



ROSATOM

STATE ATOMIC ENERGY CORPORATION "ROSATOM"

Lines of Development of Nuclear Medicine

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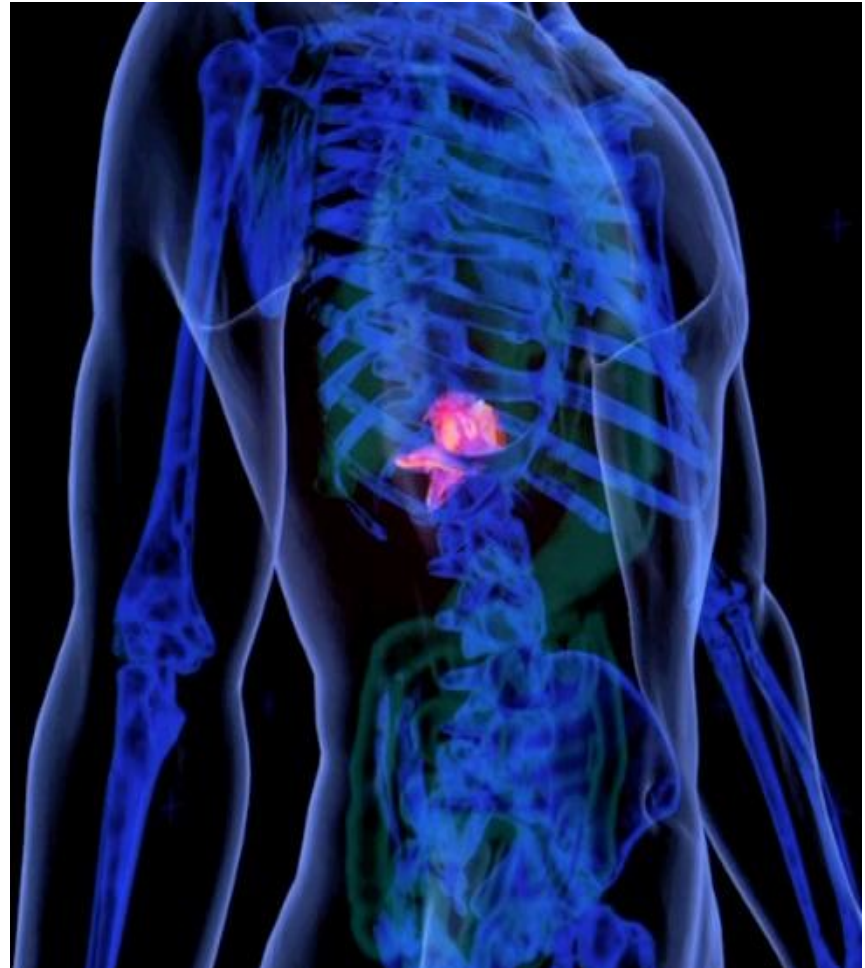
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Nuclear medicine

Nuclear medicine is a branch of medical imaging and therapy that uses the small amounts of radioactive material to diagnose and determine the severity of or treat a variety of diseases, including many types of cancers, heart disease, endocrine, gastrointestinal, neurological disorders and other abnormalities within the body.

Nuclear medicine procedures are able to pinpoint molecular activity within the body, they offer the potential to identify disease in its earliest stages as well as a patient's immediate response to therapeutic interventions.

UIC Ltd. promotes further development of cancer diagnostics and therapy methods by constructing and equipping nuclear medicine facilities worldwide, usually acting as investment partners in joint-ventures with local hospital departments and medical centers.



Radionuclide diagnostics: single-photon emission computer tomography

Nuclear medical imaging — radiation diagnostics technique involving application of the radiolabeled bioactive compounds — radiopharmaceuticals.

Single-photon emission computer tomography (SPECT) — one of nuclear medical imaging techniques. With this type of tomography radiopharmaceuticals are radiolabeled by gamma-emitting isotopes.



Basics of SPECT

- Radiopharmaceutical is introduced intravenously into the body.
- Since its concentrations are different in healthy and diseased tissues, SPECT scanner is able to reflect that.



Indications for SPECT

Oncology:

- Mainly bone metastasis control examination

Cardiology

Neurology

Pulmonology

Nephology

Gastroenterology

NIEFA products: single-proton emission computer tomograph “EFATOM”

- Tomograph is aimed for medical diagnostic tests of human viscera with imaging technique of pharmaceuticals distribution radiolabeled with gamma-emitting radiopharmaceuticals.
- In 2008 the “EFATOM” successfully tested in Hospital № 83 FMBA in Moscow, showing its compliance with the characteristics similar to the current level of foreign technologies.
- NIEFA has the registration certificate FCR 2009/05499, that confirm the permission to manufacture, sale “EFATOM”. To date more than 9,500 diagnostic workup was hold.



Radionuclide diagnostics: positron emission tomography

Nuclear medical imaging — radiation diagnostics technique involving application of the radiolabeled bioactive compounds — radiopharmaceuticals.

Positron emission tomography (PET) — one of the most informative nuclear medical imaging techniques. Used to examine functions of human organs.



Basics of PET

- Radiopharmaceutical is introduced intravenously into the body.
- Since its concentrations are different in healthy and diseased tissues, PET scanner is able to reflect that.

Indications for PET

Oncology:

- Diagnostics – stage definition
- Treatment control
- Control of metastasis

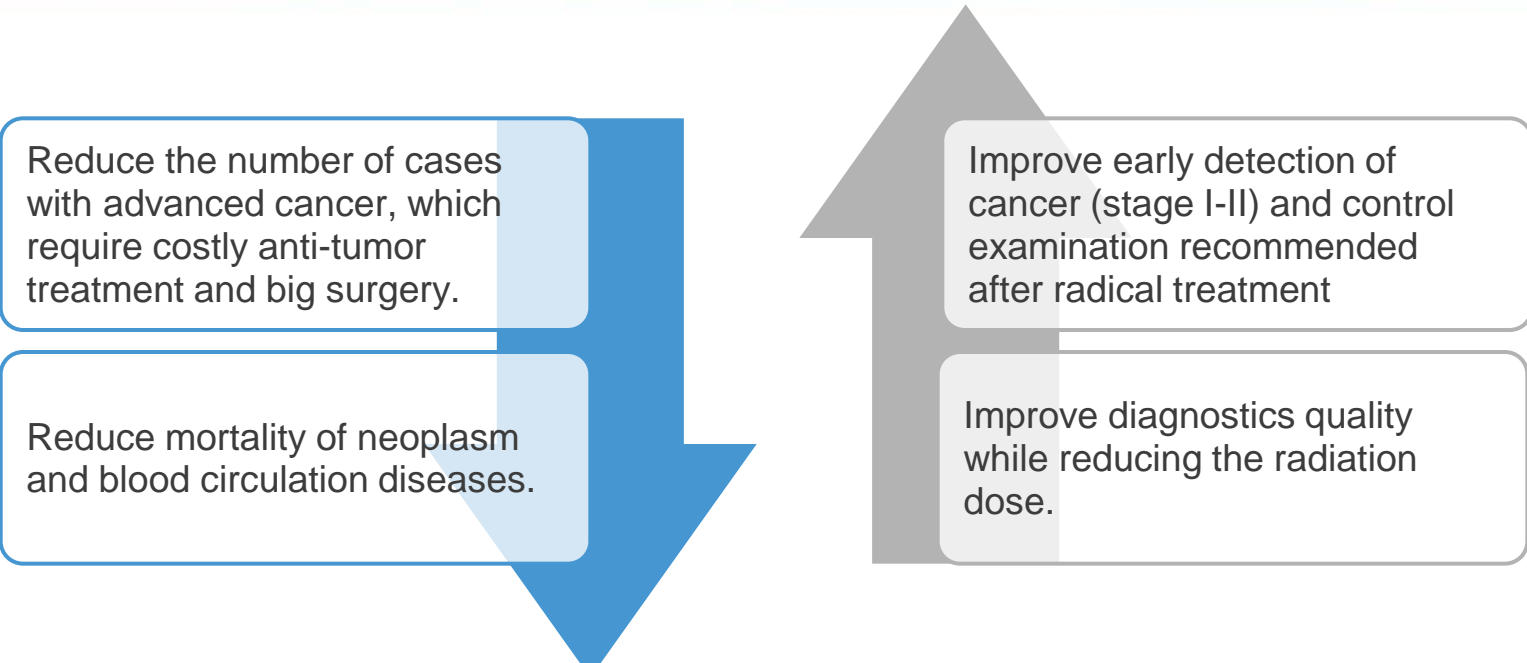
Neurology

- Brain tumors,
- Epilepsy,
- Parkinson's Disease
- Alzheimer Disease

Cardiology



PET role in diagnostics



Reduce the number of cases with advanced cancer, which require costly anti-tumor treatment and big surgery.

Reduce mortality of neoplasm and blood circulation diseases.

Improve early detection of cancer (stage I-II) and control examination recommended after radical treatment

Improve diagnostics quality while reducing the radiation dose.

PET diagnostics allow to improve the following indicators:

- **5-6 times decrease in the number of cancer recurrences**
- **15-20 % increase in the number of detected cancer cases**
- **30-40 % quality improvement of cardiovascular disease diagnostics**
- **5-30% reduction in cancer mortality**

Socio-economic effect is identified starting from 1,7 PET scanner per 1 million people.

Radiopharmaceuticals for PET

Radionuclides - substances involved in metabolic processes and radiolabeled by short-lived and ultra short-lived isotopes.

Most common positron-emitting radionuclides

carbon-11 ($T_{1/2} = 20,4$ min.)

oxygen-15 ($T_{1/2} = 2,03$ min.)

nitrogen-13 ($T_{1/2} = 9,96$ min.)

fluorine-18 ($T_{1/2} = 109,8$ min.)

Cyclotron-produced

gallium-68 ($T_{1/2} = 68$ min.)

rubidium-82 ($T_{1/2} = 75$ sek.)

Generator-produced

A short half-life of radiopharmaceuticals for PET requires the location of the production facility close to diagnostics department.

Radiopharmaceuticals Production Unit for PET diagnostics needs



Cyclotron with target complex

- Target complex includes 2 gas targets for making of C-11 and 2 liquid targets for making F-18

Radiochemistry laboratory for radiopharmaceuticals production

- Lead safe boxes consist of 3 compartments: 2 are assigned for manufacturing F-18-FDG and C-11-methionine. The third compartment is assigned for pre-packaging purpose and equipped with semi-automatic packaging system, dose calibrator and rolling system.
- Synthesis module for manufacturing F-18-FDG: tubing technology (low productivity); cassette technology (high productivity). Synthesis module for manufacturing C-11-methionine

Laboratory of quality control of the radiopharmaceuticals

- **C12** a special-purpose cyclotron for producing 12 MeV proton beams. The cyclotron is intended to produce ultra short - lived radionuclides for production of radiopharmaceuticals for PET.
- **CC18/9** a cyclotron for producing 18 MeV proton beams and 9 MeV deuteron beams. The cyclotron is intended to effectively produce both ultra short-lived and short-lived radionuclides.
- **CC18/9M** a cyclotron for producing proton beams with an energy variable from 12 up to 18 MeV and deuteron beams with an energy variable from 6 up to 9MeV. The cyclotron is intended to effectively produce both ultra short-lived and short-lived radionuclides.

All types of cyclotrons and radiochemistry laboratory equipment are manufactured by SC "Rosatom" .



Configuration of Center of Nuclear Medicine

We would like you to consider our proposals to establish such medical infrastructure as:

Diagnostic facilities: 3 variants of units

- PET diagnostics department;
- SPECT diagnostics department;
- Complex radionuclide diagnostics solution, including cyclotron and radiochemistry facility, PET/CT, SPECT and SPECT/CT.

Therapeutic facilities

- Interstitial and endocavitary radiation therapy department equipped with «Agat-VT» brachytherapy system;
- Radionuclide therapy department (use of radiopharmaceuticals with iodine-131, samarium-153 and strontium-89).

Complex solutions for GMP radiopharmaceuticals (RF) production

- Cyclotron-based PET RF production;
- Reactor-based RF production.

Upon request we would be pleased to help you find an appropriate solution using our technical expertise and industry-specific knowledge.



NIEFA products: Cyclotron complex



We offer to set up a radiopharmaceuticals facility based on the medium energy from up to 30 MeV.

One of the possible configurations provides the country medical units with PET and SPECT and therapy radiopharmaceuticals with: ^{22}Na , ^{38}K , ^{57}Co , ^{67}Ga , ^{68}Ge , ^{73}Se , $^{75-77}\text{Br}$, ^{81}Rb (^{81}Kr), ^{111}In , ^{123}I , ^{201}Tl , ^{225}Ac , ^{18}F , ^{11}C , ^{15}O , ^{13}N .

The last four are assigned especially for PET pharmaceuticals.

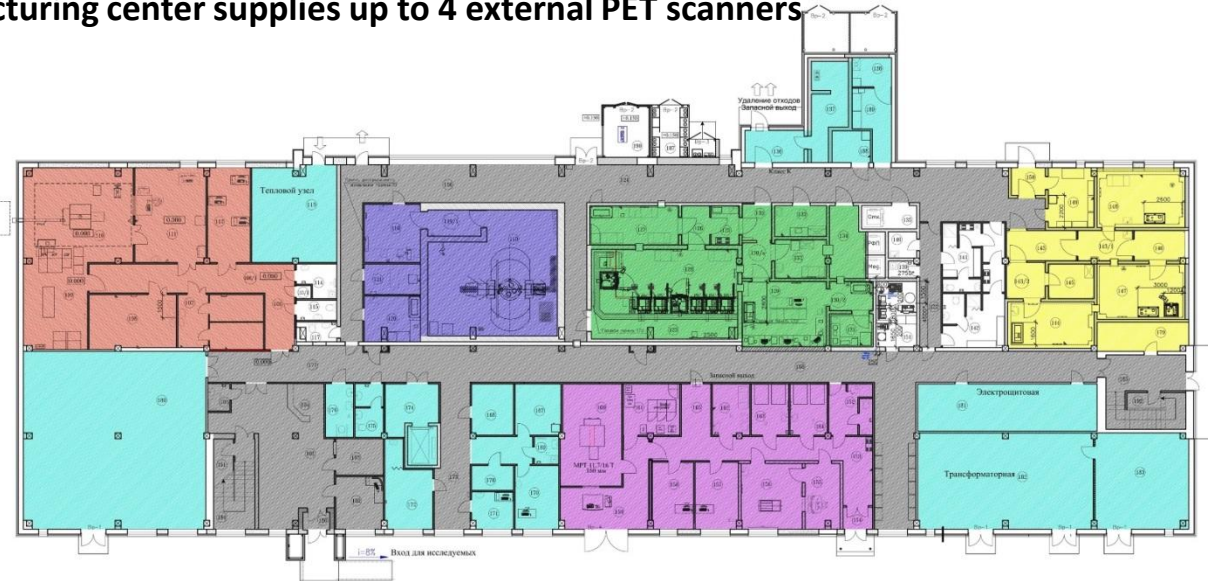
There are configurations on the base of other cyclotrons of less energy: CC18/9M and CC-12.

Model Radiopharmaceutical Manufacture on the base of 18MeV Cyclotron

Model radiopharmaceutical manufacturing center supplies up to 4 external PET scanners

The 1st Floor

- МРТ Зона
- Зона Циклотрон
- Зона синтеза РФН (Чистая зона)
- Зона исследований на лабораторных животных
- Зона свободного доступа
- Зона разработки генераторных систем
- Технические вспомогательные помещения



The 2nd Floor



- Зона ПЭТ/КТ
- Технические вспомогательные помещения
- Зона свободного доступа
- Офисные и лабораторные помещения
- Место под резервный ПЭТ/КТ

Nuclear medicine centers of the State Corporation “Rosatom” in Russian Federation

United Corporation for Innovation as a sectoral integrator and provider of end-to-end solutions on the base of competences, technologies and equipment of State Corporation “Rosatom” in Health Care. On the differing stages of the project cycle there are 3 objects of nuclear medicine.



- *High-tech Diagnostic Center, Moscow*
- *Atomic Medical Technologies – Snezhinsk of Chelyabinsk Region*

Основные параметры проектов портфеля ОИК

The sphere of activities: diagnostic and therapeutic services in nuclear medicine and radiation medical technologies.

Services and equipment: suppliers – the enterprises of the state Corporation “Rosatom”

The terms of realization: 2015-2020 гг.

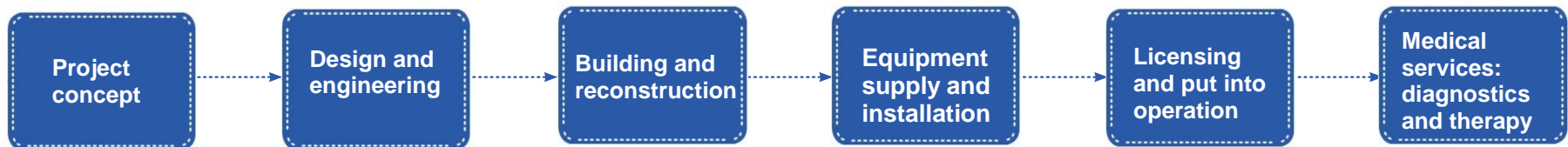
Current stage of the project realization

● Experimental-industrial radiopharmaceutical production. 4 Moscow diagnostic sites are supplied with radiopharmaceuticals for PET. Projecting of own PET department.

● Experimental-industrial radiopharmaceutical production. Reconstruction of the rooms of PET department.

Comprehensive proposal in medical center construction

Full service proposal by the project implementation



Roles of project participants



- Investments
- Project management
- Equipment supply
- Service and support
- Personnel training

- Medical center operation

- Engineering
- Scientific Supervision
- IT- solutions
- Innovation Introduction

Comprehensive proposal for the regional centers

На регион с численностью населения 2.5 млн. чел. комплексное решение предполагает:

- 1 циклотрон с энергией <20 МэВ
- до 4 систем ПЭТ

Комплексное решение включает в себя организационное сопровождение «под ключ»:

1. Обучение врачей и инженеров на существующих производственных площадках

2. Лицензирование площадок в рамках существующей лицензионной базы уже созданных производств

3. Расширение действия регистрационных удостоверений на радиофармпрепараты на создаваемые площадки

4. «Второе мнение» для медицинского персонала

New standard centers are projected in Vladivostok, Rostov-on-Don, Nizhniy Novgorod.

Comprehensive proposal will be provided with local or located equipment in 100%.

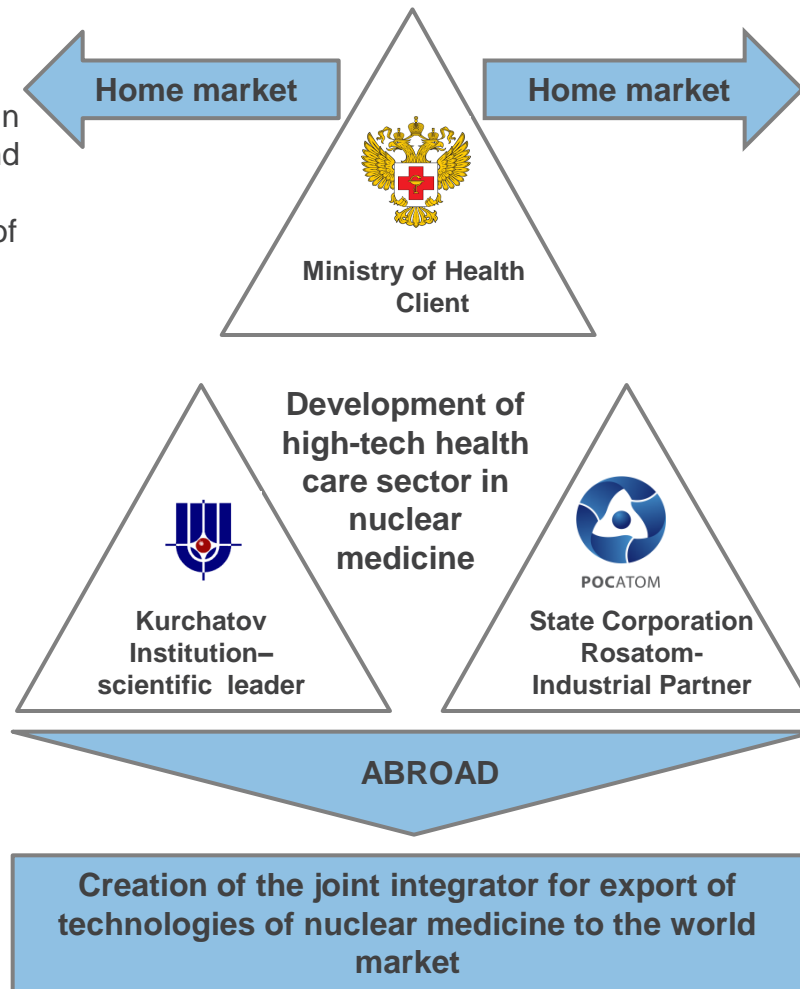
Тип оборудования	Отечественное производство	Производитель	Локализация	Потенциальные партнеры по локализации
Циклотроны с энергией до 18 МэВ	+	НИИЭФА им. Д.В. Ефремова	+	Iba
Модули синтеза	+	РОССИЙСКИЙ НАУЧНЫЙ ЦЕНТР РАДИОЛОГИИ И ХИРУРГИЧЕСКИХ ТЕХНОЛОГИЙ АО «НИИТФА»		
«Горячие» камеры	+	АМПЛИТУДА АО «НИИТФА»	+	TEMA SINEGIE
Оборудование контроля качества	+	АМПЛИТУДА	+	raytest
Дозиметрия и радиационный мониторинг	+	ДОЗА АТОМТЕХ		АО «НИИТФА»
ПЭТ для животных	+	НАЦИОНАЛЬНЫЙ ВОССТАВЛЕНЧЕСКИЙ ЦЕНТР «КОРЧАТОВСКИЙ ИНСТИТУТ»		
ПЭТ/КТ	+	АО «НИИТФА»	+	GE Healthcare SIEMENS PHILIPS
ОФЭКТ	+	НИИЭФА им. Д.В. Ефремова	+	АО «НИИТФА» SIEMENS PHILIPS



Alliance Rosatom and Kurchatov Institution for development of nuclear medicine and medical radiation technologies

Radiopharmaceutics:

- Providing with radiopharmaceuticals (FDG in particular) of PET centers and department
- R&D and state registration of newly developed diagnostic and therapeutic radiopharmaceuticals containing ^{131}I , ^{223}Ra , ^{90}Y and ^{177}Lu



In accordance to:

- “Governmental Program of Health Sector Development until 2020 of the Russian Federation” of 2012
- Road Map “Development of Nuclear Medical Centers” of 2015

Nuclear medical centers will be constructed all over the Russian Federation.

Engineering of the nuclear medical facilities, equipment supply, service, support and personnel training will be supplied.

Establishment of the radiopharmaceutical cluster in Moscow



ПРАВИТЕЛЬСТВО
МОСКВЫ

Cooperation between SRC “Kurchatov Institution” and “United Corporation for Innovations” LLC in establishment the radiopharmaceutical cluster in Moscow allows:

1

Launch of established scans and further PET departments by radiopharmaceuticals provision

2

Coordination and effective usage of present radiopharmaceutical infrastructure

3

Increase of PET examination number up to required level

4

Complex solutions for lunch and support of PET departments and centers operation

5

Enhancement of efficiency of the medical insurance system for the reimbursement of PET diagnostics

6

Reduction of the prices of PET diagnostics for patient

Moscow medical institutions, participants of the rcluster, will be provided with the radiopharmaceuticals for PET diagnostics.

