DIGEST special edition

ATOMPROM

Information and Technology Magazine of Nuclear Industry

atomexpo 2009

Event of the month

Government supported ROSATOM

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Uranium rally

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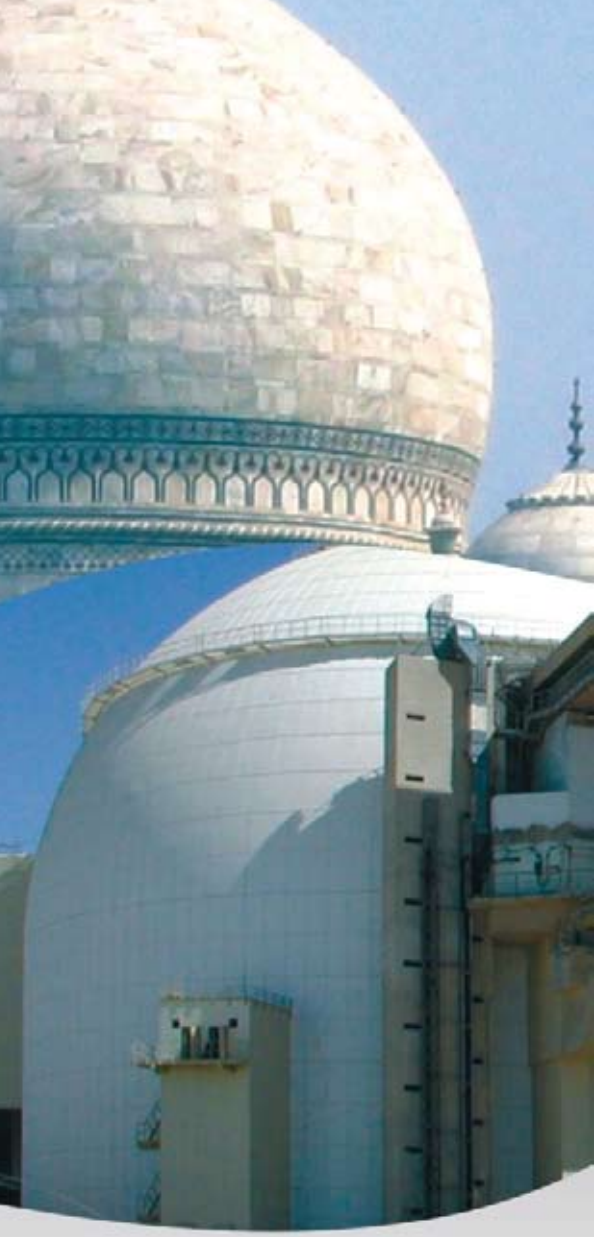

ATOMEXPO 2010

International Forum

08-10 June 2009
Russia • Moscow • Expocentre

Organizer
State Atomic Energy Corporation ROSATOM

ROSATOM

Operator
Information and Exhibition Center of Nuclear Industry (JSC «Atomexpo»)

ATOMEXPO

Business program:

- International Congress on Nuclear Energy
- International Exhibition ATOMEXPO 2010

Exhibition sections:

- Construction of NPPs
- Nuclear power plants, safe operation
- Decommissioning of nuclear facilities
- Small and medium capacity nuclear energy
- Nuclear science, innovative projects
- Nanotechnologies and nanomaterials for nuclear power
- Nuclear fuel cycle: uranium mining and enrichment, nuclear power structural materials, nuclear fuel fabrication
- Radioactive waste management
- Nuclear machine engineering
- Power machine engineering. Electrical equipment
- Instruments and equipment for nuclear power
- Nuclear medicine. Radioisotopes
- Information and communications technologies in nuclear power
- Engineering and management of NPP construction projects
- Training of staff for nuclear power, advanced training
- Environmental protection
- Public information
- Atomic energy risks insurance

atomexpo

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Dear Colleagues,

It is well known that limited resources of hydrocarbons worldwide and the growth of electricity consumption have provoked an almost speculative demand for nuclear power technologies in recent years. This phenomenon, known as the «nuclear renaissance,» has been observed all over the world – in countries both traditionally and non-traditionally nuclear power oriented.

The world financial crisis has propelled the issues of expediency, economy and shared use of available resources to the foreground. It is clear now that the further implementation of national nuclear power development programs is possible only through broad international cooperation.

Given the necessity to solve global challenges in nuclear power development with limited resources, the best practices accumulated through the implementation of joint projects should be employed and the best achievements of each should be made use of reciprocally.

This is why we have decided to organize the International Congress and Exhibition «ATOMEXPO-2009,» an international forum for working out effective cooperation strategies, discussing experiences in joint projects and implementing nonstandard business solutions

Sergey Kiriyenko,
Director General,
State Nuclear Energy Corporation «Rosatom»

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officialevent

06 **Government supported ROSATOM.**

On 15 April Russia's Prime Minister Vladimir Putin held an extended session at the Kalinin nuclear power plant (NPP) dealing with nuclear power development plans.
In his opening remarks he confirmed that the earlier set targets remain in force in spite of the crisis.

nowadaystechnology

14 **Siberian Cuisine to a French Recipe**

In 2009 Russia for starts to convert depleted uranium hexafluoride (DUH) on a commercial scale the first time.
Zelenogorsk-based Electrochemical Plant (ECP) has been doing start-up and commissioning of the W-ECP facility, which is unique to the Russian nuclear industry.
It is capable of converting chemically toxic depleted uranium hexafluoride into uranium oxide, a form safe for long-term storage.

rosatomassets

19 **Rosatom gains in «Inter RAO»**

The Russian united electricity export-import operator JSC Inter RAO UES has become part of the state-owned corporation Rosatom. On 11 November the head of Rosimushchestvo, Yuri Petrov, signed a directive to transfer the state's 42.48% share in the company to Rosatom as a state property contribution. 14.8% of the company's shares are already owned by Concern Energoatom.
Inter RAO operates in 15 countries around the world and owns about 8 GW in power generation assets (the total power capacity of all Russian nuclear power plants combined is over 23 GW). The company aims to raise its capacity to 30 GW by 2015 through power plant construction and foreign asset acquisitions.
In the coming years, it also plans to expand geographically to other continents such as Latin America.

topicalissue

22 **Cooking «uncaught» Ignalina**

The protracted negotiations between the Baltic States and Lithuania's awkward moves to retain energy leadership in the region make more apparent the doom mark on the Ignalina II project (or Visaginas NPP, as it is also called). This makes Kaliningrad Region, the would-be host of Baltic NPP, the regional energy leader.

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An interview with Vyacheslav Ruksha, Director General of Atomflot and «Person of the Russian Nuclear Industry, 2008».

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40 | **Russia regained European fuel market**

JSC MSZ, a part of TVEL Corporation, is accustomed to visits from foreign delegations. However, the delegation that visited the plant on 17 November 2008 was a special one, indeed. Elektrostal Town in the Moscow Region received top managers from Slovakia's Slovenské Elektrárne, a.s. who came to sign a contract with JSC TVEL for nuclear fuel supplies to Slovak nuclear power plants.

buildingabroad

44 | **IRAN'S nuclear pearl**

First, we see a hot desert, nearly barren, nearly lifeless. Bushehr city and seaport are left behind. Then, the dull landscape alters, and we notice rare fishing villages. The Gulf strand can barely be seen far on the horizon. On the surrounding hills, some half-hidden and some in clear view, are antiaircraft guns and radars. They appear to grow in number as we approach our destination. In this desert the abundance of military gear confirms the significance Iran attaches to its first nuclear power plant, Bushehr.

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ourcoverage

36 | **Here comes, «Kudankulam»!**

Kudankulam nuclear power plant in Southern India has started the commissioning stage. This power generation project, which is of great importance to both Russia and India, employs the most advanced Russian nuclear technologies and takes account of the climatic conditions of the location of where it will operate. The plant can be rightfully called unique, as I discovered during a recent visit.

Government supported ROSATOM

Still, it's early to relax

On 15 April Russia's Prime Minister Vladimir Putin held an extended session at the Kalinin nuclear power plant (NPP) dealing with nuclear power development plans. In his opening remarks he confirmed that the earlier set targets remain in force in spite of the crisis.

V. Putin: Today, we are reviewing issues of nuclear power development. Rather ambitious but still realistic tasks have been set up in this area; specifically, by 2030 the nuclear generation share of the total electricity production should be 25-30%. Today, I remind you, we have 16%. I remind you also that in many European countries this share is more than 25-30%. Already now! In this sense, we even have to catch up with the developed industrial countries. I repeat, the plans are not easy; they are tight but quite realistic. Certainly, taking account of our situation, their implementation requires a special attention on our part, and it is clear that we have to be keen on assessing ways of solving this task within the conditions of the world financial and economic crisis. There are no little things; what is necessary is adequate financial support, parallel and timely development of the grid infrastructure; many other issues should be solved, which are important in spite of their scale or no scale at all.

Whatever happens, we must meet the task. It means that to increase the nuclear generation share up to 25-30%, we have to build 26 nuclear reactors. Let's discuss how we are to do this. Sergey Vladilenovich, please, the floor is yours.

S. Kiriyenko: Dear Vladimir Vladimirovich, first, let me inform you on the industry's 2008 results. It was a record year in terms of electricity generation - 162.3 billion kWh. There has been no such production in the entire history of the country, neither in soviet times nor modern Russia. The important thing is that it was achieved without new generation capacities being put on line. In other words, with the efficient use of existing NPPs only. In addition, last year the plants demonstrated a high capacity factor of 79.5%. Gross revenues of the industry's companies were up by 40% and the growth in tax payments to budgets of all tiers was 13%.

Certainly, in Q1 2009 we had some reduction in electricity production due to the decrease of general electricity consumption. Though we had a much better situation in March and we hope to meet the planned target of the Federal Tariff Service in the next months.

The most important thing for us is safety. The record production of 2008 was achieved with the absolute priority set on meeting all safety guidelines and

requirements. There are also improvements; in 2008 there were 38 reportable operational events at NPPs, though not a single one was safety significant. I would note that since 2003 we have had not a single significant safety incident. While as you see on the chart, permissible doses to the personnel are tending to zero. Thus, I can state that there are no cases of overexposure of the personnel at Russian nuclear power plants.

The Prime Minister decided to illustrate the safety level of Russian NPPs using a simpler example:

V. Putin: Did you scuba dive here?

S. Kiriyenko: Yes, I did, Vladimir Vladimirovich, with the Governor.

V. Putin: When?

S. Kiriyenko: Two years ago. A lot of fish.

V. Putin: Did you eat it?

S. Kiriyenko: Yes, we did. Right here, on the bank. My suggestion.

Must build the right thing

S. Kiriyenko: When building nuclear power plants on sites we start gathering construction contractors who, regretfully, have occupational safety problems. In this regard, we have started putting rigid requirements in our contracts; when contracted, even for earthwork, you are subject to the same requirements as others. However, it's clear that our partners are not so well prepared to meet these requirements; they haven't built anything of such scope for a long time.

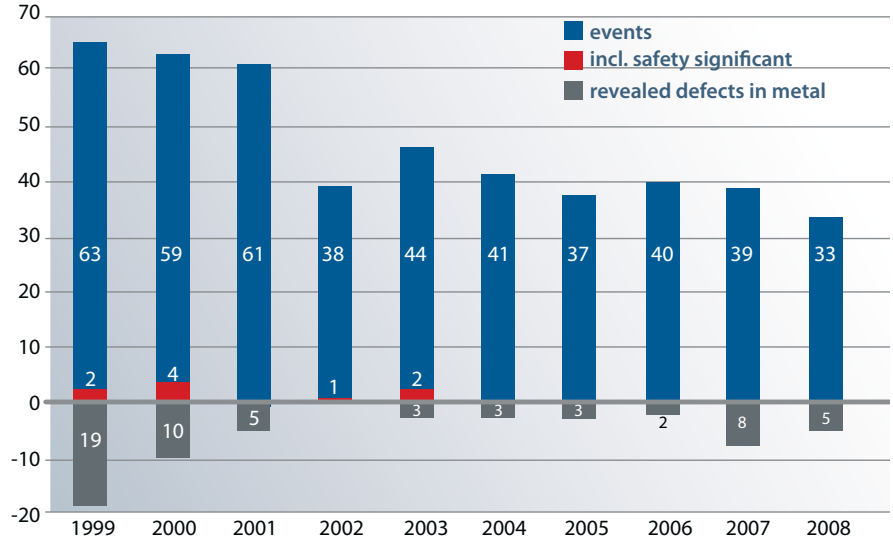
Now, what are the priority construction sites? Our top priorities are Rostov-2 with the commissioning set for 2009 and Kalinin-4, which is slated to be put on line in 2011. In addition, as instructed by the Government, we have worked out proposals for updating our plans. We think some reactors can be moved to later dates because there are no projected demands, but, conversely, some reactors may be planned to commission earlier. The acceleration of putting reactors on line is certainly possible if our colleagues at System Operator, Marker Council and the Ministry of Energy deem it possible. We understand well that we must build where it is necessary rather than where we'd like.

Now, about the sites in more detail. This year we will commission the second reactor of the Rostov NPP. I say it with a reservation. The construction has been completed; we have inspected old equipment and now we are turning it on. But there is always a risk associated with the fact that additional time might need to re-check it in the interests of safety. However, we are on schedule at this facility, we have caught up with it. Our estimates show that if we manage to build the third and fourth reactors one and two years earlier, respectively, we'll get a serious gain in terms of economics.

V. Putin: In other words, they are ahead of schedule at Rostov? ↦

SAFETY

Operating events at NPPs



S. Kiriyenko: We can do this with the 3rd and 4th reactors. And the civil works have been completed there. We've just caught up. Earlier, they were about a year and a half behind.

V. Putin: I remember.

S. Kiriyenko: Now, there are 5,000 people working at the site and, frankly speaking, if these works are stopped for a year and a half after the facility commissioning, while keeping the planned commissioning dates of two subsequent reactors, 2014 and 2016, we will need to transfer people somewhere for this period; either here to the Kalinin site or to other sites. Problems with families will arise, with infrastructure. And then, in a year and a half, to gather them again on the Rostov site. Certainly, if it were possible, we'd prefer not to dismiss the formed team but continue working incrementally. The team is well mobilized there; the work is in full gear. Upon Sergey Semenovich Sobyanin's directive we have done some economic estimates: the one-year shift in commissioning dates of the third reactor entails a savings of 5 billion rubles in terms of the price, or 6% of the reactor cost. The same is true for the fourth reactor; if it is moved back 2 years, it again means 5 billion rubles deducted plus additional revenues from electricity sales, which will start being released to the grid earlier.

I'd note that at the approval stage the state set up a rigid requirement for us, i.e. to find ways of reducing cost while approaching the series build. One of the solutions, suitable for the 3rd and 4th Rostov reactors, has already been applied; we installed two large cooling towers instead of four small ones there. Savings with this solution only are 5.7 billion rubles. Add to that the equipment integration at the plant. Thus, it is possible to save a total of about 9.5 billion rubles through the engineering solutions at the two Rostov reactors alone.

Then, the Kalinin nuclear power plant where we are now. Here, we are planning a substantial rise in capital investments in the 4th reactor construction: 14 billion rubles were invested last year and nearly 20 billion rubles will be put in this year. Of them, 13.5 billion rubles are for construction and six billion rubles are for equipment procurement. This is the order for nearly all the country's enterprises! And the work will be peaking here in 2010 when the financing of the construction and installation works is nearly doubled, up to 40 billion rubles. Today we employ 3,000 people.

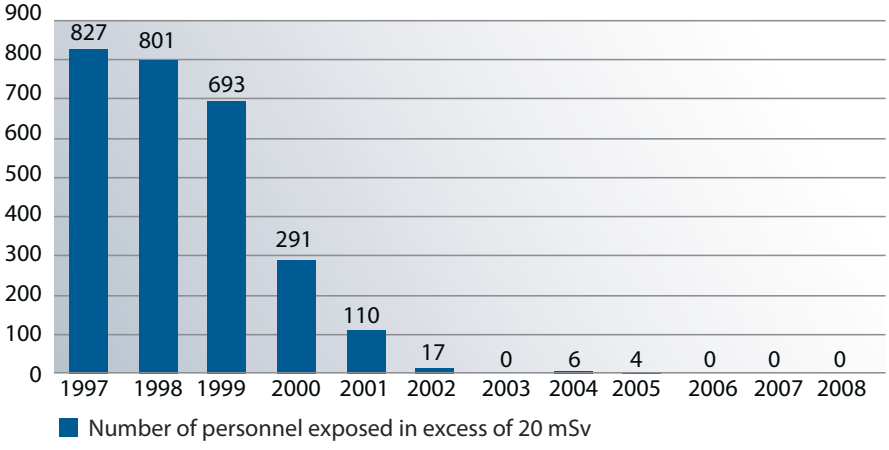
One more important task for us is to keep down price increases by vendors and contractors. The Rostov reactor was the first; we started its construction after a long outage. Now, we have compared procurements done for Rostov and Kalinin reactors. If in Rostov we were doing procurements in an integrated manner, when one vendor supplies all, at Kalinin we divided this scope into parts and set up a competition. The apparent price drop was 34%, 39%, and 25% in different areas. This is due to open bidding and a competitive environment.

V. Putin: In other words, you are having the 94th federal law working?

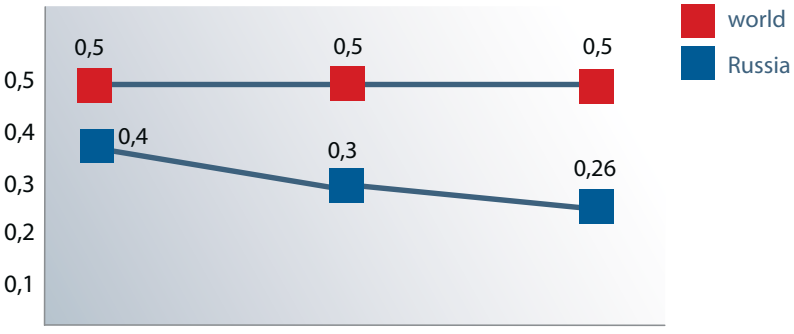
S. Kiriyenko: To tell you the truth, we have not succeeded in following all the procedures prescribed by the 94th law. Because, regretfully, it states that there could be no other winning conditions except price. But we don't have the right to do it this way because there is a great risk that they would offer us a low price but afterwards they would supply the equipment, which Nikolay Georgievich [Kutiyn, the Chairman of Rostechnadzor] wouldn't approve for operation and

SAFETY

NPP personnel exposure



Reliability of NPPs (reactor scams by 7000 operating hours)



Occupational injuries

would be perfectly right. The nuclear construction is totally supervised.

Therefore, we slightly depart from the 94th law's guidelines; we hold an open tender, moreover, we hold procurement auctions but with compulsory qualification and certification of the bidders. Therefore, any strange vendor is barred. This is the right approach. It would be risky otherwise. We have even seconded a team of our specialists to the working group of the Ministry of Economic Development, which is updating the 94th law to make it workable for us.

One more site is the Beloyarsk NPP, its fourth reactor. It is slated for commissioning in 2014. The key issue here is the reactor commissioning. We have to prepare fuel for it, and this is a fast neutron reactor. The MOX-fuel project is on the federal target program of new generation nuclear technologies that has been coordinated with all parties involved and is passing through its final review in the Government.

Then there's the Novovoronezh nuclear power plant, Phase II. The work was more difficult to launch here, since this is the first nuclear power plant to be built from scratch, on open ground, without building capacities. We had the longest delay there, but we are catching up now. We think we'll meet the schedule of key works in the nearest time and then, considering the general scheme updates, as coordinated with the Ministry of Energy (Minenergo), we'll define the final dates for putting the first two reactors on line.

At Leningrad, Phase II we also have the first two reactors. This is the second plant we have started building from scratch. The first reactor's first criticality is scheduled for 2013 with the second to follow in 2015. There, we are on schedule, on the whole. There are some 10-15-day departures as regards separate work items, but these are our internal issues.

The Baltic nuclear power plant was not on the general scheme. But, taking account of your directive, we, jointly with Minenergo, have considered the possibility of including it in the document. There is a demand in the region, and this demand is huge. Besides, the Ignalina NPP in Lithuania must be shut down in 2010. Poland has declared it wants to build a nuclear power plant and Belarus, with which we cooperate, has indicated such a wish. But in our case, the Baltic NPP is ahead in terms of [commissioning] dates; we will have to redistribute the funds available to us now. We don't ask for additional money for this project. Given your approval, we plan to build the plant using the pattern of open investment, including private and foreign investors, for the first time in the country's history. In other words, Russia will retain 51% interest, while 49% will go to investors, possibly, foreign ones. There is great interest in this project. Here, we work jointly with Atomstroyexport and Inter RAO UES. Inter RAO attracts funds for the project and negotiates, since it supplies electricity everywhere in the region. Therefore, we see our task as putting the Baltic first reactor on line in 2016.

V. Putin: This has to be synchronized with our colleagues in the region.

S. Kiriyenko: I do agree.

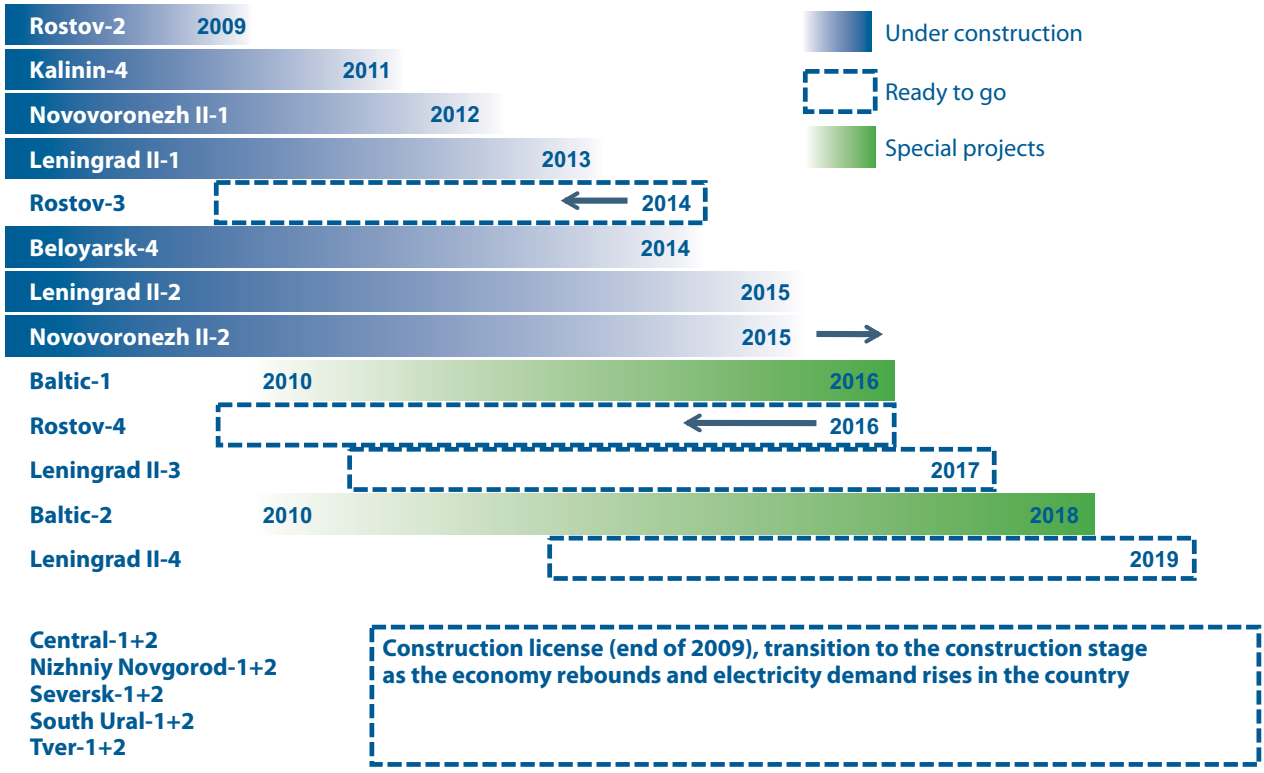
To extend life and retain prices

S. Kiriyenko: Our investment program includes not only the construction of nuclear power plants but also everything that is associated with fuel storage and reprocessing. For example, there is a large facility at the Leningrad NPP, which is almost on the same scale as the plant itself. It is the on-site temporary fuel storage facility. This year, we are going to channel 18 billion rubles to the project.

Now, about life extensions of existing reactors. This work has to be done, because otherwise NPPs could start ceasing operations in an unscheduled manner and in mass. Given the developed program, we have managed to shift this schedule and now we have a margin until about 2017; we have to build key replacement capacities during this period. The life extension plan is being fulfilled and the work is being done thoroughly. Though we justify 15-year extensions, in reality Rostechnadzor often approves only 5-year extensions and then, having checked compliance with regulations again, grants renewals. I think it is the right approach because safety is of the utmost importance. Investments in life extensions and upgrades of capacities are also substantial. In 2008 we channeled 17.8 billion rubles for these purposes and plan to put in 28 billion rubles more this year.

There is also a set of programs related to efficiency, i.e. capacity factor im- →

UPDATED ROUTE MAP



provement programs. Under the crisis conditions, everything related to the capacity factor remains in force but the installed capacity increase itself is not necessary everywhere, because today a grid dispatcher also has to set constraints for us due to low demand.

The task set by the Government when the new nuclear building program was approved, was also to ensure annual reduction of the concern's [Energoatom] specific costs of generation of each kilowatt by 2.5%. I may report that we are ahead of schedule here. We should have reached 7.5% over three years, but in reality we have reached 8.2%.

When you are building a plant, a key thing is to retain prices for machine engineering. A striking example is the growth of the cost of major equipment of Tianwan Phases I and II in China. The monopoly-made equipment price grew by times, not by percents! We saw danger there: if prices for all equipment items were to grow like that, we wouldn't be able to retain prices. What do we do in this regard? On the other hand, we are building up orders for machine engineering companies even in spite of the crisis. I don't think all machine builders will be happy since previously they hoped for 2-3 sets a year, but it is clear now that we will order 1-2 sets after the investment program has been updated. But absolute amounts grow. If in 2008 the total amount of advance payments and funding was 38 billion rubles, the orders have grown to 53 billion rubles this year. And yet we are active in de-monopolizing the market. Again, if in 2007 monopolist vendors held 86% of the total order portfolio and nearly nothing could be done with them, today this share is only 26% and we hope to zero it by 2011.

In July 2008 you visited Mashinostroitelny Zavod in Elektrostal where you gave directives to increase efficiency. I report as follows: we have fulfilled them. The enterprise has increased labor efficiency twofold over three years. And a striking example - this is not featured anywhere else - at the plant, wages are growing while the common labor compensation fund decreases. It happens at the expense of improving the use of labor resources and growth of productivity. The employees get 34,000 rubles on average there.

Loans are our headache. This year Concern Energoatom's investment program amounts to 164 billion rubles. Slightly less than half (73.3 billion rubles – editor's note) falls with the public money. We have to attract the rest from outside in conditions of somewhat dropping revenues in the energy market. Therefore, this year the Concern will need 26 billion rubles in loans. But today, the best interest for us, considering the favorable attitudes of banks and the Central Bank back-up is 16%. It's impossible to a build nuclear power plant with 16% of interest! It's possible to trade, and we attract money at these interest rates for certain operations, Techsnabexport, for example. But it's impossible to build nuclear power plants with them; here, 10% is the dead limit!

Here we need systemic support. I think it is not an issue for us only; it is topical

for other energy enterprises. The door should be open for infrastructure bonds and we have drafted relevant proposals for you to decide on. We are aware that the Government's anti-crisis program provides for a relevant mechanism, and we'd like to say it's vital for the industry.

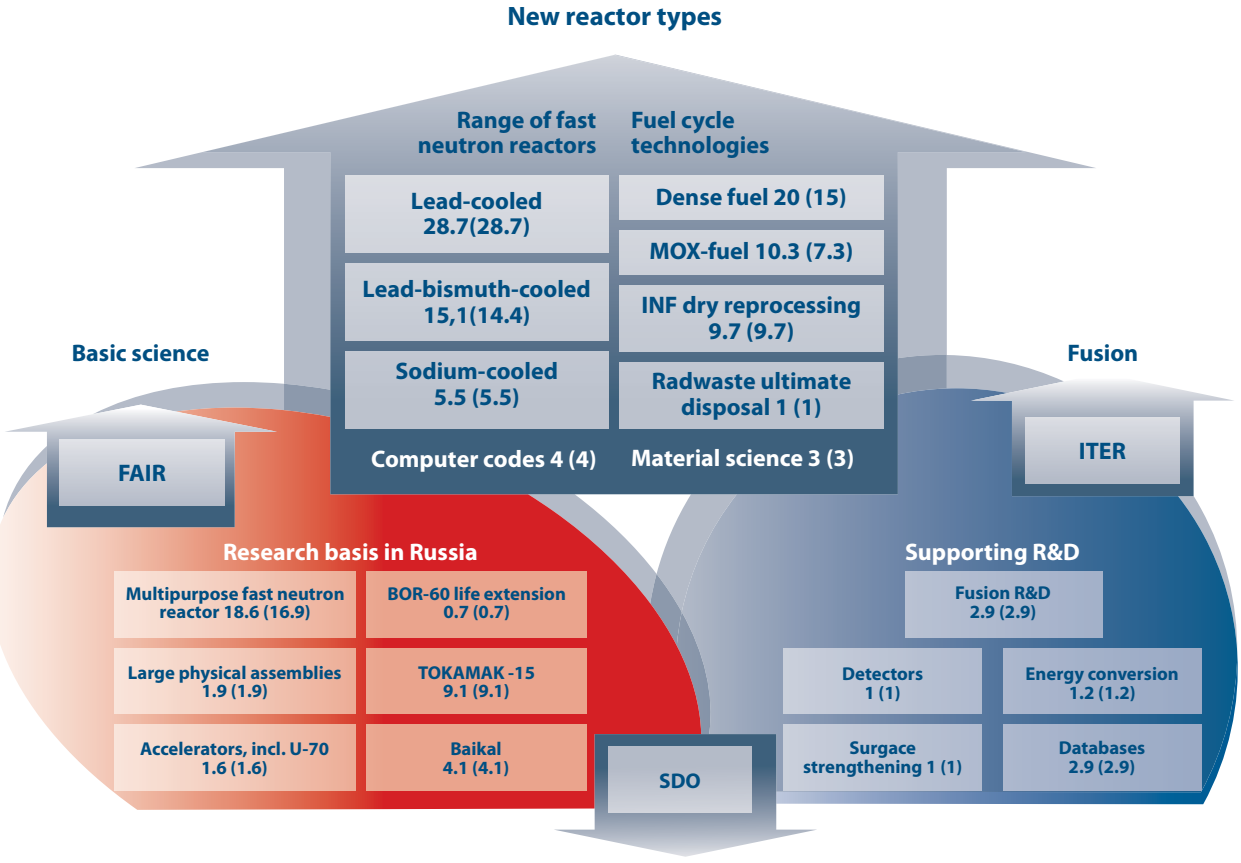
It is of utmost importance for us to expand operations in foreign markets, to load machine engineering capacities at maximum, considering the protracted implementation of our domestic program. We are planning new projects in India; we are waiting for a decision on our bid in Turkey where there is a unique organizational and financial pattern. It is the first time in history that we are suggesting not just to build a NPP for another country on a turn-key basis and leave, but to own this plant and operate it while selling electricity. This project is also possible through the integration of Atomstroyexport and Inter RAO UES.

Fast – coming future

S. Kiriyenko: The final part is the future, certainly. We have good reserves and backlogs, but it is of extreme importance to utilize them fast, to convert what scientists have done into an actual product that we can market. As we see, the products of the Russian nuclear industry are of very good price-quality ratio. It can be illustrated by the fact that we win nearly all tenders worldwide now. But we will have to put a new product on the market by 2015-2017. To this end the FTP «Nuclear Power Technologies of New Generation» has been worked out. In the program the main stake is on the neutron reactors; there are three categories of those: lead-cooled, lead-bismuth-cooled which is based on our nuclear submarine technology, and sodium-cooled BN-800 and BN-600 at the Beloyarsk site.

I'd emphasize, today we are about 10 years, not less, ahead of our rivals in fast neutron reactors! But they «woke up» some time ago. In the 90's, the Americans decided that fast reactor technologies were a dead end and today they are throwing in large money. Worldwide, nearly all are in consensus that fast reactors are apparently the fourth generation of NPPs.

Therefore, it is important for us not to lose our advantage. The program is ready, agreed upon with all parties concerned and the Ministry of Economic Development is to report to the Government on it. We have to be certain as to the FTP funding. I think it's important to get started, and then ↦



the specific amounts, taking account of budget updates, could be settled individually.

And, if you allow me, I would like to ask for one more thing. Given the programs we are launching, everything cannot be funded even through loans. We understand the complexity of the budget situation, taking into account priority tasks. However, we would like to ask for allocations to support additional capitalization of our enterprises. Our estimates show we will need about 50 billion rubles as a property contribution to the state corporation to implement target projects both domestically and abroad.

I. Sechin: I'll be brief. I'd like to draw attention to one of Rosatom's activity areas, i.e. the implementation of international projects. Primarily, the construction of nuclear power plants abroad: in the PRC, Bulgaria, India, Turkey, Belarus and other regions. The support to Rosatom in this program will mean, in the first place, the support to our machine builders who will have an opportunity to supply equipment to these sites. I would ask you, Vladimir Vladimirovich, to consider the possibility of instructing the Ministry of Finance to work through the issue of supporting these projects with loans. No doubt, this will also increase competitiveness of the state corporation and support Russian nuclear equipment producers during the world economic crisis.

No time to relax yet

During the meeting at the Kalinin NPP the implementation of investment projects in thermal power was also discussed. Minister of Energy S.I. Shmatko, Rostechnadzor's Chairman N.G. Kutiym, Tver Region Governor D.V. Zelenin and other attendees reported on the issue.

Summing up, the Chairman of the Government V.V. Putin addressed the meeting with closing remarks:

V. Putin: Certainly, we will summarize everything that has been voiced here in the final decision paper. We understand perfectly well the conditions we live in today. Electricity demand is dropping but it is apparently a temporary drop. I think the situation will change already in 2010 and energy needs will start growing gradually again. Experts project that pre-crisis energy consumption will be reached by 2012. This is about 3% per year. Besides, there are regions where the deficit remains. You and we understand what will happen when the industrial growth starts. We have come across that quite recently, about a year and a half ago, when everyone was concerned about a completely different problem of where to get energy resources from. So it is not time either for you or for us to relax yet.

We have to work actively to fulfill all declared programs. Certainly, in the crisis conditions it has become more difficult to solve some problems, perhaps. But it has become easier to address some other issues. There are also pluses during a crisis. I mean that companies have to search to find ways to optimize expen-

ditures. The market situation is favorable for this. Cement, metals, some other resources, equipment, on the whole, is becoming cheaper. I am aware of Energoatom management's plans to reduce costs - Sergey Vladilenovich has mentioned it – by more than 10% in different areas on the whole. We would like to see this work continued in the future.

As you know, a list of projects to be implemented in the Government's various activity areas until 2012 has been approved. There will be about 60 such projects. We have separated the nuclear power and industry complex and nuclear weapons complex development as one of four key pilot projects to be launched first. Its implementation, among others, will allow increasing electricity generation, supporting and strengthening our leadership in nuclear fuel fabrication, as well as deploying the most advanced technologies for radioactive waste disposal, and implementing a set of other environment protection measures. This work will require Rosatom and its affiliated companies to have close coordination. I want to say that the project related to the development of nuclear power and industry complexes and nuclear weapons complexes must be reviewed by a governmental session in the upcoming months, as we have agreed.

There is one more aspect of principle, a very important one. The development of infrastructure, primarily that of power generation, entails huge orders to be placed with the related industries, retains and creates jobs. It has been calculated that one person working in nuclear construction means 10 people engaged in related industries. Therefore, by financing nuclear construction, in fact, we invest also in the development of several industrial complexes in a row, rendering them a serious support in this moment of crisis. Therefore, we will continue investing in nuclear power! In 2009 the investment program will amount to up to 160 billion rubles, of which 73.3 billion rubles will come from the federal budget. Last week I signed the relevant governmental resolution. As a result, Concern Energoatom must commission one gigawatt of capacities this year.

There is one more thing. I consider it possible to support Rosatom's application for additional capitalization of the state corporation in an amount of 50 billion rubles.

And the last thing. The nuclear industry has always been a very powerful asset of Russia. I am sure that if we are correct in structuring our work today, in identifying priorities in the right way, in the future nuclear power will be a serious resource for our country's development in terms of power generation, defense, economy and science. I wish you success!

P.S.

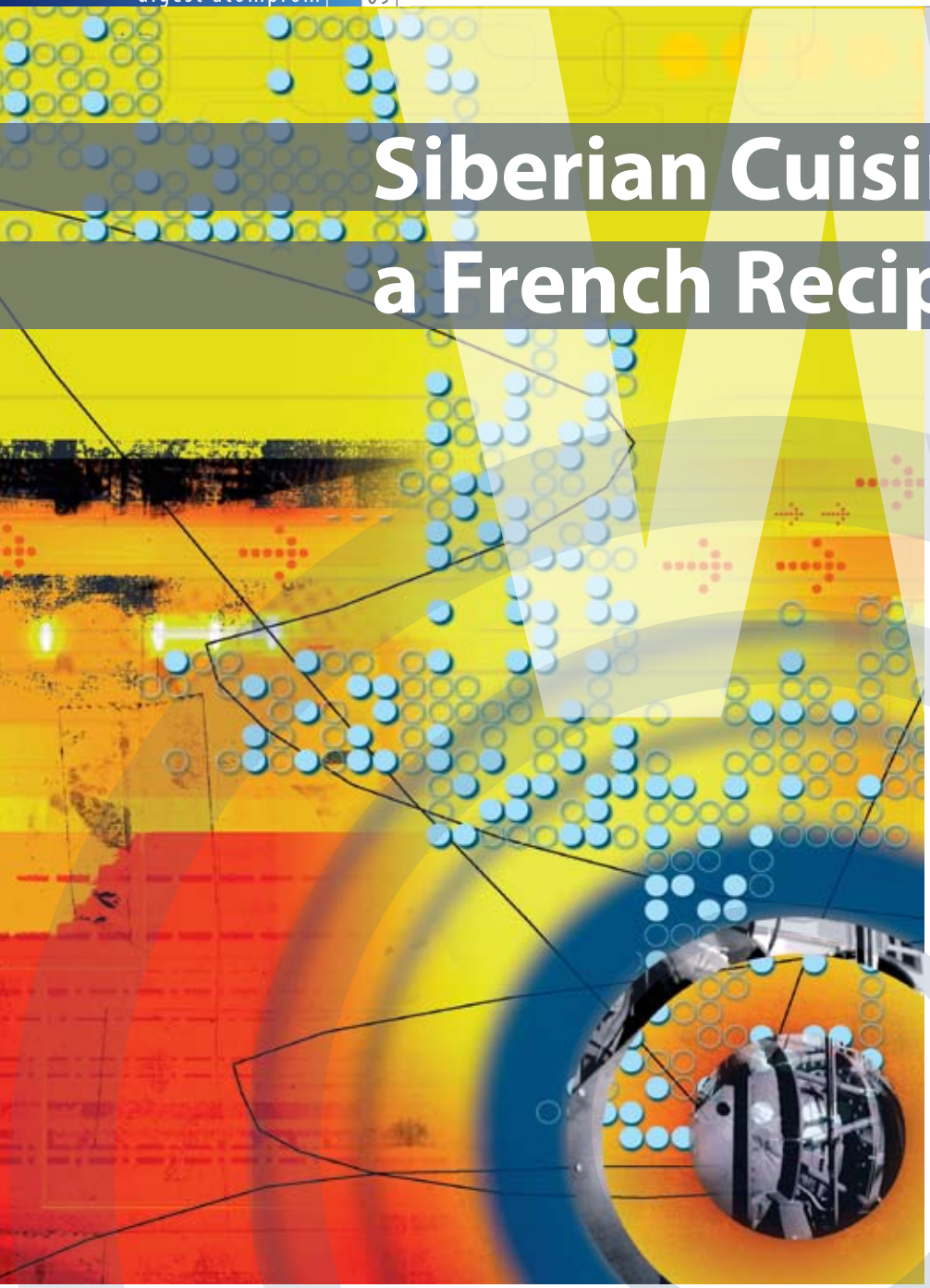
Having visited the Kalinin nuclear power plant, the Prime Minister held a meeting with workers of the Tver Railcar-Building Plant. Electricity tariffs were one of the issues raised there. One of the meeting attendees asked the Head of the Russian Government:

–You have just come from Udomlya. It is located in the Tver Region. Our region has been involved in operations in respect of both territory and labor during all these years of construction. The nuclear industry could help the region in terms of tariff reductions in the period of crisis, since we contributed to it [the plant] in the past. For, say 10-20 years, perhaps. This will reduce the cost of railcars as well.

V. Putin: As to the nuclear power, NPP, could it do something about it? Let's be frank. Everything that is created in this or any other region, a large-scale thing like a NPP, is created by all Russian people, not just by the region. And people in all regions have the right to count on living in nearly equal conditions. So if we make the NPP to operate under a certain set of principles and conditions in one region and under another set of principles and conditions in another region, we'd simply take to pieces the entire economic wealth of the country. Let's make milk cheaper in one region and more expensive in the third one; steel will cost incomparably cheap in one region and be sold at a substantially higher price in the third one. But this has no economic reason and may lead to severe consequences.

But if we implement the plans we spoke about at the Kalinin NPP, I'm sure we'll not simply retain energy capabilities of the country, we will develop them. If we develop them, the tariffs will be adequate for both the enterprises and the general public.

Siberian Cuisine TO a French Recipe



Dmitry Kadochnikov;
exclusively for Vestnik ATOMPROMa
Photo by Dmitry Konovalov
and Rustam Kuliev

In 2009 Russia for starts to convert depleted uranium hexafluoride (DUH) on a commercial scale the first time. Zelenogorsk-based Electrochemical Plant (ECP) has been doing start-up and commissioning of the W-ECP facility, which is unique to the Russian nuclear industry. It is capable of converting chemically toxic depleted uranium hexafluoride into uranium oxide, a form safe for long-term storage.

Uranium oxide (U3O8) is a substance which is close to natural uranium ores.

The product is chemically stable and easy to preserve; it is fit for transportation and can be stored as long as needed. Over the past 50 years, there has not been a single scientific laboratory that has not been involved in the search for an efficient conversion process for DUH; there have also been well-justified and experimentally verified pilot-scale engineering solutions.

French nuclear engineers were the first to solve the task of developing commercial-scale technology for reprocessing uranium hexafluoride tailings. The technology has demonstrated its efficiency over the past 25 years and will be used to reprocess accumulated DUH stockpiles in Siberia soon.

After a half a century of industry-scale production of nuclear weapons and nuclear fuel for power gener-

Filtering chamber delivery to the shop for installation

ation, isotope separation plants worldwide have accumulated large amounts of uranium hexafluoride depleted in uranium-235.

General estimates show that the world has accumulated more than 1.5 million tons of depleted uranium to date, and these stockpiles continue to grow by approximately 50,000 tons a year. Major amounts of DUH have been accumulated in the United States and Russia and are stored in metal casks on open-air pads of uranium enrichment plants. Some DUH casks have been stored for more than 40 years already.

In spite of the positive experience gained by nuclear engineers in managing DUH, one cannot ignore the potential risks of the current storage arrangements for depleted uranium hexafluoride due to its chemical toxicity. An act of sabotage, natural or man-induced disasters, which are quite probable events in our uneasy century, could potentially lead to severe consequences.

Moreover, stockpiles are growing with time while environmental laws become more stringent. Nuclear communities of all countries that enrich uranium are aware of the fact that sooner or later DUH has to be converted into a less dangerous form by this or another technique for the sake of public safety.

Waste or feed?

Byproducts that are not useful or commercially interesting are commonly called waste, like fumes and soot from stacks, chips, sawdust...

Depleted uranium hexafluoride may seem similar to «sawdust» at the first glance. Natural uranium consists mainly of uranium-238 isotope and the uranium-235 fraction is just 0.711%. To make it usable for nuclear reactors, it should be enriched up to 5% with uranium-235.

The uranium enrichment process also produces uranium tails where uranium-235 content is significantly less than in natural uranium.

An approximate ratio of DUH and enriched uranium resulting from the natural uranium enrichment process is as follows: of 8 kg of natural uranium 7 kg are treated as so-called «tailings,» depleted uranium hexafluoride.

Can they be used somehow? It turns out that it is possible to re-enrich the tailings. But this process reduces depleted uranium stockpiles to a limited amount, i.e. over 80% of DUH being re-enriched is returned to the storage facility as secondary tails, while more depleted in terms of uranium-235.

As the uranium isotope separation technology becomes more economical and efficient, and less rich and accessible uranium ore deposits become available, the lesser uranium-235 assay in DUH makes it tails.

Uranium tails are chemically pure products that contain a high concentration of uranium-238. And the latter is a readily available material in store to fabricate blankets of fast neutron reactors (these are soon to become the basis for modernization of nuclear power; for more details turn to the QUESTION-ANSWER section) and produce plutonium, which can be used as nuclear fuel.

Furthermore, uranium metal tails can (and have) be used been used as an ionizing radiation shielding in containers for transportation and storage of radioactive substances, as well as for other engineering solutions.

Still, there is no consensus on DUH. Until recently the U.S. had considered DUH a feedstock for further use but as of late the U.S. Department of Energy is actively seeking a more economical way of utilizing DUH stocks while considering its conversion into a less chemically toxic form suitable for subsequent storage. But Russia and France, following the IAEA expert advice (ISBN 92-64-195254, 2001), are considering depleted uranium a strategic feed subject for further use.

The French nuclear industry has already converted most of its uranium tails from DUH to uranium oxide. In 1984 COGEMA commissioned its first commercial W facility in Pierlatte in Southern France, and in 1993, having ascertained the effectiveness of the technology, started a second facility on the same industrial site. Annually, France repro- →

Of 8 kg of natural uranium 7 kg goes to so-called «tailings» as depleted uranium hexafluoride.

cesses several thousand tons of DUH. The W-ECP facility in the shop for the secondary uranium hexafluoride reprocessing at Electrochemical Combine will become the third in the world and the first in Russia process of its kind.

Project background

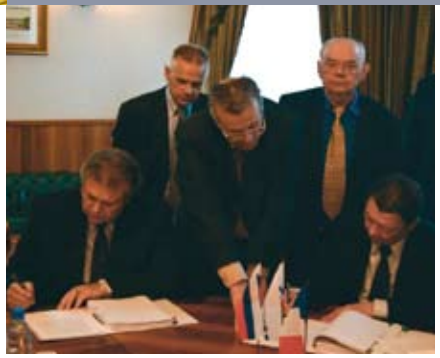
The quadripartite contract between AREVA NC (formerly COGEMA) and SGN on the French side and JSC Techsnabexport and Electrochemical Plant on the Russian side was signed in March 2005. The contract provided for the development of an industrial-scale facility to reprocess depleted uranium hexafluoride with a capacity of 10,000 DUH per year at ECP.

The contract was a result of several years of work. As far back as the fall of 2003, a small team of ECP specialists began the preparatory work: they studied the technology, process, setup conditions and sales markets for DUH conversion products.

Future W-ECP construction site

Why «W»?

The «W» letter code name of the French DUH reprocessing facility emerged from denominations by first letters commonly used in technical literature, like «Feed,» «Product,» and «Waste.» Later, it was borrowed to become a part of the Russian facility name - W-ECP.



Contract signing March, 25th, 2005

ECP specialists led by the plant's director general, Anatoli Nikolaevich Shubin, visited the Pierlatte plant to form an opinion on the facility operations. The highly automated, pre-programmed process, which required attendance for monitoring purposes only, and which met current radiation and environmental safety requirements, produced a most positive impression. So Shubin, who is known for his proactive approach, made the decision to use the French recipe without waiting for a Russian DUH reprocessing technology to come into view.

The project is financed with ECP's own funds. According to the contract, AREVA NC and SGN are responsible for the equipment supply from France and its installation follow-up and adjustment.

The uniqueness of the technology defined the precondition built in the contract by the French side: the facility, including major equipment (defluorination reactors), auxiliary equipment and engineering utilities, even lifting gear, should be replicas of those being used at the COGEMA's plant.

In December 2005 civil and erection works began on the site of the would-be facility along with preparations for the receipt and installation of the equipment.

According to Sergey Andreev, the UHF secondary reprocessing shop supervisor, in 2006 the French handed over to ECP the preliminary design documentation, which became the basis for GI VNIPIET (St. Petersburg) to develop the project accommodating the French facility at the Russian industrial site. The project documentation was immediately subjected to regulatory and other reviews.

In November 2006, as stipulated by law, public consultations were held in the «closed» city of Zelenogorsk. It was stated that the future W-ECP's capacities would not provide for reprocessing of tails brought from other sites. The future facility would reprocess what had already been stored on ECP's site and what will come from the existing enrichment processes. Also, W-ECP means 200 new permanent jobs. In early 2007 all required regulatory approvals were granted regarding the project.

In May 2007 the facility received the first batch of the French equipment. All preparatory construction works had been accomplished by then. The installation started on 1 June. Andreev explained: «The French specialists' task was the installation follow-up. Through direct participation in installation, adjustment and tests our specialists gain better knowledge of the equipment, its parts and features. Since they will operate the facility in future.»

The contract with AREVA NC/SGN also provided for training of the Rus-

Technology hints

The essence of technology employed by W-ECP is the interaction of UF6 gas and water vapor in the upper section of the rotating tube-type reactor, which results in uranyl fluoride. As it moves up the reactor at high temperatures, the latter is converted into U3O8 by a vapor-water mixture.

Rustam Kuliev, Head of Engineering Team of the DUH Secondary Reprocessing Shop:

— DUH will arrive at our shop in steel casks. In the evaporation section UF6 is converted a the solid state into a gaseous state, skipping the liquid one, and then goes to the defluorination reactor. Water vapor, hydrogen and nitrogen are also supplied to the reactor. We receive two flows at the reactor outlet – uranium oxide (U3O8) and hydrofluoric acid vapors. Solid uranium oxide, which is environmentally safe in terms of storage, is supplied to the packaging section and then shipped off to a special storage facility in containers. After condensing, hydrofluoric acid, which is an expensive and in-demand product nowadays, can be used in various industries, including nuclear. There is a rack to fill it in rail tank cars for transportation to consumers in the shop.

Work on preliminary design documentation (Zelenogorsk, Krasnoyarsk Territory)

sian personnel. In the beginning of 2007 the first group of the plant's specialists did their training at the W-2 plant in France. The training included a one-month theoretical course followed by two months of practical work. In early 2008, a second group was sent for training. A total of 20 people were trained (mechanics, instrumentation operators, electricians and process engineers), who became «teachers» for the rest of the shop staff.

Since the installation commencement, four large process units have been assembled and several kilometers of various-purpose pipelines have been laid. Cable bundles, compressed air piping, nitrogen gas piping, steam lines – all these have been manufactured and installed, as they say, from the scratch. Many operations performed at W-ECP were unique and done at ECP for the first time, for instance, the fabrication of large-size equipment out of polyethylene.

W-ECP started testing

The equipment installation took a year and five months. Specialists have called such a time frame «very tough.» The French «patrons» praised the professionalism of their Russian colleagues. In November 2008, strictly on schedule, the contract parties signed a record stating the completion of installation works at the new facility. Equipment adjustment teams began testing the equipment and engineering utilities; first individual system tests and then integrated tests.

In March 2009 the final stage of the tests will commence when DUH will be fed into the facility. Commercial operation of W-ECP is scheduled to start at the end of Q2 2009.

ECP's delegation working visit to Pierlatte, France

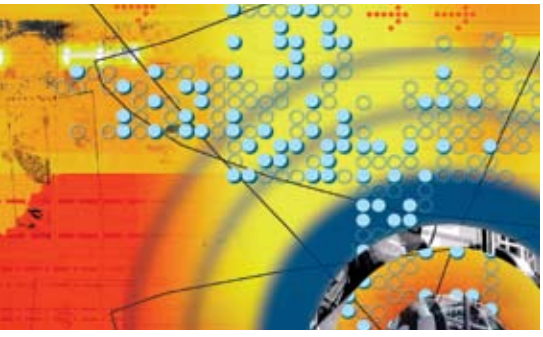
In parallel with the commissioning of phase one the work will continue on phase two, i.e. the refining section which is to produce a 40% solution of hydrofluoric acid (HF) and anhydrous hydrogen fluoride suitable for shipment by rail. This section is to be commissioned early next year.

Environmentalists say YES

«For our country, the mere reprocessing of depleted uranium hexafluoride (DUH) is an encouraging fact, because it will be done at the current technical level,» Sergey Baranovskiy, president of the Russian Green Cross and chairman of the Russian Ecological Congress, said in regards to the commissioning preparations of the commercial-scale DUH reprocessing facility in Krasnoyarsk Territory.

«In general, these are also nanotechnologies. To tell the truth, they are not Russian technologies but even if they are French ones, this is a positive factor because uranium oxide is a significantly less toxic substance than uranium hexafluoride, he explained. «In terms of ecology, it is a good step forward. But still, we will have to see how it will work in our Russian conditions. This step was preceded by a serious market and scientific analyses. We have to implement promising technologies; it's a positive thing, I believe.»

The somewhat cautious assessments by environmentalists are quite clear, but they are positive on the whole. Like nuclear workers, they understand that investing in DUH facilities means investing in the health and safety of future generations.



Defluorination reactor

Sergey Filimonov,
Director of Electrochemical Plant:

— For Electrochemical Plant, it has been a customary, long-time practice to invest exclusively its own funds in modernization and development. We continue investing in improvements of main isotope separation technology.
As a nuclear industry enterprise, ECP has always paid close attention to environmental protection.
It is no mere chance that last year the Environment Management System passed an audit to verify its conformance to the international standard ISO 14001.
Building the DUH reprocessing line is a reflection of the ECP team's commitment to meet the latest requirements.
The W-ECP facility environmental policy adopted by the plant provides for strict observance of environmental legislation and the reduction of adverse impacts of process factors on the environment. Moreover, ECP has undertaken to deploy environment-friendly technologies and allocate necessary funds to this end.
We are proving our interest and responsibility by our deeds. We are investing in the wellbeing and environmental attractiveness of the plant. The implementation of the French technology for conversion of depleted uranium hexafluoride into a form that is safe for storage here, in Siberia, is our contribution to solving one of the problems nuclear industry is facing.

INTER RAOUES

Rosatom gains in «Inter RAO»

The Russian united electricity export-import operator JSC Inter RAO UES has become part of the state-owned corporation Rosatom. On 11 November the head of Rosimushchestvo, Yuri Petrov, signed a directive to transfer the state's 42.48% share in the company to Rosatom as a state property contribution. 14.8% of the company's shares are already owned by Concern Energoatom.
Inter RAO operates in 15 countries around the world and owns about 8 GW in power generation assets (the total power capacity of all Russian nuclear power plants combined is over 23 GW). The company aims to raise its capacity to 30 GW by 2015 through power plant construction and foreign asset acquisitions. In the coming years, it also plans to expand geographically to other continents such as Latin America.

«Energy without borders»

Inter RAO was established in 1997 as a joint stock company 100%-owned by RAO UES of Russia and became active in electricity trading operations in 2001. The initial plan was to deal with trade projects related to electricity generated outside Russia and the first project was to provide electricity supplies from the Ignalina nuclear power plant in Lithuania to the Belarus and Kaliningrad regions. At the same time, Inter RAO expanded its business by setting up trading affiliates abroad.

In 2002 Inter RAO began independent exports of electricity from Russia and commenced generation at the leased power unit of Iriklinskaya SDPP in the Orenburg Region. The following year Rosenergoatom joined the company's authorized capital through the acquisition of 40% of the company's shares from RAO UES of Russia and Inter RAO obtained the status of united electricity export-import operator.

The deal to buy a part of Inter RAO put an end to the sluggish rivalry between the nuclear sector and RAO UES of Russia →

«When Inter RAO was being set up, no one thought for a moment that ten years later it would be the industry leader. Perhaps no one except me and those who were the first to come to it,» Inter RAO chairman Dod says.

over electricity exports and imports and access to grids. The block of stock obtained by Rosenergoatom was calculated based on the share of nuclear electricity in the amount of exports. Sales were mainly done through the north west region where the Leningrad and Kola nuclear power plants (NPP) are located.

Seven years after Inter RAO was set up, electricity was already being exported to over 12 countries and the company started massive foreign investments. In 2003-2005 Inter RAO and its affiliates invested about US $350 million in foreign energy assets. In particular, Inter RAO was joined by Georgian Telasi and Mtkvari Energetika. The company also bought Sevan-Razdansky Kaskad Hydro in Armenia and acquired a 50% stake in Ekibastuz SDPP-2 in Kazakhstan and Moldavian SDPP and set up the Russian-Tajik venture, Sangtudinskaya Hydro-2, to build a power plant under the same name.

At present, Inter RAO's largest electricity export-import partners are Belarus and Kazakhstan in CIS and Finland in Europe, which accounts for more than half of the total electricity supplies from Russia. The company's zones of interest also include Armenia, Georgia, Turkey, Syria, Jordan, former Yugoslavia, Romania, Moldavia, Kazakhstan, Tajikistan, Kyrgyz Republic, Mongolia, South Korea, and China.

«We have at present compiled a portfolio of projects which, if successfully implemented, will double the company's production potential. We are concerned both with the construction of new power plants and the modernization of existing ones. In some cases we are entering new energy markets where no other Russian company has ever been active before,» Yevgeniy Dod, Inter RAO's top official said.

«By entering new markets we do not only solve short-term tactical tasks, we gain a foothold for future Russian endeavors. Electricity generation is the locomotive behind industry, science and development,» the Chairman of the Board believes.

The company's foreign investment program over the coming two years is estimated at US $5.5 billion. Next year about two thirds of this money will be used to acquire new assets and the remaining third will be used to feed construction projects.

Continued growth

The near-term strategic target of Inter RAO is to enter markets in Latin America (Cuba, Venezuela, Nicaragua), Africa and South East Asia (Vietnam, Laos, Cambodia and, perhaps, Thailand). The plan was voiced by Russian Vice Prime Minister Igor Sechin at an unscheduled Inter RAO shareholders' meeting in October.

The Board of Directors was elected at the meeting, with the Chairmanship going to Vice Prime Minister Sechin. Board members include Russian Energy Minister Sergey Shmatko, SC Rosatom's Director General Sergey Kiriyenko, Inter RAO Chairman Yevgeniy Dod, Gazprom's board member and Mezhregiongaz Director General Kirill Seleznev, Rosimushchestvo's head Yuri Petrov and representatives of VTB bank and Rosneft.

«Inter RAO can become an effective tool for cooperation with foreign companies», — Igor Sechin said

According to Dod, the Board will submit shortly a company development strategy until 2020. «I'm not going to reveal details, but I may say that while retaining key provisions of the document adopted when RAO UES of Russia was still alive, we have tried to take into account the latest changes in the global economy, including world power generation,» Dod noted.

In 2008 Inter RAO's revenues will exceed EUR 1.5bn, according to forecasts by Alexander Nikitin, the company's financial director. «Financial indicators of this year will be significantly better than that of the last year,» he said. The Inter RAO revenue structure, where export-import operations account for more than half, «gives stability to the company,» the top manager noted.

It is known, however, that Inter RAO is planning to develop a new business, i.e. engineering. It remains to be decided whether it will be a new affiliate within the group or the acquisition of an existing asset. The company's priority is the construction of energy-related facilities abroad in exchange for a share in their capital. The company is ready to participate in the construction of conventional (thermal and hydro) and nuclear generators.

Atomic investment operator

In the future, Inter RAO is set to become an operator for Rosatom, attracting investments in construction, Rosatom's Director General Sergey Kiriyenko said last summer. In this respect, for nuclear and power generation communities the debut project could be the Baltic nuclear power plant in the Kaliningrad Region where Rosatom is ready to allocate a foreign investor up to a 49% interest in the plant in exchange for capital investments. Inter RAO is responsible for the implementation of the first part of this project – finding an investor and structuring a scheme of future electricity exports to European countries.

Construction of the Baltic NPP is planned for 2014 – 2015. Atomstroyexport will be the principal contractor. The total cost of the project is estimated at EUR 5 billion (two reactor units plus infrastructure). A special company is to be set up to finance the project, with 51% owned by Russia and 49% by an investor.

The first stage of the project, which was launched this year and should take approximately two years to complete, is to secure land, undertake a pre-feasibility study and obtain all necessary the approvals and licenses. Funds for these works, estimated at over EUR 100 million, are to be provided by Inter RAO. The second stage will see a call for bids from potential strategic foreign investors.

«We already have interested investors and the interest is very high. We have received a number of offers to acquire a share in the project. So we see no problems with attracting investors,» Kiriyenko said.

In the fall Atomstroyexport in collaboration with Inter RAO and Turkish Ciner Group submitted the only offer to the tender to build a nuclear power plant in Turkey. It should be noted that Inter RAO is not a newcomer to the Turkish market. In 2005 the company bought 70% of Turkish TGR Energi aiming at commercial expansion and the implementation of investment projects both in Turkey and neighboring states.

RAO has also discussed nuclear cooperation prospects with its foreign partners including Italy's Enel. Inter RAO and Enel signed a memorandum of cooperation development in the field of power generation in Russia and other countries quite recently in the Kremlin as a result of negotiations between Russian President Dmitry Medvedev and Italian Prime Minister Silvio Berlusconi. The companies have set up a work group to deal with the assessment of prospects of commercial and investment interaction.

French Electricite de France (EDF) has also stated several times its wish to be a shareholder of Inter RAO through the purchase of a small block of its stock and has even discussed the possibility of asset exchange or the possibility of setting up a joint company for electricity sales in Europe, primarily the Balkans, where Inter RAO owns assets.

Domestic market

In 2008 Inter RAO was reformed to acquire another form of ownership and completed consolidation of assets, i.e. through the dissolution of RAO UES of Russia it acquired the independent affiliates of the latter – North West co-generation plant, Kaliningrad Co-Gen-2, Sochi TPP and Ivanovo PGU (steam-gas facilities). All hae been recently built and are considered among the most advanced in Russia.

Today, Inter RAO is expanding its generation capacities. The Russian section of the company's investment program includes three projects: the second power unit of Kaliningrad Co-Gen-2, phase two of Ivanovo PGU and one more power unit at Sochi TPP. The total amount of domestic capital investments is over RUB36bn until 2011.

«Everyone knows the strategic goals that are to bring the total installed capacity of our generators up to 30,000 MW and increase capitalization up to US $14bn – US $15bn,» Dod notes. «The company has very bright prospects.»

Cooking «uncaught» Ignalina

Topical review by Andrey Timonov for Vestnik ATOMPROMa

The protracted negotiations between the Baltic States and Lithuania's awkward moves to retain energy leadership in the region make more apparent the doom mark on the Ignalina II project (or Visaginas NPP, as it is also called). This makes Kaliningrad Region, the would-be host of Baltic NPP, the regional energy leader.

The 19-th of September has all chances to become a historic date in Lithuania's contemporary history. On that day an ordinary event became the domino which, having dropped, possibly, has derailed the entire Ignalina II project for all. During the public consultations on Lithuania's would-be plant's environmentalimpact, Leo LT utility'srepresentatives cut the bag open as to estimated power of the future two-reactor plant would be reduced to 2.2 gigawatts against the initial 3.2 GW. To say the truth, they voiced a reservation that additional reactors could be built, as necessary. This, however, was heard by no one. The centrifugal flywheel started moving and key players started leaving the Baltic States community of promising customers and investors for the sake of free energy run. Still, one has to take a look back in the history to estimate the scale of this nearly detective plot.

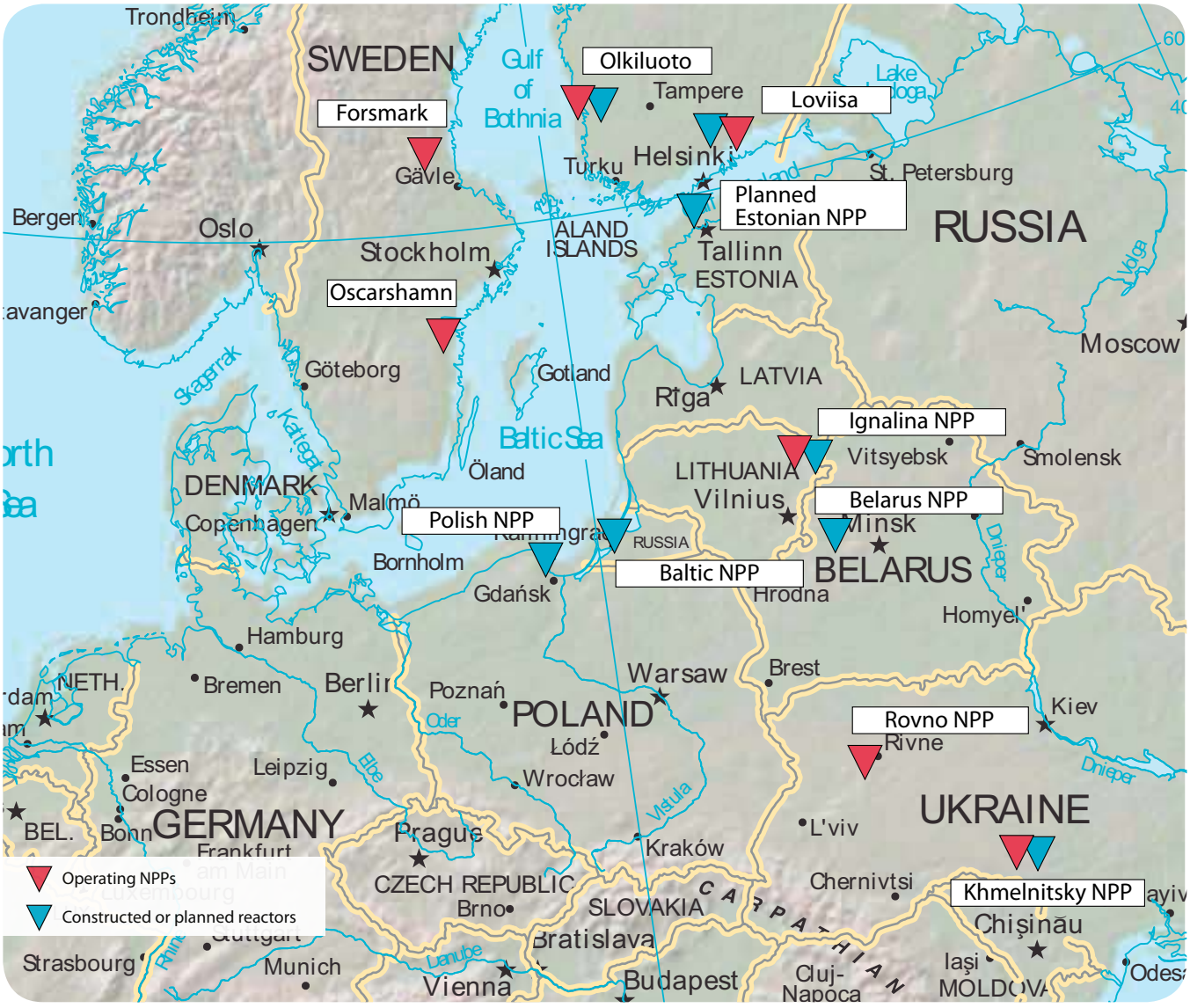
Three states in a boat (to say nothing of Poland)

Leaving the USSR, Lithuania got a foodfull dowry that included quite a gem — Ignalina nuclear power plant. The two-unit plant with reactors of the highest capacity in Europe (1,500 MW each) made Lithuania an energy monopolist in the region. Economies were strengthening and collapsing, productions were being sold out and converted, governments were being appointed and dismissed but electricity was always of value. Russia's territory — Kaliningrad Region — also became a regular consumer of the plant's electricity, in addition to the Baltic States. Poor generation capacities along with isolation from the country have made this far west region the regular consumer of the Lithuanian electricity (at present, 30% of the region's energy comes from Ignalina).

Happy days did not last long. Pursuing the integration into the European Union, Lithuania has planted a fast-acting mine under itself. Forced by the need to observe the requirements set forth by the RBMK-fearful EU, Lithuania had to shutdown the Ignalina first reactor already in the late 1990's (in terms of service life, these reactors could run until the 30's of the XXI century). Power capacity of the second reactor is still sufficient to meet 70% of all energy needs of Lithuania, however, it also must be shutdown before the 2009 yearend.

Two years ago Lithuania realized in the long run that it should close Ignalina, sooner or later. That was the point of time where they started seeking ways of combating the upcoming energy hunger. The new Ignalina nuclear power plant (Ignalina II) became the key scenario, with the first reactor to be up and running in 2015. Lithuania hoped to succeed in convincing Europe to extend the existing plant's life until, at least, 2013 or 2016, avoiding by this the scenario promising a tight energy ration.

Lithuania wouldn't manage such a huge investment project alone. Therefore, a proposal was made to Latvia and Estonia to join the mega-project, which, as Lithuanian politicians said, would ensure full independence from Russian energy supplies.



The proposal was taken with enthusiasm and the long stage of preliminary negotiations started. In a short time, Poland wished to join the project; at that point it started thinking about its future energy generation. The lion's share of the Polish generation (over 90%) uses brown coal that would lead to paying for high-cost CO2 emissions under the European rigid emission trading rules in near future. Therefore, the diversification of Polish energy mix is essential for the country's economy to survive. Poland was taken aboard without long talk; the project cost was growing while Latvia saw the first signs of the economic crisis, so a new financial partner came in very handy.

The new plant capacity was defined 3.2 MW. Though they did not name the reactor make, the Baltic consortium aimed at French AREVA's EPR-1600s, the only reactors of such power capacity in the world. The Baltic entrepreneurs were not discouraged by difficulties the French came across while building a similar reactor at Olkiluoto in Finland (the commissioning dates have moved 2 year on there). That time, the ascension to EU seemed to have more importance.

Basing on the assumed power capacity, they started sharing out yet to be generated electricity. Poland was playing tough. The Poles had an ace on hands: negotiations on building of the energy bridge from Poland to Lithuania were underway. The latter needed the energy bridge very badly, since in the pursuit to move away from Russia as far as possible, Lithuania was striving to leave the Russian united electricity grid for the East European one. This would have helped it to get the lacking power from Europe in the event of the potential energy hunger period (from Ignalina shutdown until Ignalina II startup). The Poles tightly glued the electricity transmission line construction to the electricity amount they required — «one gigawatt, at least!» The hostage position of Lithuania was recognized even by the Baltic States themselves. «I believe if Poland gets the amount of electricity it wishes to get, the energy bridge between our countries will be built. It's the unavoidable condition,» Gediminas Kirkilas, the Lithuanian prime minister, said after a governmental meeting.

Thus, the future nuclear power plant capacity was shared as follows: Poland — 1 GW, Lithuania — 1.3 GW (as the hosting state), Latvia and Estonia — 400 — 500 MW.

Experts concertedly assure Lithuania wouldn't see the first nuclear electricity earlier than 2020.

That is where the trick of the plot we have started narrating. Neither General Electric nor Westinghouse has reactors of the power capacity the French have. Therefore, the two reactors will provide totally 2,200 MW for Ignalina II. In this case, Latvia and Estonia are left without the promised electricity.

Fatal reshuffling

The Baltic's strive to use AREVA's services was a news for AREVA itself. When it came to negotiations, the French hinted to the Baltic that nuclear was not a hardware store where one came, bought and asked to pack. This is a long technological process; one has to line well in advance while having in mind that the European lead nuclear vendor has a bulging outstanding portfolio. The negotiations were complicated also by the fact that the Baltic pool members were holding endless discussions as to how to share the future plant, commissioning dates were being moved, financial parameters were being changed and the like. Unproductive negotiations, meeting and conferences at different tiers wasted two years. Therefore, it was no wonder that the French, who at a point of time started seriously studying the future contract with the party which was unprepared for it completely, ultimately seized to like this business.

October 18 REGNUM news agency, referring to the French media, reported that «representatives of AREVA group has tired of bargaining due dates and money with obstinate Lithuanians and the reactors (which could have been deployed in Lithuania) would go to China or India where the French are actively bidding for new nuclear construction. On his part, Lithuania's prime minister Kirkilas had already voiced that reactors for the new plant would be supplied either by General Electric or Westinghouse».

That is where the trick of the plot we have started narrating. Neither General Electric nor Westinghouse has reactors of the power capacity the French have. Both companies are promoting 1,100-megawatt reactors (ABWR by General Electric and AP-1000 by Westinghouse) in the nuclear construction market. Therefore, the two reactors (it is for this number of reactors the money is being allocated) will provide totally 2,200 MW for Ignalina II.

In this case only Poland and Lithuania would be catered though not in full, with Latvia and Estonia left without the promised electricity (while investing money in the construction). The Lithuanian Leo LT management and country's officials, having seemed to realize the scale of a future international scandal, have started speaking about building more reactors — three, four and on. At this, they say nothing either about an increase in the investment cost of the project, which is apparently becoming more expensive, or when the next reactors are to be up and running.

The situation is complicated also by the fact that by protracted negotiations, changes of vendors and clashes with partners Lithuania has delayed the commissioning dates of the first reactor. Leo LT has stated on 2018 already (remember, earlier it was 2015). However, experts concertedly assure Lithuania wouldn't see the first nuclear electricity earlier than 2020.

U-turn

Immediately after the said developments, during the fall several statements were made that actually doom-marked the Ignalina II project.

November 10 Poland's prime minister Donald Tusk claimed the domestic nuclear construction decision should be→

made before this yearend. Under the current energy development plan, the country's first nuclear power plant is to appear before 2030. The potential construction site is Wyszków Town. The moment was immediately seized by the French who started considering their involvement in the project. Dariusz Szwed, the leader of Green Party-2004, said French president Nicolas Sarkozy shortly could propose to Poland to sign a deal on the French participation in the nuclear construction project. It means unambiguously: Poland has abandoned its possible involvement in the Ignalina II project. Capital costs of nuclear generators construction are too high for such small countries to burden two projects in parallel in conditions of the financial crisis.

Meantime, Estonia has been active in holding consultations on its own nuclear build. Sillamae mayor Ain Kiviorg, who recently visited Olkiluoto-3 nuclear power plant in Finland within an Estonian delegation by an initiative of Eesti Energia, revealed to Viru Prospekt newspaper that the nuclear construction was quite likely in Ida-Virumaa County. The mere fact of his being on the delegation list is quite symptomatic, according the mayor. «Public opinion is built up. People have to start thinking about the mere possibility of building a nuclear power plant in Estonia. It appears clear why I turned out to be in this group: Sillamae has been traditionally associated with nuclear technologies and the idea that the plant might be built in our region has been voiced more than once,» Kiviorg said.

Experts say Estonia is considering two scenarios. Under the first scenario, Estonia could enter the Finnish nuclear construction project as an investor, and under the second one, it might build a two-reactor 600-megawatt plant of its own.

It is clear what is meant by Poland and Estonia's leaving the Ignalina II project. Lithuania, clasping in its arms Latvia, which is struggling hard through the financial crisis, is unlikely to cope with the nuclear construction. It just doesn't have money for this.

One is too few...

Still, not the least intriguing events, adding oil to the flame, have left behind our narrative.

Having realized the corner they painted, Lithuanians tried to struggle EU bureaucrats to move existing Ignalina reactor shutdown dates, but the efforts seem to bring no result. The «struggle» climax was the failed referendum of this year where the country's citizens were supposed to express their attitudes toward Ignalina-2 life extension plans (Lithuanian politicians plotted the people's will should be a weighty argument in the dispute with Europe). In spite of the fact that nearly 90% voted for the plant, the referendum was acknowledged failed. Ballot stations recorded 48% of responders came; the tiny 2% were lacking of to reach the cherished legitimacy threshold but making the voting failed. Causes of this absurd fail are hidden in discords inside the Lithuanian establishment. The lack of unity and short-run interests added with the referendum budget fivefold cutoff derailed the nationwide interest.

The row continues over the Lithuanian operator Leo LT. The company, which was established as the national investor called for to accumulate funds for the nuclear construction, became the key figure in the last year scandals. The process of

its set-up was so veiled that it gave journalists grounds to state unambiguously that «Lithuania's power generation has been sold to oligarchs.» The thing ended up in the Seimas members' voting late September to turn to the Constitutional Court of Lithuania to check on lawfulness of establishing the National Energy Company Leo LT and in the company's president along with a large part of the team's dismissal in mid October.

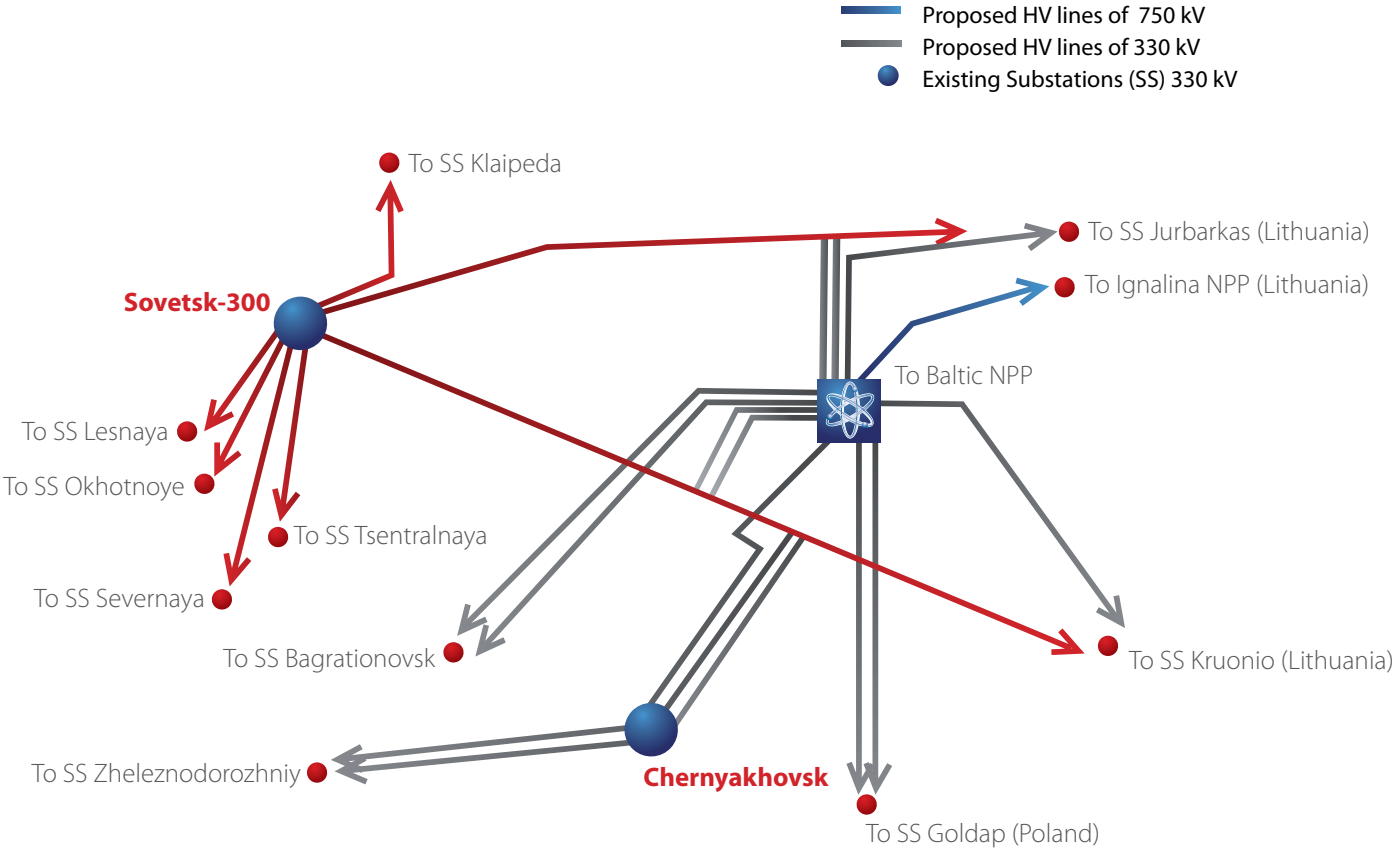
The conflict is expanding between Lithuania and Latvia over the project to build an energy bridge from Sweden to the Baltic States. In spite of the fact that it will take less cable (and, consequently, money) to reach the source from Latvia, Lithuania strongly insists on the option to route the cable across its territory.

All these and many other developments speak about just one thing: by it's awkward efforts to retain the energy leadership in the region, which appears slipping out, Lithuania, in fact, has scared away it's allies and doom-marked all energy-related west-oriented projects. In turn, this pushes the country to Russian hugs it has been running away for so long. After December 31 next year, when the Ignalina's sole reactor is shutdown, the only energy supply option will remain the upgrades of thermal power plants fired with yet the Russian hydrocarbons. As a consequence, cheap nuclear electricity will become the past giving place to costly natural gas-generated energy.

This story may have a quite positive effect on the nuclear build in Kaliningrad Region. The project announced modestly and without fuss by Rosatom this April is gaining momentum. The site selection is nearing completion; a declaration of intent to invest has been signed; the chief designer and developer have been selected. The next move is to put the plant on the general scheme of energy generators deployment.

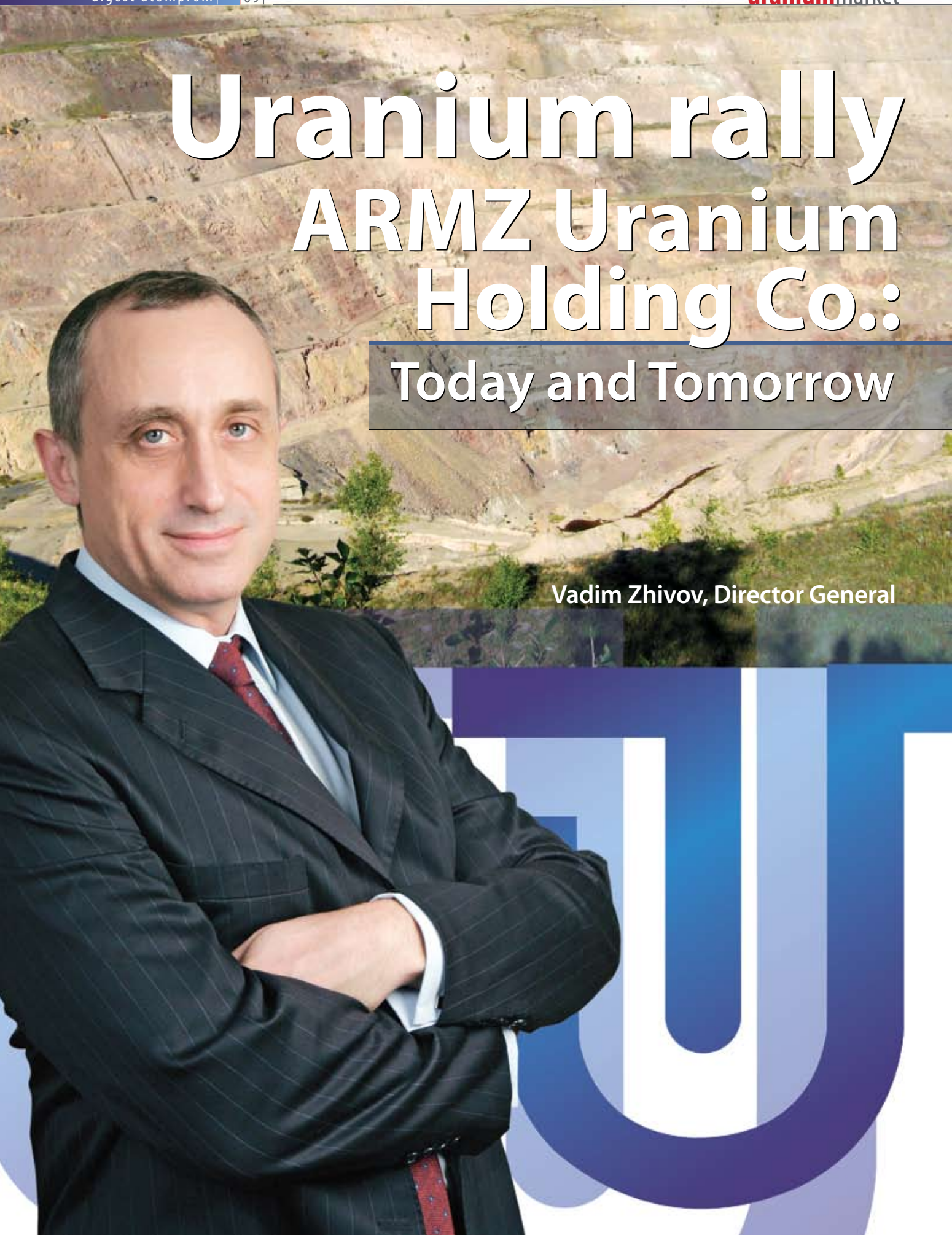
According to the plans, the first reactor of the two-reactor nuclear power plant will be put on line in 2015 with the second to follow in two years. Backed up by the entire range of technologies and required production capabilities added up with a large financial maneuverability of Rosatom and Atomenergoprom, Baltic NPP has all chances to be factually up and running in 2015. Then, in the place of the Russian energy-starving province, the map of the Baltic will show a new key energy player which will assume the role of the energy pillar of the entire region.

Proposals for Electricity Grid Development in Kaliningrad Region



Uranium rally

ARMZ Uranium Holding Co.: Today and Tomorrow

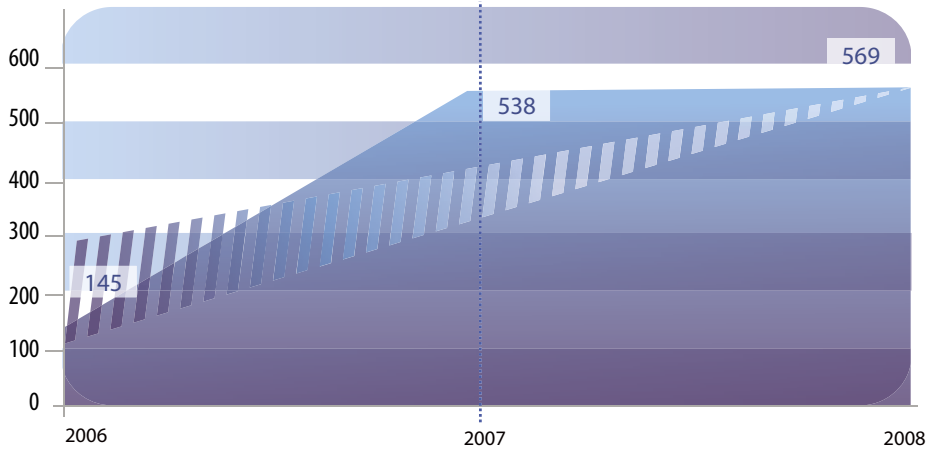


Vadim Zhivov, Director General

Mr. Zhivov, it has been a little over two years since Rosatom's uranium mining assets were brought together to be managed by ARMZ Uranium Holding Co. What has been achieved since – in regard to uranium mining and resource base expansion?

Over a pretty short period, ARMZ Uranium Holding Co.'s achievements in meeting Russian nuclear industry's growing demand for feedstock – which is viewed, by the way, as a mission of paramount importance by the national government – have been indeed impressive in what regards both mining and resource base development.

ARMZ uranium resource base expansion



ARMZ Uranium Holding Co., also known as Atomredmetzoloto, is currently ranked as the world's fifth largest uranium producer. In 2008, ARMZ's uranium output reached 3,687 tons – 3,521 tons produced by mines in Russia (Priargunsky, Dalur, and Khiagda) plus a tonnage supplied by Zarechnoe joint venture in Kazakhstan – which amounted to 8% of the global uranium production volume. This represented an increase of over 8% on the previous year, with the ARMZ overall uranium output growth of more than 15% in the last two years.

We have also substantially increased our uranium resources, a condition sine qua non for ARMZ production programs. Owner of 569 thou tons of U resources, the company has now firmly established itself as number two globally by its resource base through active exploration and new license rounds in Yakutia and the Trans-Baikal Region with the overall resources amounting there to about 400 thou tons, and thanks to a recently expanded presence in Kazakhstan's uranium resource base.

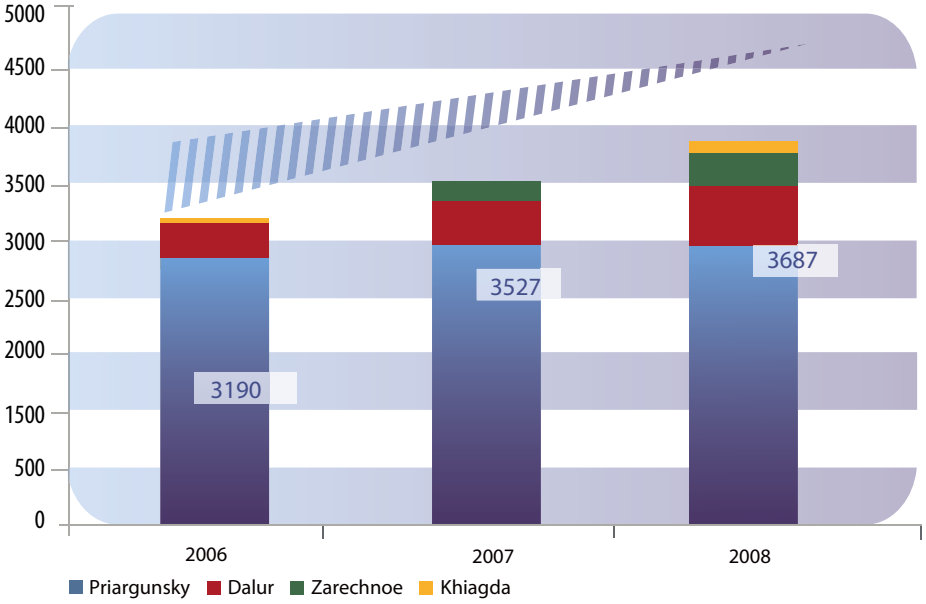
In early 2009, ARMZ Uranium Holding Co. acquired Effective Energy N.V., the owner of uranium assets in Kazakhstan (shares in Karatau and Akbastau joint ventures), in a decisive move to diversify the uranium resource base through purchases of quality assets abroad.

Has the company structuring now been completed?

Basically, yes, it has. By the end of 2008, we succeeded in shaping both production and infrastructural layouts of ARMZ Uranium Holding Co. We are now also the manager of subsidiaries and affiliated structures including management companies, service providers, exploration, and mining joint ventures at home and abroad, on top of Russian uranium mining daughter enterprises.

Though the number of our affiliates and subsidiaries has been multiplied over the last couple of years, to us, it has not been just a quantitative change. We have been busy – deliberately and meticulously – building a diversified corporation with world-class uranium assets, a company ready to assume a leading position in the global uranium market.

ARMZ uranium output growth by mine



Please clarify what subsidiaries and affiliated companies are currently part of ARMZ Uranium Holding Co. and what is it they do.

As far as uranium mining is concerned, we are talking about mines in operational and development phases (Priargunsky, Dalur, Khiagda, and Lunnoe), ones in planning stage (Elkon, Olovskaya, and Gornoe) in Russia, as well as Zarechnoe and Akbastau joint ventures in Kazakhstan.

Each of the aforementioned mines is one of a kind. ↦

Priargunsky is one of the world's largest uranium-mining complexes. Over the years of its existence – we celebrated Priargunsky's 40th anniversary last August – more than 130 thou tons of uranium, the world record for a uranium mine, has been produced. Priargunsky's existing resource base, though, is sufficient to provide for most audacious production plans.

Dalur is Russia's first and yet only operating uranium mine using a highly efficient and environmentally friendly in situ leach (ISL) mining method. Its output has been growing dramatically, and Dalur is sure to become one of the global leaders in its segment in a few years, along with best uranium mines located in Kazakhstan, Uzbekistan and elsewhere.

Khiagda is second to none among the best in uranium industry as for its potential and, together with Dalur, capable of assuming world leadership in uranium mining.

Zarechnoe, Akbastau, and Karatau are joint ventures in Kazakhstan with Kazatomprom, our strategic partner. Karatau is slated to reach its nameplate capacity of 2 thou tU/annum as early as 2010, while Zarechnoe and Akbastau are scheduled to produce in full swing by 2015.

Elkon is a one-of-a-kind deposit and prospective mine ranked world's second by resource base. The mine to be built at Elkon will have the capacity of up to 5 thou tU/year.

Lunnoe is actually ARMZ's first uranium mine in Russia where cooperation methods and partnership frameworks are undergoing testing already.

Modern highly efficient heap and block leach methods will be put to use at Olovskaya and Gornoe mines.

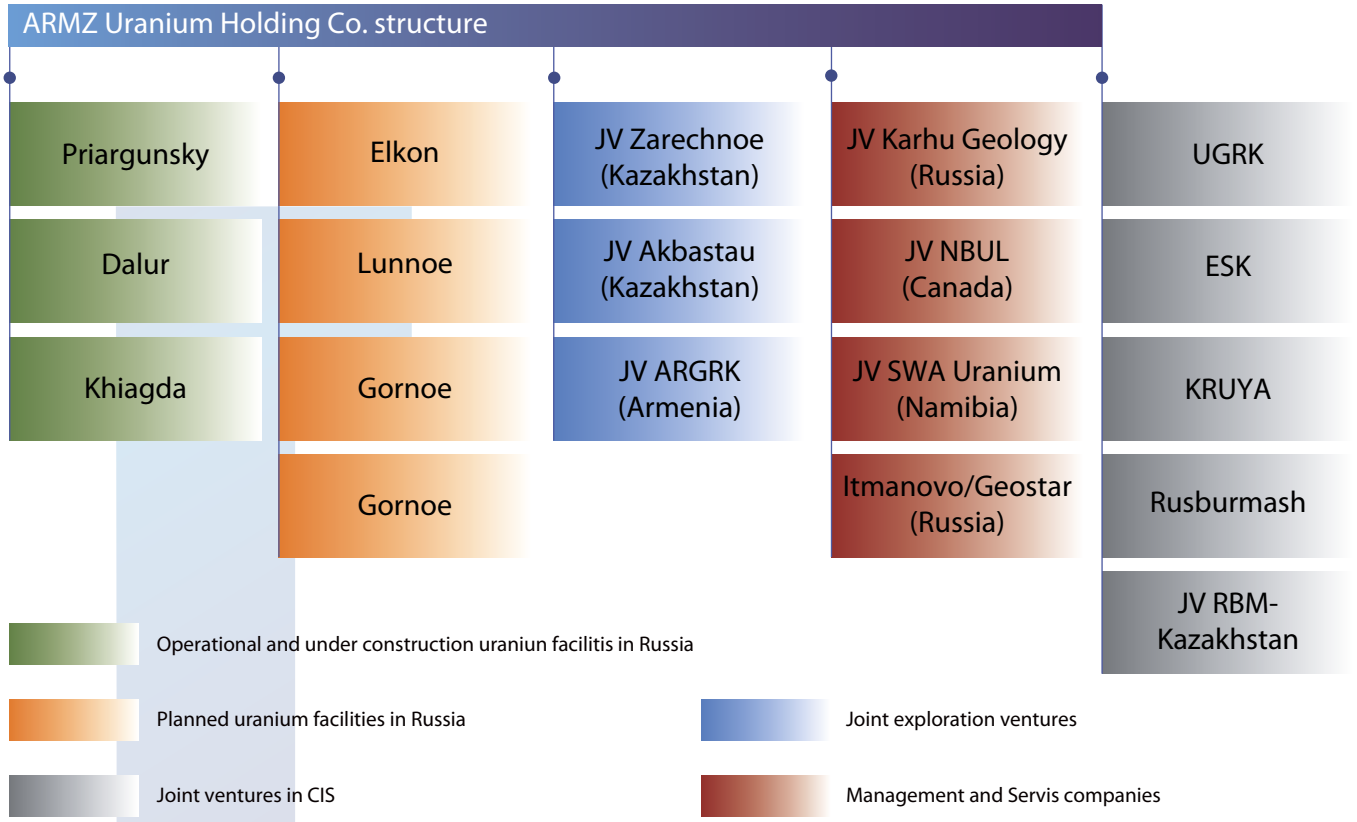
Any news on a huge Elkon field project in Yakutia?

ARMZ Uranium Holding Co. is one of the founders of South Yakutia Development Corporation established specifically to secure financing of the infrastructure of South Yakutia, including infrastructure projects supporting Elkon uranium mine, by the State-run Investment Fund. The Project of Comprehensive development of South Yakutia was included back in 2008 in the official list of investment initiatives to be financed by the Investment Fund of the Russian Federation.

The Elkon Uranium Combine is currently involved in developing Elkon ore mining and processing technologies at a pre-design stage of the project. The plan is to complete, in cooperation with the internationally renowned SRK Consulting, a Pre-Feasibility Study with a view to draw investors in the project and to start design works for the Elkon Uranium Combine.

A couple of words about ARMZ overseas uranium exploration projects.

Joint ventures with partners in Armenia and Namibia - the Armenian-Russian Mining Co. (ARGK) established in cooperation with the Ministry of Energy and Resources of Armenia, and RUNEX joint venture (with VTB and Arlan Investment),



respectively – were set up to diversify uranium exploration and mining project portfolio. Exploration joint ventures have been established with the Canadian Cameco participation – Northern Basins Uranium in Canada and Karhu Geology in Russia.

You mentioned recently that ARMZ Uranium Holing Co. was eyeing Africa as one of the most promising avenues for future development and growth. Why such interest in African projects?

Did you know Africa is the world's oldest uranium mining region with the aggregate historical output in excess of 400 thou tU? Nonetheless, Africa still holds about 19% of world's uranium resources, and the potential for its further development is quite high: an increase of 50% of the resource base over the last two years thanks to intense new exploration attests to that. A significant part of Africa's uranium deposits are amenable to the most efficient mining methods – open pit and in situ leach. Government support of mining projects in a number of African nations plays a role in decision-making.

Based on a solid business strategy for Africa, as well as good prospects of new uranium deposit discoveries on the African continent, ARMZ Uranium Holding Co. have defined country priorities for uranium exploration and mining. Namibia, Botswana, Malawi, Zambia, and Mali are just a few out of a number of countries eyed by ARMZ with considerable interest in Central, Southern, and Western Africa.

SWA Uranium Mines joint venture is ARMZ's pioneer project in Africa. The venture was established last year in partnership with VTB Namibia and Arlan Investment to explore for uranium in licensed tenements. We view our Namibian joint venture as an African pilot project. If successful, all we have to do is just to apply this matrix and expertise elsewhere in promising African projects.

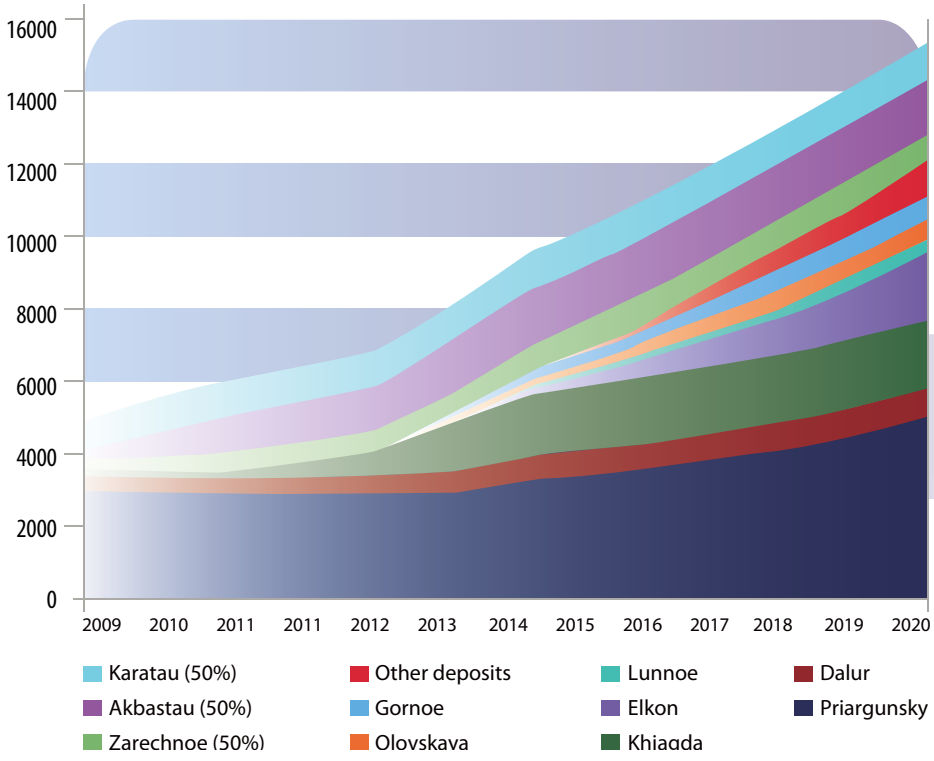
Has the world financial crunch influenced ARMZ plans and activities?

Naturally, the world economic and financial crisis affects us in a certain way, but I have got to say that ARMZ Uranium Holding Co. has an important competitive advantage in the current situation: it is part of Rosatom State Corporation and therefore is always supported by Rosatom and AtomEnergoProm – the corporation controlling Russia's civil nuclear activities.

The financial squeeze has encouraged us to assess ARMZ's real potential, to start looking for ways to effectively employ existing resources, cut production and management costs in mining centers and service companies. Thanks to the crunch, the business is forced to bring production cost down and ramp up productivity and efficiency through applying advanced techniques and materials, deployment of modern mining equipment.

On the other hand, the financial crisis provoked a sharp decline in equity markets and resulted in a drop in the value of primary uranium producers and junior companies. It is time to buy, as I said in a recent interview. ARMZ saw and timely grasped this opportunity as we purchased uranium assets ↦

Uranium production forecast, 2009-2020, tU



of Effective Energy N.V.: the move has allowed us to double the amount of quality reserves and resources in Kazakhstan (up to 31 thou tU and 60 thou tU, respectively) and to increase our future output to 4,5 thou tU/year when the mines reach their rated capacity.

A few words on ARMZ short and long-term production targets, please.

Long-term, we pursue global objectives, such as strengthening the Company's position in the world uranium market, securing ARMZ leadership in natural uranium production, and ensuring Russia's energy security in the future.

ARMZ Uranium Holding Co. has plans to become a world's leader in uranium production by ramping up its U output to 20 thou tU/year by 2025. Our production targets are supported by the long-term uranium demand forecasts for the part of Russian and world nuclear industries.

ARMZ Uranium Holding Co.'s 2009 production target is 4,510 tU to be reached largely through an increasing output of mines in Kazakhstan. The 2015 forecast currently stands at 9,500 tU.

Would you expect the Russia-Japan Agreement For Peaceful Nuclear Cooperation to affect ARMZ activities?

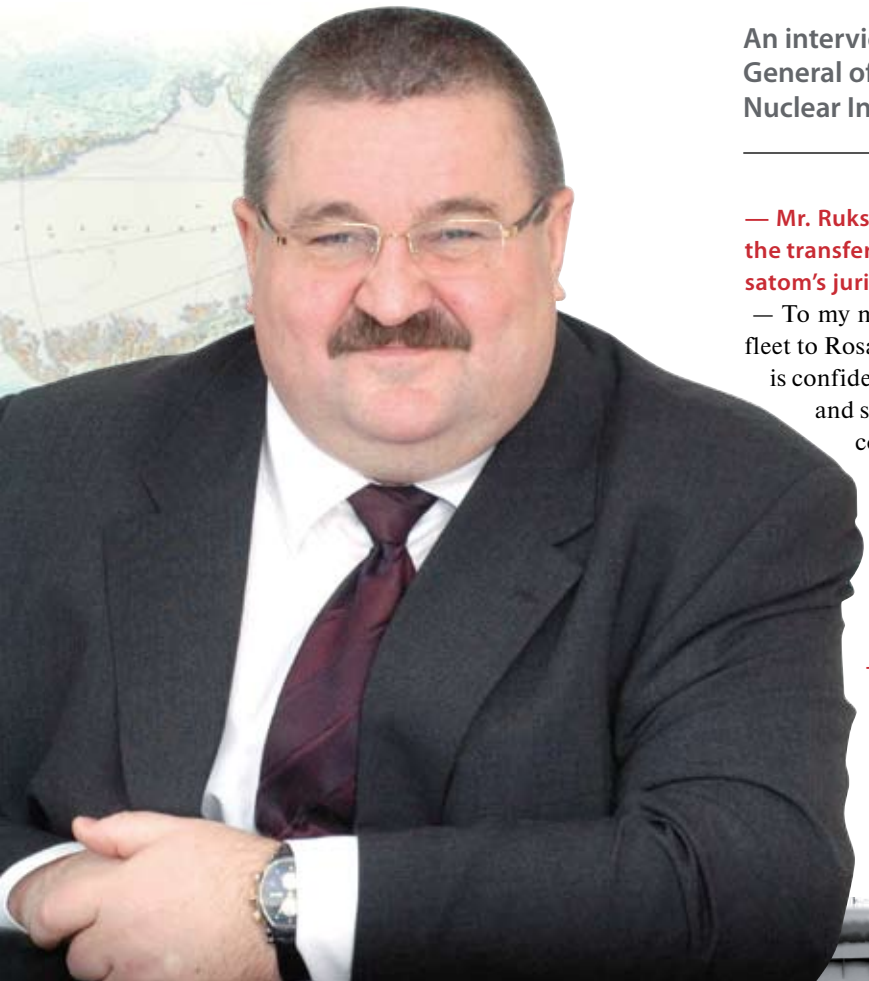
Exploration for uranium and development of uranium deposits is one of the cooperation avenues envisaged in the said Agreement. ARMZ Uranium Holding Co. has been talking about joint development of uranium deposits to a number of foreign corporations, including Mitsui of Japan. Hopefully, future success in bringing joint projects to fruition will encourage further mutually profitable steps to supply Russian and Japanese nuclear power facilities with strategically important feedstock.

Uranium production forecast, 2009-2020, tU

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Priargunsky	3000	2910	2940	2920	2950	2950	3290	3480	3760	4050	4430	5000
Dalur	460	460	460	473	510	590	680	700	730	750	800	800
Khiagda	150	150	150	350	650	1300	1610	1750	1800	1800	1800	1800
Elkon							200	400	700	1000	1500	2000
Lunnoe						60	60	60	130	180	180	180
Olovskaya						100	200	300	400	600	600	600
Gornoe						100	200	300	400	600	600	600
Other deposits								100	300	500	700	1000
Zarechnoe	240	380	500	530	550	600	750	780	780	780	780	680
Akbastau	116	500	900	1100	1150	1350	1500	1500	1500	1500	1500	1500
Karatau	700	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

The Rulers of the Arctic Seas

Today only Russia can operate without concerns for its success during ice escort operations.



An interview with Vyacheslav Ruksha, Director General of Atomflot and «Person of the Russian Nuclear Industry, 2008».

— Mr. Ruksha, let's look back at 2008, what was the reason for the transfer of the nuclear fleet to Atomflot and Atomflot to Rosatom's jurisdiction?

— To my mind, the transfer of the nuclear-propelled icebreaker fleet to Rosatom is a timely and logical process. The Russian state is confidently gaining economic potential and its drive to regain and strengthen the country's positions in the Arctic has become more prominent. The civil nuclear fleet plays a key role in this process. It's quite logical that, in the first place, it should support and secure national interests in the Arctic Region and act as a promoter of the coordinated government policy, which has large-scale prospects.

— After the transfer of the nuclear fleet to Rosatom what problems have you already solved?

— Owing to Rosatom's support we have received multi-million subsidies from the state budget, which we used not only to solve current financial and operational issues but also to raise wages for our employees. ↦

Today, in the nuclear icebreaker fleet the average wage is nearly equal to the average wage in the tanker fleet (which is one of the highest paid sectors of the commercial fleet) and exceeds 38,500 rubles per month.

The amount of state support is justified and stipulated in the federal budget; in 2009 it will be 1.8 billion rubles. The federal budget will allocate another 4.5 billion rubles in support in 2010-2011.

Such support is invaluable in the current economic crisis. But it is not just about the money we received; it's also about trust.

And this trust is extremely high, to say nothing of the mutual understanding between our partner-companies in the nuclear complex. Now, everyone is working within a unified system and is committed to the common end results.

— How is the icebreaker fleet to be renewed?

—The renewal process is a continuous one. If there is a new departure, there is always a new arrival. The same is with us. Here's a plain example. Our nuclear icebreaker Arktika has operated successfully since 1975 - that means 33 years. When she was 30 years old, she operated fail-free for an entire year in the Arctic without visiting the base. Therefore, we hope to keep up with this particularly high standard of safe operation in the future. We have to be ready with replacements by the time the old icebreakers are to retire. As you know, a design of the third generation icebreaker is to be available by 2010; central design bureau Aisberg has been working on it under State Corporation Rosatom's order. This will be a double-draught icebreaker of a new type, capable of sailing through the multi-meter-thick ice of the Arctic Ocean and approaching Siberian rivers. As Sergey Kiriyenko said, «we don't need a one-off product, we need a series of new generation icebreakers to strengthen our positions in the Arctic Region.» The cost of the building of

the lead ship is estimated at about 17 billion rubles and should be finished within a record timeframe, by 2015.

— What are the tasks pending?

— Today, the nuclear-propelled icebreaker fleet is getting ready for a new navigation season and drafting legislative amendments to the Arctic Maritime Law; we expect the Government to agree with our proposal to introduce an Arctic charge and a compulsory charge for navigation of ships through ice via the Northern Sea Route, whose water area is to be broadened. These measures will lay the basis for the nuclear-propelled icebreaker fleet's own revenues, but the state will provide us with financial support until then.

— At present, there is a rather serious problem, which is the lack of workload for the nuclear-propelled icebreaker fleet. Only one fifth of the ships' potential is utilized. This is specifically true of ships in the Northern Sea Route. How is this problem going to be solved?

— Our icebreakers are capable of supporting 10 to 15 million tons of freight traffic via the Northern Sea Route. Today, our freight traffic amounts to just 2 million tons.

We also have to take into account the building of new supermodern ships to the double-action technology. For instance, Sovkomflot has built three huge tankers using this technology under Lukoil's order for the Varandeiskiy Oil Export Terminal. Also, a series of ships – Arctic express ships – were built by Norilsk Combine. Owing to the activities of these companies we can confidently and clearly estimate high workload prospects for the nuclear icebreaker fleet for the marine transport constituent of Yamal Peninsula. It seems to me that Yamal Peninsula will make headlines in the upcoming 2-3 years. I wouldn't even dare to forecast on the development pace there, it may turn out to be much higher than we expect. Speaking of Russia, I think we can effectively develop Eastern Siberia and the Yamal Peninsula.

It seems to me that there are freights already now, which could be sent via the Northern Sea Route as transit shipments. In the first place, these are container and tanker cargoes. A sufficiently large cargo and expensive shipment allow the ship to save time and fuel. And this is certainly of interest to both the ship owner and icebreaker owner.

— What is your judgment of the Russian icebreaker fleet as compared to similar ships of the USA, Canada?

— They may set off to the North Pole during the summer season but the result is unpredictable; they may break a propeller blade as has already happened and our Yamal (nuclear icebreaker) brought them back. Our advantage is that we go to the North Pole nearly dead on time in the summer season. To tell you the truth, once even Yamal failed to make it out there in summer. In the Arctic, one of the main problems is wind blowing all the time, rather than ice. I think that today only we can operate in the Arctic without concerns for our success during ice escort operations.

Therefore, I will re-emphasize, the new generation icebreaker should be available in due time, but we'll see how many there will be – 2, 3 or 5.

Here comes, «Kudankulam»!

By Tatiana Klein for Vestnik ATOMPROMa

Kudankulam nuclear power plant in Southern India has started the commissioning stage. This power generation project, which is of great importance to both Russia and India, employs the most advanced Russian nuclear technologies and takes account of the climatic conditions of the location of where it will operate. The plant can be rightfully called unique, as I discovered during a recent visit.

Field report

Flowerbeds in front of the administrative building, a bunch of dragonflies in the air, unusual birds on palm trees. The Kudankulam NPP Construction Directorate, headed by Yevgeniy Dudkin, is on the third floor. Yevgeniy has worked for 30 years at nuclear power plants in Russia and Ukraine and has been building the Kudankulam NPP for the past four years. He gave me a safety-at-work briefing, a hard hat and an outline of the work progress.

Start-up work is underway at control systems, electrical and process equipment and water treatment facilities, which have been supplied by JSC Atomstroyexport and installed by Indian specialists. The seawater desalination facility has been adjusted and started; now it is ready to supply processed water for the plant's needs. The next stage is to purge the water treatment processiing systems, followed by integrated adjustment operations, production of desalinated water and its accumulation for flushing the reactor process systems. At the same time, installation works are progressing at full speed. The construction is nearing completion.

«You'll see everything for yourself,» Yevgeniy concludes as he presents me my guide, Vladimir Zhludenko, head of planning.

The bird's-eye view

The size of the construction deployed on the Indian Ocean coast is impressive. The work goes on at every single spot. Sparks fly, machinery moves and equipment is installed.

My guide Vladimir keeps reminding me to watch my step.

An assembling crane arm rests near the first reactor building. Nearly all the large-size equipment of the first reactor has been installed and now Indian workers are replacing the arm to get the trestle crane up to elevation 52. This crane will be used to transport heavy equipment for reactor repairs and nuclear fuel for refueling.

The wall-climber takes us to the trestle of the first reactor unit. Elevation 52. The plant site is as plain as the nose on your face; the ocean is in the background, embracing a huge hemispherical temporary dam, bridge and flood control structures. The temporary dam has been erected to allow the hydraulic structures to be built. It will be disman-

tled when the work is completed. Underneath, people are tiny, wearing different-colored hard hats. They are mainly Indian workers.

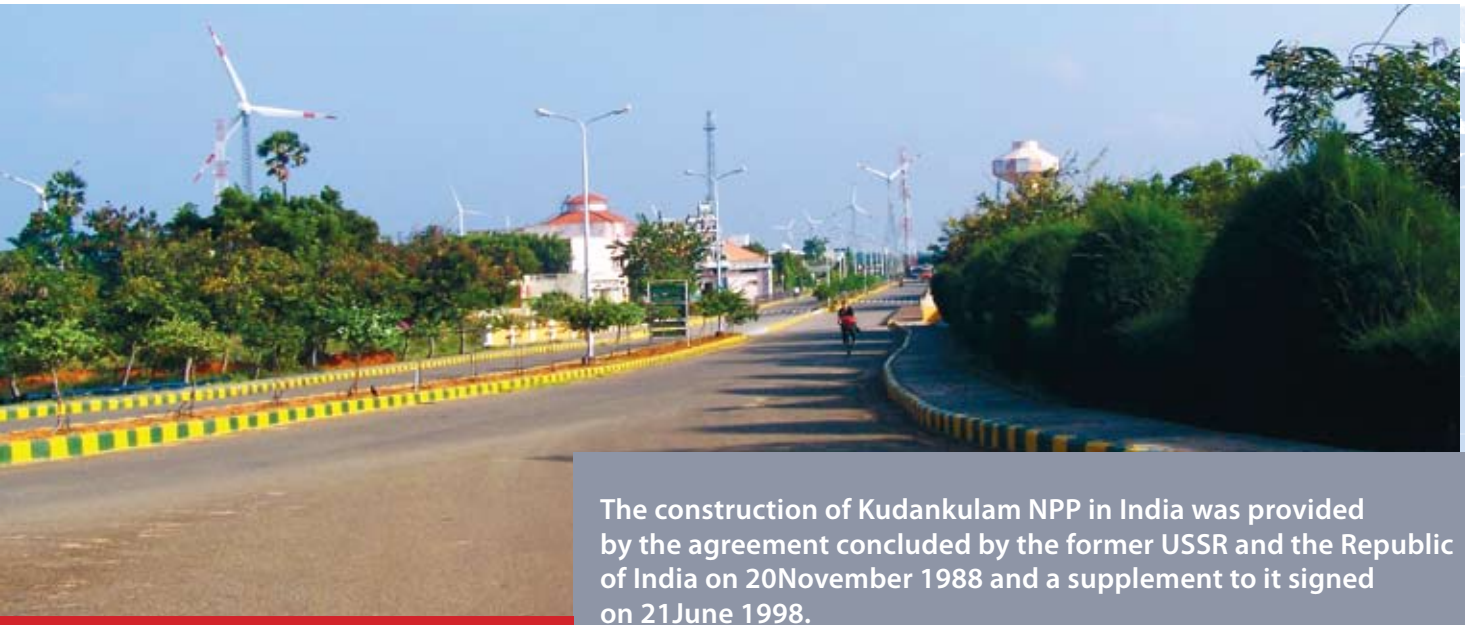
This bird's-eye view of the site reveals every single building. The civil works are nearly finished. According to the engineering design, one million and fifty cubic meters of concrete should be poured on the site; some one million and forty cubic meters have been put in so far. Ramps and underground tunnels to hide hundreds of kilometers of pipes have been built.

Looking towards the ocean, you see a picturesque curve of the Gulf of Mannar coastline on the left. There is Tutikorin Seaport somewhere there, which receives equipment for Kudankulam arriving from St. Petersburg Seaport. Atomstroyexport has already shipped off 44 batches equipment totaling to over 100,000 tons; most of this equipment has already been installed. On the right, seventeen kilometers away from the site, there is the most beautiful view of the Indian Peninsula hosting Kanyakumari City on the ocean's coast.

Under the dome

The next site to see at the first reactor unit is elevation 31.7, the reactor's central hall. Under the containment dome the inner walls are lined with metal. On the top there is a polar crane that helped install the equipment. The reactor is below; only a part of its head can be seen. The refueling machine will be placed over the hold-up pool; it is being installed. At this elevation there will be a transport airlock that will bring the equipment in and out during scheduled outages for preventive maintenance of the reactor. The 350-ton airlock was delivered to the site last fall; the producer is JSC Izhorskiye Zavody.

Atomstroyexport has supplied nearly all the major equipment for the reactor hall which Indian engineers and workers →



The construction of Kudankulam NPP in India was provided by the agreement concluded by the former USSR and the Republic of India on 20November 1988 and a supplement to it signed on 21June 1998.
According to the contracts signed by Atomstroyexport and the Nuclear Power Corporation of India Limited (NPCIL), Atomstroyexport's commitments include the development of the working documentation, supply of equipment and materials, follow-up of construction of the plant buildings and structures, technical support during commissioning, and training of operating and maintenance personnel at Russian enterprises and nuclear power plants. The Indian side is responsible for the construction, installation and start-up works on the plant site.
In September 2008 the Nuclear Suppliers Group lifted its constraints on supplies of nuclear materials and technologies to India. On 5 December 2008 Russia and India signed the agreement to build four new reactors at Kudankulam nuclear power plant site and to cooperate on other sites.

are currently installing. Atomstroyexport staff and consultants along with the designer (Atomenergoproekt Moscow) and the equipment producers' personnel are working at the reactor unit.

I managed to take a close look at the containment - the double envelope of the reactor building. The thickness of its metal and concrete walls is noteworthy. The double envelope means double safety. The inner shell will prevent propagation of radiation outside and protect the environment, while the outer shell secures the reactor hall against natural disasters and man-induced accidents that could hypothetically happen outside like strong winds and hurricanes, shock waves, earthquakes, floods and even aircraft crashes.

Extra safety systems

Double containment, a core melt trap under the reactor, four trains of safety systems in case the plant loses power fully or partially due to an abnormal event - all these were used for the first time at the Tianwan NPP released by Atomstroyexport to the Chinese customer in 2007. All these systems are also used at Kudankulam. Unlike the Chinese plant, however, the Indian project features a number of other systems that bring Kudankulam to an even higher safety level.

For instance, PHRS air pipes (passive heat removal system) have been laid on the outer shell dome of the reactor containment building. These pipes are clearly seen from below and look enormous if you are close to them. Soon, they will be hidden behind the third dome that is being filled with concrete. As construction of the third dome progresses, its «collar» and «cap,» are becoming more notable, making it look rather unusual.

The PHRS ensures continuous removal of residual heat from the reactor's core in case of blackout accidents with the primary circuit being integral and in case of primary or secondary pipe breaks. The PHRS is triggered automatically. Steam is cooled down and condensed by natural airflow running through the heat exchanger. Cooling air comes in from the atmosphere outside the containment. In heat exchangers, cooling air takes away heat from steam and, via air ducts, goes to the upper part of the third dome and then into the atmosphere.

Kudankulam's higher safety is ensured also by an additional low-pressure water tank system, located in the central hall of the containment. Each of the eight tanks contains 120 tons of borated water. The system is designed for passive boron solution supply to the reactor's core to remove residual heat and keep the core sub critical in case of a primary leak during the unit blackout, including the failure of the diesel generators. The system

design employs passive control of boron solution flow to the core.

One more entirely new process system featured at Kudankulam is the fast boron injection system. The system is intended to render the reactor's core sub critical by injecting a concentrated boric acid solution into the primary circuit together with the emergency boron injection system if the reactor's emergency protection fails.

The implementation of the above systems aims at improving safety of Kudankulam as a whole.

In the turbine hall

Finally, after the containment's central hall, we visited the turbine hall.

«These are the engineering utility premises. These are coolers. And those are compressors. The adjacent buildings are the ventilation section and the separate one is the turbine oil system building. Turbine hall layouts are nearly all the same everywhere. In other words, the condensers are under the turbine, the pumps are there as well and a turbine hall length is determined by the length of turbine,» Zhludenko tells me.

We go up and enter the nosiest place of any nuclear power plant, the turbine hall, and today is no exception. He turbine assembling is in progress; there are many Indian workers guided by Russian specialists.

When Vladimir tells me something, I clearly hear each word. I shout, he speaks, that's the mode. Later, I am told Zhludenko had worked for eight years in the turbine hall of the Zaporozhie NPP where he «taught» his voice.

The turbine was manufactured at the Leningrad Metal Works (LMZ), which is a part of Power Machines. LMZ has many years of experience in design, manufacture, installation and operation of steam turbines. The company has developed 115 types of turbine generators; LMZ has supplied steam turbines for nuclear power for 25 years. It employs modern structural materials in turbine designs, including stainless steel and titanium. LMZ designers continually improve their turbines. For example, a new design of the turbine bypass valve with a hydraulic drive, which was used for the first time at Tianwan turbines in China, has performed well during this operation.

This was the end of our tour. On the way to Atomstroyexport's representation office, I came up to a white sculpture in front of the administrative building, which has become Kudankulam's «trademark.» I had seen it many times in pictures; it reminded me a woman frozen in an odd dance move. Here, looking at it more closely, I saw quite a different thing: a powerful light beam shooting up to the skies, a symbol of reviving energy which will be brought to Tamil Nadu State by the high power and safe plant built according to Russian technologies.

They warned me: you won't see everything with your eyes in India. To understand, you have to feel with your heart.

Russia regained European fuel market

Dmitry BOBKOV, especially for Vestnik ATOMPROMa

JSC MSZ, a part of TVEL Corporation, is accustomed to visits from foreign delegations. However, the delegation that visited the plant on 17 November 2008 was a special one, indeed. Elektrostal Town in the Moscow Region received top managers from Slovakia's Slovenské Elektrárne, a.s. who came to sign a contract with JSC TVEL for nuclear fuel supplies to Slovak nuclear power plants.

The existing contract with the Slovak utility Slovenské Elektrárne, a.s. signed in December 2003, covers nuclear fuel package supplies until 2010.

Negotiations on the new deal started in April 2007 and lasted nearly a year and half, hardly surprising since the contract price is nearly half a billion euros. Sergey Kiriyenko, SC Rosatom's director general, personally informed Prime Minister Vladimir Putin about the signed contract at a Russian Government Presidium's meeting.

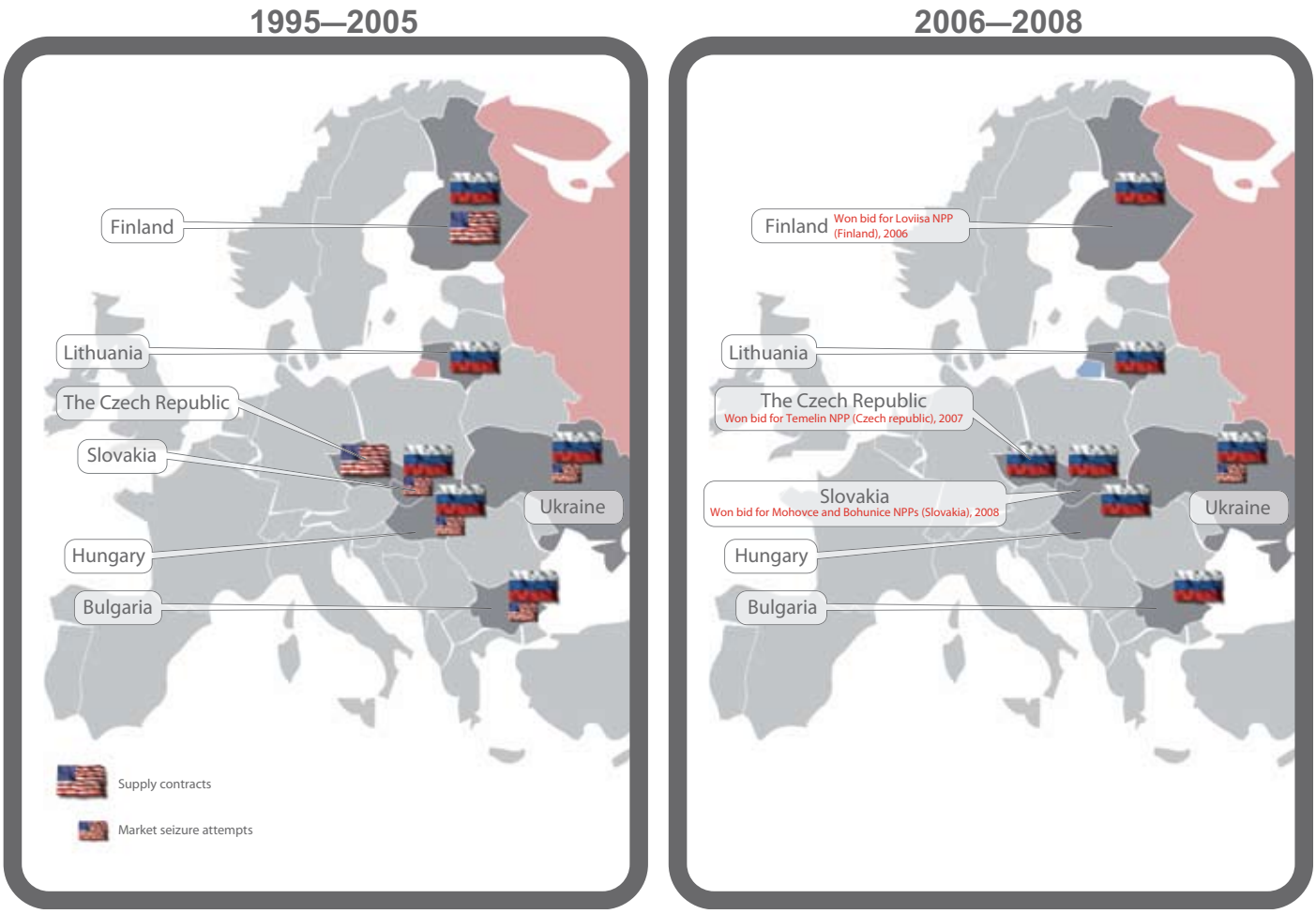
TVEL Corporation made its technical and commercial offers to Slovenské Elektrárne, a.s. as far back as 2007. At the same time, the Slovak company received an offer from American nuclear fuel producer Westinghouse. As a result, the Slovak company gave preference to TVEL whose terms and conditions turned out to be more beneficial than those of the Americans.

The nuclear fuel supply contract for the Mohovce (the 1st and 2nd reactors) and Bohunice (the 3rd and 4th reactors) nuclear power plants, signed on 17 November 2008 will come into force in October 2010 and remain in force until 2015. Therefore, TVEL remains the sole supplier of VVER-440 reactor fuel in the world.

In addition to the contract of 17 November between TVEL and Slovenské Elektrárne, a.s., an agreement was signed to define the principles of the cooperation beyond 2015. TVEL Corporation will fabricate nuclear fuel for all existing and planned nuclear power plants in Slovakia. According to Sergey Kiriyenko, the agreement provides for an option of fuel supplies (cost EUR4bn) over the entire period of operation for the Slovak reactors. «We have prevailed over Westinghouse in an open competition and have fully regained the market of Eastern Europe», he added.

The documents were signed by JSC TVEL's president Yuri Olenin on the Russian side and the chairman of the board and general director of Slovenské Elektrárne, a.s. Paolo Ruzzini on the Slovak side.

«Today, we have made an important and extremely serious step; we have signed the agreement to prolong the contract for five more years. I am sure this is the beginning of a new stage of cooperation; a new starting point for the development of long-term strategic cooperation beyond 2015», Olenin said. «Any nuclear fuel supply agree- ↦



ment requires thorough technical work; there are a lot of parameters which ultimately define the final cost of a contract. This is a feature of hi-tech production». On his part, JSC TVEL's vice president Vasiliy Konstantinov declared «the agreement reached is of a mutually beneficial nature».

The head of the Slovak delegation, Paolo Ruzzini, visited the Mashinostroitelny Zavod for the first time. That is perhaps why the visit to the fuel assembly bundling section, initially planned for just forty minutes, lasted nearly two hours.

«I am fully confident that we are working with a truly reliable partner who is keeping up with the times and possesses highly competent staff and the latest equipment. The TVEL Corporation's enterprise has good prospects», he said at a media conference held at Elemash (another name of MSZ).

The Slovak Bohunice and Mohovce nuclear power plants were built to Soviet designs and put on line in 1978 and 1998, respectively. Since their start up, fuel for the four VVER-440s of Bohunice (now only two reactors are in operation) and the two VVER-440s of Mohovce has been supplied by TVEL Corporation's company –JSC Mashinostroitelny Zavod.

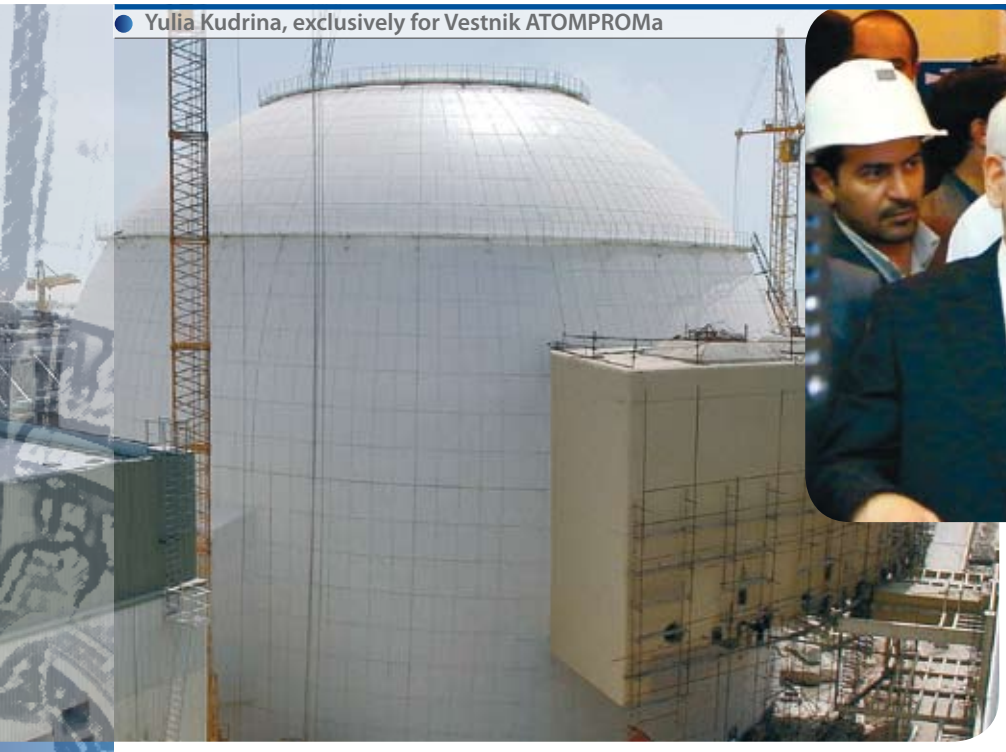
«This agreement is very important for JSC Mashinostroitelny Zavod; it is not just one more profitable contract but a sign that we are trusted. It is a matter of principle that the Italian company Enel, which acquired a 66% share in the Slovak utility several years ago, has not changed the supplier. It speaks of the high profile and irreproachable reputation of Elemash», JSC MSZ's director general Oleg Kryukov told Russian media.

Today, the nuclear share of the Slovak energy mix is 57.2%. It is easy to imagine how important the new contract with TVEL was for this Eastern European state. And it was no less important for TVEL – and Russia as a whole – as it represents one more major international success for national nuclear technologies.

IRAN'S nuclear pearl

First, we see a hot desert, nearly barren, nearly lifeless. Bushehr city and seaport are left behind. Then, the dull landscape alters, and we notice rare fishing villages. The Gulf strand can barely be seen far on the horizon. On the surrounding hills, some half-hidden and some in clear view, are antiaircraft guns and radars. They appear to grow in number as we approach our destination. In this desert the abundance of military gear confirms the significance Iran attaches to its first nuclear power plant, Bushehr.

Yulia Kudrina, exclusively for Vestnik ATOMPROMa



«We are at the final stage of the work and I'm very pleased with this. But on the other hand, I realize, it's early for us to relax yet,»

SC Rosatom's Head.

Bushehr Province sometimes is compared to our Siberia, only the other way round; there is awful heat for three-quarters of the year as opposed to our frosts ,which the Russian specialists are more accustomed to. Incidentally, in ancient times Bushehr was the place Persians sent their most dangerous criminals to serve penalties, specifically because of the harsh climate. But that's history now. During winter, air temperatures range between 20 and 25 degrees Celsius. As the Iranian New Year approaches (the festivity is usually celebrated around the middle of March) temperatures begin to rise and will reach 50 degrees and higher by July-August. No one swims in the sea because the water is too hot. People tend to go outside as rarely as possible; high capacity air conditioning is binding for public buildings and transportation.

Russian specialists live in a town called Morvarid, which means «Pearly». The former name of the nuclear workers' village is no less poetic, Niruga, which translates to «The Source of Light» or «The Place of Power» or in any case, something related to power generation. Morvarid is a town packed with single-

Bushehr (or Bushihr) is one of thirty Iranian provinces. It is located in the south of the country on the Gulf coast. The capital is the city with the same name. The province hosts the country's second significant seaport and a large industrial area featuring the world's largest natural gas deposit, South Pars. Many western companies operate in this region, including Americans, despite its government's sanctions.

floor buildings erected more than 30 years ago. Atomstroyexport is negotiating to build new houses for specialists who will operate the nuclear power plant.

Still, it has everything required for normal living: stores, schools, gyms and swimming pools. Streets are named customary to the Russian ear: Green Street, Park Street, Engineering Street. Morvarid is belted by a huge fence and is divided in two halves, Russian and Persian. Exit is guarded by local police officers known as Harasat. On the checkpoint wall, a notice is pinned explaining the compulsory women's dress code in Iran: long dress or coat and hijab (an traditional Iranian headscarf covering the hair).

Bushehr construction was started in 1974 by German concern Kraftwerk Union A.G. (now Siemens). However, the German contractor terminated this deal after the Iranian Revolution in 1980 to obey the German government's decision, which supported the U.S. embargo on equipment supplies to Iran.

A decade later, in 1992, new life was breathed into the project when Russia became involved. First, a framework agreement was signed (i.e. the intergovernmental agreement concerning the cooperation in peaceful uses of atomic energy) and in January 1995 the parties concluded a contract providing for Bushehr construction completion by Russian specialists. In another three years Atomstroyexport was entrusted to manage the plan to start a new project completion countdown.

One of the client's wishes was to use as much as possible of the equipment supplied to the site by the former contractor. Russian specialists agreed, though they now admit it would have been easier to build the plant at a separate site and from scratch. There is not - and will never be - a second plant like Bushehr in the world. To integrate some 12,000 tons of the German equipment into the Russian design and adapt Russian technologies to the infrastructure already available on site, the designer-engineers had to invent, develop and deploy many «clever» engineering solutions and know-how.

The project is based on a V-446 reactor with a 1,000 MW capacity. Its near twin operates at the fourth unit of Balakovo nuclear power plant, one of the most efficient plants in Russia. At Bushehr, construction and installation is mainly carried out by Russian subcontractors. Iranian companies were also involved in the project through bidding. However, this part of the project is history now, and the commission stage has started.

It is not immediately clear why Iran needs such power capacity in the region. There are just a few villages - Bandarga, Khalele and Sadaf with 1,500 - 2,000 residents near the plant. The local trade is mostly related to fishing and aimed at local consumption. There are no large cities or industries close to the plant. However, a large industrial center is located near Assaluyeh City, just a few driving hours away. In particular, the South Pars natural gas deposit, the world's largest, is there. Bushehr power will allow Iran not only to diversify its energy mix, but also to designate more of its natural gas to export, which is more profitable.

At present, the construction of Iran's first nuclear power plant has entered its final phase; however, just some years ago there were many reasons to doubt whether the plant would ever be started up. In fear of the Iranian nuclear program, western countries tried to hinder the project seeing it as a threat to the nuclear nonproliferation regime. These problems were put to rest in 2005 when Russia and Iran signed the additional protocol to the intergovernmental agreement on plant construction to secure Iranian commitments to return spent nuclear fuel (SNF) to Russia. Today, even devoted skeptics from the USA confirm that the nuclear power plant in Bushehr Province is intended exclusively for peaceful purposes. Evidence of this is the fact that this project is not subject to the UN Security Council's sanctions imposed on Iran after the country yet again refused to suspend its program to master uranium enrichment technology. Moreover, experts and dip- →

lomats believe the Bushehr construction is a pattern of how the nonproliferation regime works in reality.

However, even after the parties agreed on SNF return, the plant's commissioning dates were shifted several times. In September 2006 Russia and Iran announced that the plant's first criticality was to be achieved in a year's time and the first power and connection to the grid would take place in November 2007. However, two months had hardly passed when Iran nearly stopped paying for the project and on-site Iranian construction management changed. Guidelines built up by the UNSC resulted in problems with supplies of certain equipment from third countries. To avoid losing the construction pace, Atomstroyexport even had to loan. It took more than a year just to settle the payment problem.

These difficulties were mainly overcome. In late January 2008 the first reactor fuel charge was delivered to the plant site in seven air batches. That made a total of 90 packages with 180 fuel bundles (163 main and 17 spare) containing about 88 tons of low enriched uranium. The fuel was fabricated by the Novosibirsk Chemical Concentrates Plant (NCCP). Presently, the fuel is kept in a special on-site storage facility under IAEA seals. The Agency's inspectors have checked the fuel bundles safeguards several times already. The physical protection of the facility is assured by the Iranians while storage conditions are the responsibility of the Russian contractor. IAEA experts are expected to survey the fuel loading in the reactor as well.

However, this should be preceded by pressure tests involving dummy fuel bundles, which are filled with lead instead of uranium. This stage is part of the so-called cold and hot runs; it started on 25 February 2009 when a Russian delegation led by SC Rosatom's director general Sergey Kiriyenko visited the construction site. Following the runs, all reactor equipment will be thoroughly inspected; this stage will take at least one month. Then, the fuel loading can be started. One year after the startup, one third of the fuel bundles will have to be taken out of the reactor and placed in

Iran's energy system (except for Bushehr NPP) is united by the public holding Tavanir, which coordinates generation, transition and distribution of electricity in the country. Private generation amounts to only 2% with the rest controlled by the state. Of that, nearly 95% of the electricity output rests with 53 thermal power plants fired mainly by natural gas and 17 hydro plants. The latter have a 6-10% share in the country's energy mix. Iran develops wind and geothermal power and has plans to use solar energy.

The main electricity consumers are the general public who utilize about 33%; industry, agriculture and the public sector buy nearly the same amount, about 12% each; the rest goes for street lighting. In recent years electricity demand has been steadily growing by 8%. Iran also supplies electricity to Afghanistan and Pakistan; it has connections to Turkey and Armenia and plans to arrange for cross-border trade with Tajikistan, Turkmenistan and Uzbekistan.

Still, Iran's main treasure is hydrocarbons. It has 10% of the world's proven oil reserves and holds top second in natural gas reserves (15%) after Russia.

Data is by Wikipedia and http://www.energospace.ru

Loading of dummy fuel bundle

«It is Bushehr which is the real anchor keeping Iran within the nuclear weapons nonproliferation regime,»

Sergey Lavrov, the Russian Foreign Minister

er batch of fuel has to be delivered from Russia to Bushehr at that time. Commenting on his recent visit to Bushehr, Kiriyenko told journalists that a long-term contract for Russian nuclear fuel supplies to Iran for ten or more years could be signed soon. SNF unloaded from the reactor will be stored under water in the hold-up pool for three to nine years and then returned to Russia. «We proceed from the fact that if there are no unforeseen circumstances, and we are dealing with integrated, old

SNF hold-up pool

equipment, the start up should be as scheduled,» Kiriyenko said. The Head of Rosatom was reluctant to give specific dates, but said that the Bushehr start-up procedure is the standard one for all nuclear power plants built by Russia, including those on its own territory.

To tell the truth, Iranian powers, having seen off the Russian delegation, have been insistent in claiming that the Bushehr startup, by which the country is pretending to be the leader in the Middle East, could proudly announce its acquisition of atomic energy to the world community before the end of the year at the latest. According to Iran's Vice President and Head of the Organization of Atomic Energy of Iran, Gholamreza Aghazadeh, if the sacred wish of Iranians comes true before their next New Year, the event would acquire ever more symbolism as the country celebrates the 30th anniversary of the Islamic Revolution. In addition, this year has been declared the year of inventions and innovations.

However, the startup and commissioning are being undertaken by Russian nuclear specialists who set their priorities on safety rather than symbolism. The stable and reliable operation of the plant over the next half century depends on how thoroughly the startup and commissioning is done. The service life of modern nuclear power plants is about 60 years. «The quality of these test runs should not be sacrificed under any circumstances. The equipment that has been integrated will be tested in the most rigorous way,» Kiriyenko emphasized.

According to the contract, the plant will be operated by Russian personnel during the first year after startup. Some of these workers have already been involved in the commissioning process and some are new. Iranian specialists and line managers did their baseline training at Novovoronezh nuclear power plant in 2003; they are doing probation but it takes time. In addition, they will have to pass exams and obtain required licenses. To build up a competent team is a task of no less importance than gettin the plant up and running, of this Kiriyenko is certain. Russia and Iran plan to set up a joint venture to operate the plant and are discussing baseline terms and conditions of its operations, including a gross improvement of the living conditions of the Russian specialists on site. Today, it is much more difficult to attract competent specialists to work at the Iranian nuclear power plant because nuclear workers can easily find jobs in Russia where Rosatom has started massive nuclear construction.

«We are at the final stage of the work and I'm very pleased with this. But on the other hand, I realize, it's early for us to relax yet,» SC Rosatom's director general said, summing up his latest visit to Bushehr site. ↦

Staff training for Bushehr

Tatiana Klein, exclusively for Vestnik ATOMPROMa

The task facing Russian specialists during the startup and commissioning of Bushehr nuclear power plant in Iran is not only to test the equipment successfully and put the plant on line. Training of the Iranian personnel who will operate the plant and maintain its process systems in the future is an issue of not less critical importance.

On-the-job training

The Russian party has fulfilled its contractual commitments regarding the training of Iranian specialists in Russia. All plant personnel destined to work at the plant after its commissioning were trained at Novovoronezh Training Center. However, the specialists can master their practical skills only with hands on experience.

At the Bushehr site, in addition to the Atomstroyexport's Principal Contractor Directorate, there are three more Russian directorates of subcontractors. The latter include the Directorate of the Bushehr NPP under Construction of Atomtekhexport (DATEK), which is responsible for the plant commissioning and Iranian personnel probation.

Pavel Kapyrin, the DATEK Director, said 236 Iranian specialists were doing training at different levels.

At the first training level, a specialist has to pass an exam in occupational and fire safety and is granted a permit to attend the reactor unit, Kapyrin explained. At the second level, engineers and technicians who are not on the operators' list, are preparing for the exam in operating rules at their work places; once they pass the exam, they are granted permits to work independently. When an operator is trained, a specialist who has passed the exam in operating rules and nuclear power regulations becomes an alternate. Iranians have to work together with Russian specialists for not less than 13 shifts and pass emergency drills at their future work places. If they show their worth, they are permitted to work independently. If not, they remain supervised until the Russian specialists are positive about their performance.

Such alternate specialists are assigned to all of DATEK's structural divisions: operations, maintenance, engineering, metal study laboratory and others. At present, 120 specialists out of the customer's operating personnel have been permitted to work independently at Bushehr nuclear power plant. According to the staff schedule of the Iranian Operations Directorate, a total of 757 people will work at the plant. This number does not include personnel who are work in areas that do not directly relate to the operation of plant equipment and systems, for example, logistics support, economics, transport, human resources, etc.

A shade of training

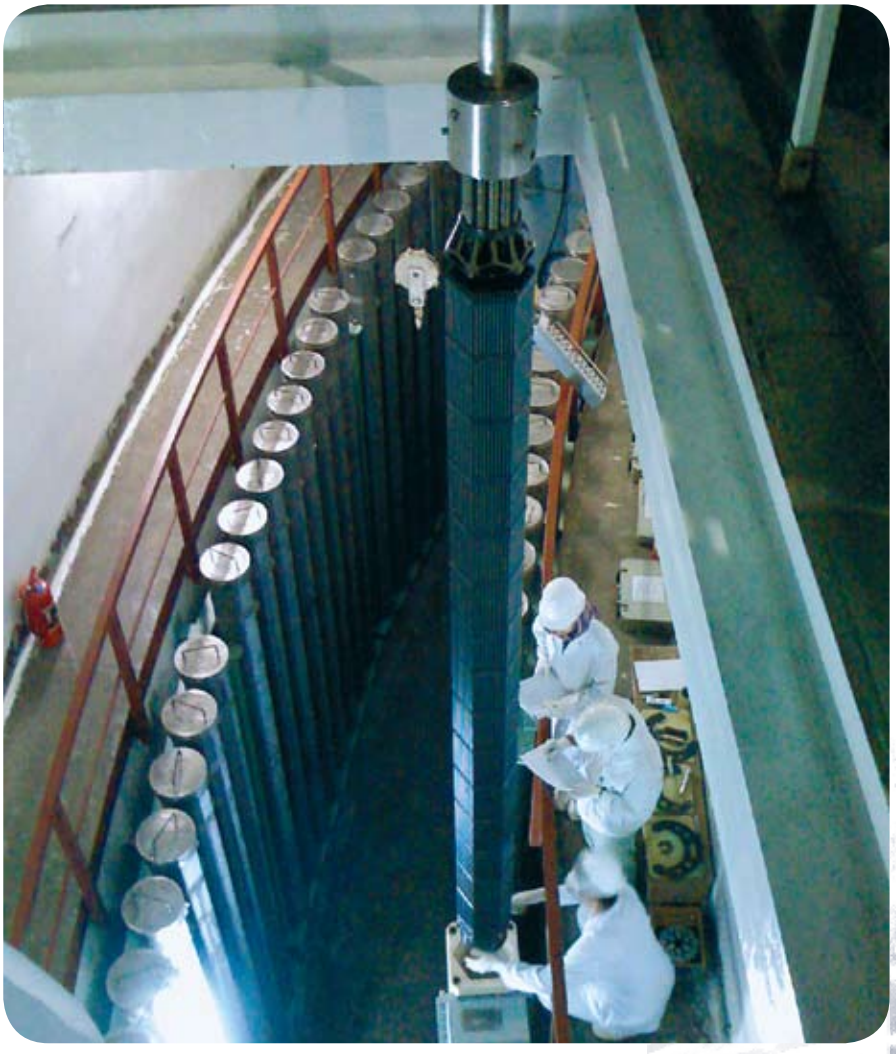
Today, the training of Iranian personnel for independent work is complicated by the fact that the probation must be done with the equipment available or subject to commissioning operations. For example, operators work independently in full scope at the water treatment facility because the equipment at all the work places has been put in operation there, while the shift supervisor of chemistry technology is limited to work independently only at the water treatment section, since other sections under his responsibility have not been commissioned yet. These include

the chlorination plant and the condensate clean-up plant, where the installation process is still underway. The shift supervisor will be allowed to work independently to cover his entire work place only after passing the exam and being granted the permit.

Plant shift supervisors successfully undergo individual training programs in the Bushehr main control room. All necessary facilities are available for the Iranian personnel's probation here. The work goes on to adjust the automated process control system (APCS). Nearly all nuclear power plant systems are controlled from the main control room. Monitoring and control systems are highly available: some of the subsystems are already in operation, while other are nearing completion of adjustment and commissioning. The Iranian specialists were involved in filling in the safety systems with unsealed reactor pressure vessels and will be carrying out all tests at the unit and will control their conduct at the APCS board in the future. This equipment was manufactured in Russia. The German equipment was not used because part of it had become outdated and another part was rejected at the inspection stage.

The task of the Russian operating personnel is to make sure that Iranian specialists are able to make the right decisions in any situation within their working areas and under their authority. The plant is only transferred to the client once there is 100% assurance. It should be noted that the Iranian personnel training covers not only the operating staff but also engineers, technicians and maintenance staff as well as other DATEK staff. The future functioning of the customer's entire operating directorate fully depends on the quality of this training.

Since the plant system's equipment is commissioned in a step-wise manner following a certain sequence, there is a probability that Iranian specialists could fail to master their independent work skills. In this regard the contractor and customer would have to jointly seek alternative options to help build up assurance in the Iranian personnel's ability to work at adequate professional levels after the plant has been put on line.



Guarantee of safe operation

Today, Russian personnel actively involve Iranians in startup and commissioning operations and fully use their potential at this complex and important stage. On the other hand, Iranian personnel will be driven by their desire to be fully involved and will hence gain the experience they need.

Many Iranian specialists will also have to overcome a psychological barrier, believes Igor Mezenin, the deputy head of the Department of Construction of NPP in Iran and Head of Atomstroyexport's Directorate on Bushehr NPP site. They will have to go from thinking as an «assistant» to thinking independently. Certainly, confidence is gained along with the experience in this highly critical stage.

Today at Bushehr everyone understands that guarantees of the safe operation of the plant are not only reliable technologies and impeccable design and manufacture of equipment, systems and mechanisms, but also high professionalism among the operating personnel who will run the nuclear power plant. Neither the Russian party nor Iranian party doubts the plant will be in safe, well-trained hands of experienced specialists.

Grigoriy Oster

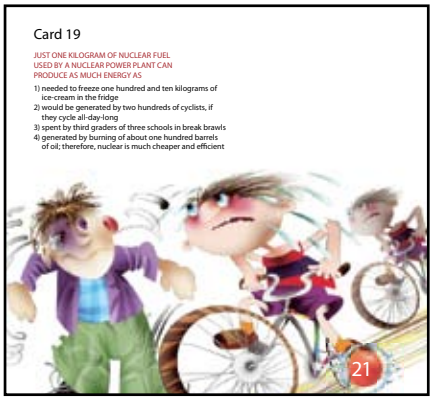
QUIZ IN NUCLEAR POWER

Children trust him; parents entrust their children to him. His screenplays were used for dozens of cartoons, and his «harmful advice» has guided more than one generation. Now, children's writer Grigoriy Oster, the author of the remarkable «The Harmful Advice» and «The Book of Physics Problems» has produced «THE NUCLEAR POWER QUIZ».

As usual, Oster has written this new textbook with children in mind. However, it is receiving interest from – as well being learnt by heart and quoted by – quite grownup nuclear folks. Our colleagues say the book is written in such a particular language that that has become Oster's trademark.

Guess what SCIENTISTS HAVE FOUND IN THE MIDDLE OF EACH ATOM? — A tiny ticking clockwork? —Wrong. — A bucket with rounds? — Wrong again. — A nucleus with protons and neutrons? — You guessed right!

These are real questions from the book. Not every grownup can answer some of them. But the idea behind the «Quiz» is not to examine schoolchildren in nuclear power but to explain in plain words that the ATOM is not a tricky thing. And it's safe, for sure!



The book has been published under a special order of SC «ROSATOM» and is distributed in Atomic Energy Information Centers. It is the basis for the quiz questions the schoolchildren so gladly answer in the information centers.

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