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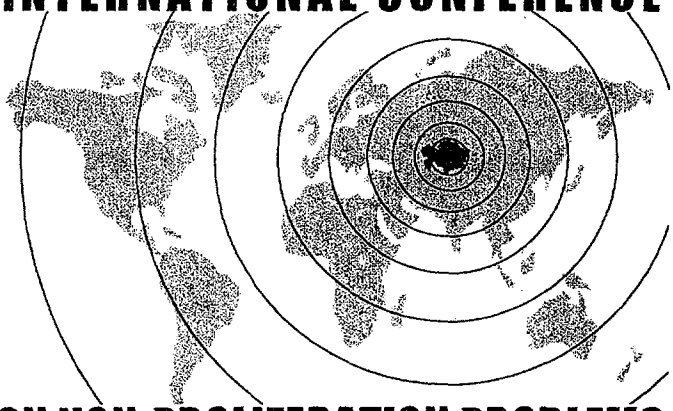

ON NON-PROLIFERATION PROBLEMS

REPUBLIC OF KAZAKSTAN

Almaty – Kurchatov 08-12 September, 1997

INTERNATIONAL CONFERENCE ON NON-PROLIFERATION PROBLEMS

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Tezisy dokladov mezhdunarodnoj konferentsii
po problemam nerasprostraneniya yadernogo oruzhiya

INTERNATIONAL CONFERENCE
ON NON-PROLIFERATION PROBLEMS

ABSTRACTS OF REPORTS

08-12 September, 1997

Almaty – Kurchatov

REPUBLIC OF KAZAKSTAN

CONTENTS

PLENARY SESSION #1

Political Aspects of Non-Proliferation

Almaty-city, 08 September, 1997

Chairman's: *V.S. Shkolnik (Ministry of Science – Academy of Science RK),*
E.A. Idrisov (Ministry of Foreign Affairs RK)

NON-PROLIFERATION POLICY OF THE REPUBLIC OF KAZAKSTAN

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ПОЛИТИКА РЕСПУБЛИКИ КАЗАХСТАН В ОБЛАСТИ НЕРАСПРОСТРАНЕНИЯ ЯДЕРНОГО ОРУЖИЯ

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After the acquirement of its independence Kazakstan has articulated its position on the problem of nuclear weapons non-proliferation. As far as in the period of the USSR existence, obeying people's will, Kazakstan President Nursultan Abishevich Nazarbayev issued the Decree of closing Semipalatinsk nuclear test site. It should be noted that after the USSR collapse a huge nuclear inheritance, including uranium industry, enterprises on uranium processing and production of the fuel for nuclear facilities, experimental and commercial nuclear reactors, powerful scientific & technical potential, and nuclear weapons as well, specifically «...104 stationary based missiles SS-18 having 1400 nuclear warheads», remained on the territory of Kazakstan. This circumstance required from the Kazakstan leadership, within the shortest possible time, to develop the state policy strategy both as regards nuclear weapons and interstate policy regarding the atomic & industrial complex. The Republic signed the Lisbon Protocols to the Treaty between the USSR and USA on the reduction and limitation of strategic offensive arms, where Kazakstan engaged to join with the Non-Proliferation Treaty (NPT) as a strategic offense arms-free state. Soon the Republic has fulfilled its obligations and, on 13 December 1993 after its joining with the Treaty, in conformity with its provisions the IAEA Safeguards Agreement between the Kazakstan Government and International Atomic Energy Agency (IAEA) was concluded and came into force in 1995 after its ratification by the Decree of the Republic President. Currently all country' nuclear installations have been placed under the IAEA safeguards. On September 1993 the Republic was joined this organization at the IAEA General conference.

The state adheres firmly to non-proliferation principles. All nuclear weapons have been removed from its territory, works resulting military sphere of nuclear power use, have been terminated. A wide program of the former military research infrastructure conversion - it concerns both the specialists involved before in the USSR military programs and infrastructure of testing sites, is being performed by the support of a number of foreign countries. Everybody knows now the joint Kazakstan/USA operation under its coding name «Sapphire» on withdrawal of highly enriched nuclear materials from the territory of Ulba Metallurgical Plant to be processed at the USA enterprises. There were materials of direct use, it means that nuclear explosive devices can be produced using them. There was no point for Kazakstan which refused from nuclear military programs, in storing such materials on its territory, and it was not profitable as well - guarding was too expensive, and their reasonable peaceful utilization in future was not expected. In addition, removing the materials to the USA the risk of their proliferation was decreased.

Another great conversion program activity is the infrastructure liquidation of the former testing holes on the Semipalatinsk test site. For the Republic - it is a confirmation of the complete non-nuclear position, the creation of a non-renewal nuclear weapon testing on its territory. At the same time a problem of radiation safety at the test locations is being solved. In conformity with this fact the appropriate agreement, which is being performed successfully now, has been signed between the U.S. Department of Defense and Ministry of Sciences and New Technologies of the Republic of Kazakstan on October 3, 1995.

A sensitive information is present on the area of the former testing site. The traditional IAEA safeguards are used to nuclear facilities and nuclear materials, it means that using the signed IAEA agreement our state demonstrates for the world community that there are no any illegal activity in Kazakstan and nuclear materials are not conversed for their illegal use. But the sensitive information is out of the safeguard system , and sometimes causes difficulties while their application. The key issue which bothers us while realizing the Safeguards Agreement is how completely data on materials and facilities, used before in defense usage, can be presented to the non-nuclear states inspectors. After a series of consultations with the IAEA and Russian Federation being the USSR assign in this sphere, there were found out suitable forms and procedures of the safeguards application on the former Semipalatinsk Test Site facilities.

A state system of nuclear materials control and accounting has been developed and run in the Atomic Energy Agency. Data of all nuclear materials throughout the country are collected in it, and on the basis of which the reports to the IAEA are prepared. Monthly the IAEA inspections take place at all nuclear installations, when accounting records and reported-physical inventory difference are inspected. Verification of all nuclear materials is performed once a year. It means that the system of nuclear materials control and accounting, reporting and IAEA inspection activity provides the clarity of nuclear activity at the country area. But to increase safety of non-proliferation regime support is required to develop the effective state physical protection system of nuclear materials and facilities. Now the Atomic Energy

Agency has prepared a draft of the State conception on physical protection, which is in the process of getting agreement with the Republic Government. Another important component of the state non-proliferation regime support system is nuclear export/import control. The export of nuclear materials and dual use materials is controlled by the state on the basis of the Law on arms, military equipment and dual use materials export control. Nuclear import control is performed for the time being according to the relative decisions of the Government. It should be noted that these three components are the integral and interdependent parts of the single state nuclear materials control system guaranteeing the support of non-proliferation regime in the Republic. Depending on the fact as far as effective they'll work and as far as effective will be the operation of the whole system, so effective will be supported the non-proliferation regime conditions. The whole of these was reflected in the draft of the Atomic Power Use Law.

Kazakstan nuclear activity is controlled on the basis of legal and standard base, the most part of which remained from the USSR time. In the time of transition to the market economics the requirement to make significant changes in provisions of the regulating documents is arisen. First of all it concerns of the legal base. Coming to the world scene as a non-nuclear state Kazakstan engages to harmonize its legislation with the international atomic law regulations. Unfortunately, there is lack of lawyers in the Republic who specialize in this sphere of jurisprudence. Therefore the first Law in the field of Kazakstan peaceful nuclear activity control, issued by the Atomic Energy Agency officials, underwent an examination by experts of international institutions, in National Boards of other states. The legal base of the atomic power use control includes the following documents:

- The Legal Code of the Republic of Kazakstan, Decrees and
- Orders of the President, Parliament Decisions;
- Government and State Administration Board Decisions, Status on Regulating and Supervision Agencies;
- Standard Documents;
- State and Industrial Standards, Building Standards and Rules;
- Departmental Standard Documents;
- Operation and Technological Documentation;

The following state offices are in charge to make supervision and control of nuclear activity now:

- State System of Nuclear Materials Control and Accountancy - Atomic Energy Agency;
- Physical Protection - Atomic Energy agency, Ministry of Internal Affairs, National Security Committee;
- Export control - Atomic Energy Agency, Ministry of Industry and Trade, Customs.

The policy of the Republic of Kazakstan in the sphere of nuclear weapon non-proliferation is based on the equal in rights partners' relations with other states without discrimination by any political motives. The sole but obligatory cooperation condition is a strict observance of nuclear weapon non-proliferation principles. In the internal country policy the issues of non-proliferation regime support take one of the central place, and the government efforts are directed to solve them. The nearest target is to create in the country the adequate legal base of atomic power and infrastructure usage control of the state supervision and control offices of all nuclear activity types in the Republic.

IMPLEMENTATION OF SAFEGUARDS IN THE NEW INDEPENDENT STATES

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ПРИМЕНЕНИЕ ГАРАНТИЙ В СНГ

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An area that has posed quite a challenge to the IAEA has been the emergence of a number of new States, known as the Newly Independent States (NIS), many with substantial nuclear programs, resulting from the disintegration of the former Soviet Union. The IAEA has been conducting the verification of the initial inventory declaration of these States. The status of the Safeguards Agreements and IAEA safeguards implementation in each State of the NIS will be reviewed with special emphasis on the Kazakstan. The implementation of IAEA safeguards in this area is a totally new experience to the NIS as well as a new challenge to the IAEA. The Agency, while experiencing good cooperation from the facility operators and st8ate authorities, experiences problems in logistics, communications, medical and radiation protection matters in some areas of the NIS. Improvements are still needed in these matters as well as in setting up an effective SSAC both the State and Facility levels. Continued assistance should be focused on these problem areas. It is expected that the initial verification will be completed in 1997 for a majority of the NIS including Kazakstan. The focus will then be shifted to the completeness assessment of the state nuclear fuel cycle and to the start of the inspection activities on a routine basis as soon as possible.

PROBLEMS OF OVERCOMING MEDICAL CONSEQUENCES OF NUCLEAR TESTS AT THE FORMER SEMIPALATINSK TEST SITE (STS)

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ПРОБЛЕМЫ ПРЕОДОЛЕНИЯ МЕДИЦИНСКИХ ПОСЛЕДСТВИЙ ЯДЕРНЫХ ИСПЫТАНИЙ НА БЫВШЕМ СЕМИПАЛАТИНСКОМ ЯДЕРНОМ ИСПЫТАТЕЛЬНОМ ПОЛИГОНЕ

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Tests conducted for many years resulted in large radioactive contamination of Semipalatinsk, East Kazakstan, Pavlodar and Karaganda regions.

About 1,5 million people underwent multiple acute and chronic influence of small ionizing radiation doses basically.

Nuclear weapons tests damaged people's health and environment. They caused increasing of total population sick rate, negatively influenced biological, ecological and higienical as well as medical and genetic situation in the Republic.

Ministry of Health Protection of RK pays much attention to the STS problems. In 1950-s there was an expedition to the Semipalatinsk region. In this expedition professors Atchabarov B. A. and Balmukhanov S. V. took part. The expedition studied factors of ionizing radiation influence on human beings. In 1989 be the resolution of the USSR Government there was conducted a similar research by a complex team directed by professor Tsyba A. F. Many researches were on studying radiation situation in the area of the STS and regions attached to it were conducted. There were made researches on how industrial waste products discharge influence on human being.

That time almost all data on STS and ecological situation in the region was closed and secret. Many of them are still unknown to us now. The results of the researches conducted are either unprocessed still or not fully published. Analyzing published data it's important to say that ionizing radiation influence is not determining factor of the critical ecological situation in Semipalatinsk region and the ones neighboring it. Though it's one of the important components of this situation. It seems that the most influence is generated from technical industry waste discharge into the atmosphere, soil and water pools (up to 300.000 tons of soot, chemical agents, heavy metals salt etc.). Along with the radiation component these factors cause considerable increase of total and oncological sick rate of population. Death rate indicators increased too. It possible to notice that 40% of grown-ups and 60% of children have lowered immunity capability. There are illnesses appearing due to the influence of mutagenous factor. There found chromosome aberrations. Among them there are hard forms of genetical mechanism damage.

In this connection Ministry of Health Protection and Social Protection Organizations are worried about the problem of recovering and rehabilitating the population of the above regions.

If, today, we don't bother ourselves with the rehabilitation issues for the people of the mentioned above regions and if we don't implement modern diagnostical and curing systems, if we don't implement complex, preventing programs, environment and health monitoring, tomorrow these issues will be more serious and acute.

To solve these problems Ministry of Health Protection RK established Scientific Research Institutes of Medicine and Ecology in Semipalatinsk and regional Medical and Diagnostical Center in Kurchatov. With the help of regional Administrations there were created medical centers: diagnostical, children's, recovering, ophthalmological, of motherhood and childhood protection.

Work on creating State National Medical Registration for people who underwent influence of ionizing radiation is being performed.

RK Governmental Resolution of March 17, 1997, concerning "Program of Medical Rehabilitation for People Influenced by Nuclear Tests at STS in 1949-1990" includes complex, system way to solving present problems. It necessary to use all the experience of world community, CIS countries, the Republic of Kazakstan in rehabilitation of this population category.

We consider it necessary 1) to generalize and analyze all the data on the ecological researches conducted in this region; 2) fulfill deep medical examination of people and additional investigation of regional zones for heavy metals salt presence, long-lived isotopes (strontium, polonium) and for their influence on human beings.

The present problems need further careful scientific investigation. This, no doubt, will be useful for all the world community.

These researches should be prior. It is necessary to consider their funding on separate article. The necessity of it is determined not only by the present. It is determined by the thoughts about future generations of our people as well.

RADIATING CONDITIONS IN REPUBLIC KAZAKHSTAN AND MEASURES ACCEPTED ON ITS IMPROVEMENT

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РАДИАЦИОННАЯ ОБСТАНОВКА В РЕСПУБЛИКЕ КАЗАХСТАН И МЕРЫ, ПРИНИМАЕМЫЕ ПО ЕЕ УЛУЧШЕНИЮ

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Radiating conditions in republic remains intense. The complication of radiating conditions in territory of Republic Kazakhstan is caused: by activity of former Semipalatinsk test nuclear range; by nuclear explosions executed for the decision of economic tasks; by functioning of the enterprises of a nuclear-industrial complex and connected with production and processing of polymetal ores, oil and gas; by natural anomalies of radionuclide in objects of an environment.

With all variety of the factors forming radioecological conditions in territory of republic, one of most significant is the pollution of an environment owing to nuclear explosions. The data, available on range, have allowed to restore calculation by a way effective dozes of an irradiations caused by loss of radioactive deposits on a trace of radioactive clouds.

The radioactive deposits on traces of radioactive clouds were distributed to territory 304 thousand km2, on which lives more than 1.7 m. persons. In 711 settlements the effective doze exceeded sanitary annual norm at a rate of 0.1 rad. The maximal meanings reach 448 rad for the whole period of tests (s.Dolon).

After disintegration of Soviet Union Kazakhstan has remained one on one with a load of radiating problems. However we carry out large work by an estimation and liquidation of consequences of nuclear tests.

For an estimation of a radiating situation practically in the whole territory of a Semipalatinsk zone of ecological disaster during 1993 - 1996 the radioecological researches which have allowed to reveal and localize territory with above permitted standard pollution radionuclides as artificial, and natural origin, and also heavy metals and others toxic elements are carried out(spent). However there is poorly investigated a situation with a level of pollution plutonium-239 and others transuranium elements.

Only last years the radiating inspection of one third of territory of republic, 34 cities and 55 settlements is carried out(spent), where is revealed and up to thousand unattended radioactive sources and subjects is withdrawn, some hundreds sites of radioactive pollution are located.

Nowadays in Kazakhstan the large work on the tax of the information about all radiating supervision in territory of republic for last 40 years is carried out and these items of information prepare for the opened publication as the collection «Radioecological conditions in Republic Kazakhstan».

Also are significant in Kazakhstan of a consequence technical of activity of a nuclear-industrial complex. On территории of Kazakhstan is concentrated up to a quarter of world(global) stocks of uranium. Production and processing uranium of ores entail radioactive wastes as wastes of mountain developments, of metal works, creating the local centers raised of radiating, rendering negative influence on environment.

The study of radiating ecological conditions actively conducted per last years in territories oil-fields Mangistau and Atyrau of areas, has revealed a problem technical of radioactive pollution of sites of oil-fields. On sites 22 largest deposits, where production of petroleum nowadays is made 267 sites of radioactive pollution with capacity of radioactive radiation from 100 till 17000 mkR/h were revealed.

In territory of republic there was intense conditions with accumulation of the fulfilled sources ionizing radiations, which, getting on environment, create real danger of life and health of peoples. The majority of the enterprises, where the fulfilled sources are concentrated have not means for their delivery on "Baikal-1". Especially it concerns budget organizations, including medical establishments.

As a result of radiating inspection of territory of republic one more radioecological problem was defined (determined) are the natural raised concentration radionuclides in objects of an environment. More 700 natural sources with the raised contents radionuclides, requiring control and restriction of economic use are revealed. More than halves of territory of republic are necessary for surveying on concentration of radon.

POLITICAL ASPECTS ON NON-PROLIFERATION PROBLEMS

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ПОЛИТИЧЕСКИЕ АСПЕКТЫ НЕРАСПРОСТРАНЕНИЯ ЯДЕРНОГО ОРУЖИЯ

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Some words about nuclear proliferation threat. Inter-relation problem of the Nuclear Club Countries and Threshold Countries. Basic contradictions.

Role of people's diplomacy, parliaments and governments in anti-nuclear movement. Used and perspective interaction mechanisms.

Religion and knowledge. Role of scientific propaganda in realization of motto: "World without nuclear weapon".

CREATION OF A ZONE FREE FROM NUCLEAR WEAPON (ZFNW) IN THE CENTRAL ASIA

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СОЗДАНИЕ В ЦЕНТРАЛЬНОЙ АЗИИ ЗОНЫ, СВОБОДНОЙ ОТ ЯДЕРНОГО ОРУЖИЯ

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Issues on non-proliferation of mass demolition weapons are of special importance for people of Kazakstan. The whole damage brought to nature and people's health by nuclear tests at the Semipalatinsk test site (STS) is not revealed yet . Kazakstan contributed much to the matter of nuclear disarmament. More than six years ago for the first time in the world by RK President's resolution an operating nuclear test site was closed. Kazakstan was the first to fulfill obligations in accordance with Lisbon protocol. Kazakstan liquidated the fourth nuclear potential in the world. It's time to undertake further steps in the field of non-proliferation. One of such steps is the creation of a ZFNW in the Central Asia.

The idea of ZFNW creation is being acknowledged more and more during last 30 years. All the four present zones include more than 100 countries. If the Antarctic Region is taken into account the zones cover more than 50% of dry land.

Regional ZFNWs attract attention as a means of reflecting and rewarding general values in the sphere of nuclear disarmament and armament control. Such zones help to narrow geographical sphere of military nuclear activity and to strengthen non-proliferation regime. The importance of ZFNW in the process of strengthening global and regional peace and safety is confirmed by the documents of Conference for countries joined the Agreement on Non-proliferation (AN) of 1995 and the first meeting of the Organizing Committee for Conference of 2000.

The initiative of Central Asian countries reflected in Almaty declaration of February 28, 1997 on creation a ZFNW in the region has become a step to strengthening the non-proliferation regime. It can become the next contributive step to providing with total safety after Central Asian Countries' joining the AN and removing nuclear weapons from Kazakstan.

The experience of the present zones shows that their creation needs careful work. In 1975 UNO General Assembly determined the following principles according to which the countries should create a zone:

- the agreement conditions for zone creating should effectively provide with the absence of any military activity of the nuclear sphere;
- zone creation should be performed on the voluntary basis and countries of the region should do it themselves;
- the support of nuclear countries and of all the countries in the world will contribute to the importance of the zone created;
- agreement conditions should include the clauses of effective verification system providing with the performing all the clauses;
- the agreement should contribute to the economical, scientific and technological development of the zone countries in the field of peaceful use of nuclear energy;
- the agreement concerning the zone should be permanent.

When ZFNWs are created in the region it's important to follow these principles and have the future agreement coordinated with all the existing international agreements.

The work performed at present shows that many countries of the world (nuclear ones included) approve of the idea to create such a zone in the Central Asia. At the same time it's evident that there is a necessity to extend the participants' quantity. We believe that in the future agreement there should be an invitation for other neighboring countries to cooperate in the field of peaceful nuclear energy use. Due to the certain circumstances it's possible to foresee difficulties in the process of determining geographical zone borders. This problem should be solved before a corresponding agreement is worked out.

Nuclear tests conducted during many years at the STS make the project of creating Central Asia Zone unique. In connection with this it seems expedient to accept an ecological protocol for attracting world community's attention to the environmental problems, caused by the nuclear programs' fulfilling at the STS and other places. At this protocol it's possible to stipulate the clauses of cooperation suggestions in the sphere of test site conversion, of abolishing the nuclear tests sequences and solving the problems, concerning uranium extraction and radioactive waste storage.

ENSURING OF NON-PROLIFERATION REGIME IN THE REPUBLIC OF KAZAKSTAN

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ОБЕСПЕЧЕНИЕ РЕЖИМА НЕРАСПРОСТРАНЕНИЯ В РЕСПУБЛИКЕ КАЗАХСТАН

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After becoming an independent country, the Republic of Kazakstan clearly declared its status of non-nuclear weapon state. Kazakstan joined the Nuclear Weapon Non-Proliferation Treaty as a state having no nuclear weapons, then it signed Agreement on Safeguards with the International Atomic Energy Agency (IAEA), number of legal acts and regulations were enforced including the Law on Atomic Energy Use, the Law on Export Control and set of Governmental Provisions - all these actions provided conditions for effective state control of all nuclear activity on the Kazakstan territory and for fulfilment of obligations of the republic in guarantees of nuclear weapon non-proliferation regime.

Most of functions in control of nuclear materials and nuclear activity in Kazakstan from the view of non-proliferation regime provisions were assigned to the Atomic Energy Agency that this year has a five year anniversary of its establishment. In spite of its low number staff, in the Agency there was developed the State system for nuclear materials accountancy and control (SSAC) that in co-ordination with the IAEA provided total control on balance inventories of nuclear materials which were under jurisdiction of Kazakstan. Licence control of export and import of nuclear materials and materials and technologies of dual use, alone with an effective system of physical protection of nuclear materials and installations are the integral parts of the nuclear material control system. The Agency is responsible for preparation of the accumulated data on balance inventories of nuclear materials in the country facilities and organisations, and for presentation of the corresponding reports on their movement to the IAEA.

In its activity on provision of the state control on export and import of nuclear materials and technologies, materials and technologies of dual use, the Agency interacts with other state authorities - Ministry of Economy and Trade, Ministry of Foreign Affairs, Ministry of Interior Affairs, Ministry of Defence, State Committee of Customs, State Committee on National Security and other bodies of the Republic. The Agency works together with the most of these authorities in elaboration of documents on establishment of the unified state system of physical protection of nuclear materials and nuclear installations. Unfortunately, at the present time there is no well developed effort co-ordination of the ministries in the field of physical protection. Therefore, for this year it was planned to prepare the State Concept of Physical Protection of Nuclear Materials and Facilities, the draft of which was worked out by the Agency together with other governmental bodies and authorities of Kazakstan; the draft had undergone international expertise including an evaluation of the Legal Group of the IAEA.

Different forms of ownership are presumed in the Law on Use of Atomic Energy for nuclear facilities that is in the stream of changes in the economical system of our country. However, this fact sets more strict requirements for the system of the state control of nuclear activity on the Republic territory. The Agency always keeps in its work the principle of total state control of nuclear activity on Kazakstan territory in order to provide fulfilment of all the provisions of enforced legal acts and international obligations of the Republic in the field of nuclear weapons non-proliferation.

PROSPECTS FOR A NUCLEAR-WEAPON-FREE ZONE IN CENTRAL ASIA

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ПЕРСПЕКТИВЫ БЕЗЪЯДЕРНОЙ ЗОНЫ В ЦЕНТРАЛЬНОЙ АЗИИ

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This paper examines the concept of a Nuclear-Weapon-Free Zone (NWFZ) as an approach to nuclear nonproliferation with special reference to Central Asia. 20 More specifically, it describes the evolution of a NWFZ in the region, the potential benefits of a zone, the principal obstacles in the path of its implementation, and the practical steps that need to be taken if a NWFZ in Central Asia is to be realized.

The paper concludes that a NWFZ in Central Asia, as with prior NWFZs, would likely lead to advances in the application of an important nonproliferation approach. One innovative aspect of the zone in Central Asia might be its treatment of environmental issues. Although it will not be a simple process to rally support from all of the P-5 states for a new NWFZ, all countries of Central Asia – as well as the global community of nations – should profit from creation of a zone which reinforces the international nonproliferation regime and improves prospects for political and economic stability in a region of growing importance.

INTERNATIONAL PHYSICIANS FOR THE PREVENTION OF NUCLEAR WAR (IPPNW) IN EUROPE AND THE DISSEMINATION OF NUCLEAR WEAPONS

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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ВРАЧЕЙ ЗА ПРЕДОТВРАЩЕНИЕ ЯДЕРНОЙ ВОЙНЫ (IPPNW) В ЕВРОПЕ И РАСПРОСТРАНЕНИЯ ЯДЕРНОГО ОРУЖИЯ

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International Physicians for the Prevention of Nuclear War (IPPNW) was founded in 1980 by American and Russian physicians under Co-Presidents Bernard Lown (USA) and Evgeni Chazov (USSR) because of their concern regarding the danger of nuclear weapons and the arms race. In 1985 IPPNW was awarded the Nobel Peace Prize in recognition of its work in informing both public opinion and the authorities of the consequences of nuclear war on health. At present IPPNW represents 200,000 physicians in 85 countries.

European affiliates of IPPNW work together under the European Vice-President who is Abraham Behar, Professor of Nuclear Medicine and President of the French affiliate AMFPGN (Association des Medecins Français pour la Prevention de la Guerre Nucleaire). Kazakstan has its own IPPNW affiliate, which is presided by Professor Saïm Balmukhanov, Assistant Director of the Institute of Oncology of Almaty, the Vice-President being Professor Tolegen Raisov, Rector of the Institute of Medicine of Semipalatinsk.

In May 1990, a congress was organised in Almaty by the Nevada-Semey Movement and IPPNW to demand an end to nuclear testing in the area. This request was granted by the President of the Republic M. Norsultan Nazarbaïev the following year. From the contacts made at that meeting grew the French affiliate's scientific research programme led by Professeur Chenal in co-operation with our colleagues in Kazakstan. It is because of the emotion felt on visits to Kazakstan and the information gathered on these occasions that I have been able to speak at the headquarters of UNESCO in Paris at a ceremony to commemorate the centenary of Moukhtar Aouezov organised by the government of Kazakstan.

This conference, organised by the Academy of Science of Kazakstan, is of the utmost importance because of the dangerous evolution of current events as regards peace. Kazakstan, which is the fourth largest nuclear power has decided to match its deeds to its words and not to have recourse to these arms of mass destruction and to help stop their dissemination by drawing the attention of governments, the media and the population to the danger they represent.

The problem of the non-proliferation of nuclear weapons is of great concern to physicians because of their professional interest in the life and health of the population. It is for this reason that we have studied and published articles on the effects of nuclear weapons, the consequences of nuclear weapon production and testing and demanded their abolition. Unfortunately we can at present observe their dissemination, both vertical and horizontal, in Europe and in the world. July 2nd marked the beginning of a series of nuclear tests in Nevada in direct violation of Article VI of the Treaty of Non-Proliferation.

Horizontal dissemination by means of the extension of NATO to the boundaries of Russia at the instigation of the USA with the support of European governments, some of which even wish to accelerate the process. This extension was initiated on July 8 in Madrid with the adhesion of the Czech Republic, Poland and Hungary. Further extensions are foreseen and even include Baltic States. It should be remembered that the deployment of nuclear weapons is part of the NATO agreement and this has not been modified since the end of the Cold War. Thus the former boundary between two blocs would be moved eastwards causing renewed international tension.

The IPPNW affiliate of the CIS organised a congress in Moscow last April. The declaration of the Chief of the Russian Defence Council, General Klimenko, to our delegation on April 18th was clear : in view of the new threat of the extension of NATO to Eastern Europe, Russia is no longer willing to take any initiative towards the abolition of nuclear weapons. This opinion is shared by the Douma, which is quite comprehensible in view of the great pressure on Russia of having American nuclear weapons almost on its doorstep.

IPPNW is part of the Abolition 2000 campaign which is working towards the abolition of nuclear weapons for the year 2 000. The American and European initiative regarding the extension of NATO will ruin all hopes of this. Although public opinion was greatly influenced by the decision taken by the President of the French Republic to resume nuclear testing in the Pacific in 1995, it is not yet aware of the danger of the extension of NATO and has been lulled into a false sense of well-being by the Comprehensive Test Ban Treaty signed in New York in 1996. It is therefore the duty of physicians all over Europe to preserve the population from these new threats and the vast military expenditure they represent to the detriment of health and education.

IPPNW-Europe proposes the creation of a « de jure » nuclear weapon-free zone (NWFZ) in Central and Eastern Europe to replace the « de facto » NWFZ which has existed since the end of the Cold War in a majority of former Warsaw Pact countries, with security guaranteed by international agreements. We oppose any extension of NATO, a military alliance which emanated from the Cold War.

As for the nuclear powers, we demand an end to the nuclear alert, since the present international situation no longer justifies this. Removing the warheads from their launching pads would be an important gesture towards non-nuclear countries and would be a considerable step to help prevent any further dissemination. Finally, we demand the abolition of the coward's weapon, anti-personnel land mines, as well as the abolition of all arms of mass destruction, whether chemical or biological, which are used against the civilian population.

Towards these ends the European affiliates work both individually and collectively. Each association has its own activities adapted to its national situation which include conferences, periodicals, information for the media, young people, the authorities or public opinion, lobbying ministers, embassies or heads of state. Collectively, our 30 organisations remain in close contact by mail, e-mail, fax or meetings to lobby at an international level. Every opportunity is taken to make contact with associations and individuals, especially members of our profession, in various parts of the globe. Delegations were organised to the OSCE (Organisation for Security and Collaboration in Europe) in Lisbon in November and to the Clinton-Yeltsin summit in Finland in March. Meetings of European affiliates were held in November in Zurich (Switzerland), in Moscow in April, near Vienna in June or with IPPNW executives in Brighton (Great-Britain) in February.

We have the support of the International Court of Justice in the Hague which has outlawed nuclear weapons, as well as that of 60 admirals and generals who support our cause. The Canberra Commisssion, which included that well-known Frenchman Commander Cousteau who died recently, has set up guidelines for nuclear disarmament and the abolition of nuclear weapons which we hope may be completed by the year 2000 thanks to the Abolition 2000 campaign. The best way of bringing an end to the dissemination of nuclear weapons is their elimination. This conference can help us achieve our aim.

NUCLEAR SOCIETY AND NON-PROLIFERATION PROBLEMS

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ЯДЕРНОЕ ОБЩЕСТВО И ПРОБЛЕМЫ НЕРАСПРОСТРАНЕНИЯ

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Ядерное Общество Казахстана

It is noted that among other well-known international organizations, the NIS Nuclear Societies activity on non-proliferation regime support and international cooperation development in this sphere was performing for last 5 years.

In the USSR Nuclear Society in1991 the special working group on the problems of nuclear weapons non-proliferation and nuclear materials control, uniting the experts of different types (nuclear physicists, lawyers, politologists, teachers), was created. This group became the mechanism of the practical Nuclear Society activity realization in this sphere. Three milestones of the innovative activity can be specified.

First Milestone. In January 1992 the Central Nuclear Society Board (of the International Public NS Association) published a special appeal to the First Leaders of all countries - former USSR republics. This address paid a special attention to the unity of the USSR power-industrial complex, and numerous problems arisen while separating this complex, including nuclear weapons non-proliferation problems, were indicated as well.

Second Milestone. In 1992 and 1993 the NS experts issued two selections «Nuclear Non-Proliferation and Control Problems» including reviewing basic papers. In addition, materials on non-proliferation and control are published regularly in the NS organs.

Third Milestone. In 1993 -1997 some special scientific and technical events (conferences, workshops, meetings) allowing to analyze the joint international projects and contracts outcomes, and establish new contacts between the specialists of NIS, Baltic states and others, have been hold.

Brief events review is conducted:

1. June 1993, Nizhnii Novgorod - 1-st NS Workshop «Non-Proliferation and Control Problems».
2. October 1994, Moscow - 2-nd NS Workshop «Scientists for Non-Proliferation».
3. April 1995, St. Petersburg - «International Meeting on European Unity/former USSR countries Cooperation in the sphere of nuclear safeguards» (organized by NS and European Power Fund».
4. May 1996, Moscow - International conference «Non-Proliferation and Control of Nuclear Materials in Russia» (organized by Russia NS, RRC «Kurchatov Institute» and INMM).
5. Active participation of Kazakstani NS in preparation of the present International Conference (September 1997) dedicated the same problems.

Currently, only minimum bureaucratic «horizontal» cooperation, when the specialists and experts of the interested countries cooperate permanently between themselves on a wide set of non-proliferation and control issues, will allow to create the basis for approval of political decisions and understandings reasonable from the technical stand point as well.

Positive experience and significant NS contribution (first, USSR NS contribution then International Association NS), now - NS of Byelorussia, Kazakstan, Russia) on the system creation on such «horizontal» cooperation earns, as it seems to us, the study and further positive use.

Just the creation of such scientific and technical base for political decisions is the basic goal in non-proliferation field for peaceful nuclear community united by national nuclear societies.

The technical professionals cooperation in this sphere will allow:

- to achieve a complete understanding between technical and scientific country experts;
- to estimate together the efficiency of the existing technical decisions;
- to develop new mutually-suitable technical decisions and estimate them both from the efficiency stand point, and acceptance on national safety considerations;
- to demonstrate the existing hardware armoury to the sets approving political decisions;
- to coordinate technical policy of countries at the international arena, while discussing the problems of functions expansion and efficiency increasing of the international IAEA safeguards.

The integral task of non-governmental institution cooperation is public informing about all processes and problems in non-proliferation sphere as one of the most important humanity task.

FAST REACTORS AND NONPROLIFERATION

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БЫСТРЫЕ РЕАКТОРЫ И НЕРАСПРОСТРАНЕНИЕ

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1. Three aspects of nonproliferation relevant to nuclear power are:
   - Pu buildup in NPP spent fuel cooling ponds (~ 104 t in case of consumption of ~107 t of cheap uranium). Danger of illegal radiochemical extraction of Pu for weapons production;
   - Pu extraction from NPP fuel at the plants available in nuclear countries, its burning along with weapon-grade Pu in NPP reactors or in special-purpose burners;
   - increased hazard of nuclear weapons sprawl with breeders and closed fuel cycle technology spreading all over the world.

2. The latter is one of major obstacles to creation of large-scale nuclear power capable of substituting for a substantial part of conventional fuels for solving the problems confronting the world:
   - depletion of cheap hydrocarbon fuel resources, rise in their prices, international conflicts around oil and gas sources;
   - releases of combustion products reaching hazardous limits.

That was the reason for termination of research involving breeders and closed fuel cycle in the USA. Other obstacles lie in the high cost of fast reactors and the failure to solve the problems of NPP safety and radioactive waste, as applied to large-scale power generation.

3. Nuclear power of the first stage using U-235 will be able to meet the demands of certain fuel-deficient countries and regions, replacing ~5-10% of conventional fuels in the global consumption for a number of decades. Nonetheless, without a prospect of large-scale development using breeders it loses its initial motivation and basic arguments, while the world will be deprived of one of the most realistic opportunities discussed to solve the arising energy problems.

4. Fast reactors of the first generation and the currently employed fuel technology are far from exhausting their potential for solving economic problems and meeting the challenges of safety, radioactive waste and nonproliferation. Development of large-scale nuclear power will become an option accepted by society for solving energy problems in the following century, provided a breeder technology is elaborated and demonstrated in the next 15-20 years, which would comply with the totality of the following requirements:
   - full internal Pu breeding (BR= CBR ~1);
   - deterministic elimination of severe accidents involving fuel damage and high radioactivity releases: fast runaway, loss of coolant, fires, steam and hydrogen explosions, etc.;
   - reaching a balance between radioactive wastes disposed of and uranium mined in terms of radiation hazard;
   - technology of closed fuel cycle preventing its use for Pu extraction and permitting physical protection from fuel thefts;
   - economic competitiveness of nuclear power for most of countries and regions, i.e. primarily the cost of NPPs with fast reactors is to be below the cost of modern LWR plants.

5. The main growth in demand for energy in the next century will fall on developing countries, which are therefore most interested in the development of a new power technology. It is on their initiative that the development depends now. No doubt the initiative will be supported by specialists from Russia and other nuclear states and their governments, provided the technology to be developed meets the requirements of nonproliferation.

6. The basic aspects of reactor concepts, which have been mastered in civil and military nuclear engineering and are studied for future use, are clear enough to decide on a certain option for the next stage. Fast reactors with UN-PuN fuel of moderate power density, which do not contain uranium blanket with BR= CBR ~1 and have a small reactivity margin $\Delta K_{tot} < \beta_{eff}$, optimal feedbacks, which are cooled with liquid lead at a low pumping rate (< 2 m/s) and assure a high level of natural circulation, seem to meet the requirements made.

7. If there is no uranium blanket in the reactor, it will not produce a surplus of weapon-grade plutonium. The value $\Delta K_{tot} < \beta_{eff}$ does not permit loading in the reactor fuel assemblies with source material for the production mentioned. At CBR~1 the fuel has a near-equilibrium composition and its reprocessing does not require either extraction or addition of Pu (the composition is corrected by adding U-238 to compensate for burn up). Various modes of refueling are possible-

up to quasicontinuous on-lead refueling (in the periods of load reduction). To avoid long-distance transportation of the fuel and radioactive materials it is appropriate to arrange the fuel cycle processes at large NPPs.

The above-mentioned factors open up possibilities for employing a simplified technology of fuel reprocessing, which excludes Pu extraction and its off-pile storage, and amounts essentially to removal of fission products from spent fuel.

8. The currently employed and investigated technologies of fuel reprocessing involve Pu extraction. The search of a new technology or improvement of the currently used ones are required. Physical methods of fuel purification from fission products, making use of approximately double difference in atomic weights, are of particular interest.

9. Primary reprocessing of today's reactor fuel and fabrication of the first loads for breeders may be performed at the plants of the nuclear states or at nuclear technology centers set up on their basis under international jurisdiction.

10. The scheme outlined above suggests simultaneous solution of two major problems:

- profitable involvement of accumulated plutonium into nuclear power fuel cycle, reducing the risk of its utilization for weapons production purposes, without special-purpose burners; and
- development of large-scale nuclear power.

Obviously, no new fuel technology can either rule out the illegal use of the available technologies for Pu extraction or uranium enrichment for weapons production. The problem may be solved solely by improving the measures of protection and control, international political regime of nonproliferation, and it is to be solved irrespective of a particular course of nuclear technology and power development.

PROPOSAL FOR HEALTH EFFECTS STUDIES RELATED TO NUCLEAR WEAPONS TESTING AT SEMIPALATINSK, KAZAKSTAN

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ПРЕДЛОЖЕНИЕ ПО ИЗУЧЕНИЮ ВЛИЯНИЯ НА ЗДОРОВЬЕ ИСПЫТАНИЙ ЯДЕРНОГО ОРУЖИЯ В СЕМИПАЛАТИНСКЕ, КАЗАХСТАН

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Populations that resided and who now reside in and around the Semipalatinsk Test Site have remained there for decades and experienced little in- and out-migration. Semipalatinsk City was literally a secret city until the dissolution of the USSR. The urban population of the city of Semipalatinsk has steadily grown from several hundred thousand to about 1 million people in the area. Although current urban and rural levels of exposure from environmental radiocontamination are not markedly increased beyond natural background, there are many villagers who resided near the Semipalatinsk Test Site whose cumulative lifetime doses are on the order of 0.8-2 Sv Over the course of 40 years, more than 470 nuclear weapons were tested at the Semipalatinsk Test Site (STS) in the Semipalatinsk region of Kazakstan. From 1949 to 1963, 38 detonations occurred on the ground and 128 in the air. Radionuclides emanating from these tests resulted in atmospheric and environmental contamination leading to various levels of acute and chronic radiation exposure. The medical, scientific and social ramifications of the nuclear testing pose serious challenges to the Kazakstan Republic and its scientific and health care systems. The release of radionuclides over a long period of time and their spread in the environment posed major problems to the Kazakstan authorities. Efforts to study the association between fallout radiation and radiation-induced health effects were prevented by official decree until 1980. Initially, efforts to address the medical and scientific challenges of the radioactive contamination in and around STS were delayed by the lack of information about the severity of contamination which was classified in the FSU. After the dissolution of the FSU, efforts to study populations around STS were hampered and further encumbered by the political and social changes that increased sharply in the FSU soon after test suspension. Since the dissolution of the Soviet Union in 1991, attempts to orchestrate coordinated, collaborative research activities in the contaminated regions have been limited until recently. Although every imaginable population that has been exposed to radiation has been subject to scrutiny, the one population that has managed to elude systematic investigation with Western internationally accepted methods has been the population living around STS.

Given these circumstances, there is a definite need to conduct collaborative research on health effects of environmental radiation exposure in Kazakstan. Estimates of cumulative dose equivalent hinged on dose reconstruction and environmental sampling performed by the Scientific Research Institute of Radiation Medicine and Ecology (formerly Dispensary Number 4 of the USSR Ministry of Health) range from 2 mSv to 5 Sv. Previous investigations conducted to date are based to a large extent on descriptive studies that are not hinged on individual radiation doses and therefore only compare average rates of disease in various exposed and non-exposed geographic regions. Descriptive studies do not lend themselves well for studying the etiology (cause-effect relationship) of radiation-induced health effects because they offer no opportunity for statistical tests of hypotheses, and for each subject, it is not known if exposure preceded disease. Analytic case-control, nested case-control or cohort studies should be undertaken.

Pilot and feasibility studies should be initiated in the first two years of research. These pilot projects should include evaluation of anthropological and cultural factors related to ethnicity, lifestyle, and genetic predisposition to disease, demographics and in- and out-migration, availability and quality of vital statistics data, availability and quality of dosimetry data. Years 3-5 should address case-control field studies to investigate interaction between radiation-induced cancer and effect modification by family history of disease, alcohol consumption, smoking, dietary habits, hormone adjuvent therapy, occupational exposure to radiation and environmental/occupational exposure to pesticides. Physical dosimetry based on electron spin resonance of tooth enamel and thermoluminescent (TL) dosimetry with building materials should be augmented with cytogenetic biodosimetry to validate dosimetric methods. Site-gender-specific confirmation and detection rates should be estimated and applied to rates of cancer when logistic regression is performed. Statistically significant differences in average village-gender-ethnicity-cohort-specific biomarker response related to chromosome aberrations and mutation spectra would be expected when comparing highly exposed villagers and non-exposed villagers. Because the presumed doses are much greater than those typically encountered in occupational settings, the research question for such research should be to compare excess cancer incidence among chronically exposed STS populations with excess cancer incidence among acutely exposed Hiroshima and Nagasaki atomic bomb survivors. Stated differently, one should propose to estimate the Dose Rate Reduction Effectiveness Factor for exposed STS populations.

UNO ACTIVITY ON CREATION AND SUPPORT OF NON-PROLIFERATION REGIME AND THE INTERNATIONAL COMMUNITY EVALUATION OF KAZAKSTAN ACTIVITY

H. Hoppe
UNO Committee on Non-Proliferation Agreement

ДЕЯТЕЛЬНОСТЬ ООН ПО СОЗДАНИЮ И ПОДДЕРЖАНИЮ РЕЖИМА НЕРАСПРОСТРАНЕНИЯ И ОЦЕНКА МЕЖДУНАРОДНЫМ СООБЩЕСТВОМ ДЕЯТЕЛЬНОСТИ РЕСПУБЛИКИ КАЗАХСТАН

Хоппе Х.
Комиссия ООН по ДНЯО

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THE COOPERATION OF THE USA AND KAZAKSTA IN THE FIELD OF NON-PROLIFERATION

E. Jones
The United States of America Ambassador in the Republic of Kazakstan

СОТРУДНИЧЕСТВО США И РК В ОБЛАСТИ НЕРАСПРОСТРАНЕНИЯ

Джоунс Э.
Посол США в РК

* * *

INTERNATIONAL AND LEGAL MECHANISMS OF NUCLEAR WEAPONS NON-PROLIFERATION

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МЕЖДУНАРОДНО-ПРАВОВЫЕ МЕХАНИЗМЫ НЕРАСПРОСТРАНЕНИЯ ЯДЕРНОГО ОРУЖИЯ

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* * *

THE CREATION OF A NON-NUCLEAR CORRIDOR BETWEEN THE ZONE FREE FROM THE NUCLEAR WEAPON IN THE CENTRAL ASIA AND MONGOLIA

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СОЗДАНИЕ БЕЗЪЯДЕРНОГО КОРИДОРА МЕЖДУ ЗОНОЙ, СВОБОДНОЙ ОТ ЯДЕРНОГО ОРУЖИЯ В ЦЕНТРАЛЬНОЙ АЗИИ, И МОНГОЛИЕЙ

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REGIONAL PROBLEMS OF NON-PROLIFERATION

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РЕГИОНАЛЬНЫЕ ПРОБЛЕМЫ НЕРАСПРОСТРАНЕНИЯ

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* * *

THE ROLE OF ALMATY DECLARATION IN CREATION OF A ZONE FREE FROM NUCLEAR WEAPONS.

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ЗНАЧЕНИЕ АЛМАТИНСКОЙ ДЕКЛАРАЦИИ В СОЗДАНИИ ЗОНЫ, СВОБОДНОЙ ОТ ЯДЕРНОГО ОРУЖИЯ

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* * *

PLENARY SESSION #2

Conversion of Nuclear-Industry Complex

Almaty-city, 10 September, 1997

Chairman: *Yu.S. Cherepnin (National Nuclear Center RK)*

CONVERSION OF SEMIPALATINSK TEST-SITE

Yuri S. Cherepnin
National Nuclear Center of the Republic of Kazakstan

КОНВЕРСИЯ СЕМИПАЛАТИНСКОГО ИСПЫТАТЕЛЬНОГО ПОЛИГОНА

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Within the period of 1947-1991 a powerful testing base for nuclear charges and rocket engine reactor testing, for research of the powerful gasodynamic lasers and other facilities and systems conducted in the defense complex of the former USSR interests was created and operated at the north-eastern part of Kazakstan in territory of 18 thous.km2.

The work only with the nuclear charges was conducted in the territory of the test-site within 1949-1957. Since 1958 the research work was expanded. On the initiative of I.V.Kurchatov, the construction of the impulse graphite reactor (IGR) was started near the experimental field of the ground and air explosions to study the physics of neutron impulse systems. In 1964 the "Baikal-1" Stand Complex construction was started at the central part of the test-site to test the ground prototypes of nuclear rocket engines. At the beginning of 80th a unique research base was created on the test-site to perform works for different defense purposes. The share of nuclear testing, at that time, was not more than 30% of the total research work scope performed by enterprises and organizations of the test-site.

Kurchatov city (Semipalatinsk-21) itself was a restricted garrison of the USSR Ministry of Defense, where enterprises and organizations of some other Union Ministries were gradually created. Basic enterprises of the city and approximate number of employees are given in the Table.

Table

Basic Civil Enterprises of Semipalatinsk-21 in 1990

#	Enterprise	Number of People	Office	Basic Function
1	"Obyedinennaya Expediciya" of R&P Association "Luch"	1200	MSE	Reactor Complexes Operation
2	Expedition 20 (Department 73) SRITP (PA "Yuzhmash")	350	MGE	Testing of Rocket and Space Systems and Facilities
3	Central Expedition of Tselinniy Chemical Mining Plant	320	MSE	Preparation of Tunnels for Nuclear Testing
4	Civil Engineering Section #24	180	MSE	Preparation of Holes for Nuclear Testing
5	Civil Engineering Section #78	122	MSE	Engineering Work the Test-Site Facilities
6	Design and Exploration Expedition DPE-113	127	MSE	Design and Exploration Work at the Test-Site
7	CES-6 of Construction Administration in Stepnogorsk	75	MSE	Engineering Work at MCM Facilities
8	Civil Engineering Section #70	25	MSE	Electronic Devices Adjustment

As a rule, the work performed by these organizations was sensitive. There were no any significant enterprises that could produce output for peaceful purposes. Almost all enterprises of the city were employed by military units. Only "Obyedinennaya Expediciya" of R&PA "Luch", which operated the reactor complexes at the central part of the test-site, was definitely independent in its basic activity from military units. However, this civil organization, being the most huge among others, entirely depended on the military units in all life- support manners as well as the remainder organizations.

The conversion of the former defense enterprises of STS (Semipalatinsk Test-Site) started under very difficult conditions, when not only research and production activity, but all social life of Kurchatov city were conversed which was caused by a fast curtailment and restationing of Russian military units from the test-site. A real risk of a complete destruction of the whole research and production structure of the city existed. From this point of view, the decision of the Republic of Kazakstan Government to create the National Nuclear Center on the base of the test-site research enterprises was actual and timely. During 1993, three research institutes of NNC RK- Institute of Atomic Energy, Institute of Geophysics Research and Institute of Radiation Safety and Environment were established. This decision, under conditions of the USSR disintegration and liquidation of the test-site military divisions, allowed to preserve the

qualified personnel, to provide and follow-up the operation of nuclearly dangerous facilities, to develop and start the realization of the full-scale conversion program.

Primarily, the program was based on assumptions regarding a possibility to continue the main research work at the test-site which did not concern the nuclear weapon testing, and was as follows.

- research and testing work in the field of nuclear rocket engines (NRE);
- development and creation of powerful gasodynamic lasers;
- reactor experiments using the fuel from nuclear power plants;
- radiation investigations of the test-site areas;
- creation of industries and technologies requiring a large implementation of science.

During this program development, specialists were having a wish to continue the work they could perform, and knew how to perform. While time was flying by, the initial variant of the program was being definitely corrected. Work in the field of NRE and lasers could be developed only under the close cooperation with research organizations of RF and USA. However, large-scale national programs on these directions are not currently developed in these countries. Therefore, the unique experimental base in Kazakstan was turned out not to be required, and demanded big efforts for the conservation. Proposals on creation of new technologies and industries were not reinforced by practical experience in these fields, and by analysis of marketing. Therefore, despite good ideas, there was no practical development of technological directions, except creation of some items.

At present time, directions and structure of basic research work in NNC RK are as follows:

- liquidation of nuclear explosions consequences;
- liquidation of technological infrastructure used for preparation and conduction of nuclear weapon testing;
- creation of technology, equipment and places for acceptance and storage of radioactive wastes;
- working out of atomic energy development conception in Kazakstan;
- study of reactor core melt behavior under severe accidents in NPP;
- development of methods and means of nuclear testing detection, and continuous monitoring of nuclear explosions;
- experimental work on a study of structure materials behavior of ITER thermonuclear reactor;
- creation of industries requiring a large implementation of science.

This work is performed by research organizations of NNC and by the enterprises of Kurchatov city of different ownership (total number of employees is 2500). Other bodies from Kazakstan, Russia and from foreign countries also take part in the research work. Foreign and international organizations finance fully or partly most of this activity.

CONCLUSIONS

1. At the time of Semipalatinsk test-site closing, research and civil engineering organizations were working only in the military and industrial complex's interest of the USSR.
2. Timely organization of the National Nuclear Center, performed by the Government of Kazakstan, prevented the destruction of unique scientific bodies and provided the job opportunities for many civil specialists and their families members.
3. The test-site conversion program is constantly being improved, and allows to solve actual scientific and environmental problems of Kazakstan.
4. Liquidation of the testing infrastructures of nuclear test-sites has been started for the first time in the world.

NUCLEAR TEST SITES: THE PAST, THE PRESENT AND THE FUTURE

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ЯДЕРНЫЕ ИСПЫТАТЕЛЬНЫЕ ПОЛИГОНЫ: ПРОШЛОЕ, НАСТОЯЩЕЕ И БУДУЩЕЕ

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This briefing will provide an overview of the U.S. Government's nuclear test sites: past, present and future. The briefing will begin with an overview of the U.S. Government's atmospheric and cratering tests. The briefing will then transition to the Department of Defense's tunnel tests and describe the five (5) tunnel complexes in Area 12 of the Nevada Test Site. The briefing will then turn to current environmental remediation efforts and describe the Discharge Elimination Plugs in N Tunnel. Finally, the briefing will discuss low level waste disposal and a plan view of the proposed high lewel waste disposal project in Yucca Mountain.

ELIMINATION OF NUCLEAR DEVICE IN TUNNEL 108K. SAFETY OF WORKS AND ECOLOGICAL CLEANNESS

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ЛИКВИДАЦИЯ ЯДЕРНОГО УСТРОЙСТВА В ШТОЛЬНЕ 108К. ОБЕСПЕЧЕНИЕ ЭКОЛОГИЧЕСКОЙ ЧИСТОТЫ И БЕЗОПАСНОСТИ РАБОТ

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This paper represents the Russian and Kazakstani specialists activity on ND elimination located in tunnel 108K at the former Semipalatinsk test site.

The completed works system which is a great realized ecologically clean project for the interests of the solution of ecological problems and environment protection at the Semipalatinsk test site, is considered successively in this paper.

The special attention is paid to the measures the application of which allowed to provide the absolute observance of ecological cleanness and operation safety - expertise of radiation and ecological project safety, joint radio-ecological control before and after the ND elimination, procedures of the end ND box opening, visualization and decision on the ND state, and the coordinated physical measuring as well confirming the fact of the charge BB acting and ND elimination.

The paper gives the detailed comments on the realized project decisions for the stemming complex erection the use of which provided the safe disposal and sealing of chemical BB explosion products and atomized fission materials in the end box and allowed to prevent their release into the day surface. While erecting the stemming complex the new materials of stemming and stemming work technology of principle were used.

The basic experiments outcomes and feasibility argumentation of the obtained experience use during the joint work while preparing and realizing the further International Agreements on the former Semipalatinsk test site, are presented in the paper conclusion.

MEASURES OF TRANSPERANCY FOR DECOMMISSIONNING OF TEST-SITE

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МЕРЫ ТРАНСПАРЕНТНОСТИ В РАБОТАХ ПО ДЕМИЛИТАРИЗАЦИИ ПОЛИГОНА

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This paper presents non-traditional directions of activity of the Institute specialists to solve complicated scientific and technical tasks within the framework of observance of international obligations on non-proliferation.

In the latest time much attention is paid to the reaching of mutual confidence between sides during a control over the observance of agreements regarding disarmament. How can we demonstrate implementation of agreements to each of both sides, not having a leakage of confidential or, so called, "sensitive " information? That means to ensure "transparency" of activity, not doing a damage to both sides. It is needed to note that the meaning of the above term can be substantially varied, depending on what field of activity it is used in. For instance, the meaning of the transparency measures adopted in joint program of RFNC and SNL for future control of disassembling of nuclear weapon is represented as "...measures which can be taken for building of the confidence of both sides, assuring that these sides reach mutual understanding, and one side can inspect activity of another side as well as its outcomes which are a part of lifetime cycle of nuclear weapon.

We consider this meaning to be acceptable for objectives and principles indicated in joint Russian-Kazakstani activity on decommissioning of the test-site. Hereafter in this paper we will use terminology on the transparency measures which is adopted for future control of the nuclear weapon disassembling.

The transparency measures application dictates a necessity of development of documentation drawing system of individual procedures and operations, which has "sensitive" information and to which some transparency measures or others will be applied. This system, to our opinion, should ensure conviction and validation of the chosen measures, and be in accord with the existent legislation of Russia and Kazakstan.

There is an example of nuclear device (ND) destruction in a tunnel 108 located on the former Semipalatinsk test-site, that represents experience gained by specialists of RFNC-RITP in the field of development and realization of the transparency measures.

People, involved in this activity, faced with a specific direction which was interaction with people of the mass information media and public movements who before were negative and watchful to any joint activity regarding the test-site. Principle of maximum transparency of the activity for the interested public, when requirements on protection of "sensitive information" and elimination of unauthorized access to ND are fulfilled, was realized by application of information system measures used to ensure the transparency.

The following information system measures were provided for the ensuring of the transparency:

- public plenary meetings in each session of Coordinators Group where representatives of the mass information media and journalists of local and Republic television of the RK as well as representatives of public movements of the RK were invited;
- development of coordinated report for the press (press-reliza), in which basic steps of activity and outcomes of radioecological measurements at the facility were presented;
- planned meetings with representatives of the press and television;
- shooting of videofilm regarding all technical steps of the activity;
- shooting of documentary film during conduction of works completing the opening of the remote chamber with the ND and destruction of the ND.

Analysis of materials, after the matter was explained with application of the transparency measures, shows that attitude of the press and television has changed, and last publications, just before the destruction of the nuclear device, can be determined as "friendly".

Complex of the transparency measures, applied for the former Semipalatinsk test-site, presented to the Sides convincing evidences explaining that the coordinated decisions on project are made, the ND is destroyed, and radiation and environmental safety is ensured.

As a result of the activity on the ND destruction, we can conclude that a real model of interaction and cooperation between non-nuclear state specialists and the state, that represents "five nuclear states", to solve the complicated scientific and technical task, was developed and tested during the agreement implementation.

The created model and experience of the interaction, gained by the Sides during destruction of the nuclear device in the tunnel 108, can be used in joint Russian-Kazakstani works on decommissioning of the former Semipalatinsk test-site as well as for preparation and realization of inter-governmental agreements regarding non-proliferation.

LIQUIDATION OF THE NUCLEAR WEAPON TESTING INFRASTRUCTURE AT THE FORMER SEMIPALATINSK TEST-SITE

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ЛИКВИДАЦИЯ ИНФРАСТРУКТУРЫ ИСПЫТАНИЙ ЯДЕРНОГО ОРУЖИЯ НА БЫВШЕМ СЕМИПАЛАТИНСКОМ ПОЛИГОНЕ

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Characterization and peculiarities of Nuclear Weapon Testing Infrastructure (NWTI) at the former Semipalatinsk test-site (STS). Brief description of Degelen test-site (tunnel complex), Balapan test-site (testhole complex) and the tests conducted there. Inter-governmental agreements between the RK and the USA and organization of work on NWTI and STS liquidation.

Degelen and Balapan projects. Projects work organization scheme. Basic stages of work execution: complex inspection, making co-ordinated engineering decisions, project papers development and state expertise, execution of work on NWTI liquidation, environmental monitoring after the work execution.

Complex inspection of Degelen and Balapan test-sites. Methods, basic results.

NWTI liquidation methods, basic engineering decisions. Usage of working results on NWTI liquidation for solving the problems of Non-proliferation Control and Environmental Protection.

Principal results of work on Degelen and Balapan projects. Closing test-holes and tunnels. Radiation condition before and after the work execution. Calibrating explosions at Balapan.

Radiation monitoring after the work execution.

Perspectives.

«SAPPHIRE» PROJECT. OBJECTIVES AND OUTCOMES

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ПРОЕКТ «САПФИР». ЦЕЛИ И РЕЗУЛЬТАТЫ

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«Sapphire» Project contains the U.S. assistance in purchasing/exporting 600 kg of highly enriched uranium from the State Holding Association «Ulba» Uranium Plant, and compensatory equipment and service deliveries under the mutually concerted list. The compensatory payments were made as separate projects in conformity with Kazakstani enterprises needs, participation quota of which was determined by the RK Government.

Realization Milestones

- 1993 - export of 600 kg of highly enriched uranium to the U.S.;
- 1993 - 1995 - discussion of the mechanisms for compensatory payments realization for the RK under the Kazakstani enterprises participation quota:
  - determination of separate projects contents;
  - discussion of financing sources and amount;
  - development and signing of Agreements;
  - development and technical expertise of projects;
- 1995 - 1997 - projects realization;
- July 1997 -implementation of «Sapphire» Project.

Activity on Separate Projects:

- Basic «Sapphire» part includes medical projects (US$10,2 mln.):
  - Partnership Program with Semipalatinsk medical organizations (US$1,74 mln.) was performed by the American International Development Agency. Five medical organizations of Semipalatinsk region (Oncologycal Prophylactic Center, Clinical Hospital, Children Hospital, Central Hospital, Diagnostics Center) have got medical equipment and established the partnership with the Balor Medical College and Methodical Hospital in Houston. The Working Cooperation Plan has been developed, exchanges of medical personnel have been made.
  - The priority medical equipment (US$2,25 mln.) has been delivered, assembled and put into operation in the Medical unit of Ulba Metallurgical plant, including: watching over patients' health system, portable apparatus for ultrasonic examination, ultrasonic equipment of common purposes, anesthesia system, lithotrite, complex rehabilitation facility and etc.
  - U.S. Department of Defense has delivered the excess of medical equipment (US$6,07 mln.) to Semipalatinsk medical organizations:
    - Regional Clinical Hospital - US$1,03 mln.;
    - Oncologycal Prophylactic Center - US$1,01 mln.;
    - Children Regional Clinical Hospital - US$0,54 mln.;
    - Station of Blood Transfusion - US$0,34 mln.;
    - Regional Stomatologic Policlinic - US$0,05 mln.;
    - Central City Hospital - US$0,9 mln.;
    - Children Regional Stomatologic Polyclinic - US$0,19 mln.;
    - Region Health Department - US$0,47 mln.;
    - Region Clinical Hospital - US$1,03 mln.
    - Regional Treatment & Diagnostics Center in Kurchatov City - US$1,54 mln.
- Kazakstani Services were equipped with computers (US$1,65 mln.) by the American International Development Agency for Taxation Services of Kazakstan (US$1,15 mln.) and by U.S. Department of Energy (US$0,5 mln.) for Monitoring preparation of Kazakstani Atomic Energy Agency.
- 7 Research projects are being realized via the International Science & Technological Center (US$7,8 mln.):
  - Procedure of beryllium materials and covering production and study of their properties under conditions simulating temperature-power, gas and radiation effects of TAR (US$4,110 mln.);

- Development of technology on IAE NNC RK Research RA reactor facility decommissioning (US$640 ths.);
- Ecological migration paths of radionuclides related to nuclear tests at Semipalatinsk Test Site (US$300 ths.);
- System of nuclear materials control and accountancy due to the IAEA Safeguards and improvement of radioecological situation of the industrial areas at the State Holding Association «Ulba» (US$550 ths.);
- Simulation of contaminating substances migration in the soil and subsoil water in Semipalatimnsk test site region (US$480 ths.);
- Creation of systems for storage, operative control, physical protection of nuclear materials and ampoule sources of ionizing irradiation ASII) at «Baikal-1» stand complex, meeting to international requirements of radioactive materials accounting and control (US$700 ths.);
- Characterization of radiological and non-radiological contamination on Semipalatinsk test site location (US$1,22 mln.).

- **Export control** (US$2 mln.). It has been realized as the equipment delivery under the concerted list.
- **Equipping of nuclear materials accounting and control system** (US$156,28 ths.) **at «Ulba» Association enterprises** was conducted by the Department of Energy in conformity with the concerted list. The equipment received under the present project, allowed to create the alarm system at uranium materials vaults and basic manufacturing buildings of uranium plants.

CONVERSION INTERNATIONAL SCIENCE & TECHNICAL CENTER PROJECTS PERFORMED BY NNC RK

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КОНВЕРСИОННЫЕ ПРОЕКТЫ МЕЖДУНАРОДНОГО НАУЧНО-ТЕХНИЧЕСКОГО ЦЕНТРА, ВЫПОЛНЯЕМЫЕ В НЯЦ РК

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The program on conversion of the former Semipalatinsk Nuclear Test Site is permanently extended. Currently the NNC RK Institutes carry out researches within the framework of eight International Science & Technical Center projects. The activity under the projects allow to solve actual scientific problems in the sphere of atomic power safety and radiation ecology, non-proliferation problems, improvement of nuclear materials control, accounting and physical protection systems at Semipalatinsk test site reactor complexes.

Researchers and experts of many key scientific centers of the USA, Europe, Japan, Russia and Kazakstan take part in the implementation of the projects.

New technologies and methods are developed in the course of the projects execution. Thus, for instance, to return Russian nuclear materials located in the reactor core, the technology on RA research reactor decommissioning is developed under K-48 project in the Institute of Atomic Energy of NNC RK. Within Project K-057 there is created the system of storage, operative control, physical protection of materials and ampoule ionizing irradiation sources at "Baikal-1" stand complex, which meet the international requirements on radioactive materials control and accounting.

The Institute of Radiological Safety and Ecology jointly with the Institute of Nuclear Physics NNC RK perform researches (Projects K-053, K-054) in radioecology and radiobiology, assessments of nuclear tests consequences on flora and fauna of the region, they reveal radiological and non-radiological contamination at STS, determine the ways of radionuclides migration.

While conducting underground nuclear explosions the hollows and areas of rocks disintegration in explosion focus neighborhood, which in some cases disturb the hydraulics existed before the explosion, are created. As a consequence of such disturbance there is radionuclides displacement in water medium at significant distance from the explosion place. It can cause the radionuclides penetration into subsoil and near-surface waters. The detailed study of Earth crust units within the range of which the nuclear explosions were conducted, construction of physical and geological model of the tested units are the priority task of works carried out under Project K-056.

Kazakstan is a unique place for seismic stations location. According to the decision of the Conference on Disarmament in Geneva, all observatories of NNC RK Institute of Geophysical Research have been included in the World Monitoring System called for the control of the Comprehensive Test Ban Treaty observance, accepted by UN General Assembly in September 10 1996. Nuclear Weapons control and earthquake monitoring in Kazakstan are performed within the framework of Project K-063.

The ISTC projects activity is directed on the conversion of the STS military-industrial complex, on restoration of natural environment in nuclear explosion places, and allowed to keep the qualified staff and let them have a job.

NUCLEAR INDUSTRIAL & POWER COMPLEX OF KAZAKSTAN

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ЯДЕРНЫЙ ПРОМЫШЛЕННО-ЭНЕРГЕТИЧЕСКИЙ КОМПЛЕКС КАЗАХСТАНА

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While selecting the national power supply strategy of economic potential development four factors are laid in the basis of discussions and technical and economic decisions: effect either power complexes on people health, consequences environmental, economics and resources existence. As alternative decisions power complexes on organic power carrier: coal, black oil and gas; renewable power sources: hydraulic power, solar energy, wind energy, biomass energy; and nuclear power are able to be considered. In many industrial developed countries of the world the nuclear power, according to the above four factors, is more preferable.

Atomic power requires the balanced approach to power politics which, by that, avoids the dependence on any energy source.

The existing electric power generation structure in Kazakstan is featured by the following numbers:

- TEPP on coal - 79%;
- TEPP on gas-black-oil fuel - 12-13%;
- HEPP - 6-7%;
- Atomic PP - about 0.7%.

In spite of the demands decreasing, the republic imported more than 7 billion kW/h of power from Russian Federation and states of the Central Asia for this period, and it was 10% of the demands.

Within the period 2000-2010 a 20-25 billion kW/h power consumption increasing is expected and to 2020 - by 35-45 billion kW/h. Power generation increasing due to the capacities inlet on the alternative-free power plants is expected within the period till 2010 by 20-28 billion kW/h and till 2020 - by 34-42 billion kW/h.

In the period after 2020 the power shortage increases throughout the all Kazakstan regions, which is especially typical for the western and southern Kazakstan.

The ground for nuclear power development is considerable uranium deposits and rather developed atomic industry.

Kazakstan Atomic Industry includes:

- uranium extractive enterprise - State Holding Company «Tselinnyi Mining-Chemical Plant» (SHC «TCMP»), Stepnoy Ore Division (SOD), Central Ore Division #6 (COD #6), KASKOR (Aktau);
- plant on fuel pellets production for APP (AOOT "UMP");
- plants on production of rare and rare-earth metals - Irtysh Chemical & Metallurgical (AO "ICMP") and Ulba Metallurgical Plant (AOOT "UMP");
- Mangyshlak Power Plant (MAEK);
- Scientific Complex of NNC RK of Ministry of Science - Academy of Science.

About 25% of world deposits and uranium resources are concentrated in Kazakstan bowels.

Total deposits and uranium resources in Kazakstan are estimated for 1617 t., including known reserves of B+C2+C2 categories - 926 ths. t, demonstrated resources for 691 ths. t.

The method of «underground extraction» used at Kazakstan uranium fields, is considered now as the most progressive and the cheapest one in the world.

The uranium is mined in six Republic regions and processed at Tselinni Mining-Chemical and Prikaspi Mining-Metallurgical Plants, and at Kirgizstan and Tadgikistan enterprises as well.

The production of fuel pellets from the low-enriched uranium for nuclear reactors at Ulba Metallurgical Plant takes an important part in the NIS uranium fuel cycle. According to numerous parameters the pellets have the world quality level. The level of the fuel pellet production at AOOT «Ulba» was in 1992 - 618t., in 1993 - 590t., in 1994 - 770t., in 1995 - 440t.

At AOOT "Ulba" there is the industrial production of superconductive materials providing the creation of magnetic systems of the acceleration-storage complex of «Tokamak» fission facilities, cryoelectromachines, devices for medical tomographies and etc. Thus, AOOT «Ulba» takes still a dignified place in the closed nuclear cycle existed the former USSR.

The general producer of electric and thermal power, and desalination in Mangistau region is MAEK including a set of power units on gas, and one unit on nuclear fuel as well - BN-350 reactor. BN-350 reactor is a fast neutrons reactor with the maximum flux of 6·106 n/cm2·s and sodium coolant using 235U in 21% enrichment. More than 20 years of accident-free operation of BN-350 facility which generates 125 MW power and heat for sea water desalination (100 ths.t distillate per day) confirmed that the reactor is easily operated, safety and has the least effect on the environment, on the field personnel and population.

The design reactor operation life expires in 2003. BN-350 decommissioning is expected.

The scientific potential of atomic production complex of the Republic of Kazakstan is concentrated in NNC RK divisions (IAE and INP) and at AOOT «UMS» and MAEK enterprises.

General share of NNC MS-AS practical activity is devoted to the implementation of the aimed republic and technical program (RSATP) «Development of Atomic Power in the Republic». NNC operates as a key organization on the implementation of this program.

A series of Control and Supervision Boards was created on its territory to perform the effective control of the whole nuclear activity from the state side. The activity objective of such Boards is, first of all, the protection of the state interests upon the whole, and it is the most important under conditions of marketing economics development.

Ministry of Energy and Nature Resources is a Board responsible for the development of atomic industry and power branches.

Atomic Energy Agency of the Republic of Kazakstan performs the independent effective state supervision and control providing safety of atomic industry and power installations operation.

Kazakstan has entered the IAEA, and in February 1994 joined the Non-Proliferation Treaty (NPT) as a nuclear weapons-free state, in July 1994 signed the Agreement between the Republic of Kazakstan and IAEA about safeguards application under the NPT .

The followings have been created or are creating in Kazakstan:

- State Control and Accounting System of Nuclear Materials (SCSANM) and the IAEA safeguards provision;
- Nuclear Materials and Technologies Export Control System;
- Nuclear Materials and Facilities Physical Protection State System (NMFPPS).

Work directed on determination of a place and role of nuclear power in the Republic power branch were started in в 1992. RK Ministries of Power and Science developed the Conception project on creation of nuclear power in Kazakstan.

Taking into account that Kazakstan has about 25% of the world known uranium reserves and a great capability for the mining increasing by the most economical and most ecologically pure method - the underground extraction, it's rather real to have the following task - to achieve a stable position on uranium market using this both as the source of financing resources for the APP development and the factor of political influence of Kazakstan, especially on the countries of South and South-Eastern Asia, where APPs are developed and there are no uranium resources.

Increasing of natural uranium production is expected according to the following trends:

- To recover mining up to the design level at PV mines in Southern Kazakstan with processing up to the production of U3O8 at the running uranium plants - TMCP (Stepnogorsk), and in conformity with the intergovernmental agreements - in KMRP (Karabalty, Kirgizstan), Vostokredmet (Hodgent, Tadgikistan).
- To recover mining at TMCP mines.
- To realize SP «Inkai» and SP «Katko» projects.
- Production of fuel pellets from low-enriched uranium for nuclear reactors of Russian project at Ulba Metallurgical Plant takes an important part in the uranium fuel cycle of NIS countries. According to a number of indices the pellets are comply with the world quality level.

The following trends of pellets industry development have been chosen:

- to achieve a guarantee order for fuel pellets up to 200-300 t per year for APP with WWPR and RBMK for Russia, Ukraine and Bulgaria.
- to enter the world market with the powder or fuel pellets of natural isotope composition for hard-water reactors, produced from Kazakstan uranium.
- to start searching of natural uranium dioxide realization ways to potential consumers (U.S., Southern Korea, India and etc.).
- to enter the world market with the powder or pellets of low-enriched uranium dioxide produced according to the scheme: Kazakstan natural uranium - enrichment in isotope 235U in Russia - production of a powder or pellets at UMP.
- to develop services on uranium-containing materials processing as ash, insoluble wastes, scrap containing gadolinium and etc. from foreign countries at UMP.
- to organize the production of fuel elements and fuel assemblies for Kazakstan atomic power as its developing.

Staff power supply will be developed in the following trends:

- Specialists of basic atomic specialties «operation of atomic plants», «nuclear-chemical technology» and others are well prepared in Tomsk Polytechnical University.
- By that, for the first two-three years, when general technical training is performed, to teach the students in Kazakstan Universities, and then to finish their education in Tomsk City, Obninsk Institute of Atomic Power, Uralsk State Polytechnic University.
- As for the training of other specialists they can be trained in Kazakstan Universities, gradually creating the system and training and material base to train staff for the atomic branch, transferring the most part of training to enterprises themselves. This year the specialties of «Environmental and Monitoring» and «Nuclear Reactors and Facilities» were opened in «Semei» University in Semipalatinsk City.
- The Republic Branch Training Center including its own training and material base and training process, should be created for the staff retraining.
- Labor is prepared in situ now. This practice will be gone on. But at the same time a united training center should be created in one of the enterprises.

BASIC WORK EXECUTED BY IAE NNC RK ON VALIDATION OF ATOMIC POWER SAFETY

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ОСНОВНЫЕ РАБОТЫ, ВЫПОЛНЯЕМЫЕ ИАЭ НЯЦ РК В ОБЛАСТИ ОБОСНОВАНИЯ БЕЗОПАСНОСТИ АТОМНОЙ ЭНЕРГЕТИКИ

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IN-PILE EXPERIMENTS

1. IGR Reactor

1.1. Ampoule Free of Flow Rate Testing

The experiments to verify the calculation codes on severe accidents study have been performed. The basic simulating accidents were the accidents with unauthorized reactivity increasing and loss of coolant accidents.

To simulate the conditions typical for the unauthorized reactivity increasing accidents the neutron burst of up to 0.12 s power half-width was realized in the IGR reactor, achieving the value of the top thermal neutrons flux of 1016 n/cm2 · s by the fluence up to 0.7·1016 n/cm2. As for uranium dioxide, for instance, it means that the rated energy release was realized to 1000 cal. per gram of fuel (by enrichment of 4.4% in uranium-235). A wide range of possible energy release allowed to determine the thresholds of fuel elements destruction. More than 200 fuel elements of WWPR-1000 reactor, 20 fuel elements of fast reactors with the lead and sodium coolant, 15 fuel elements with silicium fuel for the perspective WWPR-1000 reactor core, fuel elements of special purpose reactors and etc. have been tested.

To simulate the conditions typical for loss of coolant accidents the complicated power diagram providing a wide range of heat power variation of model fuel elements - from the rated power up to the power of residual energy release, was realized in the IGR reactor. The key objective of the experiments was the study of physical and chemical fuel elements design materials/coolant interaction and obtaining the experimental data to substantiate the testing modes for model fuel assemblies.

About ten different ampoule devices specially intended to solve these or those special research problems, were designed, manufactured and used for the implementation of ampoule experiments. Philosophies of parameters measurement, selection and validation of testing modes were tested. Now the equipment and methods allow to conduct ampoule testing of model fuel elements of any types in the shortest period of time.

The particular type of ampoule testing is the investigation of WWPR-1000 reactor core material melt/water interaction. For this purpose there was created the ampoule melting device where more than a kilogram of melt containing uranium dioxide, alloy of zirconium, steel and etc., could be melted and discharged into the water. The experimental data are able to be used not only for the description of the water/melt interaction, and for the comparison with the out-of-pile experiments outcomes to optimize the process of the results transferring (obtained under out-of-pile conditions) to the real in-pile processes, have been obtained.

1.2. Loop Testing

Loop testing of fuel assemblies in the IGR reactor is a traditional type of study in the IGR reactor. Some time later after the IGR reactor start-up the testing of gas-cooled assemblies with high temperature fuel elements which were expected to use in the nuclear rocket engine, has been started. Data on resource life and fuel pins and FA design elements stability to the effect of high parameters (thermal fluxes, temperature, irradiation and etc.) were stored during the experiments. This testing part is the most significant by the scope.

The objective of water-cooled assemblies testing was the validation of thermo-technical FA reliability under transient and accident conditions (under conditions of power maneuvering, up to considerable releases, and cooling coolant flow rate, up to its termination). In addition to the assemblies of special purpose the fuel assemblies of EWW-2M, WWPR-100 reactors were tested. The specialized technological stand systems to prepare and conduct tests, well-developed system of parameters measuring and recording, methods of post-experiment structural material investigations have been created and are under the operability state.

The experiments on PHWR fuel elements behavior study under loss of coolant accidents with the simultaneous power flesh-up superimposition by the decreasing of coolant flow rate through the reactor core, are prepared as the development of works on study of fuel elements and FA behavior under transient and accident operation modes. The experiments are expected to be conducted in the IGR reactor. In the program of the first experiments stage it is expected to study single fuel elements, in future - testing of model assemblies.

Another experimental program implementation of which can be started in the nearest future, is the program on investigation of fast reactors FA design elements providing the reactor state control under loss of coolant accidents with the following fuel melting. Currently the stage of testing parameters measuring methods is conducted, preliminary model experiments targeted to the verification of technical decisions on sensors and measuring systems design, are performed

2. EWG.1M Reactor

The main purpose of EWG.1 reactor, the prototype of EWG.1M reactor, was testing the gas-cooled fuel assemblies with fuel elements of nuclear rocket engines. The reactor was up-dated to improve some important reactor factors, such as duration of continuos running and to conduct the experiments using water as a coolant and etc. Now the EWG.1M reactor is considered as a candidate one to prepare and perform investigations of gas-phase fuel channels, resource study of model fuel assemblies of commerce reactors. Investigations on the reactor irradiation scattering into the atmosphere performed now are under significant interest.

3. RA Reactor

RA reactor has been created as a testing one. Now the most interesting experimental works conducted using this reactor, are studies of hydrogen sorption and desorption and hydro-permeability of materials which are expected to use in fusion-type reactors. Structural material investigations of fuel elements of gas-cooled reactors are performed, similar investigations of fuel and design materials can be implemented.

OUT-OF-PILE EXPERIMENTS

1. RUCHEI Facility

RUCHEI facility is intended for the study of fuel elements of water-cooled reactors in water vapor medium. It was created to study the process of fuel elements destruction during catastrophic cladding oxidation, made of zirconium alloy. It has high vapor parameters (temperature is up to 2300 K, vapor flow rate is to 0.2 kg/s), wide volume of operation section which allows to study model fuel elements of about 1 m length.

2. LAVA and SLAVA Facilities

LAVA and SLAVA facilities were created to study the processes of water-cooled WWPR-1000 reactor core materials melt/design materials and coolant interaction and processes of the melt flowing through the hole of the specified size. The facilities property is a number of melt which can exceed 60 kg. Now the works are carried out under the framework of the contract with the Japanese company Marubeni. Basic technological operations concerning the melt production and discharge, parameters measuring and post-experiment testing, have been tested. A number of experiments on study of melt/concrete interaction, which is expected to use as the material for dry traps, are conducted.

3. Perspective Facilities and Investigations

Currently the facilities intended for the study of the ITER reactor first wall elements behavior under conditions of maximum permissible thermal effect and loss of cooling accidents, are under the design. In the nearest future there is a task to study the water/beryllium interaction and determination of conditions for the development of self-sustaining beryllium oxidation reaction in the water vapor medium.

The facilities to study the processes of electrochemical, thermochemical and mechanical cleaning of the stainless steel from the surface radionuclide contamination (especially, with uranium and fission products) are under the design. The work is carried out in the framework of nuclear reactors decommissioning technology testing. The fundamental objective of the project is the determination of the capability to reuse the design materials used in nuclear reactors equipment, and minimization of radioactive wastes volume required to be disposed.

NUKEM NUCLEAR GMBH ACTIVITY IN CIS COUNTRIES IN THE SPHERE OF RADIOACTIVE WASTES AND NUCLEAR FUEL HANDLING

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ДЕЯТЕЛЬНОСТЬ НУКЕМ НУКЛЕАР ГМБХ В ГОСУДАРСТВАХ СНГ В ОБЛАСТИ ОБРАЩЕНИЯ С РАДИОАКТИВНЫМИ ОТХОДАМИ И ЯДЕРНЫМ ТОПЛИВОМ

Вайхард А.
НУКЕМ НУКЛЕАР ГМБХ

NUKEM was founded in 1960 as one of the first nuclear companies in the German Federal Republic. As a result the company has a tradition of over 30 years in the field of nuclear technology. This, together with its extensive research and development work, has brought the company international recognition. With this work, NUKEM developed not only processes for producing fuels and fuel elements, but also the plant and equipment necessary for this production. NUKEM engineers further planned and built the total infrastructure for operation of these manufacturing plants, including the supply and waste plants, the nuclear ventilation technology, the laboratory and the remote handling manipulators.

Today NUKEM is one of the worlds leading system partners of the nuclear technology industry. The scope of activities extends from the design to the manufacture and construction of turnkey plants. The points of emphasis are plants and processes for the treatment of radioactive wastes, storage and container technology, the decommissioning of nuclear plants, the planning and building of nuclear laboratories, the design of fuel elements and safety and monitoring technology.

NUKEM Nuclear Technology is an independent division within the plant construction of the NUKEM Group. Additionally, five further subsidiary and partner companies have a spectrum of nuclear technology activities. Altogether, NUKEM Nuclear Technology counts around 300 highly qualified engineers, scientists and technicians. An extensive potential of discipline skills and know-how, available to our customers for solving their individual problems. Numerous designs and patents underline the strength of innovative output this area.

The engineering service offered by NUKEM includes the whole spectrum of process and technology as well as construction and start-up as general engineer or general contractor: Basic engineering; Detail engineering; Procurement; Personell training; Start-up.

Engineering and safety for nuclear technology: Process and plant planning; Media supply and disposal; Building and architecture; Electrical, measurement and control technology; Safety and accident analysis; Licensing procedures.

Treatment of Radioactive Wastes:

- Volume reduction of solid and liquid wastes: vaporizer plants; evaporator plants; incineration plants; pyrolysis plants; compactors.
- Chemical/Physical processes for residue treatment: boric acid recovery plant; activity separation plants.
- Storage and container technology.
- Conditioning solid liquid wastes: cementation; vitrification plant; bitumisation; smelting plant.

CONVERSION POLICY PRINCIPLES OF DEFENSE ENTERPRISE

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ОСНОВЫ КОНВЕРСИОННОЙ ПОЛИТИКИ ОБОРОННОГО ПРЕДПРИЯТИЯ

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1. Research Production Association "LUCH" (RPA "LUCH") have worked at atomic industry for 51 years. Now it is one of the leading scientific production centers of Russian Minatom. Not long ago it was a complex of Scientific Research Institute, experimental plant and Obyedinennaya Expedicia at the Semipalatinsk test site (now it is the Institute of Atomic Energy NNC of Kazakstan). Basic directions of the complex activity are defense tasks. These tasks are to develop structure and technology of producing fuel assemblies for NRE (nuclear rocket engine) reactors. Also the tasks include testing the fuel assemblies at IWG-1, RWD and RA reactors. Also the tasks include structure and technology development, production and testing electric generating channels for nuclear thermal emission converters of nuclear energy into electric one (space board power engineering), power metal optics for powerful lasers, high temperature gas reactors.

2. Main directions of RPA "LUCH" conversion were determined on the basis of possibilities for developing main achievements in defense technology directions. These directions are high temperature materials and constructions (carbides, refractory metals, measurements, optics, uranium compound, beryllium, molybdenum etc.).

3. At present at RPA "LUCH" there have been created experimental and industrial productions making temperature sensors for Atomic Electric Power Stations (AEPS). Also these manufactures reprocess products with uranium and beryllium, radioactive waste. The manufactures release commercial products. They produce technological equipment of carbide-silicon for electronic industry as well as parts for X-ray tubes, items made of leuco-sapphire, plasma cutters.

There appear scientific-industrial manufactures. These are ones making optical disks at phase transitions, measuring channels. There are also manufactures making neutron flow and temperature measuring for AEP stations, silicon, X-ray tubes, vermiculite parts for cable drivings of AEP stations (high temperature, fireproof ones) of thermal and electrical accumulators.

Thus, a scientific-production center is being created. Core of it is a scientific engineers group and development directions, generated from orders of defense department, as well as new foreign technologies (along with investments).

The example of the said above can be development of a project on non-regular use of energy sources.

4. Autonomous energy complex on the basis of wind-electric power station with heat and electric energy accumulators.

This complex can be used in supplying remote villages, farms, cottages, hothouses, greenhouses and other rooms with heat and electricity. This concerns places where the ecological situation is not good and regular energy sources are not available (gas, coal, wood, oil etc.).

The scheme of such complex is in Fig. 1.

It includes wind-electric station, electric accumulator battery, heat devices and facilities for heating water made on the basis of heat accumulators and automatic complex control unit.

Functions and operating principle of wind-device, electric accumulators battery and control unit of such a complex are well known to many people. Let's talk about the heat devices developed at our institute. These devices are made on the basis of thermal accumulators operating at phase transitions. Heat accumulation at such accumulators is based on using melt heat of heat accumulating materials. You can see the scheme of such electrical-heating facility in Fig. 2a.

It includes electric heater, heat-accumulating element based on aluminum-silicon composition, and outer insulation.

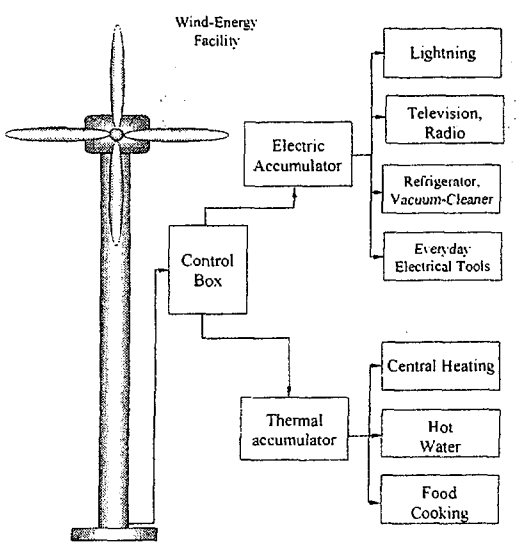

Fig. 1. Principal Scheme of the Autonomous Energy Complex

Unlike regular electrical-heating systems, heating devices of RPA "LUCH" during 8 hours accumulate heat from tube electric heater in the process of Al-Si composition melting. After the heater's turning off these electric heaters deliver heat at a steady temperature in the process of solidification during 16 hours. The phase transition temperature for heat-accumulating substance based on eutectic mixture Al-Si is 850 K. The surface temperature of a heating device, intensity and time of cooling are determined by the thickness of the outer thermal insulation.

At present the examples of such heating devices have been made at RPA "LUCH". They have been successfully tested.

The diagram of this device testing is in Fig. 2b.

According to their thermal and physical characteristics our heating devices are twice as good the heating devices suggested by a German enterprise STIEBEL ELTRON (see Fig. 2c).

A wind unit at the Autonomous Energy Complex can be completed by solar electric power station, diesel-generator or other alternative electric energy sources (in this case a combined autonomous energy complex will be meant) for rising reliability of energy supply.

Autonomous Energy Complex will be connected to local electric mains. This also makes a more reliable energy supply. Advantages of Autonomous Energy Complex (AEC) with accumulators of thermal and electric energy are seen when electric energy supply to the mains is not steady. Also when reduced night tariffs on electric energy for central heating and hot water are introduced the advantages of AEC are well seen too.

Disadvantages of the alternative energy sources are irregular supply and low quality. This needs using special converters: stabilizers for current parameters (frequency of AC and its voltage) operating only if there is electric energy.

Energy accumulation at AEC allows canceling inconvenience of irregular energy supply. It also helps to make it independent of energy quality at the use of electric and thermal accumulators operating with any current (AC or DC).

In conclusion it should be noted that according to the experts' opinion in 2025 the level of energy consumption will be twice as much than it is now in the world. We would like to hope that mankind while developing will increase energy consumption using solar and wind energy.

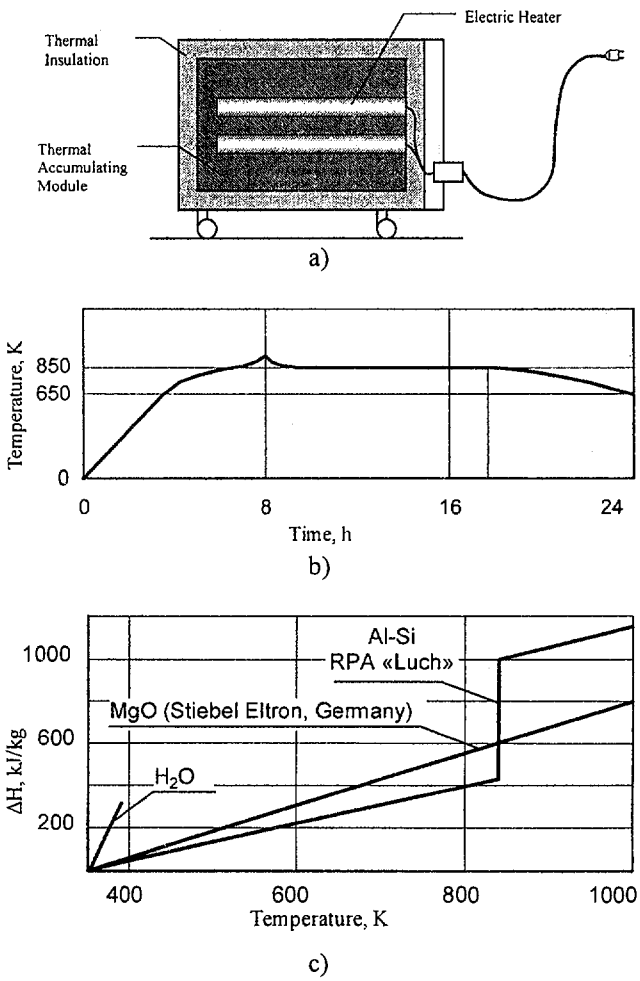

Fig. 2. Electrical Heating Device

THE 1997 REMOTE SENSING MISSION TO KAZAKSTAN

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МИССИЯ ДИСТАНЦИОННОГО ЗОНДИРОВАНИЯ В РЕСПУБЛИКЕ КАЗАХСТАН В 1997

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In June and July of 1997, the US Department of Energy, in cooperation with the Republic of Kazakstan Ministry of Science – Academy of Science conducted a remote sensing mission to Kazakstan. The mission was conducted as a technology demonstration under a Memorandum of Understanding between the United States Department of Energy and the Republic of Kazakstan's Ministry of Science – Academy of Science. The mission was performed using a US Navy P-3 Orion aircraft and imaging capabilities developed by the Department of Energy's Office of Non-proliferation and National Security. The imaging capabilities consisted of two imaging pods – a synthetic aperture radar (SAR) pod and a multisensor imaging pod (MSI). Seven experiments were conducted to demonstrate how remote sensing can be used to support city planning, landcover mapping, mineral exploration, and non-proliferation monitoring. Results of the mission will be presented.

FLYING LABORATORIES FOR COMPLEX RADIATION MONITORING BASED ON GENERAL PURPOSE AIRCRAFT

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ЛЕТАЮЩИЕ ЛАБОРАТОРИИ КОМПЛЕКСНОГО РАДИАЦИОННОГО КОНТРОЛЯ НА БАЗЕ СЕРИЙНЫХ САМОЛЕТОВ И ВЕРТОЛЕТОВ

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The application of aircraft for radiation monitoring becomes very significant both within the Comprehensive Test Ban Treaty and the Nuclear Weapons Non-Proliferation Treaty. Since 1991 a special program has been carried out, financed by the Ministry of Defense, which envisages manufacturing of a family of automated Flying Laboratories for Complex Radiation Monitoring, based on general purpose airplanes and helicopters. The main requirements for hard- and software, installed aboard the aircraft has been navigational tie-in of the measurements data for a more precise monitoring, capability to register and process information in real time mode, and unification and compatibility of the hardware and software.

The first laboratory, produced by the R & D Center for System Modeling in 1992, was an airplane-laboratory (PL), based on the conventional Antonov 30. Its equipment consisted of additional radio navigational instruments linked to the onboard computer, a SNEG Airborne gamma ray spectrometer developed by the Moscow Institute for Physical Engineering, a ZEFIR Dose capacity meter, a T2 magnetic tape registering machine, infrared vision (ZIMA) and aerial photographic (AFA-41/10, AC-707) equipment, K-514-D air sampling devices.

However, the exploitation of this PL has revealed certain inaccuracy of the navigational tie-in of the obtained measurements data, as well as automation imperfection of the operators consoles. Besides, a necessity has been observed, to provide testing of air samples for radioactive noble gases (^{85}Kr and ^{133}Xe). These shortcomings have been taken account of and successfully overcome in the next laboratory - the PL based on the Antonov 24B.

The equipment of this PL includes an onboard computing system, a NAVSTAR receiver and supplementary navigational equipment of the pilot and navigator, a SNEG Airborne gamma ray spectrometer, a ZEFIR Dose capacity meter, a sampling device for subsequent test of volume concentration of radioactive noble gases, two K-514-D filtering gondolas. Automation has been considerably improved by installation of the EVP-OPERATOR multiple interface as well as by introduction of automatic timing of air sampling. Besides, a subsystem of real time monitoring of the radiation dose situation has been introduced into the computer software of the team commander console.

The flying lab based on Mil 8MT helicopter has been developed concurrently with the Antonov 24B PL. The instruments installed there were the same as in the Antonov 30, except the TV and aerial photographic equipment. Besides, a satellite navigational system with an aircraft director was included, and SNEG spectrometer was substituted with the newer MAGS system.

Exploitation of the above laboratories has proven viability of the series basic concept. However, utilization of partially outdated hardware set limits for the overall system application, which eventually led to additional expenditures. Therefore, a decision has been made, to create an Advanced automated flying laboratory on the basis of the Antonov 72 aircraft, equipped with radiation monitoring apparatus of a new generation.

The new laboratory equipment consists of a radiation monitoring system, means for gas and aerosol atmospheric sampling, additional navigational equipment based on a Russian-made mid-orbit satellite receiver for NAVSTAR and GLONASS systems, a route deviation indicator, ground-based equipment. The software includes a specially developed package for aerial photography and air samples data processing. The laboratory was designed by VIRG-Rudgeofizika in cooperation with the Radium Institute Association and R & D Center for System Modeling.

The radiation monitoring equipment provides measurement of gamma-radiation spectra with high spatial and energetic resolution based on, correspondingly, scintillation and semi-conductor detectors. It also ensures measurement of gamma exposure capacity both on the current mission altitude and on the ground level.

The sampling equipment is designed for air samples extraction (by turning into the liquid state) for subsequent ground lab analysis of volume activity of ^{85}Kr , ^{133}Xe and other radioactive noble gases, as well as for atmospheric aerosol sampling.

The data processing system provides remote control of the onboard equipment and registration of the radiometric, navigational and auxiliary data, their input into the computers, pre-processing, processing, editing and archiving. The results of the processing include:

for gamma-ray spectrometer with scintillation detectors:

1. isolined maps of monitored terrain and diagrams of mission routes;
   - gamma exposure rates (in "radium" approximation);
   - mass content of uranium (radium), thorium and potassium in geological rocks;
   - content of one or two man-caused radionuclides in the upper ground layer;
   - local gamma-emitters;
   - objects with atypical spectrum of emission.
2. radionuclide composition of man-caused Earth surface contamination;

for gamma-ray spectrometer with semiconductor detectors:

- radionuclide composition of man-caused Earth surface contamination with estimation of specific radionuclides content;

for gamma-radiation dose meter:

- isolined maps of monitored terrain and diagrams of gamma exposure rates at the height of 1m above the ground level and at the mission altitude;

for instruments for monitoring of radioactive contamination of the atmospheric gas fraction:

- volume activity of ^{85}Kr and ^{133}Xe on the mission route;

for equipment of aerosol fraction monitoring:

- radionuclide content of atmospheric aerosols and volume activity of specific radionuclides on the mission route.

Currently the R & D Center for System Modeling is equipping an Antonov 72 aircraft with instruments of radiation monitoring for preliminary ground and flight tests.

COMPUTATIONAL STUDY OF RADIATION FIELDS IN THE INTERESTS OF NUCLEAR MATERIALS NON-PROLIFERATION

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РАСЧЕТНЫЕ ИССЛЕДОВАНИЯ РАДИАЦИОННЫХ ПОЛЕЙ В ИНТЕРЕСАХ НЕРАСПРОСТРАНЕНИЯ ЯДЕРНЫХ МАТЕРИАЛОВ

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In recent years RFNC-VNIITF has been performing activities in the interests of nuclear materials control. Considerable attention has been paid to radiation techniques enabling to detect illegal and unauthorized migration of materials that are of proliferation interest. This presentation discusses the issues of radiation detection and identification of nuclear materials and radiation sources being transported illegally.

Important phase of developing particular radiation technique for detecting masked sources is computational optimization of detecting system and scheme of measurements. These studies are based on simulation of gamma-neutron fields from various types of sources under different conditions of technique application.

To model a variety of possibilities for unauthorized movement of proliferation hazardous materials we focused on techniques and appropriate equipment which could be applied both at the customs and in specialized measuring complexes of environmental and technical radiation control. Peculiar feature of these techniques is requirement of high reliability of both measurements and interpretation of results, and use of simple in operation detecting ad recording equipment. Optimization of these main requirements leads to equipment with reasonably limited spectral sensitivity.

Studying feasible ways enabling to transport illegally fissile materials (FM) through control points, authors classified them with respect to

- isotope composition of FM (proliferation materials were considered with different contents of U, Pu, possible isotope sources of Cf type);
- mass of FM (this parameter determines dimensions, weight and radiation characteristics of objects under control);
- ways of transportation (hand luggage, luggage, containers for carriage by road, rail or sea; way of transportation specifies possible mass of masking protection and minimal possible distance between detectors and active source);
- possible types of masking protection (protection design depends on amount of material, way of transportation; both standard packages and available means can be used as protection).

Computations were performed for model systems describing in principal the whole range of the above situations. Spectral intensities of neutron and gamma radiation were obtained determining design selection and specifying required spectral characteristics of detectors under development.

Special attention is given to expediency of involving experts previously engaged in nuclear charges development in activities on NM non-proliferation taking into account their expertise in the field of computing gamma-neutron fields and modeling processes of ionizing radiation impact on matter.

CTBT VERIFICATION RESEARCH IN SUPPORT OF NON-PROLIFERATION

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КАЛИБРОВОЧНЫЕ ИССЛЕДОВАНИЯ ПО ПОДДЕРЖКЕ НЕРАСПРОСТРАНЕНИЯ В РАМКАХ ДВЗЯИ

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The Comprehensive Test Ban Treaty (CTBT) prohibits nuclear weapons testing at any yield. The detection and positive identification of any evasive tedt presents a challenge to the technical community, however. Low yield testing can be masked by normal background seismic noise or permissible chemical explosions for mining or other purposes. Cavity decoupling can reduce thr seismic signal from the nuclear explosion by a factor of 50 or more. The combination of decoupling and high explosive masking represents a particular technical challenge for positive identification.

To address this problem, a technical program in cooperation with the Kazakstan National Nuclear Center has been initiated to conduct a series of tests in the Balapan area of the Semipalatinsk Test Site to provide fundamental data on the depth of burial effects on seismic signals emanating from an explosion. If the depth of burial can be positively determined from the characteristics of the seismic waveform, near-surface mining blasts can be distinguished from deep underground evasive nuclear explosions, thus eliminating the capability to easily mask the nuclear event.

This paper will briefly describe the basic concepts of some evasive nuclear testing options and discuss the cooperative test program that is being carried out to improve the capability to positively identify such tests. The paper will also discuss possible additional cooperative tests that might be done in 1998 to further improve the identification capability.

TOPOLOGICAL IDENTIFICATION OF SEISMIC EVENTS (EXPLOSIONS, EARTHQUAKES)

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ТОПОЛОГИЧЕСКАЯ ИДЕНТИФИКАЦИЯ СЕЙСМИЧЕСКИХ СОБЫТИЙ (ВЗРЫВЫ, ЗЕМЛЕТРЯСЕНИЯ)

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In connection with the Comprehensive Test Ban Treaty (CTBT) , creation of reliable methods of distinction of nuclear, chemical explosions and earthquakes is very important. It is known that distinction of small explosions (less 1 Kt) which are detected only on region distances (till 2500 km), is the most complex. Characteristics of different wave groups (Pn, Pg, S, Sn, Lg and codas) for these distances are very sensitive to non-uniformity of lithosphere and astenosphere. So, it is impossible to extrapolate off the local (linear) methods of distinction created for some region. For absence of invariant methods of identification of small seismic sources there is necessary to use other, non-linear, approach.

Lately, to diagnose the complex processes the numerical recipes of topological dynamics have wide been used. As a rule, such processes are connected with dissipative systems. Trajectories of such in phase space fill up some compact low dimension subset: it is invariant in phase flow and have local attracting characteristics. Such subsets are named attractors of system. The phase trajectories of attractor disperse in unstable directions and compress in stable ones. Because of dissipation the compression prevails and attractor's topology become self-similar (fractal) structure of Cantor set in some directions. If this idea will be added by general suppositions about genericity it will be possible to reconstruct diffeomorphic copy of attractor on ita projection to arbitrary direction in usual Euclid's space of appropriate dimension. Usually such projection is a time series of observations. Algorithm of reconstruction (Takens' algorithm) is constructive: it also allows to estimate of attractor's dimension (a number of independent non-linear modes of system).

We used this technique to diagnose sets of records of earthquakes, nuclear and chemical explosions. The following considerations are in the basis. Reaction of non-linear and inhomogeneous lithosphere to source of event depends not only on its power but also on dynamic scenarios of influence in epicentre. The difference of such scenarios for explosion and natural event may become apparent , for example, in behavior of characteristic exponents in «local» Gutenberg-Rihter low. There is additional difference: seismic waves of strong earthquakes experience the filtering influence of environment , which is inducted by coherence of intensity. Explosion is artefact for environment those this event have not been prepared by it. Therefore, scaling structures of attractors for explosions and earthquakes must be different. This difference may be found in behavior of slopes of correlation integrals. They are used to estimate of attractor's dimension on its phase reconstructions by Takens' procedure.

20 seismograms recorded by Talgar Complex Seismological Expedition of United Institute of Earth's Physics of Russian Academy Science were analyzed 3-component records from the magnetic record ACC -6/12 station were processed and digitated. With frequency 20 Hz. The set included seismograms of underground nuclear explosions from Semipalatinsk test site, one industrial nuclear explosion from West Siberia region, two chemical explosion from Uzbekistan and also earthquakes from Altay region, West China and some other regions of Euroasia. Interval of epicentral distances is from 302 to 10978 km, magnitudes of events vary from 4.4 to 6.1. Estimations of correlation integrals were calculated on records of all three components containing about 12000 points from point of arrival of P-wave. Embedding's dimension varied within interval 7-14. The following preliminary results were obtained.

The slopes of nuclear explosions had two «humps»: they have 2 characteristic scaling areas divided by deep minimum. Such picture is observed only for records' areas including P-wave and its coda. Slopes of earthquakes, as a rule, have wide plateau in wide interval of scaling. We discovered 2 cases (among 20) when slopes have not related to one of the types. It is significant that both cases are connected with records' analyze of chemical explosions. May be the scaling's differences are connected with wider range of seismic fluctuations for earthquakes because of existence of subsources' set of different sizes in main breaks. It is necessary to note usually non-linear effects leading to singular scaling are stronger for nuclear explosions than other types of sources. It is connected with large differences of energy's density in epicenters. This agrees with theoretical notion that non-linearity becomes apparent stronger in longitudinal waves than in tangential ones.

Obtained results testify to prospects of use of this approach to distinguish explosions and earthquakes.

OPPORTUNITIES OF KAZAKHSTAN IN MONITORING OF COMPREHENSIVE NUCLEAR TEST-BAN TREATY

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ВОЗМОЖНОСТИ КАЗАХСТАНА ПО УЧАСТИЮ В МОНИТОРНГЕ ДОГОВОРА О ВСЕОБЛЕМЛЮЩЕМ ЗАПРЕЩЕНИИ ЯДЕРНЫХ ИСПЫТАНИЙ

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September 24, 1996 on session UNO in New York the CTBT was opened for signing. To the present time is signed by 146 countries. For organization monitoring of CTBT the CTBT Organization (CTBTO) was created. In its function the creation of international networks of a monitoring of the Contract by various methods and organization of International data centre enters.

The opportunity of participation in a monitoring CUPNT has some aspects:

1. Geographical
2. Seismological
3. Technical
4. Legal
5. Economic.

It is meant it, that:

1) The networks of a monitoring are planned so that in regular intervals to supervise the whole territory of globe;
2) The installation sites of stations should have a low level of microseismic noise;
3) The characteristics of all stations should answer the technical requirements CTBTO;
4) For inclusion of National geophysical station in a world network, on the one hand, consent of the state was necessary, in which territory there is a station, and with other - decision of a Conference on Disarmament about inclusion of station in an international network;
5) For improvement existing or creation of new stations, and also for maintenance of their activity it is necessary to have the appropriate financial assets.

Four geophysical stations of National Nuclear Centre - Aktyubinsk, Borovoe, Kurchatov and Makanchi - adequate to all given conditions, are included, agrees CTBT, in International Monitoring System (ISM).

Seismic station Makanchi is primary station ISM, others observatories - auxiliary. Besides Aktyubinsk enters into a network infra-sound of stations.

The large territory of Kazakhstan and its affinity to the countries developing the nuclear weapon, causes necessity of an arrangement on it of several stations. Remoteness from oceans, absence of a high background of industrial handicapes and geological structure explain a low level of seismic noise and raised sensitivity of stations.

Nowadays at all stations or the seismic equipment adequate ISM works, or there are projects of its improvement up to a necessary level. Both the equipment of seismic stations and further their improvement is made by National Nuclear Centre in close commonwealth with many organizations of world community, first of which was Lamont Doherty Earth Observatory of a consortium of universities of the USA IRIS.

The participation of Kazakhstan in International Monitoring System is very important first, essentially will raise political prestige of Republic, and secondly, it is very favourable economically. With a rather small payment of Kazakhstan in CTBTO, in development of a seismological network of Kazakhstan CTBTO and other organizations put means, on many orders exceeding this payment.

THE EXPERIENCE OF APPLICATION OF THE SEISMIC SMALL APERTURE ARRAYS FOR RECORDING OF THE UNDERGROUND NUCLEAR EXPLOSIONS AND EARTHQUAKES

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ОПЫТ ПРИМЕНЕНИЯ МАЛОБАЗОВЫХ СЕЙСМИЧЕСКИХ ГРУПП ДЛЯ РЕГИСТРАЦИИ ПОДЗЕМНЫХ ЯДЕРНЫХ ВЗРЫВОВ И ЗЕМЛЕТРЯСЕНИЙ

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The experience of operating of seismic small aperture arrays different types as «Gross», «Triangle» and «Necklace» while recording of seismic waves from the earthquakes and underground nuclear explosions have been described. These seismic systems had been realized from 1975 on the Kokchetav anticlinorium territory in the district of Borovoye seismic station of the North Kazakhstan.

The parameters of these seismic systems, main descriptions of digital recording channels and geological structure of the region are adduced.

The recording materials of seismic waves are listed and the problems of the accuracy of measuring of the coordinates and of the estimates of the energy parameters are discussed.

INVESTIGATION OF SEISMIC AZIMUTH AND MAGNITUDE DEVIATIONS IN CONNECTION WITH THE EARTH CRUSTAL PECULIARITIES IN THE AREA OF SEMIPALATINSK NUCLEAR TEST SITE

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ИЗУЧЕНИЕ АЗИМУТАЛЬНЫХ И МАГНИТУДНЫХ АНОМАЛИЙ СЕЙСМИЧЕСКИХ СОБЫТИЙ И ИХ СВЯЗЬ С ОСОБЕННОСТЯМИ СТРОЕНИЯ ЗЕМНОЙ КОРЫ В РАЙОНЕ СЕМИПАЛАТИНСКОГО ЯДЕРНОГО ПОЛИГОНА

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Seismic data from all available seismographic stations have a contributing role in verification of the Comprehensive Test Ban Treaty, because of high quality and low levels of both cultural and seismic activity. Improvement of existing nuclear test sites monitoring including countries, where new test sites can be created, as well as Southern Kazakstan and adjacent territory of high seismic hazard, proposes investigation of seismic waves azimuth and incident angles deviations, caused by peculiarities of the earth crust and upper mantle structure, and construction of magnitude curves at stations.

Studying of data, recorded by cross-seismic array and IDA/GSN broadband station during 1995-1997 on the Semipalatinsk test site territory, produced the following results. Functional dependence of magnitude for seismic events, recorded by cross-seismic array, versus magnitude of Global Seismic Network was described. Time delays of PS type exchange waves, caused by sharp seismic discontinuities, gave us more detailed earth crust and upper mantle structure. Seismic waves azimuth and incident angles deviations can be explained by the slope of Mohorovichich discontinuity in the southeast direction.

ABOUT EVACUATION PROBLEM OF NUCLEAR POWER ENGINEERING HOT WASTE

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О ПРОБЛЕМЕ ЭВАКУАЦИИ ВЫСОКОАКТИВНЫХ ОТХОДОВ ЯДЕРНОЙ ЭНЕРГЕТИКИ

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The issue of total nuclear disarmament bumps into a serious difficulty: the necessity of nuclear charge utilization. What should we do with them? How should they be stored or reprocessed? These questions along with others need the most careful pondering. At present charges in active part of nuclear weapons are stored safely enough in arsenals properly equipped. But after disassembling nuclear charges there is the need to store them. Unlike nuclear power engineering products the charges can be used as charges if a person who has an appropriate access makes some effort. These are international terrorist and criminal organizations, different extremist groups and others. Under Earth's conditions a complete isolation of nuclear charges store places is not possible. Richness of criminal bands can make access to the nuclear charges possible.

Another method of utilization can be nuclear materials reprocessing. It may be implemented in two ways: 1) nuclear material distribution in ballast medium with concentration moderating its release and 2) transformation of nuclear material into non-nuclear (transmutation). Both ways of reprocessing need much money and don't cancel main danger of interim nuclear material storage and utilization of reprocession products.

Nuclear power engineering enterprises need to solve the similar task. Urgent problem for these enterprises is hot waste utilization. Hot waste category includes radioactive waste with heat release of 2 kW/m^3 and considerable long-lived radionuclides concentration.

These are, basically, waste nuclear fuel and its reprocession products, as well as the active part of nuclear fuel. It's accepted that by 2010 world reactor park with uranium fuel will have total 400 hectowatt of electric power. By that time more than 300000 ton of waste fuel will have to be processed somehow.

At present low- and middle-active waste of nuclear power engineering can be buried and are being buried now in surface constructions. The cost of a burial is of 1900 US $\$/m^3$.

In no country there is a concept of safe and reliable radioactive waste burial. This doesn't allow to dispose it completely and stops nuclear power engineering development in developed countries. The way out of the situation can be disposal of nuclear waste off the Earth. In this connection it was suggested to bury radioactive waste on the Sun with the help of space ships (KA) using nuclear space complex infrastructure in Kazakstan.

Modern space transport systems can carry 4 ("Proton")- 28 ("Energy") tons of pay-load to the flying paths to the Moon, the Venus, the Mars or the Sun. Problems of heavy KA use are being considered at such air-space enterprises as Boeing Aerospace, General Dynammis, McDonnell Douglas, Martin Marietta, Rockwell International and United Technologies.

It should be noted that the USSR and USA dealt with radioactive waste utilization indirectly during 20 years. This is about KA burial with nuclear power facilities (NPF) at the so called orbits of burial. Period of time of NPF being at a burial orbit is 300-400 years. It's enough for decay of the most active and short-lived products. So 31 Soviet KAs with nuclear power facility and 12 American KAs with nuclear power sources were launched to the intermediate near-earth orbit. Inspite of relatively low total activity of space "rubbish" (about 110-130 Kc), potential danger of "dead" NPF is rather high.

The way out of the situation can be evacuation of transport with hot waste to the Sun [2]. To implement this three main paths:

1. Launching KA to the Jupiter, following elliptical trajectory to the Sun. This path takes the least of the energy outlay, but its calculation needs accounting positions of all the bodies on the way.
2. Launching KA directly to the Sun in the plane of the Earth's orbit. This trajectory needs more energy outlay than trajectory 1, but on following it there happens the Earth's orbit crossing at the planet.
3. Launching KA directly to the Sun in the plane perpendicular to the Earth's orbit. This trajectory needs the most of the energy outlay but, it is the safest ecologically.

When "Proton" carrier is in use and project cost is 600 million $ calculative economical characteristics are:

Maximum module weight	Start-ups/year	Profit /US$, mln	Term of pay-back; years
trajectory #1 - 5.7 t	10	199.59	3.0
trajectory #2 - 5.3 t	10	185.50	3.23
trajectory #3 - 4.6 t	10	161.0	3.72

Besides, there is a task to solve. The task of developing mathematical model of space rocket movement trajectory under condition that orthodrome is far from populated areas and limitations of mass and energy characteristics are taken into consideration.

Basic problem of the present task is to provide ecological safety for radioactive waste when launching KA to intermediate near-Earth orbit. It includes work:

- during preparation and launching space device
- at driving space device to the intermediate orbit
- in inter-orbit flights

Inspire of considerable difficulties in implementing the project of hot waste evacuation to the Sun, we think that this task is not impossible and should be solved at the nearest future. Technical possibility of nuclear disarmament and nuclear power engineering development will depend on the solution of this task in nearest future.

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THE USSR NUCLEAR TEST OF FEBRUARY, 2, 1956 AT PRIARAL'YE: RADIATION CONSEQUENCES

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ЯДЕРНОЕ ИСПЫТАНИЕ СССР 2 ФЕВРАЛЯ 1956 ГОДА В ПРИАРАЛЬЕ: РАДИАЦИОННЫЕ ПОСЛЕДСТВИЯ

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THE CONTRIBUTION OF RUSSIAN MINATOM TO STRENGTHENING THE NON-PROLIFERATION REGIME

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ВКЛАД МИНАТОМА РОССИИ В УКРЕПЛЕНИЕ РЕЖИМА НЕРАСПРОСТРАНЕНИЯ ЯДЕРНОГО ОРУЖИЯ

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PLENARY SESSION #3

Support of Non-Proliferation Regime & Nuclear Materials Control

Kurchatov-city, 12 September, 1997

Chairman: *T.M. Zhantikin (Atomic Energy Agency RK)*

CONTROL OF EXPORT OF NUCLEAR MATERIALS IN KAZAKSTAN. SITUATION AND PROBLEMS

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ЭКСПОРТНЫЙ КОНТРОЛЬ ЯДЕРНЫХ МАТЕРИАЛОВ В КАЗАХСТАНЕ. СОСТОЯНИЕ И ПРОБЛЕМЫ

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Control of export and import of nuclear materials and technologies and dual-use materials, related to nuclear activity, became one of the important part of mechanism of Non-Proliferation conditions realization in Kazakstan, after the Republic of Kazakstan (RK), as a State which has no nuclear weapon, entered into the Non-Proliferation Treatment (NT) and concluded the Agreement with the IAEA regarding the implementation of safeguards.

The necessity of creation of specific system of state export control of the above-indicated commodities was mentioned, for the first time, in the Decree of the RK Cabinet of Ministers of September 22, 1992 regarding the Atomic Energy Agency (AEA) which was assigned a function of export control. The export control of nuclear and dual-use materials and technologies, related to nuclear activity, is a system of organizing, legal and economical measures on limitation, banning and control of the commodities export which may impair economical safety, political and strategical interests of the state. Later, the AEA, in cooperation with other agencies, issued a number of standard acts and regulations to regulate the nuclear export and export control. Basic document for export control implementation of the above-indicated commodities is titled as "Regulations on export and import of nuclear materials, technologies, equipment, facilities, specific non-nuclear materials, dual-use equipment and materials and technologies, radiation and isotope products sources", and was confirmed by the Decree #183 of the RK Cabinet of Ministers of March 3, 1997. The document was developed by the AEA on the base of the IAEA INFCIRC #254 (parts 1,2), taking into account the mechanism of realization of "Safeguards Implementation Agreement".

The state system of export control currently exists in Kazakstan on the legislative base, and is based on efficient cooperation of the AEA with a number of competent state bodies (Ministry of Economy of RK, MEA RK, MIA RK, Ministry of Public Health of RK, State Customs Committee of RK), each of them has its own specific functions, duties and rights. It is very important, since the Republic of Kazakstan has atomic industry that comprises uranium extraction, fuel pellets production for nuclear power stations, nuclear power station, research reactors and industrial base for dual-use materials production. Taking into account a large volume of output of these industrial branches, exported to the countries of CIS and foreign countries, and great importance of national responsibility in nuclear materials control activity, the RK Government consecutively and objectively perform the work on development and improvement of the system of export control of nuclear and specific non-nuclear materials, dual-use materials, radiation and isotope products sources.

The export of the above commodity is carried out using licenses, issued by the Ministry of Economy and Trade of the RK, according to applications of certain standard which are previously agreed with the AEA under decision of the RK Government. The AEA, acting on the base of export control principles and observance of international obligations on non-proliferation matter, makes decisions, only after thorough evaluation of ways of export and reliability of an end-user of the commodity, to agree the application for a license. The AEA, in the territory of Kazakstan, introduced the order of previous notification when nuclear materials export is carried out and notification upon a shipment is made.

However, the export control system of the Republic, being developed, has its own problems. These are development of standard acts regulating relations of the state bodies with enterprises which export and import nuclear materials; implementation of technical expertise of nuclear export items; automation of licensing system.

The export control system of the RK is continually improved and developed. It is currently planned to perform work on further development of legislative base, provide enterprises and public with information on principles and policy of export control, stimulate international cooperation, technical and scientific assistance.

THE MONITORING SYSTEM OF NUCLEAR MATERIALS IN KAZAKSTAN

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СИСТЕМА КОНТРОЛЯ ЯДЕРНЫХ МАТЕРИАЛОВ В КАЗАХСТАНЕ

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After Kazakstan joined the Nonproliferation Agreement and signed the Agreement of Using Guarantees in Kazakstan as in an independent state having atomic industry on its territory, there appeared an issue on creating a legal base for control in this area. By the law of April 14, 1997, concerning the use of atomic energy a legal base and regulation principles of relations appearing with the atomic energy use were determined. One of the basic tasks of state governing body in the field of providing the nonproliferation regime is to implement state control and account of nuclear materials, which fall under the state jurisdiction. This system is to determine present quantity of materials where they are found, to prevent losses, illicit use and stealing, to collect information concerning presence and transfer of the nuclear material on the territory, into and out of the country. Parts of this system are export and import account and control, physical protection of nuclear materials.

The realization of account and control system objectives is implemented basically by creating systems for accounting and assessing nuclear materials to define their quantity. Organizing accounting system, which provides with completeness and effectiveness of accounting information, determines efficiency of state account system at enterprises. The state system of nuclear materials accounting has been created and is functioning at AEA now. Data collection on all the nuclear materials on the territory of the country is being performed. On the basis of this data reports are made and transferred to the IAEA. At present all the nuclear enterprises are under IAEA safeguards. All the information was checked and the IAEA is conducting inspections. Annually verification of all the nuclear materials is performed. The question on AEA inspection activity for checking pieces of information needs to be pondered. Also there is the necessity in preparing normative documents, technical equipment and staff.

State system of accountings on nuclear materials presence and transfer considers export control system interaction with nuclear material accounting system. Since 1992 nuclear export in Kazakstan has been coordinated by AEA. Nuclear export is performed on the basis of Export Control Law for armaments, military equipment and dual-use materials. Nuclear materials are imported in accordance with Government bills. Creation of database on exported or imported material makes it possible to additionally check the nuclear materials transfer into and out of the country. Summary analysis of data bank on accounting and transfer will allow making a higher level of system reliability.

Preventing illicit access to nuclear materials and facilities is the task of another part of state system control - of physical protection system. Organization of proceedings canceling possibilities of nuclear materials stealing or sabotage at a site is the end objective of this system. Nuclear materials and facilities physical protection is performed by different state organizations. These organizations work on the basis of governmental normative acts. AEA worked out a State concept of nuclear materials and facilities physical protection. Further step in this field is to develop normative documents involving departments, which participate or are interested in it.

PROBLEMS AND ORGANIZATION OF RFNC-VNIITF ACTIVITIES UNDER INTRA-DEPARTMENTAL EXPORT CONTROL IN THE REALM OF NUCLEAR TECHNOLOGIES

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ЗАДАЧИ И ОРГАНИЗАЦИЯ РАБОТ РФЯЦ-ВНИИТФ ПО ВНУТРИВЕДОМСТВЕННОМУ ЭКСПОРТНОМУ КОНТРОЛЮ В СФЕРЕ ЯДЕРНЫХ ТЕХНОЛОГИЙ

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State system of internal export control (EC) is one of the barriers deterring proliferation of weapons technologies, materials, and equipment. In RF this system is in a phase of active development. Export control in the realm of nuclear technologies (ECNT) is at the stage of organization in RF.

Technical expertise as the main phase of EC is the problem to be solved by technical experts of those branches of science and industry which products can be the object for proliferation via legal export.

The presentation discusses organizational aspects and scientific-technical directions of Minatom's intra-departmental ECNT operation. Special emphasis is on the role of experts from Russian Federal Nuclear Center - VNIITF in these activities. Attention is focused on the problems in the realm of ECNT to be solved by the experts in development of nuclear charges and nuclear munitions. These problems include both direct expertise of license applications and research and training activities, preparation of methodical materials, publishing activities. Directions are highlighted which require mandatory participation of nuclear charges and nuclear munitions developers in export control. RFNC-VNIITF shall provide complete scientific-technical expertise and other necessary activities in these directions. Scheme how to organize activities under ECNT at VNIITF is described. Problems of top priority for VNIITF's activities under ECNT are indicated.

The presentation is based on studying capabilities and peculiarities of Russia, analyzing experience of ECNT organization in the U.S., proceedings of meetings and conferences held in the U.S. and RF on the issues of organization of ECNT service within Minatom's structure.

NON-PROLIFERATION REGIME AND MONITORING OF NON-NUCLEAR TECHNOLOGIES

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РЕЖИМ НЕРАСПРОСТРАНЕНИЯ И КОНТРОЛЬ НЕЯДЕРНЫХ ТЕХНОЛОГИЙ

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The dual-use non-nuclear technologies are of great importance for nuclear weapon proliferation. The existing IAEA safeguard system doesn't cover many technological processes associated with nuclear weapon development. The monitoring of non-nuclear technologies that could be applied for nuclear weapon activities will allow improving the non-proliferation regime. These problems are mostly important for the former Soviet Union (FSU) states which territory still has a part of infrastructure required for nuclear weapon development.

Currently proliferation of dual-use non-nuclear technologies has been monitored during export operations in compliance with the " List on Dual-Use Nuclear Export ". In accordance with this document existing measures for monitoring of non-nuclear technologies have limited application.

It is expedient to improve safeguard measures relating to the application of some technologies for non-nuclear purposes. Potential directions on enhancement of safeguards for non-nuclear technologies may include the following:

- The List clarification with separation of group of objects requiring detailed study;
- Introduction of accounting and control measures for the most significant non-nuclear installations and equipment;
- Environmental monitoring of objects associated with explosion experiments;
- Inspection of the most significant non-nuclear installations;
- Clarification of wording and critical parameters for specific items of analyzed List.

The group of non-nuclear technologies requiring specific study and monitoring enhancement may include the following:

- Production of high-level HE;
- Fabrication of large-sized HE parts;
- Hydrodynamic research;
- Equipment of explosion system development;
- Equipment and components for nuclear testing and etc.

RFNC-VNIITF has been research work in the field of monitoring of non-nuclear technologies. The preliminary results have been already obtained and they could be used for the development of practical control measures.

EFFECTIVE NUCLEAR EXPORT CONTROLS: A PART OF THE LONG-TERM SOLUTION TO NUCLEAR NONPROLIFERATION

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ЭФФЕКТИВНЫЙ ЭКСПОРТНЫЙ КОНТРОЛЬ: ЧАСТЬ ДОЛГОСРОЧНОГО РЕШЕНИЯ ЯДЕРНОГО НЕРАСПРОСТРАНЕНИЯ

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The purpose of this paper is to address the critical role that nuclear export controls play in combating commerce in nuclear equipment, materials, and technology that is contrary to the objectives of nuclear nonproliferation. Often, when thinking about nonproliferation initiatives, programs such as anti-nuclear smuggling or material protection, control, and accounting (MPC&A) come to mind. Export control programs are not as visible as other nonproliferation initiatives; however, they serve an equally important role in preventing proliferation. While anti-nuclear smuggling and MPC&A efforts respectively focus on securing borders and nuclear facilities, export controls go beyond the controls of special nuclear material by establishing effective controls not only for nuclear materials but also for nuclear-related dual-use equipment, materials, and technology. Export controls seek to accomplish what other nonproliferation initiatives do not – the establishment of uniform and consistent behavior in the legal commerce of global suppliers. This paper demonstrates the importance of nuclear export controls and argues that they are an essential component to global nonproliferation and thus deserve increased attention throughout the national and international communities.

SUCCESSES AND FAILURES OF NUCLEAR EXPORT CONTROL

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УСПЕХИ И НЕУДАЧИ КОНТРОЛЯ ЯДЕРНОГО ЭКСПОРТА

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During the last three decades, those few countries which sought to acquire a military nuclear capability have required more time to develop such a capability than the first nuclear powers needed decades earlier in a less technologically developed world. Nuclear export controls have played, and continue to play, an important role in slowing the spread of nuclear weapons.

Countries seeking to obtain nuclear weapons can use many different methods to acquire the necessary facilities, materials, equipment, and know-how. Over the last several decades, there has been a continuing "struggle" between nuclear suppliers' efforts to improve export controls on the one hand, and the ingenuity of proliferating states on the other hand. The evolution of international export controls can be seen as a series of responses to lessons learned from past successes and failures.

This paper begins with the period following China's 1964 nuclear test and traces the major developments in nuclear proliferation and nuclear export controls, showing how lessons from proliferation led to changes in export controls and how improvements in export controls drove proliferating states to new methods of technology acquisition. Finally, it discusses current and future challenges, including illicit trafficking and other means of end-running existing controls.

TECHNICAL COOPERATION BETWEEN IAE/NNC AND U.S. DOE NATIONAL LABORATORIES ON NUCLEAR EXPORT CONTROLS IN KAZAKSTAN - A STATUS REPORT

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ТЕХНИЧЕСКОЕ СОТРУДНИЧЕСТВО МЕЖДУ ИНСТИТУТОМ АТОМНОЙ ЭНЕРГИИ НЯЦ РК И НАЦИОНАЛЬНЫМИ ЛАБОРАТОРИЯМИ МИНИСТЕРСТВА ЭНЕРГЕТИКИ США ПО КОНТРОЛЮ ЯДЕРНОГО ЭКСПОРТА В КАЗАХСТАНЕ – ОТЧЕТ О СОСТОЯНИИ ДЕЛ

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The Institute of Atomic Energy NNC (IAE NNC RK) of the Republic of Kazakstan has entered into Laboratory-to Laboratory agreements with two U.S. Department of Energy (DOE) National Laboratories, Argonne National Laboratory (ANL) and Los Alamos National Laboratory (LANL), for the purpose of carrying out joint projects that contribute the development of effective nuclear export controls in Kazakstan. The development, implementation, and administration of an effective export control system require the use of technically qualified experts in the area of nuclear and nuclear-related dual-use technologies. In the United States, DOE, has the responsibility of developing policy for nuclear technology transfers and reviewing export licenses for all nuclear and nuclear-related dual-use equipment, material, and technologies. In carrying out its export control and technology transfer responsibilities, DOE uses the resources of its National Laboratories to provide the requisite technical expertise. DOE National Laboratories have developed a long-standing and broad-based knowledge in nuclear nonproliferation matters in general and export control processes in particular. The primary goal of the lab-to-lab joint activities between IAE NNC RK, ANL, and LANL is to transfer a model and our experience to IAE NNC RK so that it might provide the same type of support on nuclear export control matters to its government that the DOE laboratories provide to the U.S. government. The individual projects within the lab-to-lab arrangements have been designed with this goal in mind. The successful completion of the individual projects provides both useful information to NNC and the Kazakstan organizations involved in nuclear export control, as well as training of NNC staff in nuclear export control processes and methodologies.

This report will discuss the projects completed so far since the start of these joint activities in the summer of 1996. The individual projects, although carried out either between the DOE and AEA laboratories, constitute a well-coordinated series of tasks which complement each other and address fundamental requirements of an effective export control system. Initial tasks specified: the development of a plan for the integration of IAE NNC RK technical expertise into the export control system of Kazakstan following a thorough familiarization with the processes and procedures of the existing system; the identification of a core team of experts at IAE NNC RK who would supply the bulk of technical expertise as well as a broader group of technical experts who would be called upon to provide technical support, as needed; the identification of controlled commodities and technologies in Kazakstan; the development of a conceptual design of a computer-based system for the analysis of nuclear exports; and the development of a course on export controls and nuclear nonproliferation. The salient features of these completed activities and their outcome will be presented, as will the remaining tasks and plans for future projects.

IMPLEMENTATION OF MATERIAL CONTROL AND ACCOUNTING AT THE ULBA METALLURGICAL COMPANY, UST-KAMENOGORSK, KAZAKSTAN

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ВНЕДРЕНИЕ КОНТРОЛЯ И УЧЁТА МАТЕРИАЛА В УЛЬБИНСКОЙ МЕТАЛЛУРГИЧЕСКОЙ КОМПАНИИ, УСТЬ-КАМЕНОГОРСК, КАЗАХСТАН

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During the transition from being a part of the former Soviet Union nuclear industry to an independent facility meeting the requirements of the International Atomic Energy Agency (IAEA), Ulba Metallurgical Company (Ulba) staff have had to implement significant changes in the areas of materials control and accounting (MC&A) with technical support and equipment provided by the Nunn-Lugar Cooperative Threat Reduction (CTR) Program and the Department of Energy's (DOE) MC&A cooperative program with the Republic of Kazakstan. Equipment was delivered to upgrade the facility's capability to perform accountability measurements. Focused training was provided to assist the facility staff assigned to use or maintain the new equipment. The DOE Technical Team and Ulba staff concentrated on meeting the highest priority needs and providing the tools necessary for a comprehensive MC&A program. A September 1997 Commissioning Ceremony celebrated the end of the initial development and implementation of the MC&A Program at Ulba. Follow-on MC&A activities are primarily related to system maintenance with reduced DOE funding anticipated for FY98 and beyond. As Ulba continues the MC&A implementation process program changes are likely included those required by the development of national requirements. The DOE Technical Team believes that the staff and management of Ulba have the expertise and commitment to maintain and improve the MC&A system.

UNITED STATES TECHNICAL ASSISTANCE TO THE REPUBLIC OF KAZAKSTAN FOR THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL

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ТЕХНИЧЕСКАЯ ПОМОЩЬ США РЕСПУБЛИКЕ КАЗАХСТАН ПО ФИЗИЧЕСКОЙ ЗАЩИТЕ ЯДЕРНЫХ МАТЕРИАЛОВ

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As part of the cooperative nuclear Material Protection, Control, and Accounting (MPC&A) program, the U.S. Department of Energy is providing assistance at four nuclear sites in the Republic of Kazakstan. These sites are the Ulba Metallurgical Plant, the Institute of Atomic Energy at Kurchatov, the Institute of Atomic Energy at Almaty, and the Mangyshlak Atomic Energy Complex BN-350 nuclear power plant. This paper describes the physical protection enhancements provided as part of the MPC&A program at each of the sites.

APPLICATION OF NONDESTRUCTIVE ASSAY TECHNIQUES IN KAZAKSTAN

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ПРИМЕНЕНИЕ МЕТОДОВ НЕРАЗРУШАЮЩЕГО АНАЛИЗА В КАЗАХСТАНЕ

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As the Republic of Kazakstan has transitioned from being part of the Soviet Union to a nonweapons state (Treaty of Nonproliferation of Nuclear Weapons signatory) under International Atomic Energy Agency inspections, significant changes have been required. Some of these changes have occurred in nuclear material protection, control, and accounting at the four nuclear facility sites in Kazakstan. Specifically, the Republic of Kazakstan has changed from relying primarily on a subset of physical protection methods to a graded safeguards approach using a balance of material control, material accounting, and physical protection. Once more intensive material control and accounting procedures and systems are in place, a necessary step is to supply the accounting systems with measured values of high quality. This need can be met with destructive and nondestructive methods. Material control systems can also use qualitative nondestructive assay information as input. This paper will discuss the nondestructive assay techniques and systems the United States Department of Energy is providing to Kazakstan under both Department of Energy programs and the Cooperative Threat Reduction Act as part of the nuclear material control and accounting upgrades at four facilities in Kazakstan.

NUCLEAR MATERIALS ACCOUNTING AND CONTROL AT THE FACILITIES OF THE RUSSIAN SCIENTIFIC CENTER "KURCHATOVSKIY INSTITUTE" (AS AN EXAMPLE CRITICAL STAND "ISKRA" IS CONSIDERED)

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УЧЕТ И КОНТРОЛЬ ЯДЕРНЫХ МАТЕРИАЛОВ НА УСТАНОВКАХ РНЦ «КУРЧАТОВСКИЙ ИНСТИТУТ» (НА ПРИМЕРЕ КРИТСТЕНДА «ИСКРА»)

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* * *

TECHNOLOGIES AND NON-PROLIFERATION

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ТЕХНОЛОГИИ И НЕРАСПРОСТРАНЕНИЕ

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* * *

THE IAEA PROGRAM ON ILLICIT NUCLEAR MATERIALS AND RADIOACTIVE SOURCE USE

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ПРОГРАММА МАГАТЭ ПО НЕЗАКОННОМУ ОБОРОТУ ЯДЕРНЫХ МАТЕРИАЛОВ И РАДИОАКТИВНЫХ ИСТОЧНИКОВ

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* * *

SECTION

Radioecological Study of the Consequences of Nuclear Tests

Kurchatov-city, 12 September, 1997

Chairman: *S.G. Smagulov (National Nuclear Center RK)*

CONCEPTION OF RADIOECOLOGICAL INVESTIGATIONS OF THE SEMIPALATINSK TEST SITE AREA

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КОНЦЕПЦИЯ РАДИОЭКОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ НА ТЕРРИТОРИИ СЕМИПАЛАТИНСКОГО ИСПЫТАТЕЛЬНОГО ПОЛИГОНА

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Scientific principles and major ways of carrying out state-controlled events related to complex radioecological investigations are formulated in the conception.

Radioecological investigations are supposed to solve the following major problems: setting an objective and investigation tasks, program development, obtaining the results, their analysis, prognosis and development of recommendations.

The conception was developed based on the experience of both foreign and NIS scientists and experts in the field of radioecology. This report presents developed methodological aspects of organizing complex radioecological investigations, dealing with problems of the former Semipalatinsk Test Site.

Beginning my presentation I would like to touch upon the Semipalatinsk Test Site, as an investigation object.

The first slide shows systematic approach to complex investigations of nuclear testing effect on the Test Site itself, and on its surrounding area.

This report will only illustrate the radioecological aspect.

GENERAL ASPECTS AND RESULTS OF THE NATO SEMIPALATINSK PROJECT

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ОСНОВНЫЕ АСПЕКТЫ И РЕЗУЛЬТАТЫ ПРОЕКТА «НАТО-СЕМИПАЛАТИНСК»

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To determine the long-term consequences of atmospheric atomic bomb tests for the population in the surroundings of the former nuclear weapons test site near Semipalatinsk, studies were performed by international cooperation between Kazakh, French, Czech and German institutions at two measuring locations (Mostik, Maisk) in Kazakhstan on a fieldmission in September 1995. Mostik is a village close to Dolon and downwind of the first atomic bomb explosion on August 29th, 1947. Maisk is close to Kurchatov and not too far from ground zero.

GAMMA EXPOSURE DOSE RATE. VILLAGES OF MOISTIK AND MAISK

Areas, ##	Quantity of Points	Minimum Value, nGy/h	Maximum Value, nGy/h	Average Value, nGy/h	dKa/dt, μSv/h
Mostik	16	76.7	83.3	79.7	9.1
# 1	10	88.6	99.9	92.6	10.6
# 2	13	94.5	104.8	99.7	11.4
# 3	6	90.6	10.8	98.2	11.2
# 4	9	70.4	83.3	75.7	8.6
Maisk	31	67.5	87.3	80.0	9.13
# 1	11	82.0	91.6	85.0	9.70
# 2	9	82.3	90.0	86.0	9.85
# 3	8	83.0	96.2	90.0	10.3

The results show that surface contamination from nuclear weapons tests has in the meantime decayed to a large extent. External doses largely correspond to the natural background.

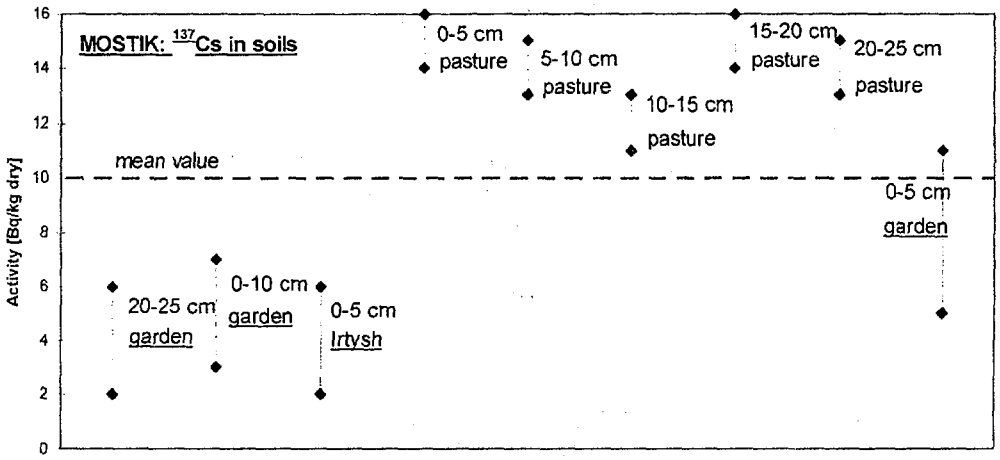

Fig. 1. ^{137}Cs results obtained by direct gamma spectrometry for Moistik soil samples collected on September 20-22, 1995.

The remaining incorporation of longer-lived radionuclides is also slight and in 1995 merely led to an annual dose of markedly less than 1 % of the natural radiation exposure for ^{137}Cs and ^{90}Sr. The question of a dose contribution by the possible incorporation of ^{239}Pu remains open.

Life in the villages of Maisk and Mostik does not currently involve any radiological threat to the inhabitants. However, dose reconstruction for the older inhabitants directly affected by aboveground atomic weapons tests remains difficult.

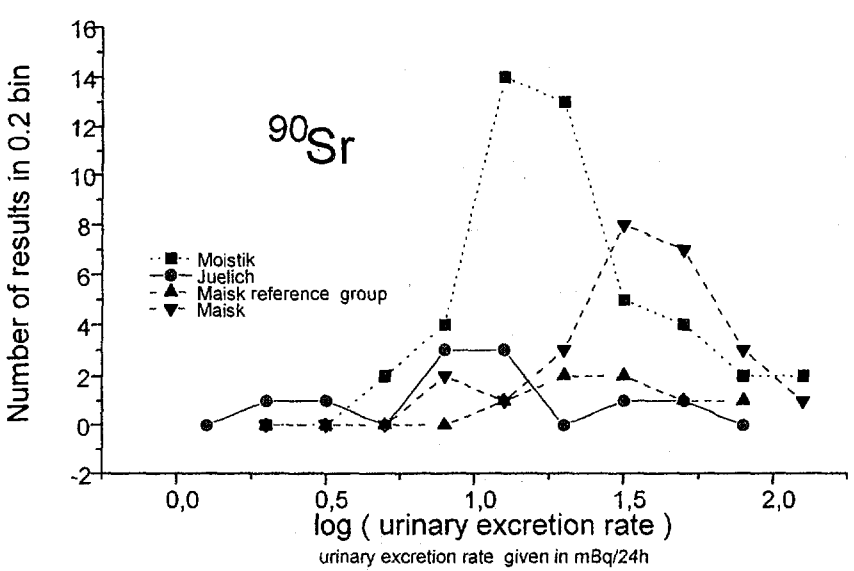

Fig. 2. Log-normal distributions of urinary excretion rates for different groups compared to urinary excretion rates in Jülich Germany

SOME METHODOLOGICAL ASPECTS OF THE SCIENTIFIC KAZAKHSTANESE-FRENCH COOPERATION IN THE FIELD OF THE STUDY OF THE CONSEQUENCES OF NUCLEAR TESTS ON ENVIRONMENT AND HEALTH: A FIVE YEARS EXPERIENCE

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НЕКОТОРЫЕ МЕТОДОЛОГИЧЕСКИЕ АСПЕКТЫ НАУЧНОГО ФРАНЦУЗСКО-КАЗАХСТАНКОГО СОТРУДНИЧЕСТВА В ИЗУЧЕНИИ ВОЗДЕЙСТВИЙ ЯДЕРНЫХ ИСПЫТАНИЙ НА ОКРУЖАЮЩУЮ СРЕДУ И ЗДОРОВЬЕ ЛЮДЕЙ: ПЯТИЛЕТНИЙ ОПЫТ

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French physicians were invited in Kazakztan to paticipate to a meeting about the nuclear tests for the first time in 1991. The meeting was held in Semipalatinsk. Several colleagues, physicians and biologists, asked us to establish a research programme about the possible consequences on environment and health of the 40 years Semipalatinsk nuclear polygon activity The " Kazakhstanese environment and health programme " was born. (PESK in french)

During two years our objectives were to define precisely the project and to convince french and K authorities. We were supported mainly by the french foreign office,and the Rennes 1 (F), Almaty and Karaganda (KZ) Universities. Several meetings in France and KZ were organized ; several difficult contacts by phone or by fax were established. We decided in 1993 to focuse the reseach programme on the following subjects :

- to gather all the available dosimetric data, on and around the polygon
- to establish a cartograhy of the polygon vegetation
- to study the potential mechanisms of adaptation on radiaoactive low dose irradiation stress on selected species of plants and on animals (blood and testis)
- to assess the possible long term effects of external low dose irradiation on the female fertility
- to develop the links between F an KZ searchers through the training in biology of KZ colleagues

The main difficulties to implement the PESK programme were :

1) the subject by itself : the assesment of the possible effects of nuclear tests on environment and health is a matter of controversies in western countries
2) the objectives of the programme : the effects of low dose irradiation consequences is in a same way a matter of controversies in nuclearized for a civil purpose (electrical nuclear plants) western countries
3) the difficulties to communicate between F and KZ : language barrier, inadequate faxes facilities, impossibility until a recent period, to phone outside Almaty, the difficulties to transfer money from Europe to KZ, several KZ banks beeing in bankrupt
4) the socio-economical problems in KZ : the resarch activity doesn't seem to be the actual priority.
5) in matter of radioactive contamination, the international support has been mainly devoted to Tchernobyl. Therefore the situation in Semipalatinsk has not been considerd as a priotity until a recent period

Despite all theses difficulties, the PESK programme, supported from a financial point of view in 1992-93 by the french ambassy in KZ, effectively started in 1994.

At this time, two studies are on going

- the first one is sponsored by the EC through an INTAS programme : it involves 8 teams including the Rennes 1 University (F), the French Medical Institute for Medical Reseach, the London School of Hygien and Tropical Medicine (UK), the National Environmental Research Council (UK), the National Nuclear Center of KZ, two teams of the national Academy of Sciences of KZ, the Research Institute of Epidemiology of Almaty. The intermediate report has been sent to Brussels in 1996 and the final report will be ready at the end of 1997.
- the second one is sponsored by the Rennes 1 University through a grant of the EDF (French Electrical Company). The final report is assumed to be done at the end of 1997.
- a third grant coming from the french ministry of the research allowed the training in France of a KZ searcher in radiobiology

The collaboration between french/european and KZ searchers in the frame of the PESK programme is now improved :

- the communications are better (phone, fax, electronic mail.
- more people are speaking english and some of them french...
- the radioecological problems in Semipalatinsk are now taking into account by the EC. Despite the fact that the official reports of IAEA and WHO are not, to our knowledge, published, even so the missions went to KZ two years ago, the EC send recently new call of tenders on this question. KZ authorities accepted to give a financial support to these programmes.

In conclusion, we can say that the first period of implementation of the PESK programme was very difficult. We can notice some important improvements in the communication facilities. Therefore it seems easier now to propose some new competitive projects. Despite all these difficulties, the initial scientific objectives have been assessed. These data will be published in a few time. In particular they concern the adaptative mechanisms of plants to chronic radioactive stress. Similar experiments are done in France (Rennes 1 University) in laboratory . We hope to draw some conclusions on human beeings (fertility) in less that one year. These on field observations and laboratory experiments shoud contribute to bring new informations on the effects of low doses irradiation on environnement and health. Moreover the descriptive cartographic part of the PESK programme should contribute to give new recommendations about the rehabilitation of the contaminated areas of the Semipaltinsk nuclear test site.

INDEPENDENT RADIATION MONITORING EXPERIMENT CONDUCTION

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ОПЫТ ПРОВЕДЕНИЯ НЕЗАВИСИМОГО РАДИАЦИОННОГО МОНИТОРИНГА

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Goskomghidromet carries out composite radiation monitoring in Russia. The independent investigation conduction is explained by a low trust of population and the general public to the authorities and institutions representing departmental interests. The work was conducted on the initiation of a public organization named as Soyuz "Chernobil" of Russia and supported by the headquarters of RSC KI, Bremen University (Germany) and Portsmut University (England) under the financial aid and technical assistance of "Korolevskoe Obshestvo" (England).

A group of independent experts monitored a level of the contamination in Bryansk, Orlovsk, Tulsk and Kaluzhsk regions of Russia, using the means of the field radiometry and spectrometry as well as outcomes of the ground and water samples investigations conducted in laboratories. The obtained data are compared with official ones. The detected deviations (Sudimir, Kaluzhsk region) and features of the independent monitoring organization are being discussed.

RADIOECOLOGICAL SUPPORT OF INDUSTRIAL ACTIVITY ON THE TERRITORY OF SEMIPALATINSK REGION WITHIN THE SEMIPALATINSK TEST SITE

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РАДИОЭКОЛОГИЧЕСКОЕ СОПРОВОЖДЕНИЕ ПРОИЗВОДСТВЕННОЙ ДЕЯТЕЛЬНОСТИ НА ТЕРРИТОРИИ СЕМИПАЛАТИНСКОЙ ОБЛАСТИ В ПРЕДЕЛАХ ПОЛИГОНА

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An intensive economic activity including both the mining of minerals and the agricultural activity is currently carried on at the Semipalatinsk Test Site territory. Besides, works on closure of Degelen Mountain tunnels are also under the progress. So, it is impossible to carry on all these activities without any radiation control and radioecological assessment.

The necessity of radioecological support of industrial activity on STS can be particularly seen on the example of Karazhyra Coal Field which is located near to Balapan Test Field. Underground nuclear tests (107 explosions, ~ 20 % of the total number of tests conducted at STS; the closest boreholes are located 1 - 3 km away from the boundaries of the coal-bearing layer) were carried out in vertical boreholes here. Exactly these boreholes are the greatest potential hazard for mine operation, though both the mine and technological and living areas that surround it are located outside the main "traces" of atmospheric nuclear test fall-out. Last years, several radioecological assessments of Karazhyra Coal Field and adjacent territories were carried out.

The main potential hazard for the manufacturers and consumers of agricultural products in Abralinsky Region of Semipalatinsk Oblast within the STS comes from so-called south-eastern (thermonuclear test of 12.08.1953) and south-western (24.09.1951) radioactive "traces". Detailed surface investigations as of the whole territory as well as of settlements and agricultural lands have been carried on here the other years. Many laboratory analyses of soil, water and vegetation contamination were performed. Degelen Mountain Complex is also situated on the territory of Semipalatinsk Obalst within the Test Site. 215 underground nuclear tests in horizontal tunnels were conducted here during the Test Site operation.

Investigation materials, results and conclusions concerning the present radioecological situation of the territory of Semipalatinsk Oblast within the Semipalatinsk Test Site will be presented in the report.

COMPARISON OF RADIATION DOSES TO THE POPULATION OF THE RUSSIAN FEDERATION FROM ATMOSPHERIC NUCLEAR TESTING AT THE TEST SITES OF THE FORMER USSR AND FROM THE CHERNOBYL ACCIDENT

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СОПОСТАВЛЕНИЕ ДОЗ ОБЛУЧЕНИЯ НАСЕЛЕНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ ПОСЛЕ ПРОВЕДЕНИЯ ЯДЕРНЫХ ИСПЫТАНИЙ В АТМОСФЕРЕ НА ПОЛИГОНАХ БЫВШЕГО СССР И ПОСЛЕ АВАРИИ НА ЧЕРНОБЫЛЬСКОЙ АЭС

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Studies of the consequences of radiation emergencies, which occurred on the territory of the Russian Federation for a variety of reasons, are of great scientific as well as social and political importance.

Sound data on public exposures in the area affected by the Semipalatinsk atmospheric nuclear tests are presented in the reports on the "Semipalatinsk Test Site -Altai" programme and in an IAEA publication (Assessing the radiological impact of past nuclear activities and events, July 1994). Summing up the archival information and radiation survey evidence resulted in an album showing essentially all contaminated offsite spots with doses of above 0.1-0.5 cSv.

A good deal of effort has also been undertaken in collecting and pooling the experimental data on environmental radioactive contamination and the radiation survey results for the area affected by the Novozemelsky tests. This material served as the basis for estimation of potential public exposures in 21 regions of Russia.

The Table gives population size values for the areas contaminated due to atmospheric nuclear testing at the both test sites of the former USSR and potential maximum, average and collective external doses to the population in 30 Russian regions. For all the regions, average individual doses to the population are shown to be below 1 cSv, in the range of 0.12-0.15 cSv, i.e. about an. order of magnitude lower as compared with public exposures from the Chernobyl accident.

The highest gamma doses to the population (52 cSv) have been registered in the Altai Territory. This is a result of the first USSR ground nuclear test at Semipalatinsk on 29 August 1949. Such doses, as shown by investigations, might have been delivered to a small portion of residents, numbering a few thousand persons.

A considerable body of evidence on radiation conditions has been integrated and potential radiation doses to the population in the area affected by the nuclear tests have been estimated. Exposures from the Chernobyl accident and from the nuclear tests have been compared.

The comparison shows that the collective doses for the population due to the nuclear tests differ significantly from those due to the Chernobyl accident. The difference is primarily associated with the size of the population of the contaminated area: in the former case the exposed residents total above 50 million while in the latter case their number is not more than about 2 million.

The analysis indicates that the Chernobyl accident heads the list with regard to public exposures which might cause health effects.

TO THE ISSUE OF AN EXPERIMENTAL ASSESSMENT OFAREA CONTAMINATION BY Pu OF THE TERRITORY OF SEMIPALATINSK TEST SITE

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К ВОПРОСУ ОБ ЭКСПЕРИМЕНТАЛЬНОЙ ОЦЕНКЕ ПЛОЩАДНОГО ЗАГРЯЗНЕНИЯ ПЛУТОНИЕМ НА ТЕРРИТОРИИ СЕМИПАЛАТИНСКОГО ИСПЫТАТЕЛЬНОГО ПОЛИГОНА

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Only a few methods of an experimental assessment of an area contamination by Pu are known; moreover, their practical applicability is limited. For example, an army radiometer of PDR-77 type is suitable only for measurement of activities higher than 1 Ci/km2 generated by low intensive gamma-radiation [1]. A standard method of radiochemical analysis is inapplicable due to economical reasons.

Basing on experience of an international expedition of 1994 [1, 2], a composition of methods is proposed to be used for assessment of the area contamination by Pu that is 0.05 Ci/km2 or higher. This composition includes a determination of Am-241 using Ge (Li) or HPGe detectors and a graduate determination of Pu-239 by a radiochemical method. It is supposed that a ratio of Am/Pu is a constant within the limited areas of about 100 x 100 m2. In this case, to measure an area of such dimensions using a portable detector placed at a height of 1 m, it requires to perform about 300 measurements (about 20 days). Thus, it is possible to assess a Pu content of the whole area of 100 x 100 m2 according to the detected ratio of Am/Pu and basing on only four or five measurements of Pu-239 by the radiochemical method to be performed in areas of Am determination. To assess the Pu contamination of such area correctly, it is necessary to perform a radiochemical analysis hundred and even more times.

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^{241}Am AND Pu CONTENT DETERMINATION IN SOIL SAMPLES FROM PEACEFUL NUCLEAR EXPLOSIONS CONDUCTION AREAS USING γ/X SPECTROMETRY METHOD

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ОПРЕДЕЛЕНИЕ СОДЕРЖАНИЯ ^{241}Am И Pu В ОБРАЗЦАХ ПОЧВЫ ИЗ РАЙОНОВ ПРОВЕДЕНИЯ МИРНЫХ ЯДЕРНЫХ ВЗРЫВОВ γ/X-СПЕКТРОМЕТРИЧЕСКИМ МЕТОДОМ

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The soil of some areas of CIS countries are contaminated with Plutonium and Americium. Radiochemical methods, being very labor-consuming and requiring high-qualified performers, are used to monitor soil's contamination. Outcomes, however, obtained by different groups of radiochemists, greatly differ from each other.

At the latest time, due to improvement of equipment, the capabilities of γ/X spectrometry measurements of ^{241}Am and Pu content in the environmental samples have been increased. First of all, LEGe-detectors, having a large area of sensitive surfaces (1000-2000 mm^2), were developed to provide high effectiveness during the soft γ- and X-ray radiation registration of L-type actinoids. Secondly, automated measuring systems, which are available for continuous long-term (several days) measurements and based on PC Computers, were developed.

In 1994-1995, γ/X spectrometry monitoring methods of ^{241}Am and Pu content in the soil samples were developed, approved during many measurements, and certified in AURIP&RTM (All-Union Research Institute of Physico-and- Radiotechnical Measurement) by a group of MSIE&P (Moscow State Institute of Engineering and Physics) specialists in cooperation with Byelorussian and Kazakstani colleagues. It took averagely 5-20 hours to conduct one analysis when the ^{241}Am activity in a sample was 10-50 Bk/kg, and results error was ≤30% in 2σ. Labor expenditure and cost of γ/X- analyses were turned out to be 1/5-1/10 times as much than those of radiochemical analyses. Thus, large-scale investigations of contaminated areas are possible to be conducted using γ/X-spectrometry methods. Instrumental and methodical base was created in MSIE&P to conduct the above-mentioned measuring.

Outcomes of γ- and X- radiation measurements of 61 soil and vegetation samples from nuclear explosions areas (NEA) are given in the abstract.

One of the goals during the measurement was to determine the A_{Pu}/A_{Am} ratio. Values, obtained during the soil and vegetation samples analysis from Yakutia, Permsk region and "Chagan" (Semipalatinsk test-site) where nuclear explosions were conducted, are within the experimental errors.

Comparison of the values of the A_{Pu}/A_{Am} ratio in the investigated NEA with its value for weapon-production Pu discovered that the environmental processes, within 25 years, had not significantly influenced on the proportion of ^{241}Am and Pu concentration. Thus, the obtained outcomes confirm the correctness of assumptions which are made as a base of γ/X-monitoring methods of the soil contaminated with plutonium.

The conducted investigations allowed to make conclusions that γ/X- spectrometry methods can be successfully used for mass analyses conduction of the soil and vegetation samples contaminated with ^{241}Am and Pu, for mapping of contaminated areas, for actinoids migration study and others.

CHIRONOMINI AS A UNIQUE OBJECT FOR RADIOECOLOGICAL MONITORING OF WATER PONDS ON THE TERRITORY OF SEMIPALATINSK TEST SITE

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ХИРОНОМИДЫ – УНИКАЛЬНЫЙ ОБЪЕКТ ДЛЯ РАДИОЭКОЛОГИЧЕСКОГО МОНИТОРИНГА ВОДОЕМОВ ТЕРРИТОРИИ СЕМИПАЛАТИНСКОГО ИСПЫТАТЕЛЬНОГО ПОЛИГОНА

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To study nuclear tests consequences for environmental objects, it is necessary to develop a system of environmental monitoring. This system should include a wide range of test objects from protozoa to a man and cover various organisation levels from molecular-genetic through populational to biocynological one.

Recently, Chironomini (Diptera, Chironomidae) have become subject of biocynological and ecological studies of anthropological influence on water ponds.

Chironomini's larvae are particularly at risk of contaminants as they live in the sediment which accumulates radionuclides and heavy metals. Chironomini have polygenic chromosomes that is their important advantage comparing to other bioindicators and allows to perform high-resolution cytogenetic analysis and assess radiation consequences at chromosome level.

This report represents data on Chironomini communities in water ponds located on radioactive contaminated territory of Balapan Test Field: Chagan Lake, Atomic Lake, an artificial water pond at Karazhyra Coal Pit etc. It reports also on a cytotaxonomic identification of Chironomini types and on their "model" types for cytological and molecular-biological analysis.

Several tasks have been specified to determine remote genetic consequences of radioactive contamination of water ponds: to draw up the cyto-photo-maps of "model" types, to estimate a spectrum and a frequency of disk reverse sequences, to determine a level of cytogenetic differentiation inside each population, and to analyse a nucleotide sequence in specified genes of selected types.

INFLUENCE OF LOW CHRONICAL DOSES OF RADIATION ON COMPOUND COMPLEX OF ENZYMES AND PROTEINS OF STIPA CAPILLATA FROM SEMIPALATINSK POLYGON

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ВЛИЯНИЕ НИЗКИХ ХРОНИЧЕСКИХ ДОЗ РАДИАЦИИ НА КОМПОНЕНТНЫЙ СОСТАВ БЕЛКОВ И ФЕРМЕНТОВ ЛИСТЬЕВ КОВЫЛЯ С СЕМИПАЛАТИНСКОГО ПОЛИГОНА

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Three enzymes and fraction of soluble proteins of leaves from the 36 populations of Stipa capillata by the methods of native electrophoresis, IEF and SDS-PAGE-electrophoresis were analized. The level of radioactivity the places, where the plants grew were 20-25, 1500; 3000 microren/hour. This is low, but chronical doses of radioactivity. It has been found, that the level of radioactivity effect on the compound complex of peroxidases, esterases, acid phosphatase and soluble proteins. With help first two methods we have got significant difference between population on the level of enzymes and proteins.

SDS-PAGE and IEF did not show differences in spectra of peptides between 36 populations of Stipa capillata. It means that differences between "contaminated" and "noncontaminated" populations not so big as we expected.

Compound complex soluble protein of Stipa capillata leaves changes under chronical doses of radioactivity. The differences in spectra between control and "contaminated" leaves 3-6 bands . "Control" leaves have more high molecular weight proteins then "contaminated". Appearence new bands is one of the ways adaptation plants on a level of soluble proteins.

It has been found new components in spectra of enzymes and soluble proteins. It can be genetic mutation or posttranslation modification this proteins in postaction of chronical irradiation irradiation of Stipa capillata. To prove exactly genetical nature of this alteration we have to campaire; aminoacids sequence of these proteins or DNA sequence of genoms different population Stipa capillata.

PRESENT RADIATION CONDITION AT THE FORMER SEMIPALATINSK TEST SITE

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СОВРЕМЕННАЯ РАДИАЦИОННАЯ ОБСТАНОВКА НА БЫВШЕМ СЕМИПАЛАТИНСКОМ ПОЛИГОНЕ

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Technical editors:

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Technical translation:

V.P. Golovko, N.A. Dyatchenko, A.V. Grebennikov

Оригинал-макет подготовлен в издательском комплексе
Института атомной энергии НЯЦ РК

Отпечатано в типографии фирмы "Σ^{+}", г. Курчатов, 1997

Тираж 100 экз.