ON INTERNATIONAL COOPERATION IN NUCLEAR WEAPONS SAFETY

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RFNC-VNIIEF

Appendix II

Summary of RFNC-VNIIEF Joint Nuclear Safety Projects

The following descriptions and pictures offer a sample of the many international projects in which VNIIEF experts participated in the area of nuclear weapons safety.

Under a contract with the U.S. Department of Defense (DoD), a monograph was written on, 'The History of Soviet nuclear weapons," along with a book on, "Safety of nuclear weapons in Russia."

Commissioned by Lawrence Livermore National Laboratory, a system was developed for thermal vacuum desorption of water from samples of soil, vegetation, food, etc. for express analysis of tritium content in the environment. The device is protected by a RF patent (Principal Investigator D.V. Gorbenko).

The exterior view of the device for thermal vacuum desorption of water

Under a contract with the Sandia National Laboratories, we completed the project on "Evaluation of the nuclear terrorism aftereffects in a big city." The paper presents computational and theoretical evaluation of radioactive contamination after the explosion of a radiological dispersion device, and the employment of the dust suppression and surface decontamination technology applied in facilities, on roads, in parks, etc. (Principal Investigators Ye.A. Kushnir and V. Shcherbakov).

Dust suppression

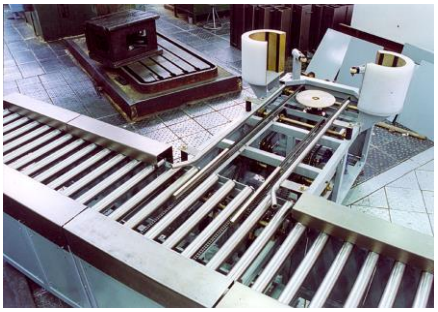
Pressure suit "Violinist"

Device for determining the area plutonium contamination

Under the contract with the Los Alamos National Laboratory (2002-2008) we designed and manufactured a prototype for a mobile automated facility for air purification from radioactive and chemical toxic pollution – MAUGOS. The unit is designed for radiological and chemical disaster recovery in confined spaces. The invention is protected by a RF patent (Principal Investigator A.A. Poklonsky). For the Los Alamos National Laboratory, we also developed technology to decontaminate construction materials (concrete, marble, and granite) in case of radiological dispersion caused by terrorists (Principal Investigator V. M. Shcherbakov).

VNIIEF employees contracted with Sandia National Laboratories to create a “Training system for safe radioactive materials and explosives handling,” and to investigate “Markers of third parties development and testing of nuclear weapons.”

Under the contract with the U.S. company Bechtel, VNIIEF developed technology for handling fissile materials recovered from nuclear weapon dismantlement in the long-term storage facility. Based on the VNIIEF-developed technology, a long-term storage facility for fissile materials was designed. All structures and systems for safe and reliable long-term storage were built and put into operation.



Fissile Materials Storage Facility conveyor line

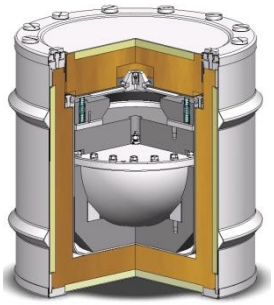
Moreover, VNIIEF designed, manufactured, installed and commissioned the following key elements of technological equipment for the fissile materials storage facility (Principal Investigator N. Ya. Sysoev):

- Series of conveyor lines for an automated movement of containers with fissile materials to the storage facility;
- Fissile materials accounting and control system;
- System for radiation passportization of fissile materials inside the containers;
- Detection system for alien enclosures inside the containers;
- System of local automated equipment control;
- Pedestrian and vehicle radiation portals.

RF-US negotiations on the RFMSF Design Project, Moscow, Bechtel, 1998

A VNIIEF-designed AT-400R container (Sandia, USA) was manufactured for the storage facility. In 1996, a batch of containers (about 28,000 units) was delivered to Russia to outfit the fissile materials storage facility (RFMSF).

In 1994, VNIIEF developed an AT-400 container in compliance with IAEA requirements. This design and its further modifications allowed us to proceed and design packaging for the entire range of devices developed by VNIIEF and VNIITF. Serial enterprises produced several thousand containers for fissile materials transportation and storage at Rosatom installations.



AT-400 Container

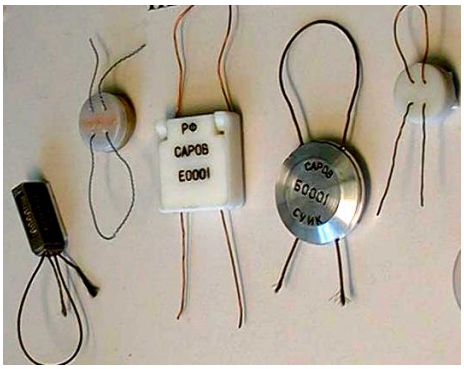
As part of the international investigation of the site of the “Komsomolets” submarine, which caught fire and sank in 1989 in the Barents Sea with nuclear reactor and nuclear warheads on board, VNIIEF analyzed the processes of corrosion decay in seawater that affected both fissile materials and structural materials of nuclear devices. Various sorbents for confining silos with nuclear warheads were also under study in order to prevent the release of fissile materials.

During 1995 – 2008, the following projects were completed:

–"Risk assessment for hazardous production facilities" (Principal Investigator N.A. Bilyk.);

–"Development of a smart container for radioactive and fissile materials storage and transportation" (Principal Investigator B.P. Barkanov);

–"Development of access indication devices and sealing devices" (Principal Investigator A.A. Poklonsky). The project resulted in creating various kinds of seals: padlock seals as an alternative to aluminum and lead seals, intelligent padlock seals operating in the radio frequency identification system, and power seals (powered locking elements.) These designs were protected by 12 Russian Federation patents.

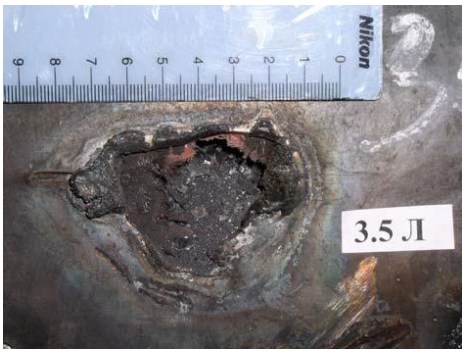


Padlock seals

Power seals

–"Designing an intrusion-resistant sheet protecting against unauthorized forced entry" (Principal Investigator M. P. Kuzhel). The protective sheet provides resistance against a simultaneous impact of various intrusive factors: mechanical (including bullet shots), thermal, chemical, and their combination. It is used to protect vehicles (motor- and special rail cars), storage facilities, safes, etc. The design is protected by a RF patent.

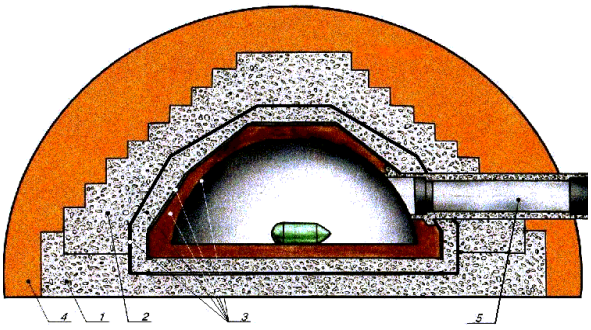
Plate structure

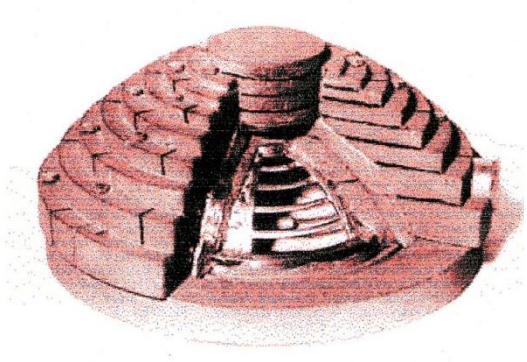


The plate impacted by electric arc cutter, angle grinder, autogenous cutter (an oxygen torch), drilling tool, milling tool and small-arms bullets

- "Development and production of a prototype rotary centrifugal separator for fine purification of gases from radioactive and chemically active aerosols" (in cooperation with Central Aerohydrodynamical Institute) (Principal Investigator D.V. Gorbenko). The separator is capable of isolating submicron particles of 0.5 ... 1.0 μm in the gas flow at a flow rate of 0.5 m^3/s. The invention is protected by a RF patent.

–"Development of a mobile rapidly deployable device to confine the explosion debris at eco-dangerous facilities" (Principal Investigator G.P. Motorikin). The project was implemented jointly with other VNIIEF departments. The device ensures confinement and containment of the explosion products for up to 100 kg of TNT equivalent. It is designed for containment, temporary storage and the charge deactivation operations with damaged nuclear warheads. Structurally, the securing device is implemented in the shape of a hemisphere, built up of individual blocks that can be delivered to an accident site by any mode of transportation. It is protected by 4 Russian Federation patents.

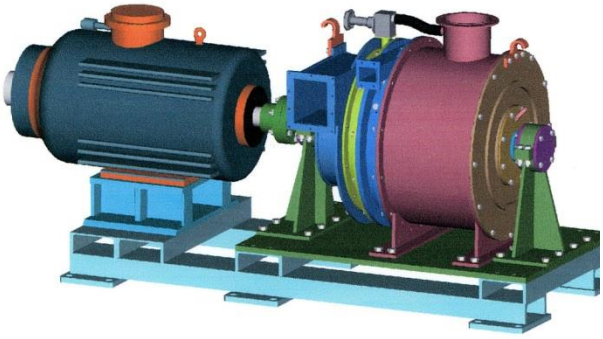




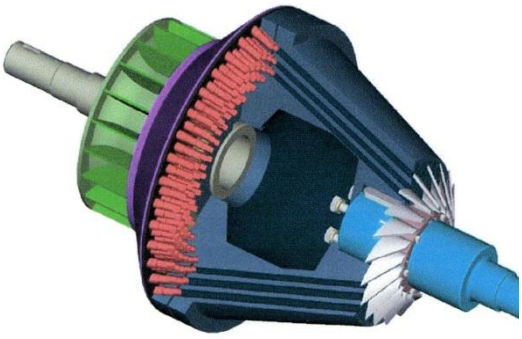
1 – foundation, 2 – sarcophagus 3 – sealing protective chamber, 4 – dirt filling, 5 – escape hatch

–“Design development of an air purification system to clean confined spaces from radioactive and chemical aerosols and gases in case of accidents”. The project was a joint effort with other VNIIEF departments. The prototype was fabricated under a Los Alamos National Laboratory contract (Principal Investigator A.A. Poklonsky). The system is comprised of vehicles, automated control subsystem, shut-off and pumping gas ducts, gas purification units to eliminate aerosols and toxic substances. It is equipped with a ventilation unit, valves and sensors of control instrumentation. The invention is protected by a RF patent.

– “Development of technology for production and use of radionuclide sorbents derived from technogenic tailings of the apatite-nepheline ore enrichment” (Principal Investigator V. M. Shcherbakov). The sorption capacity of radioactive tailings in relation to the solutions of cesium-137, strontium-90 and cobalt-60 was computationally and theoretically determined and experimentally verified. A system for liquid radioactive waste remediation was designed. The project was implemented in cooperation with the Institute of Chemistry and Technology of Rare Elements and Mineral Raw Materials at Kola Scientific Center, Russian Academy of Sciences (city of Apatity).

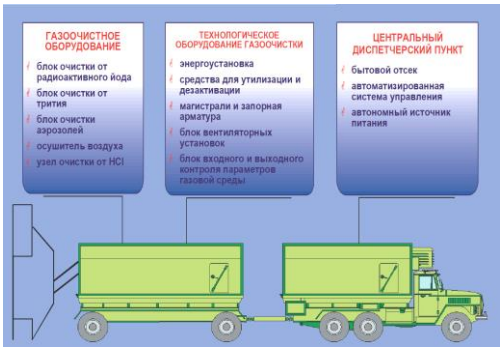


General view of separator

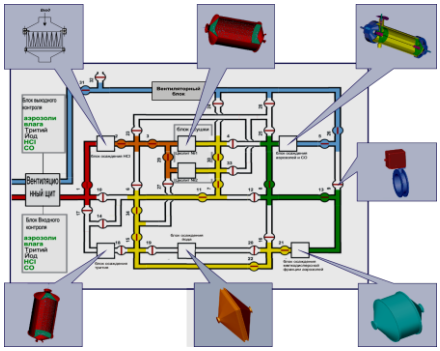


Separator rotor

– “Developing methods and means of passive sampling for tritium and tritium oxide environmental monitoring” (Principal Investigator R.M. Tagirov).



Facility configuration



Pneumatic circuit

The developed passive sampling (air and water) devices to monitor tritium and tritium oxide are easy to operate and enable parallel sampling at multiple locations, at a large distance from the emission point. They do not require power supply. The design is protected by three invention patents of the Russian Federation.

Sampling units

- "Development of a method and repair systems to restore the functionality for accident-prone areas in operating long-distance pipelines without operation shutdown" ((Principal Investigator Yu.I. Sladkov).

In to these contractual activities conducted under WSSX and other agreements, a series of workshops and conferences were held at VNIIEF, Los Alamos, Livermore, and in Albuquerque, Amarillo, Washington D.C., and Vienna on topics such as the following:

- Hazardous materials;
- Nuclear post-accident clean-ups;
- Nuclear weapons disassembly safety;
- Firefighting measures in the proximity of nuclear facilities;
- Response measures for terrorist acts.

Participants of the Russian-American workshop on the post-accident cleanup

Participants of the Russian-American workshop for firefighters protecting nuclear facilities

VNIIEF specialists at international conferences