the plant stability against natural external impacts. Requirements of “Assignment for stress-tests” prepared on the basis of proposals of WENRA were taken into account during the preparation of the report.

The report analyzed the sources of external floods, assessed extreme design water levels and possible consequences for the NPP, considered protective measures against external impacts. It also studied the consequences of loss of NPP safety function during such possible events as loss of external power supply, loss of ultimate heat sink, severe accidents.

Analysis of the results of additional assessment of Belene NPP safety confirmed the reliability of the design solutions in terms of ensuring safety at the highest level. Belene NPP design envisages safety systems whose automatic work is aimed at sustaining or restoration of safety critical functions in the conditions of beyond design basis accidents. The joint report on stress-test of Belene NPP was submitted to the Nuclear Regulatory Agency (NRA).