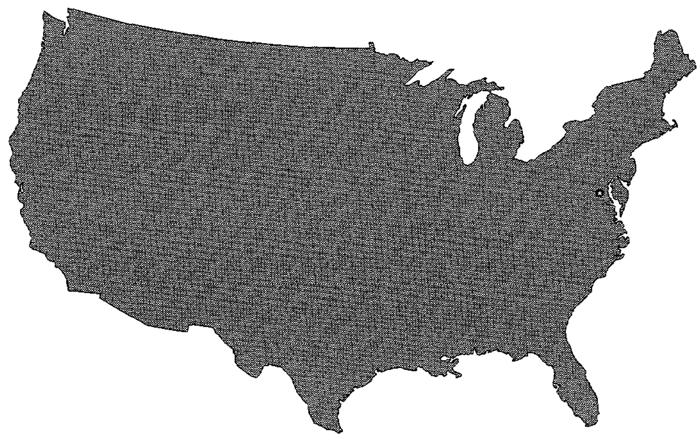
DOE/EM-0328

UNITED STATES - RUSSIA

Environmental Management Activities

Spring 1997



MASTER

A U.S. Department of Energy Cooperative Program with the Russian Federation

United States - Russia

Environmental Management Activities

Table of Contents

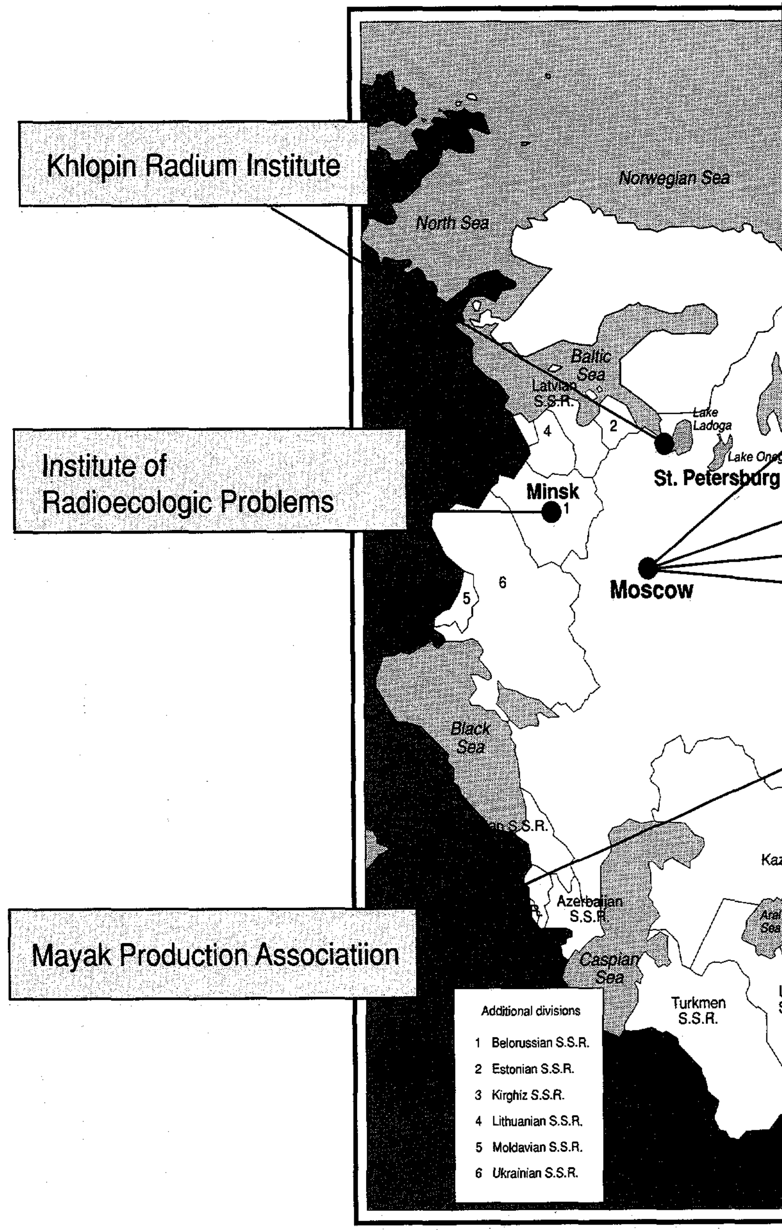
Introduction

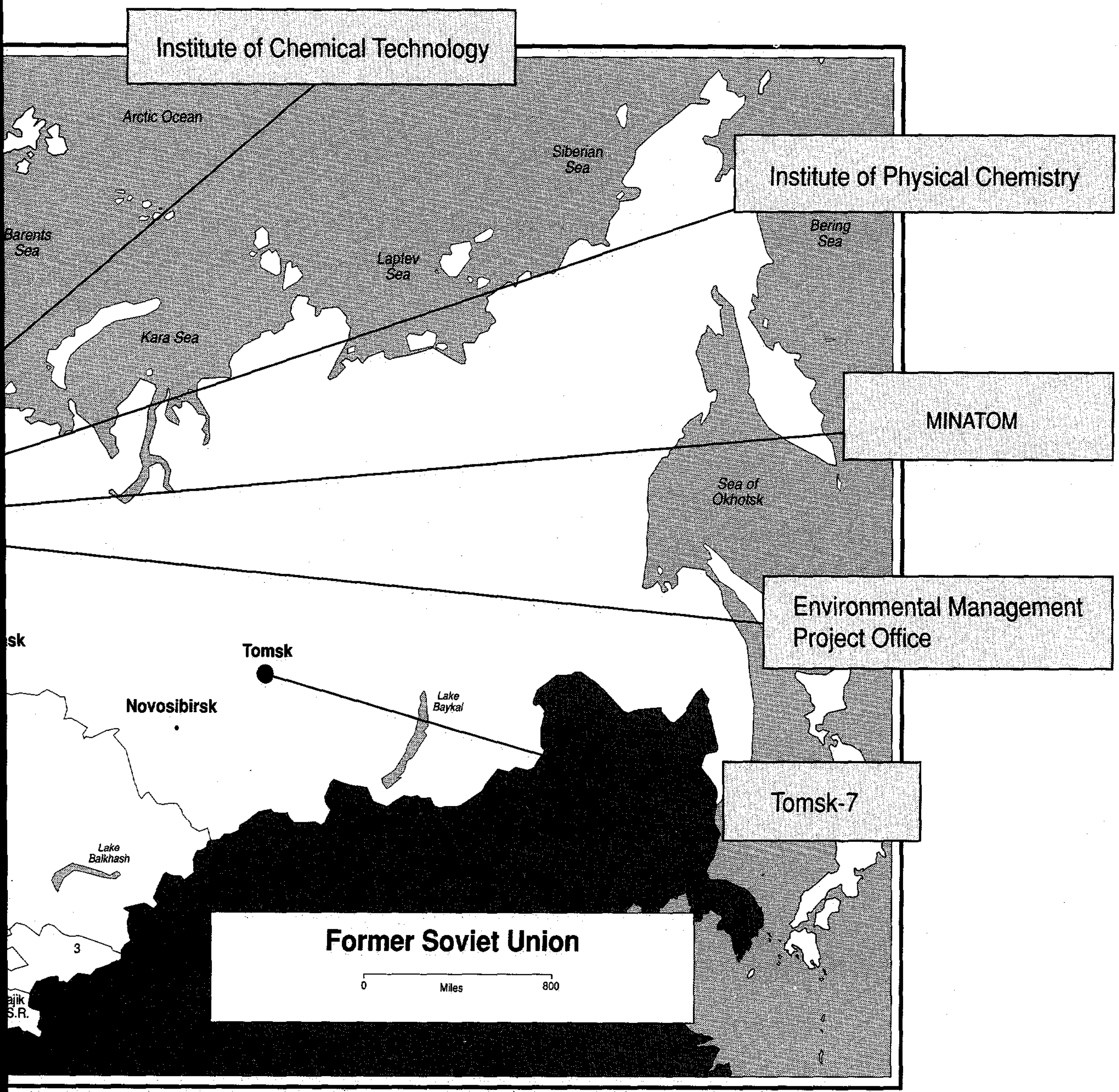
The Office of Environmental Management (EM) has been delegated the responsibility for the Department of Energy's (DOE's) cleanup of the nuclear weapons complex. The nature and magnitude of the waste management and environmental remediation problem requires the identification of technologies and scientific expertise from domestic and foreign sources.

Within the United States, operational DOE facilities, as well as the decontamination and decommissioning of inactive facilities, have produced significant amounts of radioactive, hazardous, and mixed wastes. In order to ensure worker safety and the protection of the public, DOE must: 1) assess, remediate, and monitor sites and facilities; 2) store, treat, and dispose of wastes from past and current operations; and 3) develop and implement innovative technologies for environmental restoration and waste management.

Goals of U.S. Investment in EM Activities

The investment made by the U.S. in environmental restoration and waste management activities must serve a dual purpose. Taxpayer dollars are spent primarily to cleanup sites, but they must also assist in strengthening the national economy, particularly the environmental industry. A stronger domestic environmental services and products industry will improve U.S. competitiveness in international markets and enhance domestic technology development and application.




Institute of Chemical Technology
Institute of Physical Chemistry
MINATOM
Environmental Management Project Office
Tomsk-7
Arctic Ocean
Barents Sea
Kara Sea
Laptev Sea
Siberian Sea
Bering Sea
Sea of Okhotsk
Tomsk
Novosibirsk
Lake Baykal
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EM Mission

The EM mission is to: 1) treat, store, and dispose of hazardous, radioactive, and mixed waste in an environmentally sound and effective manner; 2) bring all DOE facilities and sites into compliance and operate them in accordance with applicable laws and regulations aimed at protecting public health and the environment; and 3) develop and implement innovative, cost-effective technologies to facilitate compliance with applicable laws, regulations, and agreements and to minimize the generation of waste. EM supports DOE's research and development goals through its waste management and compliance activities, and through its Office of Science and Technology's campaign for applied research and development to resolve major technical issues. EM is also responsible for decontamination and decommissioning of surplus facilities. The focus of EM's mission is to ensure that potential risks to human health and safety and to the environment will be either eliminated or reduced to prescribed, safe levels through cleanup of the existing inventory of inactive sites and facilities.

The EM directive necessitates looking beyond domestic capabilities to technological solutions found outside U.S. borders. Following the collapse of the Soviet regime, formerly restricted elite Soviet scientific expertise became available to the West. EM has established a cooperative technology development program with Russian scientific institutes that meets domestic cleanup objectives by: 1) identifying and accessing Russian EM-related technologies, thereby leveraging investments and providing cost-savings; 2) improving access to technical information, scientific expertise, and technologies applicable to EM needs; and 3) increasing U.S. private sector opportunities in Russia in EM-related areas.

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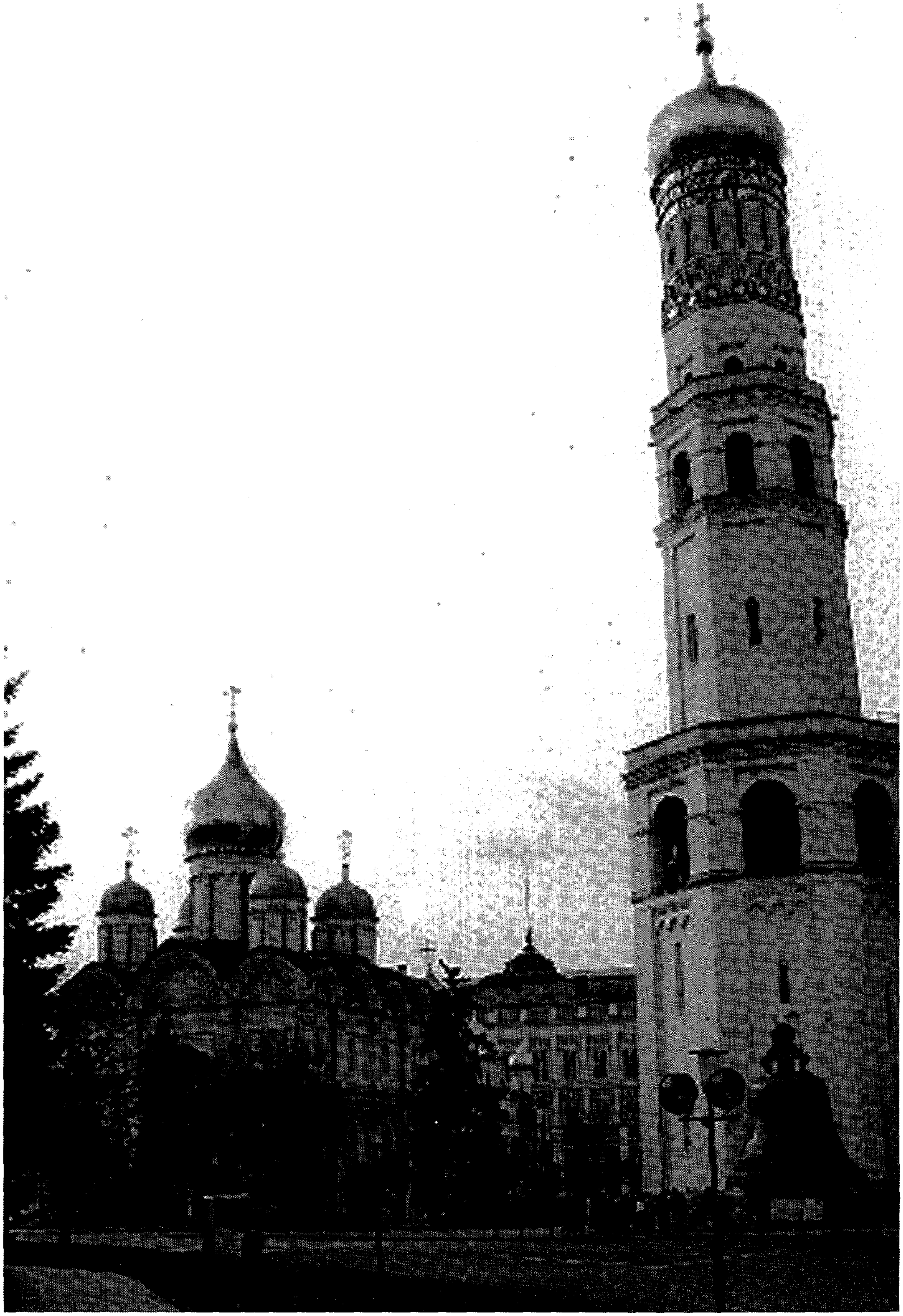

Environmental Situation

General Problems

During the 1990s, the U.S. and Russia have begun to come to terms with the environmental legacy and by-products resulting from the arms race. Among the many dangers posed by current conditions and results of past practices are leaking or deteriorating containment vessels, seepage of radioactive or chemical wastes into ground water, contamination of rivers and lakes, transport of airborne contaminants, soil contamination, identification and separation of collectively stored wastes, handling and treatment of those wastes, and the permanent storage of those wastes. All of these issues demand attention and illustrate the need to redirect resources from weapons production to environmental restoration and waste management efforts.

Comparison of the DOE and Russian Complexes

DOE has approximately 4,000 contaminated sites covering tens of thousands of acres (approximately 3,300 square miles) replete with hazardous or radioactive waste, soil, or structures. Currently, EM is managing roughly 375,000 cubic meters of transuranic waste and at least 15,640,000 cubic meters of low-level radioactive waste. In addition, DOE is responsible for thousands of facilities (over 7,000 contaminated buildings) awaiting decontamination, decommissioning, and dismantling. Consequently, EM faces major technical, planning, and institutional challenges in meeting its expanded environmental responsibilities while controlling cost growth.

Like DOE, Russia also operates a vast radioactive waste complex. Accidents at reprocessing sites and discharge of radioactive waste into the environment have caused significant environmental damage. Increased public concern by Russian citizens and international scrutiny have resulted in environmental restoration and waste management issues receiving greater emphasis and attention. In both countries, determining exact volumes of waste is problemmatic as record-keeping of waste generation was not a high priority during the Cold War build-up.

The maps on page 2 and 3 provide some information on the locations of former weapons design laboratories, test sites, weapons production facilities, production reactor and reprocessing sites, and uranium enrichment. The geographic, geologic, climatic and other differences between these sites, along with the various chemicals, substances and other materials used at each facility, suggest some of the obstacles needed to be overcome in order to more accurately determine waste stream information and to take appropriate corrective action.

Comparison of Hanford and Chelyabinsk sites

At the Hanford Site in Richland, Washington, there are 177 metal tanks containing waste generated from plutonium separation processes. These tanks hold 410,000 metric tons of stored HLW that must be deactivated, decontaminated, decommissioned, and dismantled. DOE has made progress toward the resolution of safety issues associated with high-level waste storage, but uncertainties remain regarding new tank construction and design.

Within the borders of Russia, one example of a highly contaminated region is the formerly secret site Chelyabinsk-65. Chelyabinsk is managed by the Mayak Production Association and is Russia's first weapons materials production site. Chelyabinsk-65 suffered a devastating accident in 1957, when a high-level liquid waste tank experienced a failure in its cooling mechanism and exploded.

The resulting fire spread nitrates and acetates throughout the region to the extent that extreme health risks remain today. This unfortunate accident provides a rich source of data and information that can be used to verify EM contaminant transport models, develop risk-based standards, and evaluate health effects.

Dr. V Silin, Prof. V.F. Peretrukhun, and Mr. V. Perminov (L to R) of the Institute of Physical Chemistry, Russian Academy of Sciences, with Cal Delegard (farthest right) and the Liquid Scintillation Counter purchased for the IPC/RAS by the ESP technical liason task in 1996. The instrument permits more sensitive measurement of alpha and beta radioactivity to be made.

Hanford and Chelyabinsk-65 are similar in that they share historical missions, site contamination, experience in the transition from weapons production to environmental restoration, and a new emphasis on worker retraining. These similarities have created interest in establishing cooperative programs that work towards resolving the environmental problems both countries face. It must be stressed that the best solution to environmental contamination from the weapons complexes in both countries involves working together and sharing technologies. Russia is unique in that past practices offer an unprecedented opportunity to learn certain aspects of contaminant migration and conduct integrated technology demonstrations, to the mutual benefit of both countries. This, in fact, is the intent of the work being done by DOE and organizations within Russia.

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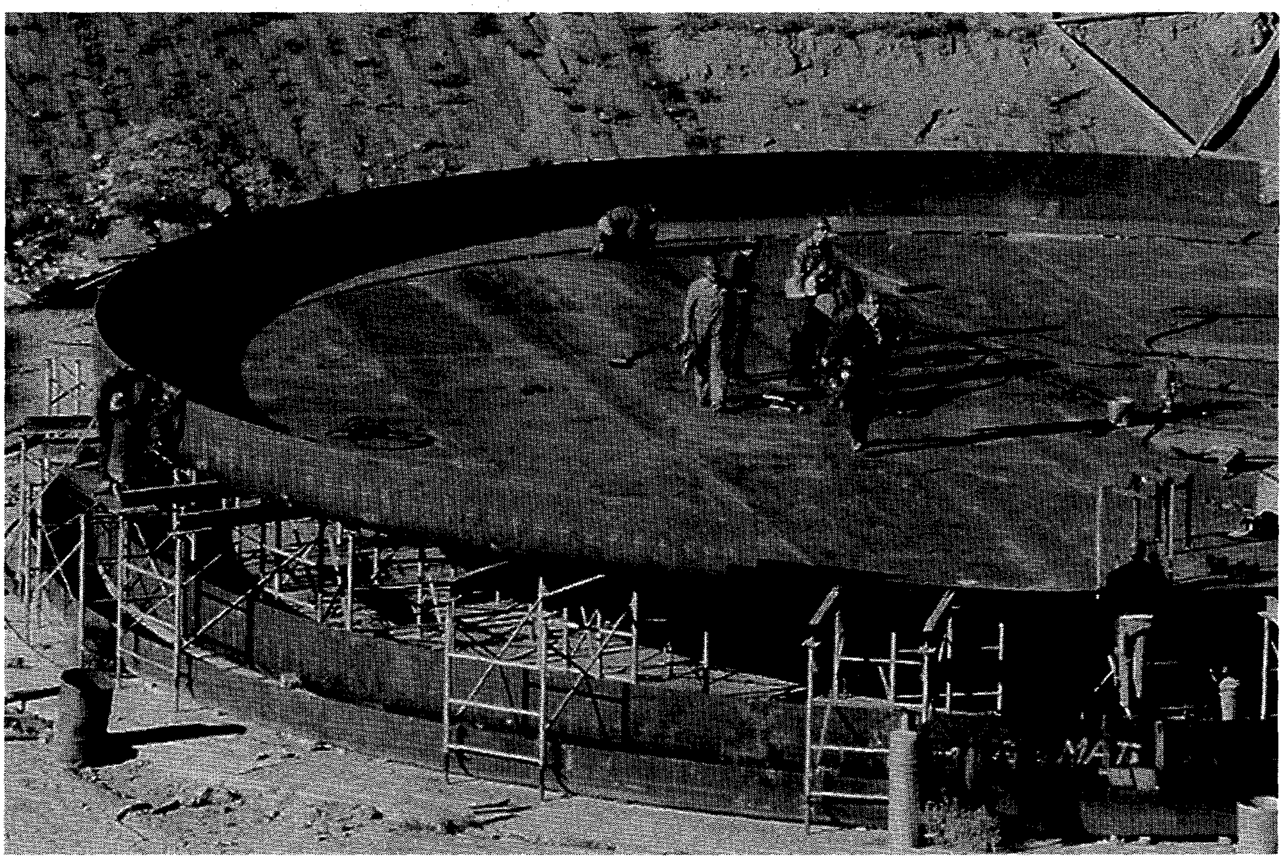


High level liquid radioactive waste is being transferred to new double-shell tanks at the Hanford Site.

MOC and the JCC for Environmental Restoration and Waste Management

The Peaceful Uses of Atomic Energy (PUAE) Agreement signed by the U.S. and Russian governments provides a mechanism for cooperation in research, development, and safe utilization of nuclear energy. The agreement's primary objective is to develop new, safe, and environmentally sound energy sources. Under the umbrella of the PUAE Agreement, DOE and the Ministry of Atomic Energy for the Russian Federation (MINATOM) signed a Memorandum of Cooperation (MOC) in the areas of Environmental Restoration and Waste Management in September 1990. The MOC provides the mechanism for conducting joint technology development activities in environmental restoration and waste management. Both DOE and Russia have been engaged in aggressive technology development programs over the past several decades.

The current MOC identifies five areas for cooperation:

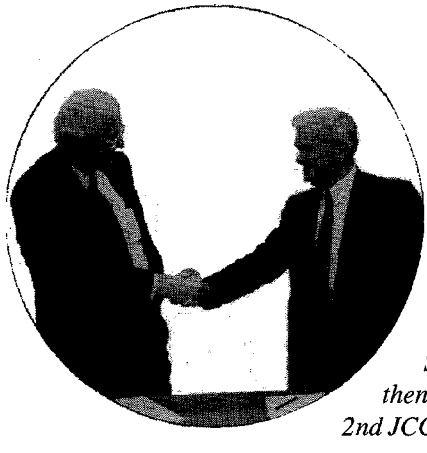
1. Development of policy and practices regarding environmental restoration and waste management,
2. evaluation of problems related to environmental remediation, decontamination and decommissioning of facilities and materials contaminated by radioactive and other hazardous waste,
3. research and development directed at improving the effectiveness, economics, safety and public acceptability of methods of handling, storing, and permanently disposing of radioactive and associated hazardous waste,
4. analyses and investigations related to waste partitioning to facilitate permanent disposal, and
5. analyses and investigations related to geologic disposal of radioactive wastes.

The Joint Coordinating Committee for Environmental Restoration and Waste Management (JCCEM) was established as the managing body for the MOC. JCCEM responsibilities include review of progress and plans for activities conducted under the MOC, approval of JCCEM actions and proposals, coordination and approval of future cooperative activities with respect to technical merit and level of effort, improved access to technical information and commercial opportunities in Russia, support of the selection of cost-saving technologies, and ensured continued dialogue and cooperation in EM-related areas.

The 1st JCCEM meeting was held in Russia in November 1990. A detailed plan was devel-

Fiscal Year 1996 Technical Focus

Areas of cooperation
- Separation Technologies
- Contaminant Transport and Site Characterization
- Mixed Waste
- High-Level Waste Tank Remediation
- Decontamination and Decommissioning
- Scientist Exchanges



Clyde Frank, Deputy Assistant Secretary, DOE, and Eugeniy Mikerin, then Deputy Minister, MINATOM, at the 2nd JCCEM meeting in Moscow.

oped for the implementation of a series of technical exchange workshops in three areas: vitrification, separations, and contaminant transport. A provision for the exchange of students and senior scientists was provided for in the implementation plan. Initial efforts were focused on identifying available technologies and increasing understanding of the Russian government's structure, roles, and responsibilities.

The 2nd JCCEM meeting was held in Moscow in November 1992. It resulted in the first contracts with Russian institutes for cooperative technology development. These contracts: 1) established a scope of work for cooperative projects in separations chemistry; 2) initiated contaminant transport activities at the Mayak Production Association; and 3) ensured that intellectual property rights were protected under the PUAE Agreement.

The 3rd JCCEM meeting was held in Washington, D.C. in September 1993. The purpose of this meeting was to review the progress of activities conducted during 1992 and to determine the scope of cooperation for the following year. Areas of cooperation were expanded to include radiochemical processing safety and geologic repositories.

The 4th JCCEM meeting was held in Moscow in September 1994. The purpose of the meeting was to discuss the progress of projects conducted under the MOC for 1994 and to determine the scope of the 1995 program. It was decided that in addition to continuing and expanding cooperative programs, EM would establish an Environmental Management Project Office in Moscow to coordinate the activities of this growing program.

The 5th JCCEM meeting was convened in Berlin, Germany during the first week of September 1995. This JCCEM meeting was held in conjunction with the Fifth International Conference on Radioactive Waste Management and Environmental Remediation, sponsored by The American Society of Mechanical Engineers. At this meeting, the MOC was reviewed for renewal for an additional five years. It was agreed that the Radiochemical Processing Safety work would be completed and that Decontamination and Decommissioning (D&D) would be added as a new area of cooperation.

The 6th JCCEM meeting was held in Phoenix, Arizona on April 30-May 1, 1996. Dr. Clyde Frank, the lead for the U.S. delegation, introduced Dr. Al Alm to the committee as the future Assistant Secretary of the Office of Environmental Management. The purpose of this meeting was to discuss the progress of projects conducted under the MOC for 1996 and to determine the scope of the 1997 program. Areas of cooperation were expanded to include Risk Assessment, Transuranic Stabilization, Solidification Experiences, Spectral Tables and Russian Internet Home Pages.

The 7th JCCEM meeting will be held in St. Petersburg, Russia in the Spring of 1997.

Benefits of Cooperation

DOE Objectives

- Identify and access Russian technologies that accelerate the U.S. cleanup mission, thereby leveraging U.S. investment and providing cost savings
- Improve access to technical information, scientific expertise and technologies that are applicable to U.S./Russian needs
- Increase private sector opportunities in the area of environmental restoration and waste management

During the past several years, DOE has capitalized on the opportunity to benefit from developments in Russian technology that augment and complement its own technology development program. At the same time, Russia benefits from a cooperative technology development program by acquiring desperately needed resources from the identification, adaptation, and commercialization of EM-related technologies. Following economic stabilization of Russia, the U.S. private sector looks to benefit from Russian environmental restoration efforts. All of these activities advance U.S. government policy objectives by promoting political and economic stability in Russia, accelerating defense conversion; halting the "brain drain" from Russia, and increasing private sector opportunities in the U.S./Russia in the areas of environmental restoration and waste management.

Russian Science Stabilization

The end of the Cold War and ensuing financial collapse of the U.S.S.R. left Russia critically lacking in funds necessary for the research and development of new technologies to address environmental cleanup requirements. Russian scientists, struggling with hyper-inflation and salary cuts, found themselves to be highly marketable abroad. Although DOE is not funding the development of Russian infrastructure, it can assist in curtailing the exodus of scientists by using and employing their knowledge on cooperative projects conducted in Russia. By contracting with Russian scientists, the U.S. will benefit financially from a highly leveraged labor force, and Russia will benefit politically and fiscally.

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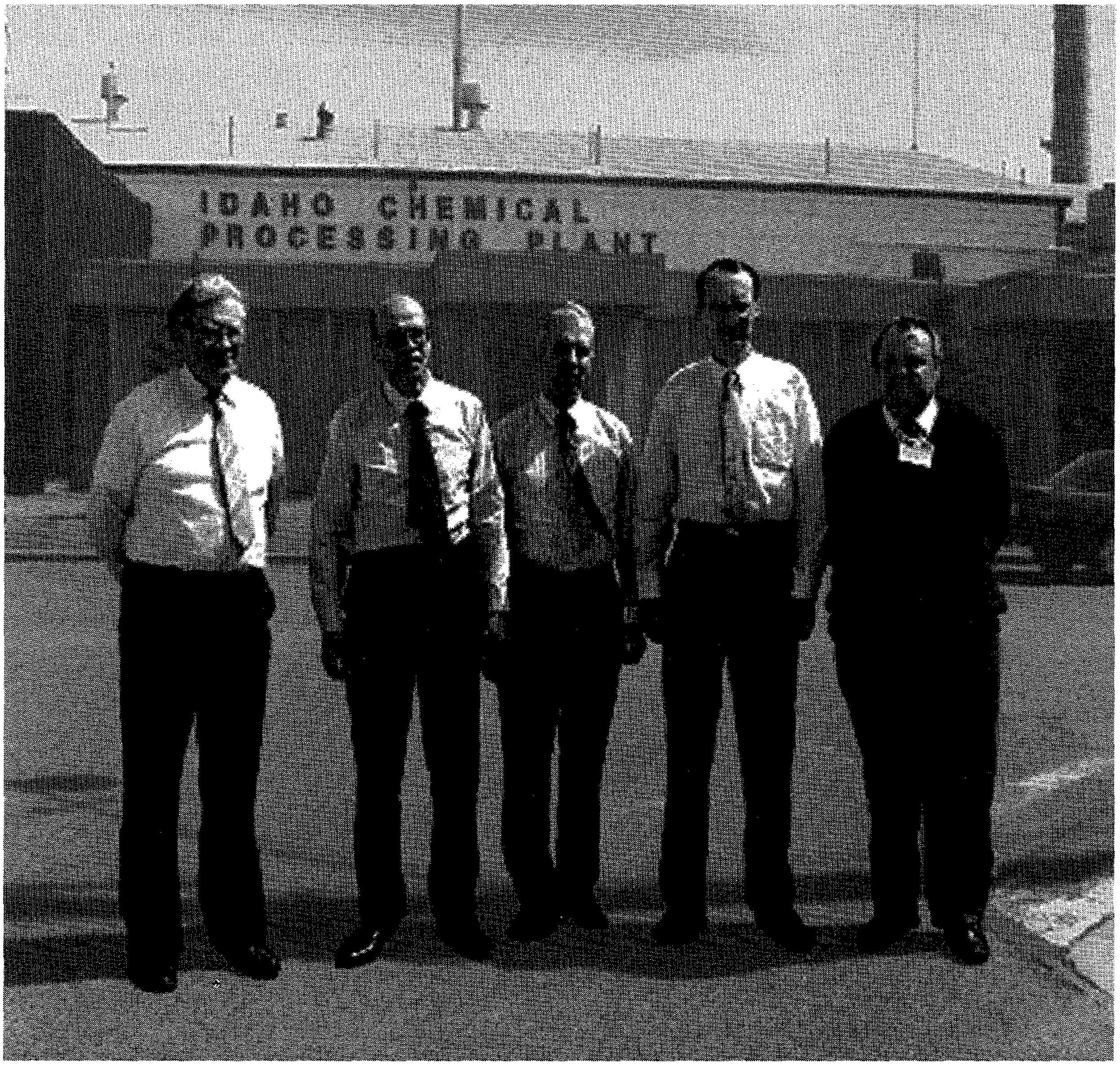

Scientists from the Khlopin Radium Institute participate in Cobalt Dicarbollide experiments at the Idaho National Engineering Laboratory (INEL). They are (L to R) Leonard Lazarev, Vyatcheslav Esimantovskiy, Valeriy Romanovskiy, Igor Smirnov, and Boris Zaitsev.

Science and Technology Process

Technology Development Projects

DOE has implemented a technology evaluation and demonstration process to identify and access technology development efforts at key Russian institutes that are applicable to EM needs. This process allows the U.S. to evaluate the qualifications and credentials of key Russian scientists, as well as the potential interest in and likelihood of success of cooperative technology development programs at relatively low risk.

The phased technology development process ensures that the technology is applicable to EM efforts and allows additional project investment when progress is confirmed. The technology development program guarantees a cautious approach to investing in Russia and assists in the development of business, legal, and contractual relationships with Russian institutes, while leveraging U.S. labor investment at a ratio of 30:1. All technology development projects conducted in Russia must assist in the DOE domestic cleanup mission. Several different contractual arrangements were evaluated to demonstrate that subcontracts with Russian organizations can be established and managed in full compliance with both U.S. Government procurement practices, as well as the laws of the Russian Federation. DOE's mechanism for working with Russia is designed to be conducted under the same contract procedures as it would with a U.S. company. This contract mechanism ensures fiscal accountability and provides an audit trail.

Consistent with DOE's focus on fiscal accountability, all money sent to Russian institutes in the form of contracts is transferred via wire transfer through the DOE Office of Accounting. The primary benefit of this mechanism is that there is no overhead charge or cost to the sending agency. This mechanism provides a 30-45% cost savings to DOE by eliminating laboratory or private company overhead costs. Russian scientists are paid based on the submission of monthly progress reports and other deliverables.

CASE STUDY: Khlopin Radium Institute

As the first significant technology development project between DOE and MINATOM, the project with the Khlopin Radium Institute (KRI) on its Cobalt Dicarbollide-based technology, has served as the prototype to develop and refine the process for other technology development projects. The first phase of the project was begun in August 1992 to establish the integrity of contract mechanisms and technical approach used by KRI.

Based on the success of this pilot project, further agreements were reached under the MOC and project definition and contract negotiations were completed. Following a U.S. commitment to provide for the protection of intellectual property rights of both parties, agreements were reached and a series of scientist exchanges and major workshops were conducted to trade experience and knowledge, and support contract discussions.

For the past three years, KRI has been under contract to EM to perform an Experimental Research Program on the Applicability of Russian Separations Technology to Processing of U.S. Defense high-level waste (HLW). Following successful testing of the dicarbollide technology on simulated Idaho waste at the KRI research facilities in Gatchina, near Saint Petersburg, a series of experiments have been conducted at INEL on real Idaho HLW and with the participation of the Russian scientists. Current tasking includes the development of diluents which are more acceptable to U.S. requirements and the development of improved flowsheets for application to INEL requirements.

Intellectual Property Rights Protection

Since the KRI project was the first to involve intellectual property rights (IPR) concerns, a significant effort was undertaken to include protection of IPR and proprietary data rights within contractual documents. Prior to entering into contracts with Russian institutes, DOE had to resolve the issue of IPR protection. At a time when political and legal uncertainties overshadow Russia, it was vital that both countries assure each other of their commitment to mutual professionalism, respect, and advocacy of the principle of the rule of law. DOE used standard U.S. government "flowdown" of IPR protection language. When negotiating a contract with KRI, two of the key areas addressed were limited technical data rights and issues dealing with pre-existing data. Limited technical data rights, pre-existing data, or knowledge (i.e. any pre-existing knowledge held by the Russians prior to entry into contract) can only be used by DOE in terms of evaluating the project being conducted under contract. New data or knowledge generated under the contract can be used by both sides. The U.S. and Russia have unlimited rights under these circumstances. If the U.S. desires to use new data for purposes outside the scope of the contract, then the U.S. must enter into a licensing agreement with the Russian party. Furthermore, DOE has filed two U.S. patents on behalf of Russian Institutes to further ensure the protection of these technologies. Work continues on streamlining and institutionalizing the IPR protection and patent application process for JCCEM projects.

Key Concepts

- Program directly supports EM mission and priorities
- Most highly leveraged program in EM
- Meet/leads Administration objectives with Russia

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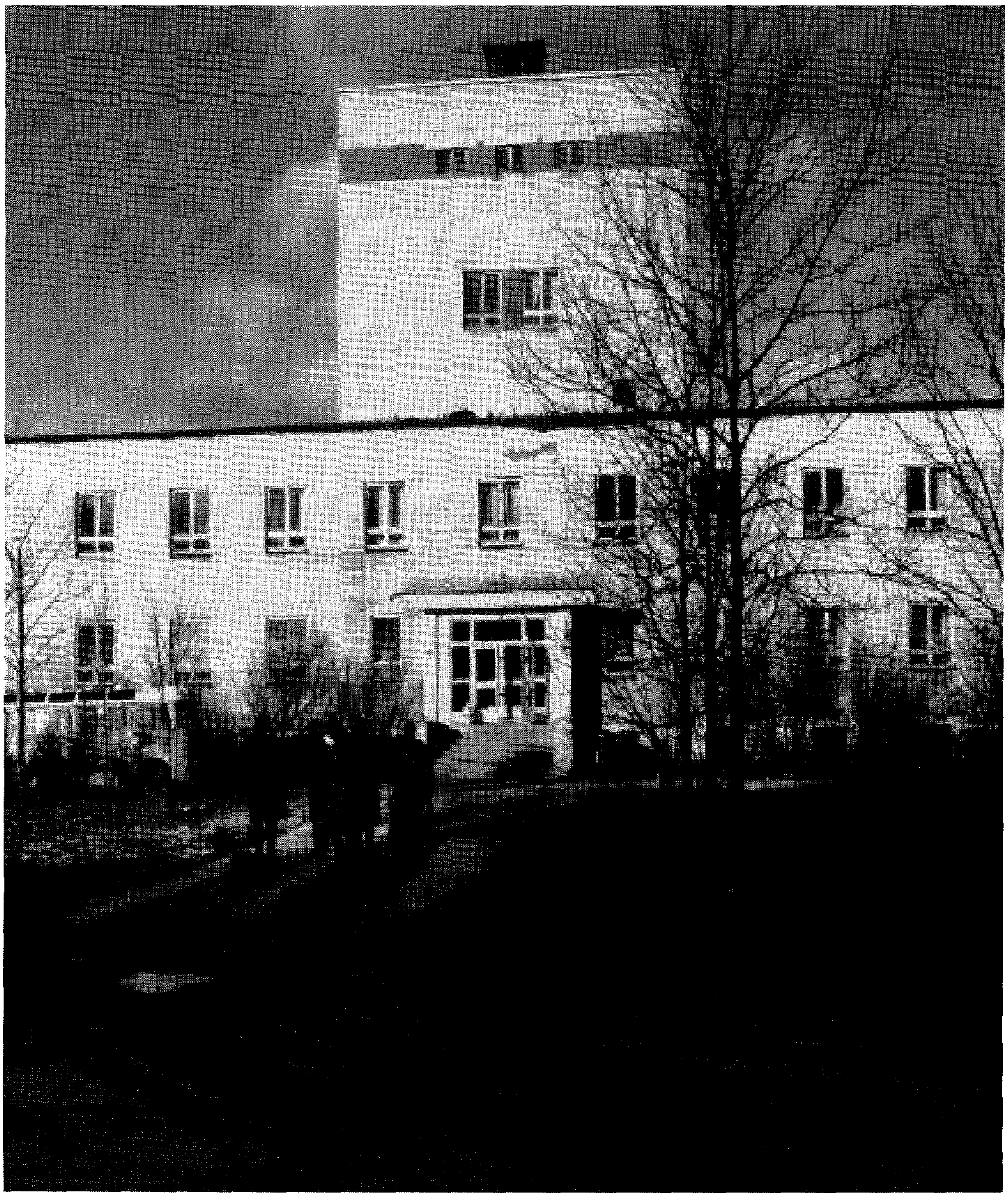


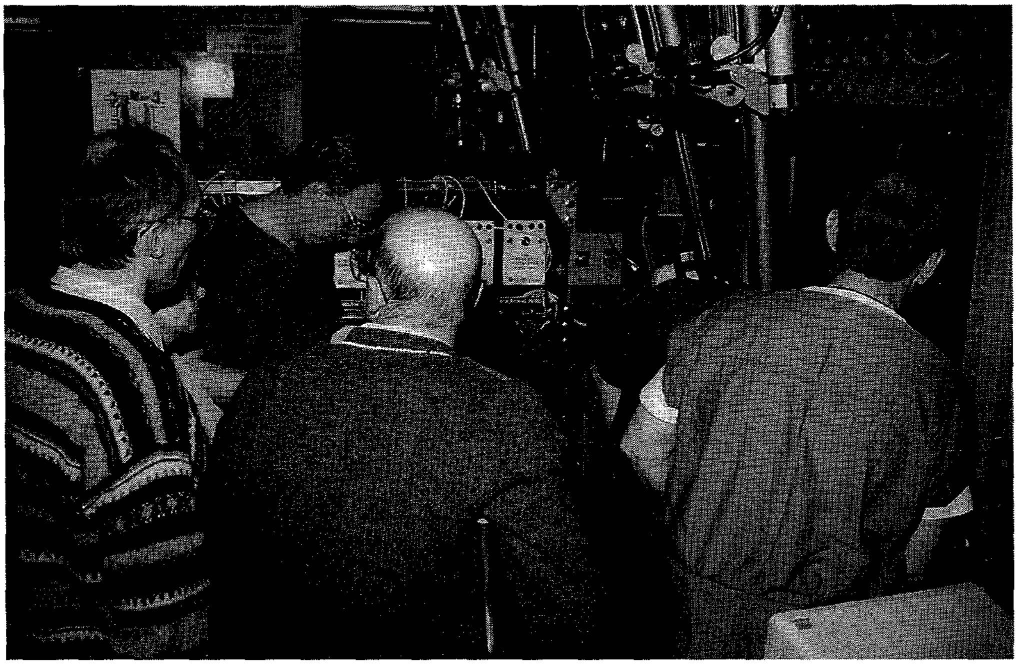
Technical Projects

JCCEM: Separations

At the first JCCEM meeting in Moscow in 1990, it was agreed that a technical exchange would occur in the area of separations technologies. The need for separations technology is particularly important with respect to the treatment of waste streams at the Idaho, Hanford, and Savannah River sites. The mixing of waste streams at these sites make them difficult to identify, treat, and prepare for final disposal.

Project 1: Applicability of the Russian Separation Technology to Process U.S. Radioactive Waste (Cobalt Dicarbollide)

In fiscal year 1993, EM initiated an experimental research program with the Khlopin Radium Institute (KRI) to study the possibility of applying the cobalt dicarbollide process to the pretreatment of the liquid phase of U.S. wastes. The studies were conducted on synthesized waste samples, and demonstrated that a suitable flowsheet could be developed for the liquid complex concentrate waste form.



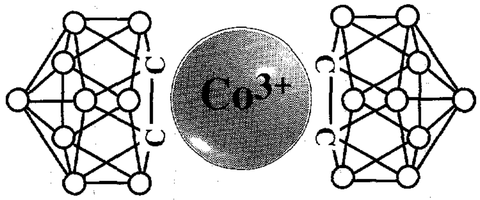
Russian and American scientists performing test of Cobalt Diarcarbollide Technology in INEL Hot Cell.

Russian and American scientists discuss Cobalt Dicarbollide tests at the INEL.

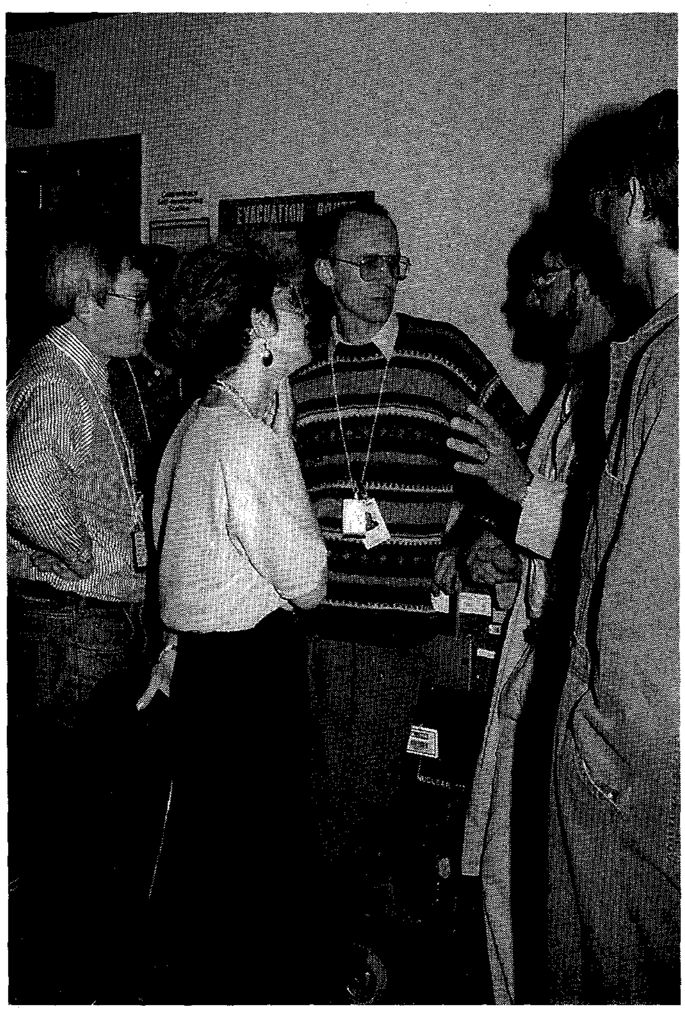
Data was also provided on the degree of separation of the long-lived isotopes and indicated that significant cost savings could be realized due to the reduction of the volume of HLW. Based on the results of the technology development project, a technical approach and statement of work was developed with the objective of obtaining initial data on the applicability of the Russian cobalt dicarbollide process for separation and management of radioactive wastes.

The research program is being conducted over a three-year period. The first year consisted of three tasks: 1) laboratory investigations on reprocessing of simulated solid phases of HLW; 2) design and construction of a test facility for dynamic testing; and 3) dynamic trails of reprocessing technology applied to simulated high-level waste. The second year focused on optimizing and testing a flowsheet for application to the sodium bearing wastes at INEL. The goal of the third year was to develop diluents that would be more readily implemented in the U.S., and to test the flowsheet with these alternative diluents.

One of the most effective ways to reduce the heat generation and immediate hazard of many liquid nuclear wastes is to remove the cesium and strontium isotopes from the waste. To minimize the volume of wastes produced, these elements should be removed in as pure a state as practical. One interesting and effective approach to this problem was developed in, and is used today, in Russia. This approach involves the use of an unusual molecule, cobalt dicarbollide, which has a high selectivity for removing cesium from acid solutions while leaving essentially all of the other materials with the waste solutions. By use of an additive, cobalt dicarbollide can be made to remove strontium as well. Cobalt dicarbollide (ChCoDiC) is an interestingly shaped molecule that consists of two "cage-shaped" carbollide groups attached to



a cobalt ion. Each carbollide group carries a -2 electric charge, and the net charge from the two carbollide groups is only neutralized by the +3 charge of the cobalt ion. This leaves a net charge of -1 that can be neutralized by a positively charged metal ion. The interesting property of cobalt dicarbollide is its strong tendency, under the proper conditions, to prefer cesium or strontium. It is this property that makes it so potentially useful in treating nuclear waste solutions. The separation process involves dissolving the cobalt dicarbollide into an organic solvent that is insoluble in the nuclear waste solution. Then, when the waste solution



Russian and American scientists discuss test parameters for Cobalt dicarbollide test.

and solvent are mixed and dispersed, the cesium or strontium contaminant moves from the solution to the solvent. The solvent can then be allowed to separate from the dispersion, and the solvent containing the contaminant is removed from the system. The contaminant can then be chemically removed from the cobalt dicarbollide in a second step, and the cobalt dicarbollide and solvent can be recycled. The contaminant solution can be concentrated or even dried to give a concentrate suitable for packaging for disposal with minimal volume. Additional efforts are currently being directed at the identification of alternative diluents to the aromatic nitrobenzenes, currently implemented in the Russian commercial process.

When working with the Russians, one-on-one interactions between U.S. and foreign scientists are extremely important, particularly in areas where environmental regulations play a large role in technology selection. As noted previously, Khlopin Radium Institute scientists are now working with colleagues at INEL and at Hanford to test the use of cobalt dicarbollide with actual DOE radioactive wastes at these sites. Current tasking includes dynamic testing of the Russian technology for HLW separation, searching and testing of new reactants, and processing and presentation of the Russian methods for analysis.

This collaborative effort is one example of how the U.S. is learning of new technologies that were originally developed in Russia, and is evaluating their potential use for solving problems with U.S. nuclear wastes. The difficulties, potential risks, and costs of treating nuclear waste are so great in all countries, that it is important to utilize the best technologies worldwide and the best experts to develop those technologies. Separation of long-lived radionuclides from defense HLW affords significant reduction of required glass volume for disposal. According to U.S. estimates, DOE could realize a program cost savings of up to $14 billion. The technical expertise in Eastern Europe is very good and they have investigated technologies that have not been evaluated in the West. This joint development program, combined with the appropriate experts, promotes cooperation among the countries and provides faster and less costly development, so that technologies can be optimized and used more effectively in the U.S. and other countries.

Project 2: Crown Ethers Evaluation of Russian Liquid/Liquid Extraction Technologies Using Crown Ethers (CE) for Decontamination of Low and High Level Radioactive Wastes from Long-Lived Radionuclides and Toxic Metals

In fiscal year 1994, EM initiated a project with the Russian Institute of Chemical Technology, in conjunction with "INFORM-ATOM," the Association on Information of the Nuclear, Power & Industry Enterprises. The purpose of the collaboration was to evaluate a Russian-developed technology for using crown ethers for the removal of long-lived radionuclides and toxic metals from low- and high-level radioactive wastes. Crown ethers are compounds consisting of carbon and oxygen. The electronegative nature of the oxygen forces it to bind to metal substances, allowing for separation. For that reason, the crown ethers have the potential to be customized to extract particular elements. The project studied the use of crown ethers for removing radionuclides and toxic metals from low-level waste (LLW) and HLW, as well as the potential of crown ethers to control chemical (redox potential) conditions in alkaline waste and process solutions. This project was expanded in fiscal year 1995 to address the "Application of Extraction Technology Using Crown Ethers for Removal of Cesium from HLW on the Acid Side." For fiscal year 1995, tasks included the following:

- identify and report potential expedience of Russian extraction technology for the specific problem of removing ^{137}Cs from acidic HLW stored at the INEL; and
- test and optimize the proposed solvent extraction systems on aqueous solutions simulating INEL waste.

The final report for this project is available upon request.

The main goal achieved in fiscal year 1996 was the dynamic testing of the solvent extraction system for Cs recovery using the earlier designed and manufactured bench-scale equipment (multi-pass counter flow extractor).

Additional Separations Projects:

In addition to these separations projects, EM has contracted with the Institute of Physical Chemistry of the Russian Academy of Sciences in Moscow to undertake six research projects:

- *Recovery on ^{137}Cs from HLW by Sorption Technique with Copper Ferrocyanide:* This project is a continuation of a fiscal year 1995 project in which the Russian experience in application of copper ferrocyanide based sorbents for the recovery of ^{137}Cs from HLW solutions was documented. The sorbents were tested on simulants of INEL HLW. The fiscal year 1996 project continued this work with the goal to fabricate the equipment for tests of the ferrocyanide based sorbents with real INEL HLW solutions. While the results of the INEL experiments with actual waste were considered successful, they did not completely duplicate results obtained in Russia using a waste simulant. A parallel INEL test using a waste simulant did achieve results that were in agreement with those obtained in Russia. Additional measurements have been recommended to determine the discrepancy of results between the two wastes. Cesium eluted from the column in the actual waste test was extremely pure, with no other gamma emitting radionuclides detected in the eluant.

• *Crystallization of Sodium Nitrate from Radioactive Wastes:* The purpose of this project is to compile a technical summary report of the laboratory and pilot scale studies performed in Russia on this topic.

• *Investigation on Removal of TRU from Alkaline Solutions on Carriers Obtained by the Method of Appearing Reagents*: This project includes an investigation of the influence of aging Pu(IV) in alkaline solutions, the co-precipitation of Np(IV) both before and during the process of forming carriers, and the localization of Am(III) by its co-precipitation with selected carriers.

• *Investigation on Disproportion of Pu(V) in Alkaline Media of Various Compositions in Liquids and Model Sludges*: The objective of this project is to determine the influence of NaOH concentration, temperature, and Pu(V) concentration on the kinetics and completeness of its disproportion in alkaline solutions; and the investigation of Pu(V) redox transformations in solid hydroxide compounds.

• *Investigation on Isolation of Technetium from Alkaline Solutions*: The goal of this project is the search for an effective method of Tc isolation from alkaline waste which contains nitrate, nitrite, and other components.

• *Investigation on Application of Homogeneous and Heterogeneous Catalysis for Alkaline Waste Treatment*: This project is an investigation on the search for applicable catalysts, and conditions for their usage, for stabilization of Np(V) in alkaline solutions.

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JCCEM: Contaminant Transport and Site Characterization

The Chelyabinsk site, in the southern Ural Mountains of Russia, presents an unfortunate but unique opportunity to study transport of radioactive contaminants in soils and groundwater systems. During past operations and accidents at the site, radioactive materials were directly released to the environment. The 1957 high-level liquid waste tank explosion at Chelyabinsk released 2 million curies and scattered radioactivity along a track over 200 km long and an area over 1000 km square. From 1949 to 1952, medium-level wastes were directly discharged into the Techa River. After 1951, medium-level wastes were continuously sent to Lake Karachai, which currently contains 120 million curies of radioactive wastes. In 1967, the water level of Lake Karachai decreased significantly, allowing for the airborne release of 600 curies. In comparison, the Three Mile Island accident released 5-50 curies. At Chelyabinsk, approximately 1 billion curies of high-level liquid wastes are stored in tanks, as vitrified wastes in bunkers, and as buried solid wastes. Since the early 1960's, data were collected at the Chelyabinsk site (5m to 100m in depth). Though the quality of the data needs to be evaluated, the database can be used to study various physical and chemical processes present during radioactive contaminant transport. Characterization and contaminant transport projects are centered around the information gathered from the Chelyabinsk region. This data and the exchange of Russian experts familiar with the region will assist in the validation of U.S. mathematical models and the establishment of risk-based standards for evaluation of contaminated sites in the U.S.

1996 Technical Focus

1. Study of Savannah River Site:
   - Savannah River Ecology Lab
   - Defense Waste Processing Facility
   - Saltstone Facility
2. Completion of Chelyabinsk Field Testing Report
3. Collection of data for input into U.S. Models at:
   - Mayak Production Association
   - 2nd Chelyabinsk Field Test
   - Krasnoyarsk-26
4. Visit to Pacific Northwest National Laboratories:
   - EM sponsored research resulted in the publication of the following technical reports:

Russian Report List for Fiscal Years 1993-1994

Authors	Report Title	Affiliation
Mironenko, M.V., Spasennykh, M. Yu., Polyakov, V.B., Ivanitskii, O.M., Garanin, A.V., Volosov, A.G., Khodakovsky, I.L., Smirnov, A.B., Mokrov, G. Yu., Glagolenko, Y.G. Drozhko, Eu. G.	The Cascade Reserviors of the MAYAK Plant: Case History and the First Version of a Computer Simulator	MAYAK Production Association, Chelyabinsk, Russia
Mironenko, V.A., Rumynin, V.G., Konosavsky, P.K., Pozdniahov, S.P., Shestakov, V.M., Roshal, A.A.	Development of Analytical and Numerical Models for the Assessment and Interpretation of Hydrogeological Field Tests	Russia Academy of Sciences, Moscow
Malkovsky, V.I., Pek, A.A.	Computer Simulation of Radionuclide Transport Through Thermal Convection of Groundwater From Borehole Repositories	Institue of Geology of Ore Deposits (IGEM), Russian Academy of Sciences, Moscow
Wollenber, H., Tsang, C.F., Frangos, W. Solbau, R., Lowder, W. Stevenson, K., Foley, M., Drozhko, E., Romanov, G., Glagolenko, Y.,Posochov, A., Yvanov, Y., Samsonova, L.k Petrov, A., Ter-Saakian, S., Vasil'kova, N., Glagolev, A.	A Joint Russian-American Field Test Chelyabinsk-65(MAYAK) Site: Test Description and Preliminary Results	MAYAK, Chelabinsk, Russia Hydrospetzgeologiya (HGS) Moscow and Lawrence Livermore National Labaoratory (LBNL)
Rumynin, V.G., Mironenko, V.A., Pereverzeva, S.A.	Development of Hydrogeological Modelling Approaches for Assessment of Consequences of Hazardous Accidents at Nuclear Power Plants	Russian Academy of Sciences, Moscow
Solodov, I.N., Velichkin, V.I., Zotov, A.V., Kochkin, B.T., Drozhko, E.G., Glagolev, A.V., Skokov, A.N.	Distribution and Geochemistry of Contaminated Subsurface Waters in Fissured Volcanogenic Bed Rocks of the Lake Karachai Area, Chelyabinsk, Southern Urals	IGEM, Russian Academy of Sciences, Moscow, HGS, Moscow, and MAYAK, Chelyabinsk, Russia
Pozdniakov, S.P., Tsang, C.F.	Random Fields Generation by the Source Point Method	Russian Academy of Sciences, Moscow LBNL, California
Pek, A.A., Malkovsky, V.I.	Modelling of the Fault-Controlled Hydrothermal Ore-Forming Systems	Russian Academy of Sciences, LBNL, California

To order reports listed, contact Elizabeth Flage, EM-54, on (301) 903-7955.

Russian Report List for Fiscal Years 1995-1996

Authors	Report Title	Affiliation
Drozhko, E.G., Glagolenko, Y.U., Mokrov, Y.G., Ivanov, I.A., Postovalova, G.A., Samsonova, L.M., Glagolev, A.V., Ter-Saakian, S.A., Glinsky, M.L., Vasil'kova, N.A., Skokov, A.V., Wollenberg, H.A., Tsang, C.-F., Frangos, W., Solbau, R.D., Stevenson, K.A., Lowder, W.M. and Foley, M.G.	Joint Russian - American Hydrogeological-Geochemical Studies on the Karachi-Mishelyak System, South Urals (accepted for publication in Journal of Environmental Geology)	Mayak Production Association, Chelyabinsk, Russia; Hydrospetzgeologia, Lawrence Berkeley National Laboratory (LBNL), Moscow, Russia; L Berkeley, California; Environmental Measurements Laboratory, New York; Pacific Northwest National Laboratory, Richland, Washington
Frangos, W. and Ter-Saakian, S.A.	Resisivity and Induced Polarization Survey at a Russian Nuclear Waste Site (submitted to Geophysics, January 1996)	LBNL, Berkeley, California; Hydrospetzgeologia, Moscow, Russia
Solodov, I.N., Zotov, A.V., Khoteev, A.D., Mukhamet-Galeev, A.P., Tagirov, B., Apps, J.A.	Geochemistry of Natural and Contaminated Subsurface Waters in Fissured Bed Rocks of the Lake Karachi Area, Southern Urals, Russia (submitted to Journal of Applied Geochemistry, February 1996)	Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry (IGEM), Moscow, Russia; LBNL, Berkeley, California
Velichkin, V.I., Asadulin, A.A., Tarasov, N.N., Poluektov, V.V., Petrov, V.A., and Myskin, V.I.	Geology and Geochemical Features of the "Mayak" Area Bedrock	IGEM, Russian Academy of Sciences, Moscow, Russia
Novikov, A.P., Pavlotskaya, F.I., Korobova, E.M., Goryachenkova, T.A., Kazinskaya, I.E., Kuzovkina, E.N., and Myasoedov, B.F.	Distribution, Specialization and Computational Migration Model of Selected Radioactive Nuclides in Some Ecosystems From the Mayak Region	Radiochemical Laboratory, Vernadsky Institute of Chemistry, Geochemistry and Analytical Russian Academy of Sciences, Moscow, Russia
Myasoedov, B.F.	The Development of Radiochemical Procedures for Determination of Uranium, Neptunium, Plutonium, Americium, Strontium-90, and Cesium-137 in Selected Samples From Mayak Region	Radiochemical Laboratory, Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Moscow, Russia
Petrov, A.V., Samsonova, L.M., Vasil'kova, N.A., Zinin, A.I., and Zinina, G.A.	Numerical Modeling of the Groundwater Contaminant Transport for the Lake Karachi Area: The Methodological Approach and the Basic Two-Dimensional Waste Solutions Through Fresh Groundwaters Regional Model	Hydrospetzgeologiya, Moscow Russia; Institute of Physics and
Samsonova, L.M., and Drozhko, E. Chelyabinsk, Russia	Migration of High-Density Industrial Power Engineering, Obninsk, Russia	Hydrospetzgeologiya, Moscow, Russia; Mayak,
Mironenko, V.A.	Flow and Tracer Tests at Sites for Underground Storage of Liquid Waste	St. Petersburg Mining Institute, St. Petersburg, Russia
Rybal'chenko, A.I., Pimenov, M.K., and Munaev, E.N.	Application of Accumulated Experience of Deep-Well Injection of Radioactive Waste in Hazardous and Industrial Waste Management	Scientific Research and Design Institute for Industrial Technology, Moscow, Russia

Authors	Report Title	Affiliation
Rybal'chenko, A.I., Kurochkin, V.M., Kostin, P.P., and Pavlov, P.N.	Basic Principles of Safety Assessment and System Control During Deep-Well Injection of Radioactive Wastes	Scientific Research and Design Institute for Industrial Technology Moscow, Russia
Rybal'chenko, A.I., Pimenov, M.K., and Kurochki, V.M.	Deep-Injection Disposal of Liquid Radioactive Waste in Russia	Scientific Research and Design Institute for Industrial Technology, Moscow, Russia
Zakharova, E.V., Kaimin, E.P., Mikerin, E.I., Kudryavtsev, E.G., Rybal'chenko, A.I., Pimenov, M.K., and Kurochkin, V.M.	Behavior of Radionuclides in Geologic Formations Used for Underground Disposal of Liquid Nuclear Wastes	Institute of Physical Chemistry and Design Institute for Moscow, Russia; MINATOM, Moscow, Russia; Scientific Research Industrial Technology, Moscow, Russia
Solodov, I.N., Velichkin, V.I., and Laverov, N.P.	Safe Geological Disposal of Liquid Wastes: Isolating Geochemical Properties of the Injection Zone Rocks	Department of Rare Metals Geology and Radiogeoecology (IGEM), Moscow, Russia
Dorogokupets, P.	Development of Thermodynamic Databases for Geochemical Models, with Potential Application to Contaminant Transport	Institute of the Earth Crust, Siberian Division of Russian Academy of Sciences, Irkutsk, Russia
Pozdniakov, S.P., and Shestakov, V.M.	A Model of Salt/Fresh Groundwater Flow in the Layered Aquifer	Hydrogeological Division, Geological Department of Moscow State University, Moscow, Russia
Pozdniakov, S.P., Tsang, C.F., and Korneev, V.A.	Flow and Tracer Transport of a Double Well System in an Aquifer with a Circular Inclusion	LBNL, Berkeley, California
T.A. Todd, I.Y. Glagolenko, R.S. Herbst, and K.N. Brewer	The Extraction of Rare Earth Elements from Idaho Chemical Processing Plant Sodium-Bearing Waste and Dissolved Zirconium Calcine by CMP and TRUEX Solvents	Idaho National Engineering Laboratory (INEL), I Idaho Falls, Idaho
R.S. Herbst, K.N. Brewer, T.A. Todd, and I.Y. Glagolenko	Chemistry of Mercury in INEL Acidic Sodium-Bearing Waste with the TRUEX Solvents	(INEL) Presented at the American Chemical Society National Meeting, New Orleans, Louisiana, March 1996
Caroline Purdy, Karen Stevenson	2nd Chelyabinsk Field Study	DOE/EM-53; Environmental Measurements Laboratory, New York

To order reports listed, contact Elizabeth Flage, EM-54, on (301) 903-7955.

Project 1: Mayak Contaminant Transport Modeling

Currently, the JCCEM is managing contaminant transport modeling projects at the Tomsk and Mayak Sites in Russia. In conjunction with Hydrospetzgeology (HSG), VNIPIPromtechnologii and the Siberian Chemical Combine, EM is collating existing characterization data on these sites:

- *Contaminant Modeling of the Tomsk Site:* The Siberian Chemical Combine and the Moscow firm VNIPIPromtechnologii have been tasked with collating the existing Tomsk site characterization data set needed for understanding contaminant surficial disposal and/or releases and any subsequent migration; and

- *Mayak Contaminant Migration Studies:* The P.A. Mayak Production Association and the HSG firm have been tasked with collating the existing Mayak Site characterization data set needed for understanding contaminant disposal and/or releases and any subsequent migration and collaborating with PNNL on modeling the Mayak site.

Specifically, EM is interested in fostering a better understanding of contaminant surficial disposal and/or releases and any subsequent migration. Relevant information will be gathered to provide for modeling and evaluation of the effectiveness of existing waste injection strategies. Missing data will be synthesized from existing data sources and site understanding.

Project 2: Chelyabinsk Field Study/Characterization Demonstration

EM and MINATOM are collaborating on a multi-year demonstration project to characterize and model the subsurface migration of contaminated groundwater in fractured rock systems. The purpose of this joint initiative is to develop and demonstrate instrumentation, and improve characterization management strategies for characterizing contaminated groundwater plumes. The key for success is to develop characterization and management strategies that combine low-cost direct monitoring with predictive computer modeling.

Contaminated groundwater plumes in fractured rock systems that are of specific concern to DOE include those found under the reservation at the Idaho National Engineering Laboratory (INEL) and Oak Ridge National Laboratory (ORNL). An area in Russia that has a groundwater contamination problem which resides within a similar hydrogeological setting to these U.S. sites is located within the territory of the Mayak Production Association.

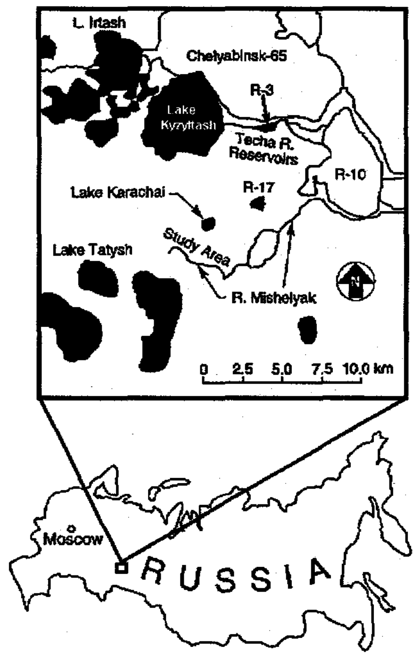
It was agreed upon by the JCCEM members to focus the initial collaborative activities on examining the frontal boundary of the contaminant groundwater plume that is moving south from Lake Karachai towards the Mishelyak River. Beginning in 1951, Lake Karachai was used by Mayak as an unlined surface repository of liquid radioactive wastes from a former nuclear production and separations facility. An accumulated total of 4,440 PBq (120 MCi) of liquid wastes has been deposited in this 0.2 km^2, 2 x 10^5 m^3 lake. The Mishelyak River is located approximately 2 km south of this repository, and flows into the Techa River.

Previous work conducted by the Russians has established that the groundwater flow pattern is downward near the source and upward near the river, and that the flow of contaminants in the fractured rock is through discrete zones. In order to ascertain the vertical component of discharge into the Mishelyak River, the pattern of connections and continuity of connections both vertically and horizontally must be determined. These connections, combined with the regional controls (i.e., where water enters and leave the ground), and waste characteristics (e.g., density) will control where the main plume from Lake Karachai is going.

The first joint Russian - U.S. field site demonstration (hereafter referred to as the first Chelyabinsk Field Study) was conducted within the Mayak territory in September of 1994.

During this demonstration, a joint team of scientists conducted hydrogeological, geochemical, geophysical and radiometric measurements. Field activities included: 1) surface and soil water sampling for radiometric and chemical analysis, and *in situ* radiometric analysis of river water; 2) isolation of specific hydrologic intervals in two different groundwater wells and production of water from the intervals to compare isolated and open-well sampling methodologies and to determine hydraulic transmissivities of these intervals; and 3) surface electrical resistivity

Chelyabinsk-65 Area



A map of the September 1994 field site demonstration in Russia near the city of Chelyabinsk-65. The demonstration site, labeled as "Study Area," was located 2 km south of Lake Karachi along the Mishelyak River.

profiling in areas of expected contrasting resistivities using a dipole-dipole resistivity array. A map indicating the study area of interest is depicted in Figure 1. Also shown are the locations of Lake Karachai and surrounding reservoirs, rivers and lakes, and the city of Chelyabinsk-65 (now named Ozersk) where Mayak is located.

Participants in the first Chelyabinsk Field Study included Russian scientists from the Mayak Production Association, Hydrospetzgeologia (HSG), an analytical lab based in Moscow, and U.S. scientists from Environmental Measurements Laboratory (EML), Lawrence Berkeley Laboratory (LBL) and Pacific Northwest National Laboratory (PNNL). Following the field study, members of the team met on several occasions to finalize the results and to plan joint demonstration activities for fiscal year 1996. The scientific findings of the first Chelyabinsk Field Study were submitted to and accepted for publication in the following peer reviewed journals 1) *Journal of Environmental Geology*, 2) *Geophysics*, and 3) the *Journal of Environmental Radioactivity*.

Upon completion of the analysis from the first Chelyabinsk Field Study, it was mutually agreed to return to Mayak to continue testing and measuring the plume movement over the next two years. Participants for the second Chelyabinsk Field Study (in fiscal year 1996) included Russian scientists from Mayak, HSG, and U.S. scientists from Savannah River Laboratory, PNNL and EML. It was agreed that PNNL and HSG would develop a joint site characterization database and would perform cooperative predictive computer modeling of the Lake Karachai plume. This work began in fiscal year 1996 with joint modeling of intercomparison problems relevant to physical phenomena in the Lake Karachai plume, and will evolve in subsequent years to three-dimensional modeling of the plume itself.

Multi-Packer Well Tests

Multi-packer research was used to verify the methods and to identify the filtration and water storage properties of the fractured media in the Mishelyak river valley in the area of contaminated water discharge. Tasks included:

- development of a test plan and the installation of two monitoring wells near Well 8/69;
- developing the wells and performing baseline measurements, including telephotometry, resistivity log, caliper log, and gamma logs;
- baseline and field test radiochemical and chemical sampling and analysis;
- site logistical support during the field sampling; and
- evaluation of the data and description of the results.

Self-Cleaning of the Mishelyak River

Verification of the "self-cleaning mechanism" was done on the Mishelyak River to support forecasting and decisionmaking (e.g. clean-up versus land use restrictions). Tasks included:

- determining radionuclide concentration levels in the river water, and providing depth profiles of radionuclides deposited in river sediments for the "self-cleaning mechanism;" and
- comparison of radiometric and analytical methods using standard and representative field site samples and field measurements.

For the second Chelyabinsk Field Study, a multi-packer multi-well array was deployed to ascertain the three dimensional array of the subsurface fracture zones in an area just north of the Mishelyak River. This multi-packer multi-well array consists of two monitoring wells with five isolated fractured zones each, and an adjacent interval sample collection well. A depiction of the multi-packer multi-well array, showing the interval sample collection well and one of the two monitoring wells, is shown in Figure 2. The size of the isolated area between each inflatable packer pair is dependent on the size of each individual fracture zone. As water is pumped from an isolated fracture zone in the interval sample collection well, pressure change readings will be recorded within each of the isolated fracture zones in the two monitoring wells.

A direct investigation of the plume interaction with the Mishelyak River will continue during the second Chelyabinsk Field Study. Several hydrogates were installed above and below the zone of discharge to monitor the water velocity throughout the summer, including periodic collection of water samples for radionuclide concentration level and water chemistry analysis. During the actual demonstration, sediment cores will be obtained to determine radionuclide inventories in the river bottom.

Results of the second Chelyabinsk Field Study will be used to develop joint computer models with existing site characterization data and results of the 1996 computer-model intercomparison studies at PNNL and HSG for predicting contaminant plume migration in this type of fractured system. It is anticipated that the maturity of the characterization strategy (i.e., low-cost monitoring combined with predictive computer modeling) will enable the collaborative effort to direct its efforts in evaluating a similarly contaminated U.S. site. A contaminant transport/site characterization program review will be held in December 1996 to determine the technical program for fiscal year 1997.

Project 3: Tomsk Contaminant Transport Modeling

Tasks include:

- providing preliminary site characterization data for mathematical modeling of radioactive contaminant groundwater transport in the Siberian Chemical Enterprises area;
- describing the hydrogeological conditions and justification for the contaminant transport model beyond the nuclear waste disposal sites; and
- providing the appropriate data to PNNL for modeling.

For more information about JCCEM:
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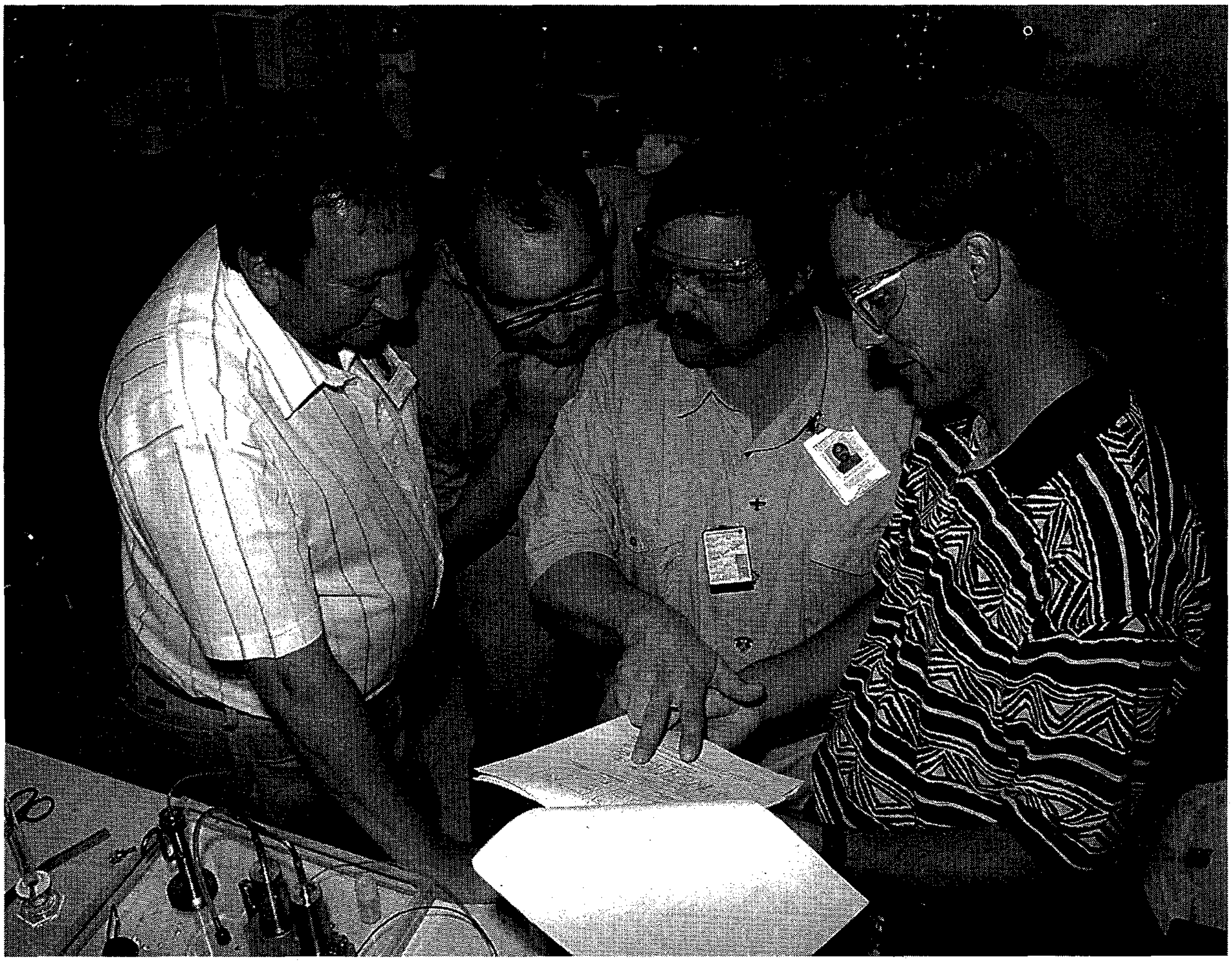

Russian and American Scientists Test Apparatus for Cyanoferrate Ion Exchange Test at INEL.

JCCEM: Mixed Waste Processing

DOE activities in mixed waste treatment and removal have involved aggressive investigation and implementation of innovative and cost-saving technologies, which include technology development projects in the treatment of mixed waste off-gases and vitrification.

Project 1: Designing and Manufacturing a Pilot-Scale Apparatus for Reprocessing Solid Mixed Radioactive Waste - Plasmatron with Induction Cold Crucible Melter (PICCM)

In fiscal year 1994, a pilot project was completed to evaluate the application of this unique combined plasma and induction heating in a cold crucible melter for application to the destruction and volume reduction of mixed wastes. Based on the evaluation of the application of this technology to DOE mixed wastes, an experimental program was developed and executed which demonstrated the technology on simulated mixed wastes. Due to the success of this experimental demonstration, the project was expanded into two major components. The first component involved the design and completion of experiments to determine the disposition of transuranic elements in the melting process. The second focused on the design and construction of a melter system for delivery and installation in the U.S.

The experiments on the disposition of trace quantities of transuranic materials in the melter are being conducted at the Institute for Chemical Technology in Moscow. A similar melter and cold crucible system was manufactured for installation in the plasma laboratory at the Georgia Institute of Technology in Atlanta, Georgia. Nonradioactive tests will be conducted at Georgia Institute to complement the radioactive tests performed at the institute in Moscow.

The system was successfully assembled and tested in Podolsk, near Moscow, early in 1996. It was subsequently disassembled and shipped to Atlanta where it was reassembled in a new research facility on the Georgia Institute of Technology campus.

Because of the unique characteristics of the hybrid plasma and induction heating system in combination with the cold crucible technology, a patent application was filed by DOE on behalf of the Russian inventors. This project is the first JCCEM sponsored technology development project for which patent protection has been filed. There is currently commercial interest in the further development and exploitation of this technology for application to DOE and commercial needs.

Project 2: Assessment of Russian Waste Treatment Technologies and their Applicability to DOE Mixed Waste Focus Area

EM has engaged KRI to perform a comprehensive review and evaluation of Russian mixed waste treatment technologies which may be applicable to DOE Mixed Waste Focus Area (MWFA) needs. The state of development of these technologies will be evaluated. The results of this work will be used to initiate feasibility studies, joint development, demonstration, and application of these technologies to DOE mixed waste problems. Tasks include:

- provide KRI with an inventory of DOE mixed wastes and a list of technology needs and gaps;
- review of Russian waste treatment technologies which may be applicable to DOE MWFA needs; and
- document the study results in the final Russian waste treatment technology assessment report. The results will contain a table with MWFA technology needs cross-linked with Russian technologies applicable to those needs. The table will also provide information on the technology development status, as well as estimated financial and time requirements necessary for completion of the development and application of these technologies to the specified MWFA problems.

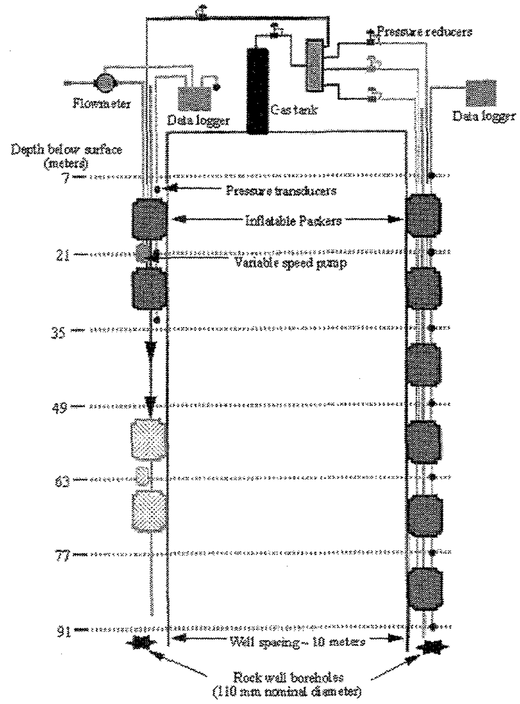

Figure 2:
A multi-packer, multi-well array, with an interval sample collection well (left side of figure), a monitoring well (right side of figure), and associated above ground equipment. As water is pumped from an isolated fracture zone in the collection well, pressure transducers record the pressure change readings in the isolated intervals in the monitoring well. The rock wall boreholes have a nominal diameter of 100 mm and are spaced approximately 10 meters apart.

Project 3: Experimental Investigation of Radionuclide Partitioning In a High Frequency Induction Melter

EM has engaged KRI to undertake a series of tests on a laboratory scale high frequency induction melter to study a problem of radionuclide partitioning during melting processes. The composition of the waste streams for this investigation will be recommended by the MWFA technical team. The distribution of radionuclides in the metal, slag, and off-gases will be studied. A precise mass balance study will be conducted. The final waste forms will be analyzed according to MWFA specifications. The results of this project will be used to develop fundamental understanding of, as well as practical data on, the radionuclide partitioning during melting processes. Tasks include:

- provide KRI with specifications on the chemical composition of the waste streams which are of interest to the MWFA (KRI will prepare similar waste compositions);
- provide KRI with recommendations on the experimental evaluation of the processing parameters which may effect the radionuclide partitioning and mass balance during the melting process;
- conduct tests on selected wastes. Monitor operating, system, and waste form parameters. Operating parameters are: feed rate, induction frequency, and power consumption. System parameters are: composition and quantity of the gases produced during the melting processes, corrosion of the off-gas system, mass balance in the system, etc. Waste form parameters may include: viscosity and conductivity vs. Temperature data, chemical and phase analysis, and waste form leach tests by Product Consistency Test (PUT) or Toxicity Characteristic Leaching Procedure (TCLP); and
- evaluation of the system and waste form parameters will be used to obtain data on partitioning of the radionuclides.

Project 4: Development of the Mixed Waste Technologies Monitoring and Demonstration Capabilities at KRI

The Mixed Waste Technology Monitoring and Demonstration Capabilities will be developed as a part of the Russian Mixed Waste Technologies Assessment project, which is currently being supported by the MWFA at KRI. Augmented by the technology monitoring and demonstration capabilities, this project will facilitate continuous technology search and evaluation processes, as well as establish strong ties between the technology developers and users, and stimulate development of new waste treatment technologies.

Current tasks include:

- prepare and send out requests for information and descriptions of the mixed waste technology deficiencies to various Russian research and industrial organizations;
- collect, evaluate, and store in a computer database the received information. Make this information available to the MWFA team in a form of technical reports, data sheets, etc.;
- provide in-depth evaluation of the technologies maturity and applicability to the MWFA needs by conducting demonstrations of promising waste treatment technologies. These demonstrations can be arranged as a display of posters, films, presentations, and technology prototype exhibits. The demonstration participants may be Russian and U.S. government and private organizations which are engaged in waste treatment technologies development;
- perform the data collection process on a continuous basis. Maintain close contacts with the appropriate Russian research and industrial organizations and periodically update the information on the mixed waste technology development. Coordinate the evolution of the MWFA needs with development of emerging new technologies in Russia; and
- evaluate the applicability of presently available and emerging Russian mixed waste treatment technologies to MWFA needs. Document results of these evaluations in a technical report to the MWFA.

Project 5: Experimental Investigation of Low-Temperature Iron-Phosphate Ceramic for Solidification of Mixed Low-Level Wastes

The Mixed Waste Focus Area requires technologies to immobilize volatile hazardous or radioactive components (Hg and Cs) which may accumulate in the offgas systems of high temperature processes. Specific waste types and feed materials should be determined, but in general, low temperature immobilization processes such as the orthosilicic acid derivative process would be applicable for treatment of ash, filter cake or filter leachates, and blowdown sludges from high temperature offgas cleanup processes. It would also be applicable for high nitrate salts, which are not compatible with cementatous waste forms. This project will be performed on wastes as close to the actual secondary waste streams as possible with emphasis on demonstration with actual waste streams in the next phase.

This project will complement current efforts which are focused on utilization of MgO as a reactant to "set" the waste. The problems experienced with this process are caused by the rate of this reaction, which is very rapid and is very exothermic. The proposed work may provide an alternate means of controlling the reaction rate and therefore alleviate the mixing and temperature control problems.

Tasks include:

- provide KRI with surrogate waste formulations for solidification needs with low-temperature phosphate-ceramics. KRI will then prepare Russian surrogate wastes of similar compositions for the project;
- conduct tests on selected wastes and investigate operating, system and waste form parameters. The operating parameters are: feed of settings, temperature and time of phases formation. The system parameters are: com position of phosphate phases, method of mixing and pouring into the form. The waste form parameters may include: open and closed porosity, hardness (mechanical strength), phase analysis and microstructure, and leachability by Product Consistency Test or Toxicity Characteristic Leaching Procedure;and
- summarize the project results and recommendations in a final project report.

Project 6: Cold Process of Solidification and Stabilization of Solid Wastes Containing Radionuclides and Harmful Impurities Using Orthosilicic Acid Derivatives

This project will complement current efforts focused on phosphate-based ceramics (see Project #5). The proposed work may provide an alternate means of low-temperature im mobilization for volatile or high-nitrate wastes. In addition, this technology is potentially applicable to Landfill and Plume Focus Areas as a barrier to prevent contaminant migration, and to the Tank Focus Area for in-tank stabilization. This technology differs from phosphate-ceramics because it forms a very stable spacial structure around the contaminant. The waste form will retain its geometry after solidification. Sodium can be incorporated into a stable matrix in quantities up to about 25wt%. The process is not corrosive and solidification rates may be varied by the rate of catalyst addition or microwave intensity.
Tasks include:

- provide Russian Research Institute of Chemical Technology (RRICT) with surrogate waste formulations for solidification needs with low-temperature orthosilicic acid derivatives. RRICT will then prepare Russian surrogate wastes of similar compositions for the project;
- conduct tests on selected wastes and investigate operational, system and waste form parameters. The operating parameters should include: temperature and time of phases formation. The system parameters should include: determination of binder composition, modifying components, and catalysts (including microwave hardening). The waste form parameters may include: open and closed porosity, hardness (mechanical strength), phase analysis and

microstructure, and leachability by Product Consistency Test or Toxicity Characteristic Leaching Procedure; and

- summarize the project results and recommendations in a final project report.

For more information about JCCEM: Mixed Waste, contact:

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HTTP://em-52.em.doe.gov/ifd/mwfa/mwfa.htm

JCCM: High-Level Tanks Remediation

Project 1: Solid-Liquid Phase Separation of HLW Using U.S. and Russian Technology

EM has engaged the Designing-Constructing and Industrial-Inculcating Enterprise "Daymos, Ltd." of St. Petersburg, Russia to undertake research toward, "Solid-Liquid Phase Separation of HLW Using U.S. and Russian Technology"
Tasks include:

- elaboration of the technical documentation on the laboratory installation for conducting tests of both the U.S. and Russian filters using simulant solutions;
- fabrication of the installation units. Receipt of the drawings of a "Cells Unit Filter (CUF)" and 15cm filter element provided by the U.S. specialists;
- elaboration of drawings and fabrication of 15cm filter element suitable for establishing into CUF. Receipt of the recipe and methods provided by the U.S. specialists for the preparation of a simulant suspension for the tests of both the U.S. and Russian filters;
- fabrication of a CUF for filter elements provided by the U.S. and Russia;
- assembly of the installation for conducting tests of 15cm filter elements provided by the U.S. and fabricated in Russia. Preparation and testing of simulant suspension together with the U.S. specialists;
- conducting tests of both the U.S. and Russian filters using a simulant sludge;
- elaboration of technical documentation on the installation for conducting tests of both filters in "hot chambers" using radioactive waste;
- assembly of the installation in "hot" chambers, tests of the installation and its preparation for experiments using radioactive waste;
- conducting tests of both filters using radioactive waste; and
- designing of a final Report.

Project 2: Development and Manufacturing of a High Capacity Pulsating Pump

Current tasks for this project include:

- the continuation of experimental industrial testings of the pulsating pump device as a part of the unit for the radioactive sludge retrieval from 3000 m^3 tanks. The development of this part of the work will give the opportunity to increase the concentration of solid phase in the retrieved sludge owing to the optimal operation conditions selection for hydromonitors and hydroelevators; and
- the pulsating pump device with the productivity of 12-15 m^3/h for sludge retrieval from the depth of 10-30 m will be developed and produced for further demonstration tests at EM facilities.

Project 3: Russian Retrieval Equipment Demonstration

EM has engaged the Integrated Mining Chemical Company (IMCC) of Krasnoyarsk, Russia to undertake research toward, "Russian Retrieval Equipment Demonstration." The objective of this project is to demonstrate Russian retrieval equipment designed for use at Krasnoyarsk-26 in a DOE HLW tank. The project will consist of modifying the equipment (Hydromonitor, Hydroelevator and Pulsating pump) for demonstration at a U.S. site using U.S. simulated high-level tank waste sludges. Performance and cost data will be developed as a result of this demonstration that could result in this equipment being deployed in a radioactive waste tank in fiscal year 1998.

Stage 1 tasks included:

- the continuation of experimental industrial testings of the pulsating pump device as a part of unit for the radioactive sludge retrieval from 3000m^3 tanks. The development of this part of work will give the opportunity to increase the concentration of solid phase in the retrieved sludge owing to the optimal operation conditions selection for hydromonitors and hydroelevators; and
- the pulsating pump device with the productivity of 12-15 m^3/h for sludge retrieval from the depth of 10-30m will be developed and produced for further demonstration tests in DOE enterprises.

Stage 2 tasks included:

- design, develop and perform a non-radioactive verification test of the Hydromonitor, Hydroelevator and Pulsating pump. This test will be performed on U.S. simulated sludge to ensure the Russian equipment is capable of mobilizing and transporting the U.S. sludge;
- deliver the retrieval devices to a U.S. site and support the set-up and demonstration of the equipment. This hardware will be delivered with sufficient Quality Assurance Records that would allow eventual deployment in an actual waste tank. Send a Russian team of operational specialists along with the equipment to work with the U.S. team for set-up and initial operation;
- the U.S. will provide the Russian principal investigator with the appropriate simulant recipes (physical and chemical constituents) with emphasis on Hanford sludges of the type that might be expected in the Hanford tank 241-C-106; and
- the U.S. will provide the Russians with data (tank size, ventilation equipment size, etc.) to ensure compatibility of this new hardware with potential demonstration sites or deployment sites.

During the September 1996 review meeting on Tank Retrieval Technologies, there was a discussion on planned testing of the Russian equipment at the Quarter Scale Tank Installation demonstration facility at the Pacific Northwest National

Laboratory. One concern noted during the meeting was that the clay available in Russia and in the U.S. may have different characteristics. Additionally, as it was not deemed practical to provide the U.S. clay in the required quantities, members at the meeting agreed that the equipment should be built in Russia and then tested at the PNNL facility.

Project 4: Analysis and Modeling of Sludge Behavior (Radioactive Sludge Storage Modeling)

EM has engaged the Integrated Mining Chemical Company (IMCC) of Krasnoyarsk, Russia to undertake research toward, "Analysis and Modeling of Sludge Behavior (Radioactive Sludge Storage Modeling)." The purpose of this work is to use available data and models to predict changes (emphasis on rheological but not ignoring chemical changes) that may have occurred in U.S. stored sludges over the decades in a high temperature and environment. Russian experience has shown that slow kinetic processes occur in sludge in this tank environment, which may lead to changes that could have a marked effect on the retrieval of these wastes or on pretreatment of these sludges. The original proposal seemed to place emphasis on chemical and radiochemical properties. It is requested that the major emphasis of this task be on the rheological properties.

Tasks include:

- using Russian and U.S. data, this task will develop a predictive tool to estimate relevant properties and potential changes to those sludges that will be found in Hanford or Savannah River tanks;
- this tool will be used to help analyze the applicability of various retrieval technologies for "aged" sludge wase. Initial analysis will be performed in combination with the U.S. Tank Focus Area Group; and
- the original MINATOM proposal will also be performed as written with the exception to the above changes.

Project 5: Technology and Apparatus for Solidification of Radioactive Waste by the Method of High Temperature Adsorption of Metals on Inorganic Matrices

The silica gel technology under development at the Russian Research Institute for Chemical Technology has great promise for immobilization of actinides (particularly Np, Am, and Pu) and long-lived fission products (technetium) contained in HLW. In this process, silica gel is fed to a specially designed batch reactor and then contacted with a solution containing the species of interest. The resulting mixture is dried, and then calcined, all in the same vessel. The free-flowing product is then removed from the vessel. Preliminary tests indicate that the silica gel has a very high capacity (up to .8 g/g silica gel) for the species identified above, and produces a chemically stable and mechanically robust product. Current project tasks include:

- sorption capacity of the silica gel for the species of interest (Tc, Np, Am, Pu) using solution compositions provided by EM's Tank Focus Area. The solutions will represent the products coming from pretreatment or immobilization processes which may be used for tank wastes;
- determine the effects of silica gel particle size on sorption capacity and product properties (strength, chemical durability);
- evaluate the sensitivity of the silica gel process to the type of silica gel used;
- determine the effects of undissolved solids on sorption capacity, drying and calcining;
- identify the effects of anions (halides) in the starting solutions on the process and product; and
- ascertain the effects of solution pH on the adsorption and sintering process for Tc.

Project 6: U.S./Russian Retrieval Users Development Working Group

This project's objective is to establish a working group to discuss the Russian Retrieval Equipment Demonstration designed for use at Krasnoyarsk-26 in a DOE HLW tank. As noted earlier, the project will consist of modifying the equipment (Hydromonitor, Hydroelevator and Pulsating pump) for demonstration at an EM site using U.S. simulated high-level tank waste sludges. Performance and cost data will be developed as a result of this demonstration, which could result in this equipment being deployed in a radioactive waste tank in fiscal year 1998. Current tasks include:

- the Integrated Mining Chemical Company will design, develop and perform a non-radioactive verification test of the equipment on U.S. simulated sludge to ensure that the Russian equipment is capable of mobilizing and transporting the U.S. sludge;
- deliver the retrieval devices to an EM site and support the set up and demonstration of the equipment. This hardware will be delivered with sufficient Quality Assurance Records that would allow eventual deployment in an actual waste tank. Send a Russian team of operational specialists along with the equipment to work with the U.S. team for set up and inital operation;

- the U.S. side will provide the Russian principal investigator with the appropriate simulant recipes (physical and chemical constituents) with emphasis on Hanford sludges of the type that might be expected in the Hanford tank 241-C-106; and
- the U.S. side will also provide the Russians with data (tank size, ventilation equipment size, etc.) to ensure compatibility of this new hardware with potential demonstration sites or deployment sites.

For more information about JCCEM: High-Level Waste, contact:

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Professors Vladimir F. Peretrukhin, Nikolai N.Krot, Vladimir P. Shilov and Alexei K. Pikaev (l to r) of the Institute of Physical Chemistry, Russian Academy of Sciences, during a visit to the Hanford Science Museum, Richland Washington, April 1996.

JCCEM: Decontamination and Decomissioning

A workshop was held in August 1996 to review the JCCEM program on Decontamination and Decommisioning. Technical discussions were held on technologies for characterization, decontamination, dismantlement, material disposition and recycling, and worker protection technologies. Following these technical discussions, possible opportunities for joint research projects were discussed for future consideration by the JCCEM. Currently, EM has contracted with the Khlopin Radium Institute and Institute of Chemical Technology to undertake the following three projects.

Project 1: Biotechnological Decontamination of Open Ponds Contaminated by Low-Level Waste

The goal of this project is to demonstrate a biotechnology based on a high sorption ability of a sorbent developed on the basis of biomass of some strains of microorganisms belonging to mycelial fungi and Trichoderma species for separating a number of radionuclides (Sr, Cs, Pu).

Project 2: Use of Supercritical Fluid Extraction for Transplutonium Element Decontamination of Solid Materials

The objective is to study the potential use of neutral phosphorous and organic compounds (including bifunctional and/or fluorinated compounds) for supercritical fluid extraction of transplutonium elements from solid materials (concrete, cotton, ion-exchange resins, etc.)

Project 3: Cryogenic Technology and Development of Equipment for Production of Granulated Materials

The project will result in compiling the report describing the potential applications of cryogenic technology for environmental remediation and waste processing needs and, specifically, for the needs of decontamination and decommissioning of the nuclear and hazardous facilities. The report will also contain a detailed description of the further experimental research proposals.

For more information about JCCEM: Decontamination and Decommissioning, contact:

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JCCEM: Scientist Exchange

At the first JCCEM meeting in November 1990, it was agreed that the exchange of senior scientists would be vital in facilitating future cooperation in the areas of environmental restoration and waste management. A scientist exchange program was established to enable Russian and U.S. scientists the opportunity to investigate the following EM-related issues:

- policy and practices associated with past and current operations relating to the nuclear fuel cycle;
- problems of process design development and operations related to environmental remediation and control of materials contaminated by radioactive and other hazardous waste;
- research directed at improving the effectiveness, economics, safety, and public acceptability of methods of handling, storing, and disposing of radioactive waste;
- investigations related to waste partitioning to facilitate permanent disposal; and
- investigations related to the geological disposal of wastes.

Project 1: Technology Development Workshops

The EM Office of Science and Technology program managers have played a very active role in pursuing technical exchanges with their Russian counterparts. The workshops listed below were being conducted through the initiative of these program managers, and have proven thus far to be a great technical exchange forum from which both countries have greatly benefited.

Separations Workshop	*February 1992*	*Tucson, Arizona*
Contaminant Transport Workshop	*June 1993*	*Berkeley, California*
1st Cobalt Dicarbollide Separations Demo	*April 1994*	*Idaho Falls, Idaho*
Contaminant Transport Workshop	*May 1994*	*Berkeley, California*
Crown Ether Workshop	*August 1994*	*Gatlinburg, Tennessee*
Tank Remediation Workshop	*August 1994*	*Miami, Florida*
2nd Cobalt Dicarbollide Separations Demo	*July 1995*	*Idaho Falls, Idaho*
Radiochemical Processing	*August 1995*	*Los Alamos, New Mexico*

Contaminant Transport Program Review	*November 1995*	*Washington, D.C.*
Tank Retrieval Workshop	*January 1996*	*Augusta, Georgia*
Mixed Waste Workshop	*January 1996*	*Idaho Falls, Idaho*
Site Characterization Workshop	*February 1996*	*Augusta, Georgia*
3rd Cobalt Dicarbollide Separations Demo	*April 1996*	*Idaho Falls, Idaho*
Modelling Workshop	*June 1996*	*Richland, Washington*
Copper Ferrocyanide Testing	*July 1996*	*Idaho Falls, Idaho*
D&D Workshop	*August 1996*	*Morgantown, West Virginia*
Spectral Tables Workshop	*August 1996*	*Seattle, Washington*
Risk Assessment Workshop	*August 1996*	*Seattle, Washington*
TRU Stabilization Workshop	*August 1996*	*Seattle, Washington*
Solidification Experiences Workshop	*August 1996*	*Seattle, Washington*
Russian Home Pages Workshop	*August 1996*	*Seattle, Washington*

For more information about Technology Development Workshops, contact:

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Project 2: Idaho State University Exchange

In fiscal year 1994, four Russian graduate students began Master's Degree classes at Idaho State University, in Pocatello, Idaho. The students are studying in the areas of nuclear engineering, chemical engineering, and computer science. Each summer these students have been employed as research assistants at INEL and private U.S. companies. All four Russians expect to complete their graduate degrees by May 1997. To date, this exchange has been characterized as being very advantageous for both INEL and the students.

The Russian students have been very successful in completing their 1996 school year courses. During the summer, two students worked at the Idaho National Engineering Laboratory, and two at the Argonne-West Laboratory. All four students received excellent marks from the leaders of their summer research projects. Based on the results of the summer work experience, the students have chosen the topics of their Master's Degree thesis, which is a requirement for obtaining a Master's Degree from Idaho State University. The students have already made some initial progress in their dissertation research.

Irinas Glagolenko, one of the students, has co-written several reports of interest. Ms. Glagolenko also presented the results of one report at the "Western Governors Association Weapons Complex Waste Management and Cleanup Colloquim" in Phoenix, Arizona in May 1996. See the Russian Report List for Fiscal Years 1995-1996 for report titles, or see the point of contact listed below for more information.

In fall 1997, the U.S. will send its first long-term scientist to Russia for a three to four month exchange in the area of separations technologies at the Institute of Physical Chemistry, the Khlopin Radium Institute, and the Mayak Production Association.

For more information about the Idaho State University Exchange, contact:

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Project 3: Berkeley Post Doctural Candidate

As part of the JCCEM Science Exchange, a Russian scientist from the Khlopin Radium Institute received a post doctoral fellowship in fiscal year 1995 at the Glenn T. Seaborg Institute for Transuranium Science at the Lawrence Livermore Laboratory.

Dr. Vadim Valer'evich Romanovskii completed his undergraduate and graduate studies at the Saint Petersburg Institute of Technology specializing in the technology of rare and trace elements. Since receiving the Candidate's degree, he has continued his research as a Staff Scientist at the Institute. Currently, he is conducting research on "Plutonium Complexation by Siderophores (PuCS)." The ultimate goal of this project is to develop a new separation system for the removal of radioactive metal ions from contaminated DOE sites. One of these new systems uses highly selective complexing agents derived from natural materials to remove plutonium (IV) from solutions. The target solutions may vary in ionic strength, pH and competing ions depending on the exact flow-sheet of waste stream.

In nature, bacteria and other microorganisms produce siderophores, low-molecular-weight multidentate iron chelators, to scavenge ferric ion from their environments. The main binding groups employed by siderophores are catechol, 1,2-hydroxypyridinone and hydroxamate. These bidentate chelating groups are strong Lewis bases and show remarkable selectivity for Lewis acidic metal ions including Pu(IV) and Th(IV). Very selective sequestering agents can be synthesized by incorporating these chelating groups into multidentate ligands. These chelating groups can also be incorporated into molecules appropriate for use as liquid/liquid extractants or into insoluble polymers for use as ion exchange resins.

At the present time over sixteen liquid/liquid extractants and three polystyrene based chelating ion exchange resins have been synthesized and tested to determine the ability of these materials to remove Pu(IV), Th(IV) and Fe(III) ions from acidic solution. Some of the agents show excellent kinetic and uptake properties for Pu(IV) extraction.

For more information about the Berkeley Post Doctural Candidate, contact:

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Project 4: National Academy of - Grants

The National Academy of Sciences (NAS) is administering an EM sponsored program which provides grants of $16,000-$30,000 to support Russian scientists at U.S. national laboratories. This program hosts Russian students and scientists to conduct research at national labs and universities. Eight exchanges have been conducted to date and six more are planned.

Project statements submitted by the grantees under the NAS's Radioactive Waste Management Grants Program with Russia are listed below:

Host: Dr. Stephen Aja, City University of New York - Brooklyn College
Phone: (718) 951-5405
Visitor: Dr. Dmitry Kulik, State Scientific Insititute for Environmental Geochemistry, Ukrainian Academy of Sciences, Kiev, Ukraine
Topic: Development of an integrated model of equilibria and sorption by clay minerals of selected actinide and lanthanide elements

Host: Dr. Stephen Aja, City University of New York - Brooklyn College
Phone: (718) 951-5405
Visitor: Dr. Vasily Sinitsyn, Institute of Geochemistry, Mineralogy, and Ore Formation, Ukrainian Academy of Sciences, Kiev, Ukraine
Topic: Experimental investigation of the sorption of lanthanides on clays and clay minerals under hydrothermal conditions

Host: Dr. Garrett Brown, Washington State University and Pacific Northwest National Laboratory
Phone: (509) 373-0165
Visitor: Dr. Dmitry Marinin, Institute of Chemistry, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia
Topic: Synthesis and evaluation of inorganic ion exchange materials for removal of Strontium from high hardness groundwaters

Host: Dr. William C. Burnett, Florida State University
Phone: (904) 644-6703
Visitor: Dr. Evgeny Kontar, Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia
Topic: In-situ extraction of radionuclides from natural waters

Host:	Dr. Rodney Ewing, University of New Mexico
Phone:	(505) 277-4163
Visitor:	Dr. Boris Burakov, Khlopin Radium Institute, Russian Academy of Sciences, St. Petersburg, Russia
Topic:	Design of waste forms for actinide immobilization

Host:	Dr. Steven Grant, Cold Regions Research and Engineering Laboratory
Phone:	(603) 646-4446
Visitor:	Dr. Mikhail Mironenko, Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Moscow, Russia
Topic:	Modify existing 3D finite-element solute-transport model so that it could be used for cold-region remedial technology development and evaluation

Host:	Dr. Matthew Kozak, QuantiSci, Inc.
Phone:	(303) 985-0005
Visitor:	Dr. Boris Serebryakov, Institute of Biophysics, Ministry of Health, Moscow, Russia
Topic:	Development of a safety assessment methodology for Russian regulatory system

Point of Contact:	Kelly Robbins
Program:	National Research Council
Phone number:	(202) 334-3656
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Internet Site:	HTTP://www2.nas.edu/oia/22da.html

For more information about JCCEM: Scientist Exchanges, contact:

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New Areas of Cooperation

At the 6th JCCEM, it was agreed to add the following areas of cooperation for implementation in fiscal year 1996:

Risk Assessment

To initiate Risk Assessment as a new area, a workshop was held in Seattle, Washington, in August 1996. The U.S. and Russian delegations discussed several potential risk assessment topic areas worthy of further exploration. Important considerations were given to the role of stakeholder involvement, regulatory framework, continuing pressures on budget, incorporation of scientific innovation, near-term and long-term risk, prioritization of risks, and other issues.

Relating to the U.S. experience, comments were made on how risk assessment affects EM in evaluating waste remediation criteria, methodology, and decision-making. To illustrate the point, the example of the Consortium for Risk Evaluation with Stakeholder Participation (CRESP) was used. CRESP was established to develop a credible strategy for risk based clean-up of DOE facilities. Stakeholder involvement was noted as an important tenant in reaching risk assessments that were both credible and politically feasible.

Among the action items resulting from the workshop, it was recommended that:

- a proposal be drafted to conduct a risk assessment of the potential for contamination of the Yenisey River from operations at Krasnoyarsk-26;
- a compilation be drafted of major safety issues at the MAYAK Production Association as the basis for development of joint projects; and
- other potential projects be identified and a prioritization list be drawn up for review.

For more information about Risk Assessment, contact:

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Solidification Experiences

A second workshop was held in Seattle, Washington in August, 1996 to initiate Solidification as a new area. It was noted that there are currently two JCCEM projects relevant to the topic of waste solidification; the silica-gel project and the hybrid melter project. Both of these are presently seen as important activities and should be continued.

Opportunities for future collaborative projects were also discussed. To pursue these projects, a process using two groups of tasks was identified. The first group of tasks include:

1. information exchange about the opera tion status of vitrification facilities;
2. preparation of a handbook providing an overview of the creation, start-up, and operation of DOE and MINATOM vitrification facilities;
3. an exchange of specialists in the following areas:
    - facility maintenance (operators),
    - system monitoring and diagnostics, and
    - safety monitoring;
4. examination of the condition of the EP-500 after its six-year period of operations; and
5. development of a decision-making methodology, including formal procedures for shutting down vitrification facilities.

The second set of activities are suggested projects that could be accomplished on a contract basis:

1. altering conditions for conducting the vitrification process;
2. comparison of research conclusions as well as results obtained through processing (vitrification) of real wastes, including studies of:
    - criticality safety,
    - noble metal and nickel-sulfide behavior, and
    - behavior of mercury;
3. development and verification of the vitrification process for HLW and MLW containing complex salts inside a ceramic melter with molybdenum electrodes insulated by a tin dioxide barrier;
4. accoustic diagnostic methods for assessing the condition of the vitrification facility;
5. development of a real-time, in-situ method and device to measure viscosity in the melt;
6. performance assessment for disposal of glass and ceramic waste forms in shallow land disposal;
7. experience in achieving homogeneity of melter feed material, and the effect of inhomgeneity on glass product performance; and
8. experience in sample analyses, i.e. rapid, reliable, and efficient diagnostic methods for process control.

For more information about Solidification Experiences, contact:

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Spectral Tables

KRI and the Russian Gamma-ray Spectrometry community have proposed a relationship with DOE and the International Committee on Radiation Measurements (ICRM) for evaluation of nuclear structure and decay data. The cooperative program would:

- establish contact with specroscopists in the major Russian metrology laboratories;
- identify need for new gamma-ray experimental data; and
- develop a methodology for calculation spectra for large volume detectors.

The objectives of this project are:

- to upgrade the quality of presentation of data;
- to add decay schemes to the gamma-ray spectral tables;
- to calculate detector response functions for large volume Ge(Li) semiconductor detectors;
- to agument database with Russian data;
- to publish the updated database on CD-Rom and the Internet.

For more information about Spectral Tables, contact:

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Transuranic Stablization

A workshop was held in Seattle, Washington in August, 1996 to initiate Transuranic Stabilization as a new area. The stated goal of this workshop was to initiate the exchange of information regarding plutonium stabilization successes and problems in the U.S. and in Russia, and to identify opportunities for cooperative plutonium stabilization research and technology demonstrations. It was noted that the production of plutonium in Russia was stopped in 1986, and another year was taken to finish the processing of plutonium that was already in process.

Representatives from several DOE sites, including Rocky Flats and Savannah River, shared their experiences with solid residues resulting from plutonium processing. On the Russian side, information was provided about the Khlopin Radium Institute's experience with immobilization of waste streams containing plutonium. The U.S. Congressional directive to stabilize Pu wastes on DOE sites by 1997 was mentioned as a possible reason for interest in existing Russian vitrification or other technologies capable of dealing with these residue waste streams.

Several recommendations were offered, including:

- the Russian scientists involved would develop a short description of each project suggestion, and distribute the list to EM for review;

- after reviewing this list, EM would respond to the Russian side concerning which suggestions should be developed into full proposals; and
- the Russian scientists would then submit formal proposals for consideration following the protocol established by the JCCEM.

For more information about Transuranic Stabilization, contact:

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Non-JCCEM Projects

Project 1: Electrokinetic Extraction Process for Soil Remediation

Electrokinetics for the cleanup of soils and groundwater contaminated with heavy metals is another area of joint research activity. Russian scientists have knowledge of electrokinetic remediation of sites contaminated with heavy metals (lead, mercury, cadmium), radioactive species (^{137}Cs, ^{90}Sr, ^{60}Co), and anionic species (nitrates, sulfates). An extensive portion of Russian scientific experience with electrokinetics has been with uranium-contaminated soils.

Electrokinetic phenomena in soil can be divided into three categories: electrophoresis, which is the movement of soil particles within the soil moisture or groundwater, electroosmosis, the movement of soil moisture or groundwater from the anode to the cathode, and electrolysis, the movement of ions and ion complexes within the soil moisture or groundwater. These phenomena occur when the soil is electrically charged with direct current. The fundamental configuration for all three processes involves the application of an electrical potential between one or several electrode arrays in physical contact with the soil, in order to cause migration of positive species to a cathode and negative species to an anode.
Of the three electrokinetic phenomena, electrolysis has the most applicability for remediation of uranium, plutonium, and other toxic metals at

DOE sites, since these contaminants may exist in an immobile phase (i.e. solid oxides, entrapped particulates, etc.) and may require solubilization into an electrolytic medium for mobilization during in-situ treatment.

This project includes pilot-scale demonstration of electrokinetic removal of uranium from contaminated soil. Site selection and treatability studies will precede the pilot test, and a full-scale field test, at a site to be determined, is envisioned following evaluation of the pilot scale results. Removal efficiency, control of added fluids, contaminant recovery and disposal, power consumption, mass balance, and control of soil pH must all be evaluated to assure that this process is viable. Technology advances made by Russian scientists in this area of environmental remediation will be used as extensively as possible. The site should be selected to allow easy permitting for testing, be representative of the uranium problems throughout the DOE complex, and be accessible to industry, regulatory agencies, and academia.

Remediation of uranium-contaminated soil is one of the major cleanup tasks facing DOE. In- situ methods are needed that can remove enough uranium to reduce contaminant concentrations to acceptable levels and allow the soil to return to productive use. Electrokinetic methods are being evaluated for this purpose, and applicability to uranium removal from saturated and partially saturated soils needs to be documented. Soils from the K-311 and K-25 sites at Oak Ridge have been analyzed for treatability by electrokinetics, with results contrasted to previous characterizations made at the Drum Storage Area at the Fernald Site. The latter site has shown good response to carbonate leaching if electrokinetics can be used to move the solu bilized uranium through the silty clay soil. Other DOE sites may also be identified for treatability analysis. A report has been prepared by Hazardous Waste Remedial Action Program (HAZWRAP) and K-25 personnel summarizing site selection sampling activities. Regulatory and criticality issues also have been investigated by K-25 personnel.

HAZWRAP personnel have visited sites in Russia where electrokinetics have been used to remediate uranium contamination from soil. In addition, four teams of Russian electrokinetic experts travelled to the U.S. during 1994 for short visits to meet and work with their U.S. counterparts on small samples of soil from the K-25 Site at Oak Ridge. Laboratory-scale and pilot-scale testing on Oak Ridge soils were completed in fiscal year 1996 and preparations are underway to accommodate pilot-scale demonstrations during fiscal year 1997 on uranium-contaminated soil from the Fernald Site in Ohio.

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Project 2: Tulane/Xavier

With continuing support from DOE, there is enhanced collaboration between the Tulane/Xavier Center for Bioenvironmental Research and the Institute of Radioecological Problems of the Academy of Sciences, Minsk, Belarus (IRPB). Research involves two Chernobyl-related modeling projects: 1) the transport of radionuclides in marsh and forest fires and 2) the Iput River, which flows through the Bryansk Cesium Spot," one of the most hea vily contaminated regions. Two graduate students from Minsk are currently enrolled in Ph.D. programs in the Tulane University School of Engineering, and are analyzing data using computer simulations to see if they apply to the situations in Belarus.

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HTTP://em-52.em.doe.gov/ifd/intl/intl.htm

Program Coordination

Cooperative programs require rapid and reliable communications between U.S. and Russian institutes, scientists, and organizations. This program establishes electronic communications and computer support for messages and data transfer between scientists in both countries. The Russian electronic network, GLASNET, provides a capability for basic electronic mail with the U.S. through a gateway to INTERNET, as well as the capability within Russia for binary file transfer. EM has established an electronic mail system with Russia. The network also provides DOE headquarters program managers with direct lines to their Russian counterparts. This access eases the management burden in terms of accountability, timeliness, and integration with U.S. EM technology development efforts.

Project 1: Internet Web Sites/ Russian Home Pages

The objective of this project is to develop information about the JCCEM program so that it is accessible on the Internet. The Khlopin Radium Institute will serve as the coordinator on the Russian side for the development of information for the Web site, including the use of text, photographs, and other graphic data about the JCCEM. MINATOM retains the responsibility of approving all information content for the site.

For more information about the Internet Web Sites, contact:

Point of Contact:	Elizabeth Flage
Program:	EM-54
Phone number:	(301) 903-7955
Fax number:	(301) 903-7234

Email address:
elizabeth.flage@em.doe.gov
Internet site:
HTTP://em-52.em.doe.gov/ifd/intl/intl.htm

Project 2: Environmental Management Project Office, Moscow

The Waste Policy Institute, in support of EM, has established an Environmental Management Project Office in Moscow, Russia to provide technical assistance to program managers on Russian-related projects and to facilitate greater communication between U.S. and Russian environmental organizations. The operation of the Project Office is designed to reduce management and travel costs associated with administering EM's Russian initiatives. The Project Office is staffed with one and one-half contractor FTEs in order to accomplish the assigned mission of the office.

Charter:

The Project Office assists EM program managers, especially focus group and cross-cutting programs, with the planning, implementation, administration, and oversight of project work being conducted in Russia to address EM needs. The types of projects that the Project Office supports include U.S./Russian ventures in science and technology cooperation, international technology transfer, and international coordination. The Project Office also assists EM in the identification of technologies for application in the U.S., facilitatation of technology transfer between U.S. and Russian organizations, and establishment of an information center to promote U.S. and Russian scientific exchange.

Functions:

The Project Office functions required to carry out the above charter include:

1. Administrative management related to progress reporting, technical reviews, in-country logistics, bilingual translation, and support of technical information exchange;
2. Close coordination with EM program managers, especially focus group leaders, regarding Russian project planning, initiation, execution, and administration;
3. Technical monitoring and assessment of Russian pilot technology development projects;
4. Communication interface with Russian Ministries and Scientific Institutes to identify high-payoff EM-related R&D and to facilitate greater technical and scientific exchange;
5. Contract management related to proposal solicitations, contract tracking, and auditing.

For more information about the EM Project Office in Moscow, contact:

Point of Contact:	Elizabeth Flage
Program:	EM-54
Phone number:	(301) 903-7955
Fax number:	(301) 903-7234

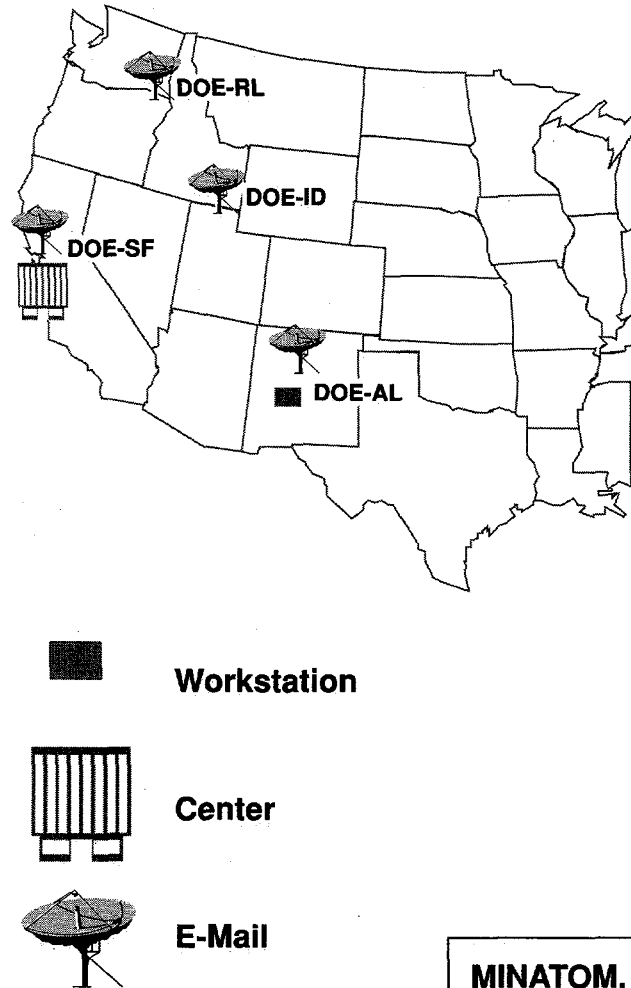
Email address:
elizabeth.flage@em.doe.gov
Internet site:
HTTP://em-52.em.doe.gov/ifd/intl/intl.htm

American Business Centers

The "Freedom for Russia and Emerging Democracies and Open Markets Support Act" (FSA) of 1992 calls for the establishment of environmental and agribusiness American Business Centers (ABC) in Russia. The FSA authorizes a total of $410 million for economic assistance, and $12 million targeted directly for the establishment of the ABCs. The ABCs focus on establishing commercial partnerships for U.S. industry. Section 301 (b)(1) of the FSA states:

For more information about the American Business Centers, contact:

Point of Contact:	Business Information Service for the Newly Independent States
Program:	Department of Commerce
Phone number:	(202) 482-4655
Fax number:	(202) 482-2293
Internet Site:	
HTTP://www.iep.doc.gov/bisnis/bisnis.html	



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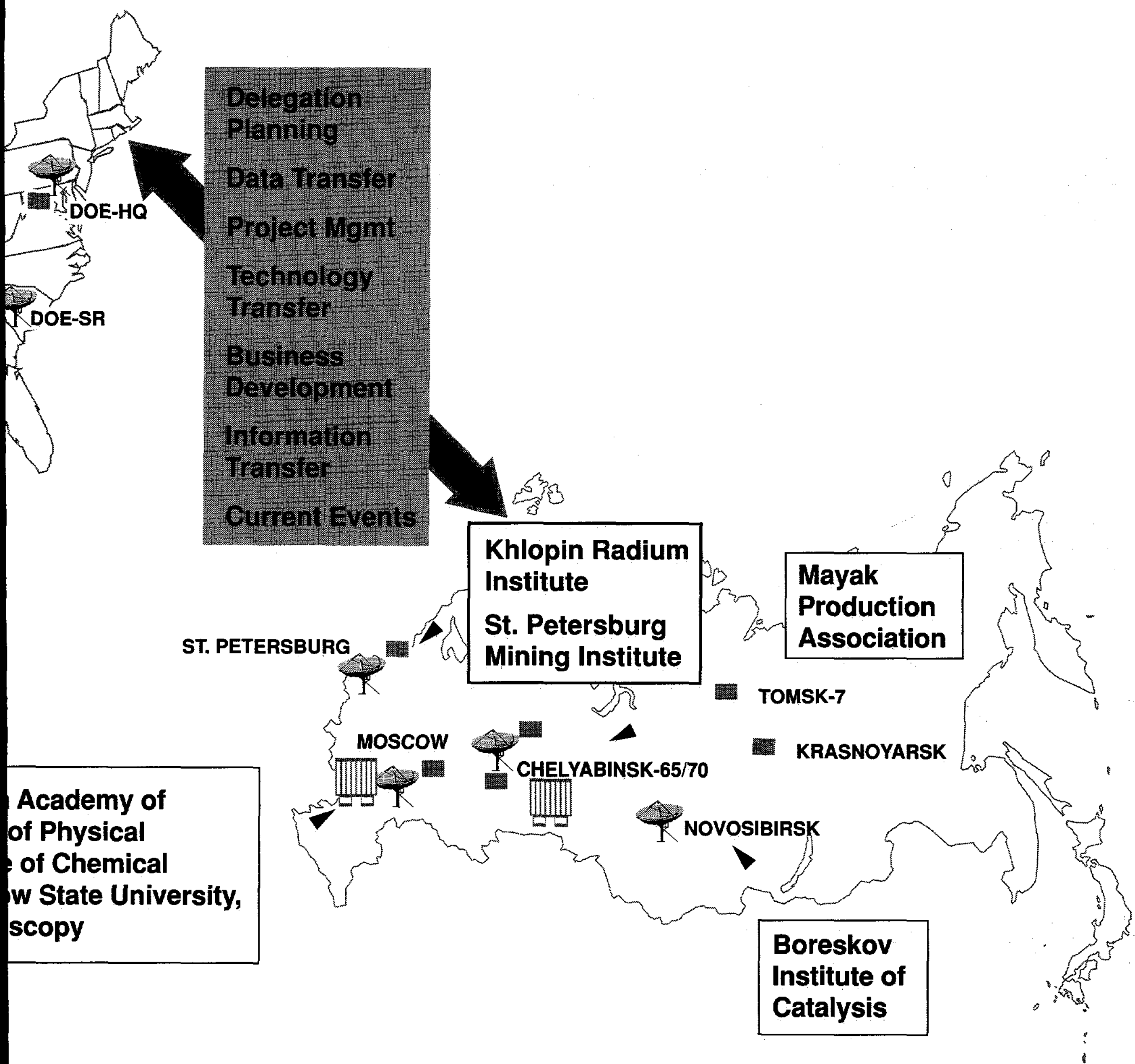
"Environmental Business Centers should be established in the republics which offer promising market opportunities for U.S. environmental goods and services and the Far East of Russia. The Centers shall emphasize small and medium-sized business facilitation; offer office space and business facilities, and market analysis services on the user-free basis; centers will serve as repositories of commercial, legal, technical, and environmental information."


Delegation Planning
Data Transfer
Project Mgmt
Technology Transfer
Business Development
Information Transfer
Current Events
DOE-HQ
DOE-SR
Khlopin Radium Institute
St. Petersburg Mining Institute
Mayak Production Association
ST. PETERSBURG
TOMSK-7
MOSCOW
KRASNOYARSK
CHELYABINSK-65/70
NOVOSIBIRSK
Academy of
of Physical
of Chemical
w State University,
scopy
Boreskov Institute of Catalysis

Future Actions/Conclusions

DOE and MINATOM will continue to confirm their commitment to implementing the MOC, and the existing programs will be continued and enhanced in the newly identified areas of Risk Assessment, Transuranic Stabilization, and Solidification. It is vital that Russian technologies applicable to DOE's mission be identified, evaluated and demonstrated for potential application in the DOE domestic cleanup effort. DOE will continue to focus on fostering Russian technology development and transfer that address the EM mission, as well as Russian remediation activities.

Given the available resources and mandate, DOE may also have a substantial impact on other areas. DOE has technologies and scientists that actively support site characterization efforts at Semipalatinsk (Semey), the nuclear weapons test site in Kazakhstan. DOE resources that are spent in buying Russian-produced plutonium may be used by Russian scientists to demonstrate U.S. technologies at Chelyabinsk. Using the DOE model, expansion of technology development efforts fulfills Clinton Administration desires to stabilize the Russian scientific base. Valuable environmental management expertise can be used to conduct environmental assessments at former Soviet defense facilities in Estonia and other Former Soviet Union countries. DOE has demonstrated technologies for the cleanup of soils and groundwater contaminated with petroleum products, and these technologies perform significantly better than industry standards and could have broad application in the remediation of pipelines, refineries, and petroleum distribution centers in Russia. DOE has also demonstrated technologies for the distinction of biological and chemical warfare agents. These are a few examples to consider regarding the DOE's ability to meet Administration objectives in Russia.

JCCEM Program Costs

(Figures in $000s)

Program Area	FY92	FY93	FY94	FY95	FY96	Totals
Separations Technologies	0	500	460	335	385	1680
Contaminant Transport/Site Characterization	0	300	650	300	220	1470
Mixed Waste	50	70	130	315	291	856
HLW Tank Remediation	0	0	0	50	372	422
D&D	0	0	0	0	30	30
Scientist Exchanges	330	685	1150	1150	600	3915
Program Support/Workshops	15	115	145	150	300	725
Totals	**395**	**1670**	**2535**	**2300**	**2198**	**9098**

Reader Reply Card
(place holder)

International Technology Systems Application (ITSA)
program information

The *United States - Russia Environmental Management Activities* *is produced once a year by the International Technology Systems Application (ITSA) staff. For additional copies of this document, to request other publications, or for more information on ITSA, please fill out and return the attached reader reply card.*

You can also learn more about the ITSA program on the Internet. The ITSA Home Page is located at:

HTTP://em-52.em.doe.gov/ifd/intl/intl.htm