（№1　2000年8月1日号目次）

特集：原子力省関連研究開発機関（その1）

ソ連時代は「中型機械製作省」と呼ばれ、名前からは何を所管するのかまったく分からなかったが、ロシアになって「原子力省」と改称され、初めて中身と名前が一致するようになった。

ソ連時代には膨大な予算のもとに、十数ヶ所の秘密都市を抱え、核開発に邁進していたが、チェルノブイリ原発事故（1986年）、ソ連邦崩壊（1991年）と二つの激震を経て、原子力の平和利用、また蓄積された技術の原子力以外の分野への利用を推進している。

周知の通り、原子力は裾野の広い分野であり、関連の研究所や企業も、原子力だけに特化しているところはむしろ少なく、未利用技術開発の宝庫と言えよう。

今号と次号でロシア原子力省および傘下の研究開発機関の概要を紹介する。

なお、１の原子力省概観は、ババーエフ原子力省科学技術理事会書記に寄稿して頂いた。

１．ロシア原子力省概観………………………………………………………… 1

２．ロシア原子力省組織図

３．原子力省関連研究開発機関

①クルチャトフ研究所……………………………………………………… 3

②ボチヴァル無機材料研究所……………………………………………… 9

③理論・実験物理学研究所………………………………………………… 23

④高エネルギー物理学研究所……………………………………………… 27

⑤核科学研究所……………………………………………………………… 32

1.ロシア原子力省概観

1943 年にソビエト政府は、イーゴリ・クルチャトフに、初の原子力研究所の所長となり、原子力に関するすべての研究のリーダーとなるよう指示した。1945 年 8 月 29 日に、原子力の分野を管轄する政府機構が誕生し、それはソ連閣僚会議付属第 1 総局と呼ばれた。

その後、続々と大型の研究所と原子力産業が設立され、短期間のうちに新たな科学技術の分野ができあがった。ウランの採掘と加工、核物質の取り扱い、放射線化学、原子力関連の機械機器製造、放射線計測と防護、高温および高圧物理学、高エネルギー物理学、マイクロエレクトロニクスである。作業員の健康管理と放射性廃棄物の処理も大きな問題だった。

1953 年にソ連中型機械製作省が設立され、原子力の分野を管轄するようになった。1989 年にソ連原子力産業省と改称され、1992 年 1 月 28 田に、大統領令により、ロシア原子力省となり、現在に至っている。ロシア原子力省は、ソ連時代の施設の 80%を傘下に擁している。

原子力省の機能は次の通りである。

一核および放射線の安全性を確保し、放射性廃棄物を管理して、環境汚染を防止する。
一原子力関連施設において、法律や規則を遵守させる。
一原子力に関する科学技術製作、投資政策を遂行する。
一核軍縮路線にもとづいて、核兵器計画を遂行する。

統合された科学技術政策を実施するために、原子力省学術会議と科学技術委員会は、共同して作業を行う。会議と委員会は選ばれた専門家により構成される。

ロシアの原子力部門は原料の濃縮、核分裂物質の生産、原子力発電と軍事への利用、使用済み燃料の再処理、放射性廃棄物の処理の研究と実施に当たっている。インフラを支えるための様々な企業もある。核あるいは放射能の非常事態の際に迅速に対策を取るシステムも持っている。

原子力省傘下の組織も、市場経済への適応を余儀なくされており、ここ 10 年、対外経済活動を拡大している。輸出の 90%は天然および濃縮ウラン、原子力発電所用設備と燃料、レアメタルである。

原子力省傘下の研究・生産部門を分類すると次のようになる。

１．核兵器

研究、開発、生産部門を持ち、基礎研究から応用研究、核実験、量産を行う。

セキュリティの観点から外部と遮断された閉鎖都市を擁し、その合計人口は 80 万人

に達する。

これら研究開発･生産機関の持つポテンシャルを用いて、核兵器の安全性、信頼性、効率を高めるのが、原子力省の優先課題である。

現在の原子力省の重要な活動の一つは、寿命を終えた、または核軍縮計画により余分となった核弾頭の処理である。今では核弾頭の生産よりも処理の方が予算も倍以上である。

2．原子力発電

現在、ロシアには原子力発電所が 9 ヶ所(原子炉 29 基)あり、合計出力は 21GW である。

原子力省傘下の研究・開発・生産機関は核分裂の基礎研究から原子力発電の研究、原子炉の開発、設備の据え付けまで行っている。

現在の重要な責務は原子力発電の安全性を最大限に高めることである。

3．機械・機器製造

原子力に関連した様々な機械、機器を開発、生産している。例えば、イオン放射線検出器、放射線計測器、高速運動の記録システム、ラジオエレクトロニクス機器、半導体レーザーラジエーター、各種研究設備等である。通常および異常条件下で機能しうる耐化学および耐放射線設備の研究も優れている。

4．核物理学と高エネルギー物理学

核物理学、高エネルギー物理学、熱核融合、高出カレーザー、超伝導の分野では伝統的に世界トップレベルの R&D が展開されている。

5．国際機関

原子力省は、CERN、ドゥブナ合同原子力研究所といった国際研究機関に積極的に参加している。

IAEA と協調し、核拡散防止、原子力の平和利用推進、核輸出の制限を進めている。

原子力の安全性を高め、軍民転換を図るために国際連携を強めることが将来の課題である。この分野では、1992 年に設立された国際科学技術センター（ISTC）の活動に、原子力省は積極的に参加している。

6．建設、据え付け

原子力傘下には建設と据え付けの企業があり、原子力関連施設について、広範な経験を持っている。国内外で、デザインから建設、設備の据え付けまでターンキーで仕事を請け負うことが可能である。

３．原子力省傘下の研究・開発機関

①クルチャトフ研究所

I. Name of the Institute (Organization)

In Russian:

Государственный научный центр Российской Федерации «Курчатовский институт»

In Russian abbreviation: РНЦ «Курчатовский институт»

In English: State Research Center of the Russian Federation "Kurchatov Institute"

In English Abbreviation: RRC "Kurchatov Institute"

II. Location

Official address: RRC "Kurchatov Institute" 1, Kurchatov Sq., Moscow 123182, Russia

Mail address: RRC "Kurchatov Institute" 1, Kurchatov Sq., Moscow 123182. Russia

Telephone number: 196-92-41

Fax number: 943-00-23

E-mail for representative: offic@offic.relcom.eu.net

Access (transportation, necessary time):

Moscow international airport Sheremetjevo-2, then one our driving by car

III. History

During the Second World War, the Kurchatov Institute was founded to solve, within the shortest possible time period, a purely defence problem, that is, to develop and test the nuclear weapon. In April 12, 1943, a decree was signed to create Laboratory No.2, the Academy of Science of the USSR. I.V. Kurchatov, 40 years in age, professor of the Leningrad Physics and Technical Institute became the head of the Laboratory. At once, I.V. Kurchatov involved the most talented and qualified scientists in solving the problem assigned: Yu.B. Khariton, Ya.B. Zeldovich, G.N. Flerov, I.K. Kikoin, A.I. Alikhanov and others. According to the original plan, Laboratory No.2 should have solved all aspects of the problem from producing nuclear explosives and ending by designing and manufacturing all the components of the bomb and also by testing it at the test site.

1944-1946 were the years when solutions, leading to the achievement of the purpose within the shortest possible time period, were sought. The selection of nuclear explosives (^{235}U, ^{239}Pu and ^{239}U) was thoroughly analyzed, and means of their production were compared.

In early 1946, three sections were formed in Laboratory No.2. The "K" section headed by I.V. Kurchatov was responsible for developing mass production of plutonium at the uranium-graphite pile and for conducting nuclear physics research and measurements for the bomb. The section was also responsible for the most important radiochemical problems. The "D" section headed by I.K. Kikoin was involved in creating a diffusion plant to enrich uranium to 90 % ^{235}U, and the "A" section headed by L.A. Artsymovich tried to solve the same problem by using electromagnetic devices.

Next three years, 1947-1949, were the years when the first plants of the nuclear industry were rapidly constructed under the supervision of I.V. Kurchatov. The start-up of the physical uranium-graphite pile F-1 on the territory of Laboratory No.2 gave the opportunity to successfully complete the designing of the production uranium-graphite pile "A".

In the middle 1949, the previous name of the Institute, Laboratory No.2, was substituted for LIPAN, the Laboratory of the Measuring Devices of the Academy of Sciences of the USSR.

Once the plutonium bomb had been successfully tested in August 29, 1949, the next problem should have been solved, that is, the development of the hydrogen bomb. Already in September 1948, A.D. Sakharov gave basic ideas in this field.

For the hydrogen bomb case, LIPAN conducted investigations of nuclear reactions between deutons and lithium and iron isotopes, and also measured cross-sections during the synthesis between deuterium and tritium at various energies.

In August 1953, the explosion of the first Soviet hydrogen bomb (400 kt) was successfully conducted. Once the problem of creating the nuclear weapons solved, problems of the use of the fission and fusion reactions in the development of new power engineering became of top priority. The new problems demanded the experimental basis to be extended and the staff to be increased. Many active young scientists graduated from the special chairs of a number of the educational institutes came to the Institute. And all this together with the necessity of solving the scientific problems, inevitably arising in creation and improvement of the new technique, required extension of the range of the fundamental studies carried out at the Institute, with constant reduction of defence-oriented projects and due to the demands of disarmament.

Kurchatov Institute soon came to the front line in solving the most advanced trends of the fundamental science far beyond the framework of the branch atomic ministry under whose authority the Institute was placed. At the same time a high-capacity resource intense scientific and experimental basis including large sophisticated installations such as research nuclear reactors, thermonuclear fusion systems, accelerators etc., as well as large computer complexes and developed design and production basis, exceeded the accepted limits of the academic institute, so Kurchatov Institute accomplishes, as a rule, the whole R&D run beginning from the birth and substantiation of the scientific idea and terminating with the creation of experimental technologies and developments.

Therefore, it became clear that for the reason of maintaining the intellectual potential and the unique experimental basis of the Institute, it needed a new special status. It received such a status in accordance with the Decree of the President and the Government of Russia in November, 1991. The State has assumed the obligation of basic financing the Center i.e. to allocate funds for maintenance of the experimental basis and infrastructure. The rest of the expenses have to be covered with its own financial resources earned by winning at contests, obtaining orders for carrying out research and development works, participating in development of various projects and expertises (independently of any branch departments) both in this country and abroad.

IV. Management

Kind of organization: State Scientific Center of RF

Ownership: State property of RF

Responsible Ministry: Ministry of RF for Atomic Power

V. Executives

Board of RRC "Kurchatov Institute"

E.P. Velikhov - Chairman

N.N. Ponomarev-Stepnoi - Vice-Chairman

S.T. Belyaev - Vice-Chairman

B.B. Kadomtsev - Vice-Chairman

S.V. Antipov - Secretary

Directors of the Institutes associated into RRC:

P.A. Aleksandrov, V.G. Asmolov, V.Yu. Baranov, V.G. Gnedenko, N.E. Kukharkin, A.Yu. Rumyantsev, V.D. Rusanov, E.P. Ryasantsev, A.A. Soldatov, B.B. Chaivanov, N.A. Chernoplekov

VI. Current major activities

Safe development of Nuclear Power:

- nuclear power installations (NPI) for nuclear power plant, including safety problems
- commercial reactors
- NPI for marine
- NPI for space vehicles
- research reactors and reactor material science
- environmental safe power generation
- nuclear-hydrogen power

Nuclear low and medium energy physics:

- use of the charged particle beams for material testing and development of new technologies
- material testing using the nuclear physics methods
- set up of the Moscow Center of Synchrotron Radiation
- development of the methods and detecting systems for registration of charged and neutral particles
- measurement and estimation of the nuclear constants
- nuclear medicine
- muon catalysis and alternative breeding methods

Controlled thermonuclear fusion and plasma processes:

- designing the International Thermonuclear Reactor ITER
- studies on the thermonuclear installations TOKAMAK- 10 and TOKAMAK-15
- fundamental research of physics of pulse plasma system

Solid state physics and superconductivity programs and fundamental and applied studies:

- high temperature superconductivity
- solid state physics and technical superconductivity

Public safety and ecology
Resource-saving and environmental safe processes in metallurgy and chemistry.
Conversion.
Health.
Advanced information technologies.
Technologies, mashing and productions for the future.
Special programs for defence purposes.
(詳細データ略)

VII. Number of employee

Total Number of Regular Staff - 7.320

Researchers - 2973

- members of RAS - 13
- doctors and candidate of sci. - 1050

Engineers and Technicians - 2047
Workers - 1716
Others - 584

VIII. Major facilities

Basic experimental facilities of the RRC "Kurchatov Institute" were continuously developed and improved. At present, they include large physical facilities (the multiloop test reactor MR, the research beam reactor PR-8, the up-to-date hot

laboratory) equipped with unique devices for conducting research works. Also, they include ion-plasma facilities and other test rigs, computer complexes for conducting research in all application fields of RRC "Kurchatov Institute"
(詳細データ略)

IX. Commercial proposals

The Institute is highly integrated into scientific and technology cooperation on bilateral, multilateral and international basis.

The Institute provides a broad array of theoretical, experimental and expert services. The test and experiment facilities are available for the coordinated research within agreed programs and are also subject to separate agreements.

For more details, please refer to i.i. VII "Current major activities" and X "Major facilities" of the above document.

②ボチヴァル無機材料研究所

I. Name of the Institute (Organization)

In Russian:

Государственный научный центр Российской Федерации Всероссийский научно-исследовательский институт неорганических материалов им. А.А. Бочвара.

In Russian abbreviation: ГНУ РФ ВНИИНМ

In English: State Research Center of the Russian Federation A.A. Bochvar's All-Russian Scientific Research Institute of Inorganic Materials named after A. Bochvar.

In English Abbreviation: SSC VNIINM

II. Location

Official address: VNIINM p/b 369, 123060, Moscow, Rogov st., Russia

Mail address: VNIINM p/b 369, 123060, Moscow, Rogov st., Russia

Telephone number: (095)190-49-94

Fax number: (095)882-57-51

E-mail for representative: u002@opek1.msk.su

Access (transportation, necessary time):

Moscow international airport Sheremetjevo-2, then 1 and half an hour by car.

III. History

The Institute was created according to the decree of the State Committee for Defence of December 8, 1944 and at first was named as the Institute of Special Alloys. In 1967 it was called as the All-Union Research Institute of Inorganic Materials. In accordance with the decree of the Soviet Government of November 27, 1984 the Institute was named after academician A.A. Bochvar who headed the Institute above 30 years. According to the decision of the Government commission of February 3, 1993 the Institute received its current name.

In different times prominent scientists such as academicians A.S. Nikiforov, A. N. Volsky, corresponding members of Academy of Sciences A.S. Zaimovsky, S.T. Konobeevsky, V.V. Fomin worked at the Institute.

New First Deputy Director is Corresponding member of Academy of Sciences F.G. Reshetnikov, Deputy Directors are Drs. Sci. V.K. Oriov and A.S. Polyakov. The Scientific Board is an advisory body and comprises deputy directors, department heads, leading experts. The Board coordinates research and production activities.

IV. Management

Kind of organization: State scientific center of Russian Federation

Ownership: State property of Russian Federation

Responsible Ministry: Ministry of Russian Federation for Atomic Power

V. Executives

Director - Dr. Sc. Michail Solonin.

VI. Current major activities

Tradition trends in Institute's works include:

- Theoretical, fundamental and applied studies on physics of metals, metals science, solid state physics, fission and structural materials, and the development of advanced ecologically clean processes for manufacturing experimental and serial products to develop designs of a new generation
- The improvement of the existing fuel elements and the development of new ones, the development of structural materials to increase the safety and reliability of the reactor cores for a variety of purposes .
- Investigations of physical, chemical, radiation and kinetic problems of extraction and the development of processes and equipment on their basis to regenerate irradiated nuclear fuels of all types discharged from nuclear reactors. The improvement of the refabrication of secondary uranium and uranium-plutonium fuels.
- The development of processes and equipment designed for handling radioactive wastes of the high, medium and low levels by their concentrating and solidifying using the vitrification, bituminous grouting and cement grouting methods to bury them safely and to protect the environment. The development of methods to clean gas discharges of radioactive airbornes and gases.
- The investigation and development of low-temperature and high-temperature

superconducting materials and processes of their production for the use in fusion devices, charged-particle accelerators, MHD-generators, medical tomographs, magnetic separators and other devices of the nuclear industry and the national economy.

- Investigations and the development of processes and equipment to produce materials and devices made of steels, aluminium, zirconium, tantalum, tungsten, niobium, nickel, beryllium, etc. and their alloys for the needs of the industry and the national economy.
- Studies on tritium cycle and blanket materials of fusion reactors.
- The development of systems for the analytical checking, the control of technological processes and monitoring.
- The foundation of an experimental basis for improving the technology of handling radioactive wastes and cleaning sewage of radioactive contamination of enterprises in the Choroshevski district of Moscow.

Conversion works are performed in the following directions:

- Conversion of plutonium which was used for military purposes .
- The investigation and development of non-traditional alloys and technologies to produce workpieces of hard magnetic disks with high density of magnetic recording.
- The improvement of materials and the development of processes and equipment for plants producing dairy equipment.
- The development of new magnetic materials and technologies to manufacture high-energy constant magnets .
- The investigation into the production of high-porosity materials and the development of a technology to manufacture filtering elements and filtration equipment for medical and biological purposes.
- The creation of efficient productions to manufacture various metals of high purity and new materials based on the up-to-date technologies including studies aimed at producing amorphous products based on alloys of a new type and at manufacturing metal glasses. Also Invar problem and a new class of nonmagnetic materials based on system with structural transitions are studied.

The scientific laboratories and departments of the Institute conduct studies in the following fields: radioactive materials, their alloys and compounds, radiochemistry, metallurgy, metals science, analytical monitoring and inspection, fuel and fuel elements for nuclear power plants, structural reactor materials, solidification and burial of radioactive wastes, gas purification, pulse devices and some fusion problems.

Radiochemistry studies

- The development of extraction and pyrochemical process schemes, equipment, monitoring and control methods for reprocessing irradiated fuel from nuclear power plants;
- Investigations of physical and radiation chemistry of solutions, studies on chemistry of complex compounds of actinides and fission products and on the extraction and sorption theory;
- The development of pulsation and vibration devices for the radiochemistry and hydrometallurgy industries and other branches of the national economy; the separation of radioelements by the distillation method, the analysis of radioactive gases, the investigation of sorption and desorption of gases;
- The investigation of the properties of radioactive emitters, including methods for their separation, the production of radioactive sources, the studies on and the development of methods and means for cleaning gas discharges of radioactive and toxic gases and aerosols, methods of cleaning, solidifying and burying radioactive wastes of all activity levels, methods for decontaminating surfaces and equipment of nuclear power plants, methods of determining radioisotopes at the level of maximum permissible concentrations in gas discharges investigations of fuel cycles (tritium and lithium cycles) for the plasma chamber and blankets of fusion plants and reactors.

Metallurgical investigations

- Investigations concerning the production of metal uranium and other radioactive materials, zirconium, tantalum, niobium, beryllium, calcium, refractory and insulating ceramic materials for nuclear power;
- Physical, chemical and thermal investigations of the properties of fission materials;
- Investigations and the development of a technology to rip fuel elements of nuclear

power plants by the electrochemical and gas-thermal methods.

Metals science investigations

- □ The investigation, development and production of structural materials for fuel element dads and other components of reactor cores of nuclear power plants, reactor steels for fast reactors and zirconium alloys for thermal reactors. Corrosion investigations on samples made of structural and radioactive materials in autoclaves, dynamic and reader loops;
- □ Studies on problems of the radiation damage to materials: embrittlement, swelling, the change of the structural state and superconductivity, intensified corrosion and hydrogen permeability;
- □ Metal-physical investigations of uranium, other radioactive species and their compounds, study of phase transformations, diagrams of the state, and, also, roentgenographic, electron-microscopic and micro-sample investigations of fission and structural materials.

Fuel element technology investigations

- □ Methods of calculations, designing, pre-reactor rig tests and analysis of reactor tests on mock-ups and real fuel elements for power and research nuclear reactors;
- □ Investigations concerning the fabrication of nuclear fuel for power and research readers with thermal, intermediate and fast neutrons (oxides, carbides, uranium and plutonium nitrides, metal uranium, plutonium and their alloys), and, also, compatibility of these compounds with structural materials;
- □ The development of processes, technologies, equipment and control systems to process structural and fission materials, in fabricating fuel elements and semi-finished items : smelting, thermal treatment, welding, soldering and brazing, pressure treatment, atomization of melts, the production of powders and coatings, plasma treatment, power metallurgy;
- □ The development of a technology to produce cermets and to manufacture pieces of them, using beryllium, tantalum, niobium and their alloys;
- □ The investigation of metal deforming methods (pressing, extrusion, rolling, drawing, stamping) ;
- □ The development of process schemes for manufacturing pipes, bars, rods, wire, sections, sheets, made of reader materials.

Investigations on superconducting materials

- The study of materials on the basis of deforming alloys and intermetallic compounds;
- The study of superconductivity characteristics, depending on the structure and the physical and mechanical properties of superconductors;
- The development of methods to produce multicore and band superconducting materials for creating magnetic systems: investigations aimed at improving the existing superconducting materials. Analytical investigations. The development of chemical, chemical-spectral and nuclear physics methods to analyse, monitor and inspect fission and structural materials and the reprocessing of irradiated fuel;
- The investigation of physical and chemical characteristics of fission and structural materials;
- The investigation of several operations in fabricating fuel elements and semi-finished items.

Research in Chemical Technology

The research is specialized in developing and improving a technology for regenerating irradiated nuclear fuel for all types of nuclear reactors. The technology is based primarily on the extraction methods. Technologies have been created to produce plutonium for military purposes and to reprocess, in a complex way, irradiated fuel elements at the RT plant, the first plant in the country designed to regenerate fuel of nuclear power reactors.

The second main work is the development of a technology to treat radioactive wastes of the high, medium and low activity levels by their concentration and solidification, using vetrification, bituminous grouting and cement grouting methods. By the main parameters, these technologies are competitive, and, by some parameters they are superior over foreign technologies.

A concept of the dosed fuel cycle of nuclear power, and an idea of the safe handling of radioactive and highly toxic wastes are developed. It is assumed that some radionuclides, technetium, palladium, rhodium and others may be used for industrial and medical purposes.

The applied research and development works conducted at the radiochemical plants are based on fundamental research works of their own in the following fields:

- extraction theory;
- quantum-chemical calculations;
- extraction chemistry of actinoids, noble metals, technetium, strontium, caesium and others;
- kinetics and thermodynamic of redox reactions of actinoides and fission products;
- physical chemistry of polyphase and heterophase systems;
- radiation chemistry;
- mathematical simulation.

Chemical technology development is conducted using up-to-date physical and chemical methods, including:

- optical and infrared spectroscopy;
- nuclear magnetic resonance;
- electron paramagnetic resonance;
- Messbauer spectroscopy;
- positron annihilation;
- roentgenostructural and roentgenophase analyses;
- Auger-spectroscopy;
- emission and atom-adsorption spectroscopy;
- gamma-spectroscopy;
- neutron activation analysis;
- gas and liquid chromatography;
- dispersion analysis;
- mass-spectrometry;
- thermogravimetry and other methods.

During a 45 year period, a team of highly qualified scientist and engineers has been formed. The experience and knowledge of this team have given the opportunity to be involved in conversion works. These works are: extraction and separation of rare earth elements from various ores and ore concentrates; the production of silicon and its compounds of high purity; the complex processing of precious metal ores; the extraction of precious metals; purification of industrial effluent and waste gases of a corrosive and ecologically dangerous substances; the extraction of valuable components from geothermal waters and others.

VII. Number of employee

Number of employee - about 1,500.

VIII. Commercial Proposals

Complex researh development and processing wastes obtained from electric power stations and regional steam electric power stations for production of vanadate pentoxide

Project entails attracting direct external investment in amount of $ 1,500,000 into creation of joint venture (investor share is up to 45% of capital), and also attracting credit in amount of $8,500,000 to perform complex research development, to buy additional technological equipment and controlling devices and to organise processing wastes obtained from thermal electric power stations and regional electric power stations for production of vanadate pentoxide using existing SRC facilities.

Project will be recouped by the profit gained from the sales of vanadate pentoxide to the enterprises of oil and chemical industry (to be used as catalyst) and also to enterprises producing special alloys. There is preliminary project investigation. SRC is concerned in creation joint venture, joint technology patenting, co-operative production and in having assistance in licensing, expert examination, marketing and management of the project.

Product's characteristics

Vanadate pentoxide powder (98% and 9.5% purity) - TU-48-4-429-82. Project also suggests solution to compiling the Ash slime Register for Russia and solution to producing concentrates of other elements that are part of ash slime (Ni, Fe, Al, Si, Na2 SO4) being used within production line process.

Market evaluation

Market investigation was performed by SRC in 1994. Demand for the product in RF and CIS countries is estimated as 120,000 tons per year.

Creation of pilot plant and organization of industrial coat plating of decorative thin film sun- and heat-reflecting coating for glass

Project entails attracting credit in amount of $ 1,300,000 to buy additional production equipment, to manufacture trial plant and to organise serial production of decorative thin film sun- and heat-reflecting coating on glass using facilities of one of RF construction materials plant. Combined financing including direct investing to joint venture (investor share is up to 45%) and credit attracting are possible.

Project will be recouped by the profit gained from the sales of glass and double glass packets with decorative coating to Russian enterprises and also abroad (under compensatory agreements).

Preliminary project and market investigation have been performed. Business plan and technical design have been elaborated (technical design was elaborated by "Molniya" enterprise and "Mirat" research enterprise).

SRC is concerned in creation of joint venture, in having assistance in equipment supplies, product licensing and access to external market, in project management and joint patenting.

Product's characteristics

1. Glass sheet of 2.2 *3.5 m size and 4-8 mm wide with metal oxides coating. It provides super protection from sun and preserves heat. Volume of production is 100,000 sq. m per year.
2. Glass of the same type with mirror coating and wide choice of colours for facing buildings. Volume of production is 140,000 sq. m per year.
3. Glass plate for facing with mirror coating of 150*350 mm size and 350*350 size with wide choice of colours. Volume of production is 30,000qg.m per year.

Coating quality meets the world standards.

Market evaluation

Market evaluation has been performed by Moscow institute of technological equipment in 1994.

Demand for glass with decorative coating in RF is estimated as 200,000-250,000 sq. m per year, in CIS countries - as 200,000-250,000 sq. m per year.

Tinted glass is basically delivered to RF from abroad and only 0.1% is being supplied by Russian manufacturers.

Delivery of product to England and Germany is forecast.

Financial scheme

Credit - $ 1,300,000Terms of credit - for 3 years under 20% of interest rate with credit and interest repayment delay for 1.5 years and equal quarterly installments.
Joint venture with up to 45% of investor share is possible.

Financial forecast (4-th year)

- net present value - $956,320
- payback period - 3 years
- internal rate of return - 59%
- accountant rate of return - 51%

Increase of volume and nomenclature of hyper conducting materials production
Project entails an attraction of direct investments in the joint venture, that would be created in amount of $900,000 and additional credit in amount of $3,300,000 to modernize existing SRC capacities and increase production of a wide range of hyper conductors, corresponding to the world standards, up to 10 tons per year.
The project will be recouped from the profit of selling hyper conducting materials to Russian and foreign customers (producers of tomographs of different types, cryogen electric machines and etc.)
There is a preliminary technical study and request for proposal for feasibility study, market research was made. The product has know-how, protected by copyrights and patents of Russia.
The Russian partner is interested in creating a joint venture or organizing a production cooperative, having assistance for the product's licensing and a break to the world market, in organizing management and technical assistance of the foreign partner.

Product's characteristics

- Nb-Ti conductors in copper and resistive matrices with diameter of 0.2-1.0 mm, a number of fibers - ZY - 180,000, critical density of current up to 3*10^5 (A/sm2) in a magnetic field 5 Tl.
- Nb-Sn conductors, stabilized with copper of 0,5-1,5 mm diameter, a number of fibers -7225-25530, physical density of current (without copper)

- 1000-1400 (A/mm2) (under magnetic field of 5 Tl);
- 500-600 (A/mm2) under magnetic field of 1 2 Tl).

The technology is based on the application of high homogenous materials, modern methods of processing and control.

Market evalution

Market research is being made by SRC in 1995-1996.

Demand in the products for Russia and CIS countries up to 2000 year is estimated about 25 tons per year (50% - each product).

On keeping the world level of quality, the price for conducting materials will be 10-15 % less, than world price.

It is planned to organize materials export to the leading countries of the world, elaborating devices on hyper conductors.

Financial scheme

- Total amount of financing - $5, 100,000
- Share of the Russian partner - $900,000
- Share of an investor - $900,000 (49% of the company capital)
- Additional credit - $3,300,000 under 10% year interest rate for 3 years, with a delay of credit repayment and interest payments for 1.5 years and quarterly equal payments.

Financial forecast (7-th year)

- payback period - 5 years
- internal rate of return – 13%
- accountant rate of return – 26%

Modernization and production increase of micro filtration units made from corrosion-resistant materials

Project entails credit attraction in amount of $500,000 to modernize existing SRC facilities and to increase production of high effective micro filtration units comparable with the world standards.

Guarantees of the Ministry of Nuclear Power of Russia may be received as a credit guarantee.

The project will be recouped from the profit gained from the sales of units to Russian

and foreign customers (to the enterprises of nuclear power, electronic, medicine and food industries).
There is a preliminary technical research and detail business plan and project design are being elaborated, market research was made. The product has know-how.
The Russian partner is interested in having assistance in marketing investigation support and in penetration to the world market.

Product's characteristics

Unified filtration units and installations made from corrosion-resistant materials (steel, titan).
Recommended filtration elements made from corrosion-resistant steel, titan, and zirconium with membrane coatings, holding capacity - from 0.1 up to 80 mkm. Proposed technology has higher productivity in comparison with analogues and wider range of hydrogen (pH) index of purified mediums, less cost. The products are ecologically safe.

Market evaluation

Market investigation is being provided by the SRC and SRC Atominfrom in 1995-1997. Demand at RF market is more than 2000 units and 10,000 filter components; for CIS - more than 4000 units and 20,000 filter components. Before contract delivery evaluation was made in a number of enterprises in medicine, electronic and food industries.
Export of units and filter components is being planned mainly to developing countries.

Financial scheme

- Amount of attracted credit - $500,000
- Share of the Russian partner - $ 100,000
- Terms of credit - with 20% year interest rate for a term of 3 years, with a delay of credit repayment and interest payments for 5 quarters and quarterly equal payments.

Financial forecast (4.5 year)

- net present value - $ 152,750
- payback period – 3.5 years

- internal rate return – 29%
- accountant rate return – 33%

Organization of mass industrial production of fast-hardening magnetic powders of "Nd-Fe-B" system for high-energy permanent magnets
Project entails an attraction of direct investments to the joint venture, which would be created, in amount of $1,983,000 and an additional short-term credit in amount of $688,000 for purchasing technological equipment and organizing a mass production of fast-hardening magnetic powders of "Nd-Fe-B" system for high energy permanent magnets.
The project will be recouped from the profit of selling the magnetic powder and magnet plates made of it (mainly - in the world market through dealer companies of the USA, having necessary international licenses)
There is feasibility study, technical design, market research was made. The project has been under4 examination of the Government of Russia, approved by the Ministry of Nuclear Power and UNIDO. There are applications for international patents for material and methods of its manufacturing.
The Russian partner is interested in creating a joint venture and (or) organizing a production cooperative.

Product's characteristics
High energy fast hardened magnetic powder of Nd-Fe-B system for high energy magnetic plates. Magnetic plates for electric motors, sensors, actuators, acoustic systems, microphones etc.
The own exclusively ecologically safe technology of centrifugal dusting is used, what increases economic indexes of production of the best foreign analogues and in a number of cases - makes it possible to produce the product, which has no analogues.

Market evaluation
In 1992-1995 the market research was made by JSC "Conversbank" (Russian market) and by "Synmatix Corp" and "JEK Inc"(USA) in the world market.
Demand in the product for Russia and CIS countries is 100 tons per year.
Forecasted export of the product (based on the before contract works, with companies of the USA, France, China) will be more than 100 tons per year.

There is an experience of the product exports.

Financial scheme

- Total amount of financing - $3,671,000
- Share of the Russian partner - $1,641,000
- Investor's share - $1,342,000 (up to 45% the company capital)
- Additional credit - $688,000 with 20% year interest rate for a term of 3 months.

Financial forecast (3-rd year)

- payback period – 1.5 years
- net present value - $4,956,000
- internal rate of return – 131%
- accountant rate of return- 95%

③理論･実験物理学研究所

I. Name of the Institute (Organization)

In Russian:

Государственный научный центр Институт теоретической и экспиременталъной физики

In Russian abbreviation: ГНЦ ИТЭФ

In English: State Research Center of the Russian Federation Institute for Theoretical and Experimental Physics

In English Abbreviation: SSC ITEP

II. Location

Official address: 25,B.Cheremushkinskaya, 117259, Moscow, Russia

Mail address: 25,B.Cheremushkinskaya, 117259, Moscow, Russia

Telephone number: (095) 123-31-95

Fax number: (095)123-65-84

E-mail for representative: semenov@cl.itep.ru

Access (transportation, necessary time):

From the Sheremetjevo-2 International Airport:

- by car - 1.5 hours;
- express bus to "Rechnoi Vokzal" metro station. (Bus stop is located behind the nearest parking lot in the Airport. Buses leave every 30 minutes. Transfer at the "Novokuznetskaya" metro station to "Tretiakovskaya”.

- By the metro: The nearest metro station is "Profsoysnaya”. It is located at the orange line in the south direction. (4th stop from "Okybrskaya")
- By bus or tram: You can take bus #4l, that stops near "Profsoysnaya" metro station and leave at the 3rd stop or you can take tram #26, that stops 75 meters from the metro in the direction to the center, and leave at the 3rd stop also.

III. History

ITEP was founded in 1945 for the goals of the research in field of nuclear physic.

ITEP is a multiprofile center for research and education, focused on the study of the fundamental properties of matter and their use for development of new technologies, especially ecologically-safe sources of energy, energy-saving equipment, telecommunications and medicine.

The main research topics are in the fields of theoretical and mathematical physics, astrophysics, high-energy (elementary particle) physics, nuclear physics, plasma physics, solid-state physics, nanotechnologies, reactor and accelerator technologies, medical physics, computer physics and computer sciences.

ITEP has a broad and effective education program, mostly at the graduate, postgraduate and postdoctoral levels, which prepares qualified people for the future work in science, finances, businesses and engineering.

IV. Management

Kind of organization: State Research Center

Ownership: State property of Russian Federation

Responsible Ministry: Ministry of Russian Federation for Atomic Power

V. Executives

Director: Danilov Mikhail Vladimirovich

Secretary: 125-90-80 (Galakhova Tatiana Petrovna)

Deputy Directors:

V.S. Kaftanov, V.F. Radchenko, O.V. Shvedov, M.M. Sokolov, A.L. Suvorov

Scientific Secretary: Terekhov Yuri Vasilievich

VI. Current major activities

- theoretical study of the properties and interactions of elementary particles and atomic nuclei and astrophysical aspects;
- study of hadron-hadron and hadron-nuclear interactions and resonance systems;
- investigation of fundamental interactions using colliding beams and high energy accelerators;
- study of electroweak interaction at accelerators and low background facilities;
- investigation of low-energy interactions;

- solid-state physics, physical chemistry and superconductivity;
- nuclear fusion at powerful heavy-ion and electromagnetic drivers;
- development of new proton therapy methods and construction of a positron-electron tomograph for medical diagnostics;
- development of new methods of proton and heavy-ion acceleration;
- development of a new generation of safe nuclear-power facilities.

VII. Number of employee

Number of employee: about 1500.

VIII. Major facilities

The Institute possesses all necessary traditional and modern equipment, including original scientific tools and computational centers. The installed equipment allows to conduct all stages of R&D at most advanced level,

including equipment for the research in the fields of:

- quantum electronics;
- quantum chromodynamics;
- high-energy particles;
- nuclei interactions;
- interactions of large transferred pulses;
- mesons rare decays;
- properties of heavy quarks and leptons.

Major facilities:

- 10-GeV proton synchrotron;
- 24-MeV proton linear accelarator;
- the heavy water setup "Maket";
- six meters spectrometer.

IX. Commercial Proposals

Creation of a medical and diagnostic complex for proton-radiation therapy and positron emission tomography

Project entails creation of a medical and diagnostic complex in Moscow. To implement the project, either a credit in amount of $26,500,000 (guaranteed by Moscow Government as possibility) is necessary, or combined financing: loaning and investing to a joint venture set up with the SRC participation is feasible. An investor will have up to 49% shares of capital.

Project includes financing of designing and construction work, purchasing of equipment and overhead costs.

Project will be recouped by the profit gained from medical and diagnostic services rendered.

Product's characteristics

Product 1 - complex for proton radiation therapy (up to 2500 courses of treatment per year)

Product 2 - center of positron emission tomography (300-500 courses of treatment per year)

Market evaluation

Market investigation based on foreign press and data of the Ministry of Health of the Russian Federation has been performed by the SRC. Creation of complex in Moscow is being agreed upon with Government of Moscow and Moscow region. Need in such complexes in Russia is estimated as 1 complex for 2-3 years.

Financial scheme

Credit - $26,500,000

Terms of credit - for 8 years with 10% year interest rate, with a delay of credit repayment and interest payments for 4 years, with quarterly equal payments.

Financial forecast (10-th year)

- net present value - $2,310,000
- payback period - 8 years
- internal rate return - 18%
- accountant rate return - 20%

④高エネルギー物理学研究所

I. Name of the Institute (Organization)

In Russian:

Государственный научный центр Российской Федкрации Институт Физики Высоких Энергий

In Russian abbreviation: ГНЦ РФ ИФВЭ

In English:

State Research Center Of The Russian Federation Institute for High Energy Physics

In English Abbreviation: SRC IHEP

II. Location

Official address: Russia, 142284,Protvino,Moscow region, Pobeda str., 1

Mail address: Russia, 142284,Protvino,Moscow region, Pobcda str., l

Telephone number: 924-67-52

Fax number: 230-23-37

E-mail for representative: karpenko@mx.ihep.su, tyorin@m10.ihep.su

Access (transportation, necessary time):

Moscow international airport Sheremetjevo-2.

Reach Protvino and IHEP - any three ways

- by car via Serpukhov to Protvino (about 90- 120 minutes);
- by bus number 363 from metro "Yugo-Zapadnaya" (about 120 minutes);
- by electric train Kurski railrway station to Serpukhov (about 120 minutes), then by bus number 127 (about 40 minutes) to bus station "Protva, Hotel" at Protvino or by taxy (about 15 minutes) from the Serpukhov.

III. History

The Institute for High Energy Physics (IHEP, also known as Serpukhov) is among the leading Russian centers in elementary particle physics. It was founded in October 1963. On October 14, 1967 the proton accelerator with 70 GeV beam energy, which was the largest at that time, was put into operation. All leading institutes of Russian Federation and other republics of CIS took part in the investigations at this machine. Right here a wide international collaboration in the field of high energy physics with participation of scientists from Europe and the USA has been established, and it still continues at present.

The fundamental discoveries, recognized throughout the world, have been made at the IHEP accelerator. They are:

- Observation of two antinuclear and 19 elementary particles, among which are high spin resonance's, the particles with properties of new form of matter (glueballs), and exotic states .
- Discovery of the scale invariance of hadronic interactions. These results, together with the analogous ones obtained at SLAC for the electron interactions, have been an experimental foundation for the quark theory of elementary particle structure.
- Discovery of the growth of the hadronic interaction total cross sections (Serpukhov effect).
- Confirmation in polarization experiments of the importaut role played by spin at high energies.
- Discovery of the beam RFQ field focusing principle realized at IHEP and now successfully applied in numerous laboratories around the world.

Eight discoveries, made at IHEP, have been registered at the State Register of Discoveries of Russian Federation. Nine series of scientific works of the IHEP scientists have been marked with the highest government awards. Many results, obtained at IHEP, are widely used in other fields of science and technology.

The Institute participates in both national and international cooperation in high energy physics. The scientific program is carried out by the scientists from Joint Institute for Nuclear Research. Institute of Theoretical and Experimental Physics, Institute for Nuclear Research. Lebedev Physical Institute. Konstantinov Nuclear Physics Institute, Budker Institute of Nuclear Physics. Skobeltsyn Institute of Nuclear Physics at Moscow State University, Russian Research Center "Kurchatov Institute", Moscow Engineering Physics Institute, Yerevan Physics Institute, Kharkov Institute of Physics and Technology, and CERN. The physicists from Germany. Japan, and the USA participate in the research program as well.

APPLICATION OF RESULTS OBTAINED
AT IHEP IN OTHER FIELDS OF SCIENCE AND TECHNOLOGY

In parallel with the results of investigation, which integration into national economy being marked with state prizes, the IHEP staff carried out also a large number of works widely used in different branches of national economy. The most significant are as follows:

A superconducting niobium-titan wire was developed in collaboration with industry and its commercial production has begun. The current-carrying capacity of the wire is 2.3* l05 A/cm2 at 4.2 K temperature and 5 T magnet field that corresponds to the world standards. The wire has a diameter of 0.8 mm and contains 89100 6-micron niobium-titan fibers inside a cooper matrix.

A unique complex of automatic machines and devices (for wounding, twisting, formation, isolation, and non-contact monitoring of a current-carrying capacity) was elaborated and developed for production of a superconducting transport cable, used in the manufacturing of SC-magnets for UNK. This complex is adopted for industrial production now.

A complex of electronic equipment for automatic control of the cryogenic units (awarded by silver medal of VDNKh) was developed for the first time in our country in a collaboration with NPO "Kriogenmash".

A superconducting power supply of the topological type, the so-called topological generator was elaborated and constructed at IHEP for the first time in the world practice.

This generator provides energizing of 6 meter superconducting magnets, and 5.5 kA current is achieved in the coils.

The results on the design and construction of the IHEP measuring and computing center have been adopted at 17 enterprises of 6 Ministries.

A laser plotter for manufacturing of the photo-profiles for printed plates was developed at IHEP. It takes about 15 minutes to draw a print plate of any complexity instead of 7-8 hours needed at widely-used optical-mechanical devices. At the basis of this design a specialized laser printer was developed and manufactured in the industry.

An automatic system for the diagnostics of heart arrhythmia was developed on the basis of industrial microprocessor of series K580 and experimental data processing device.
This system was put into operation in the Bakulev Institute of Heart-Vascular Surgery of the Medical Academy of Science of Russian Federation.

Another example of the usage of the electronic modules developed in IHEP is the construction of an automatic system for monitoring and diagnostics of the basic equipment of the Krasnogvardejsk telephone unit of the Moscow telephone network. This system allows one not only to collect information about troubles but to classify these troubles according to significance, to display messages about defective elements, to gather statistics and analyze the typical troubles.

A graphic program package "Atom" for various data visualization is elaborated and manufactured at IHEP. This program is inculcated into 32 organizations of our country. Eighteen programs for solving the problems on the magnetostatics, the heat conductivity, heat exchange, for evaluation of resonators and accelerating cavities were developed and adopted into 52 organization of the country.

IHEP pioneered the usage of the bent mono-crystals for splitting and focusing of the beam particles. These engineering's provokes interest in the world largest accelerating laboratories.

IV. Management

Kind of organization: State Research Center Of The Russian Federation
Ownership: State property of Russian Federation
Responsible Ministry: Ministry of Russian Federation for Atomic Power

V. Executives

Director - A.A. Logunov
Deputy Directors: A.I. Ageev, N.E. Tyurin

VI. Current major activities

- accelerator physics and technology;
- radiation safety;
- high energy and elementary particle physics;
- meson spectroscopy;
- search for exotic states (glueballs, multiquark mesons, etc.);
- neutrino and polarization studies.

VII. Number of employee

Number of employee: about 6,000 persons, among whom are 627 scientists, 2 academicians, 1 corresponding member Russian Academy of Science, 52 scientists with Doctor degrees, 270 Candidates of science, 25 Professors.

VIII. Commercial Proposals

The Institute is highly integrated into scientific and technology cooperation on bilateral, multilateral and international basis.

The Institute provides a broad array of theoretical, experimental and expert services. The test and experiment facilities are available for the coordinated research within agreed programs and are also subject to separate agreements.

For more details, please refer to i.i. VII "Current major activities" and X "Major facilities" of the above document.

⑤核科学研究所

I. Name of the Institute (Organization)

In Russian:

Государственный научный центр Российской Федерации Институт ядерных исследований Российской Академии Наук

In Russian abbreviation: ГНЦ РФ ИЯИ

In English:

State Research Center Of The Russian Federation Institute for Research of Russian Academy of Sciences

In English Abbreviation: SRC-INR

II. Location

Official address: 7a, Prospekt 60 Let Oktyabrya, 117312, Moscow, Russia

Mail address: 7a, Prospekt 60 Let Oktyabrya, 117312, Moscow, Russia

Telephone number: (095) 135-77-60

Fax number: (095)135-22-68

E-mail for representative: gevorkov@inr.msk.su

Access (transportation, necessary time):

Moscow international airport Sheremetjevo-2, one and half hour by car

III. History

The Institute for Nuclear Research of the Russian Academy of Sciences was founded in 1970 for further development of the experimental base and research activities in the field of atomic, nuclear, elementary particle and cosmic ray physics and neutrino astrophysics.

For these purposes a meson facility on the basis of a high-intensity linear proton and H-accelerator for 600 MeV at the average current of 0.5-1.0 mA was built at the Academy of Sciences Research Center (the town Troitsk of the Moscow region) and a complex of underground low-background laboratories equipped with neutrino telescopes was set up in Prielbrusye (the Kabardino-Balkarian Autonomous Republic in the Caucasus). Since 1980 studies on deep-water muon and neutrino detection have been developed.

Nowadays the Institute is one of the leading nuclear physics centers. In 1994 INR RAS was given the status of State Research Center. Among the staff members of the Institute there are 4 academicians, 2 corresponding members of the Russian Academy of Sciences, 37 doctors and 152 candidates of science.

IV. Management

Kind of organization: State Research Center Of The Russian Federation

Ownership: State property of Russian Federation

Responsible Ministry: Russian Academy of Sciences

V. Executives

V.A. Matveev - Director general

VI. Current major activities

The Directions of Research Activities

- elementary particle physics, theory of gauge fields and fundamental interactions, high energy physics, particle physics and cosmology;
- neutrino astrophysics, neutrino and gamma-astronomy, cosmic ray physics, investigation of neutrino fluxes from the Sun and collapsing stars;
- development and construction of neutrino telescopes in the low-background underground and underwater laboratories for studying natural fluxes of neutrino and other elementary particles;
- nuclear physics, dynamics of nuclear and photo-nuclear reactions, physics of radionuclides and heavy ions
- neutron physics, intensive neutron source technologies, studies of condensed media on neutron beams;
- intermediate energy high-intensity accelerator physics and engineering, physics and technology of high-intensity accelerators .
- applied nuclear physics, radioisotope investigations, electric nuclear transmutation of decaying materials, radiation material science and nuclear medicine.

Of especial interest became theoretical research in the field of high energy physics and the development of the perturbation theory in quantum theory of field, studies of vacuum structure in gauge theories, development of research methods of dynamic of hadrons strong interactions beyond the perturbation theory, research of the processes beyond the Standard Model of the elementary particle theory, description of baryon asymmetry of the Universe and studies of correlation between particle physics and cosmology.

VII. Number of employee

Number of employee:

4 academicians, 2 corresponding members of the Russian, Academy of Sciences, 37 doctors and 152 candidates of science.

VIII. Commercial proposals

The Institute is highly integrated into scientific and technology cooperation on bilateral, multilateral and international basis.

The Institute provides a broad array of theoretical, experimental and expert services. The test and experiment facilities are available for the coordinated research within agreed programs and are also subject to separate agreements

For more details, please refer to i.i. VII "Current major activities" and X "Major facilities" of the above document.

2. ロシア原子力省組織図 （2000年7月時点）