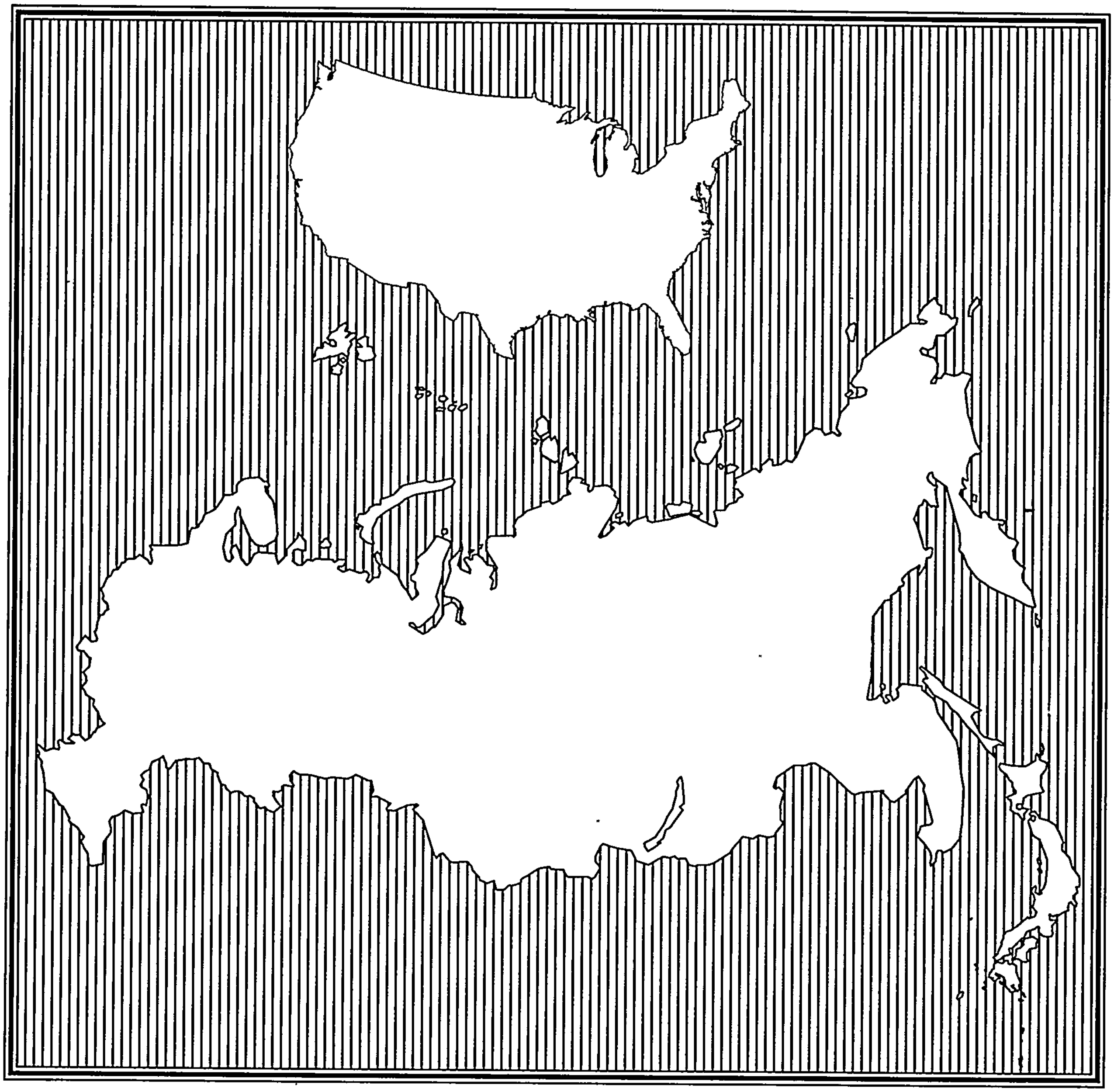
DOE/EM-0263

U.S. - Former Soviet Union

Environmental Management Activities

September 1995



A U.S. Department of Energy Cooperation Program with the Former Soviet Union

DISCLAIMER

U.S. - Former Soviet Union

Environmental Management Activities

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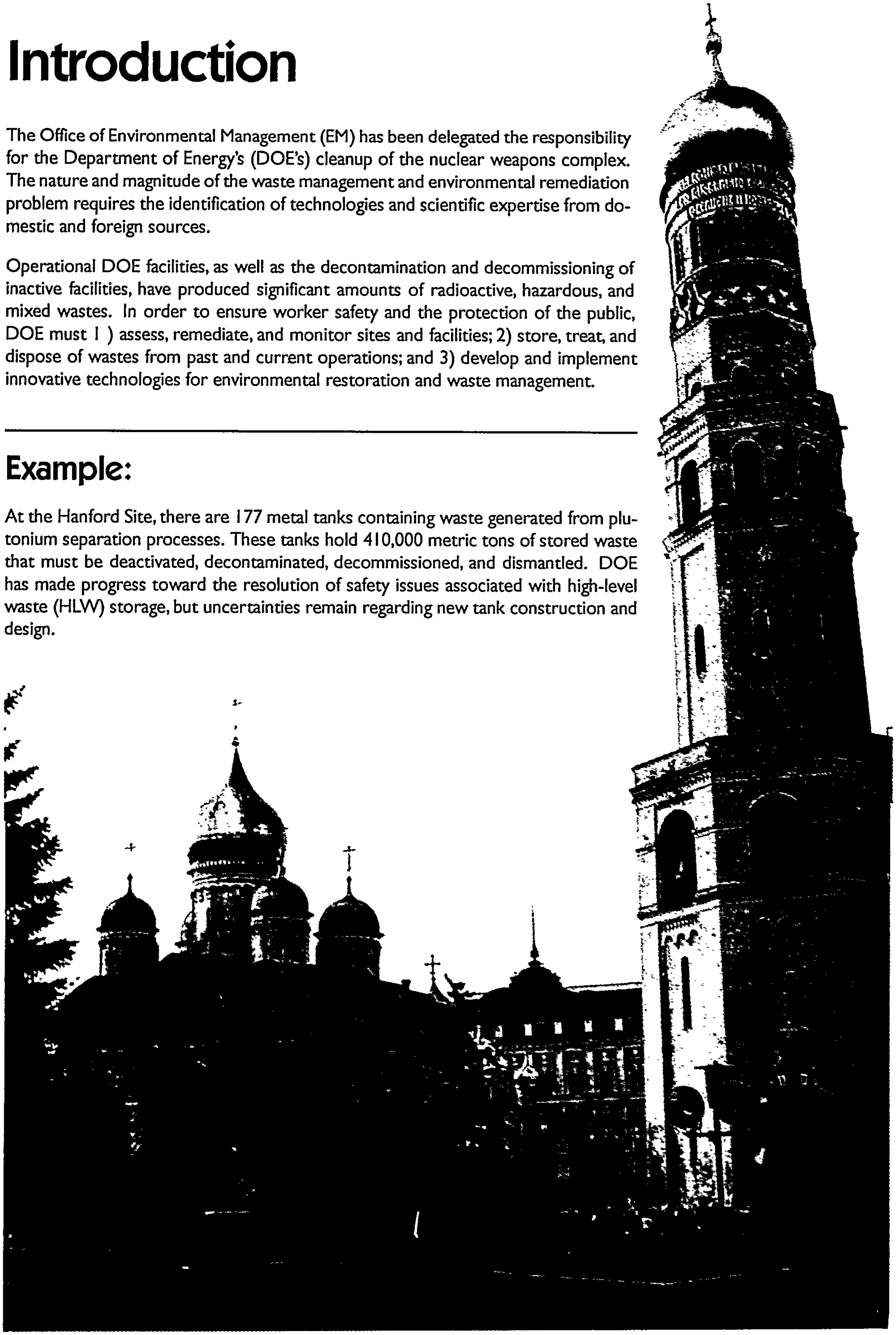
Introduction

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.

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.

Example:

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

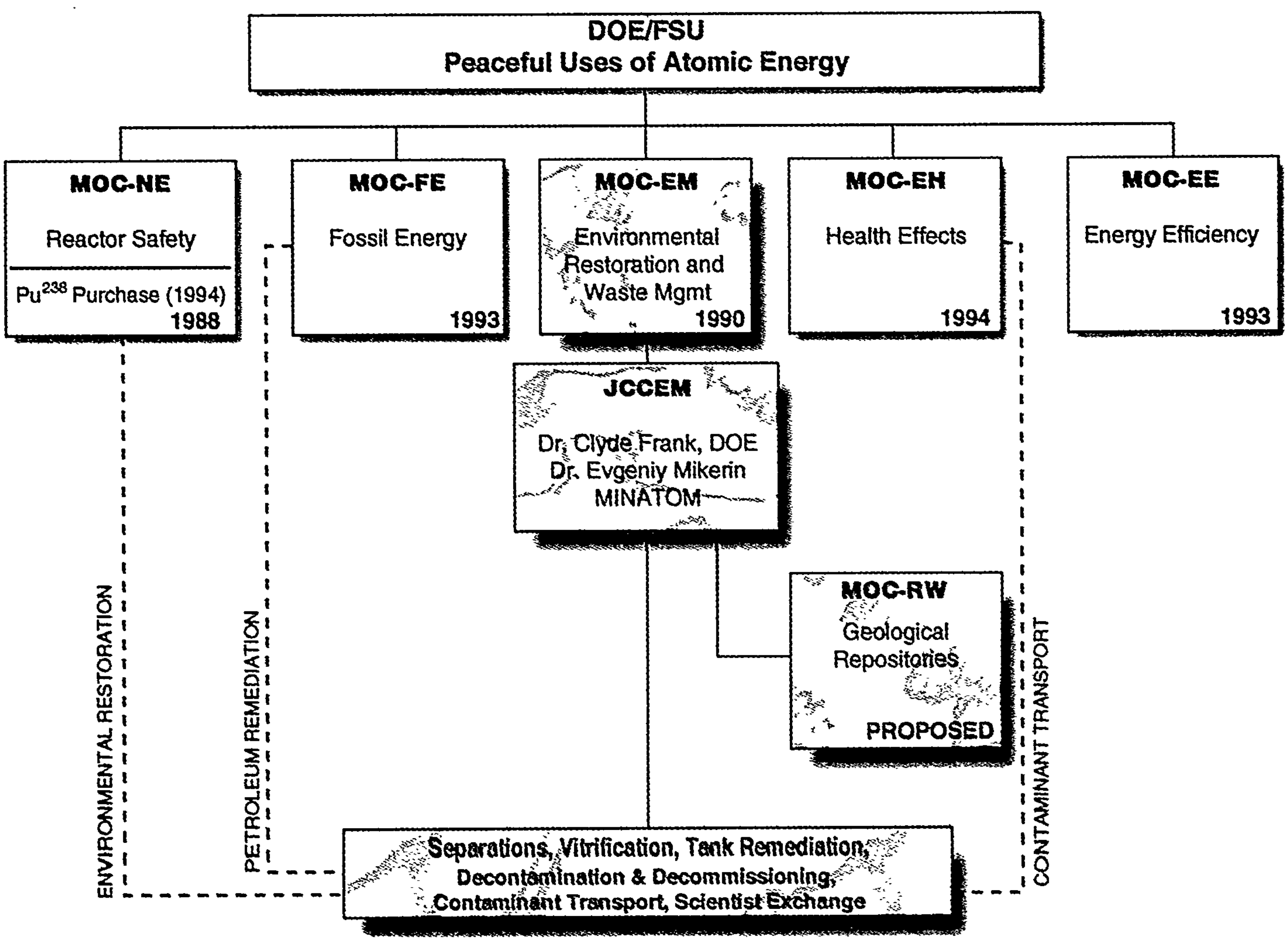


The investment made by the United States in environmental restoration and waste management activities must be double-edged. Taxpayer dollars are spent on site cleanup, but they must also assist in strengthening the national economy, particularly the environmental industry. A stronger domestic environmental industry will improve U.S. competitiveness in international markets and enhance domestic technology development and application.

The EM directive necessitates looking beyond domestic capabilities to technological solutions outside the boundaries U.S. DOE interactions with the former Soviet Union (FSU) clearly illustrate this opportunity. The collapse of the Soviet regime has made formerly restricted elite Soviet scientific expertise available to the West. EM has established a cooperative technology development program with FSU scientific institutes that meets domestic cleanup objectives by: 1) identifying and accessing FSU 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 the FSU in EM-related areas.

EM Mission

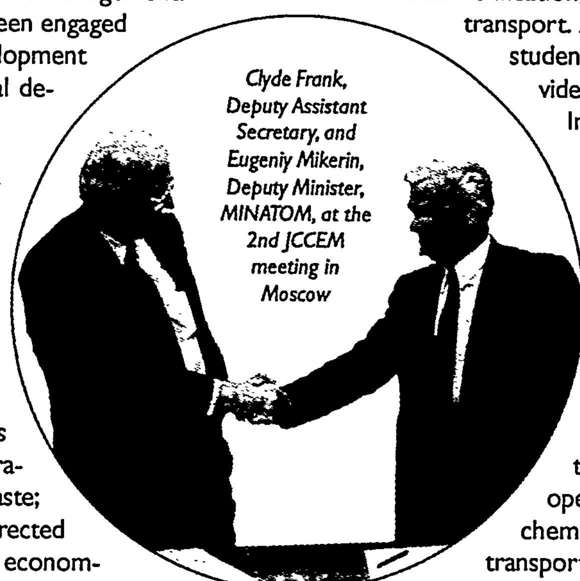
The EM mission is to: 1) treat, store, and dispose of hazardous, radioactive, and mixed waste in an environmentally sound and effective manner; 2) bring all DOE facilities and sites into compliance and operate them in accordance with applicable laws and regulations aimed at protecting public health and 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 production and research goals through its waste management and compliance activities and is also responsible for decontamination and decommissioning of surplus facilities. EM works to ensure that potential risks to human health and safety and to the environment, as posed by the Department's past, present, and future operations, will be either eliminated or reduced to prescribed, safe levels through cleanup of the existing inventory of inactive sites and facilities by 2019.



Memorandum Of Cooperation and the Joint Coordinating Committee for Environmental Restoration and Waste Management

The Peaceful Uses of Atomic Energy (PUAE) Agreement signed between the U.S. and Russian governments provides a mechanism for cooperation in research, development, and safe utilization of nuclear energy, with the primary objective being 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 the FSU 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.



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

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.

FY 95 Technical Focus

Areas of cooperation

- Vitrification/Mixed waste
- Separations
- Contaminant transport/ Characterization
- Radiochemical processing safety
- Scientist Exchanges

The 1st JCCEM meeting was held in Russia in November 1990. A detailed plan was developed 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 FSU government structure, roles, and responsibilities.

The 2nd JCCEM meeting was held in Moscow in November 1992. It resulted in contracts being let with Russian institutes. 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 co-operative programs, EM would open an Environmental Management Project Office to coordinate the activities of this growing program, (see Office description in Program Coordination Section).

The 5th JCCEM meeting was held 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 (ASME International). At this meeting, the MOC was reviewed for renewal for an additional five years. Additionally, Radiochemical Process work was completed and Decontamination and Decommissioning was added as a new area of cooperation. The 6th JCCEM will be held in april 1996 in Phoenix, AZ.

Benefits of Cooperation

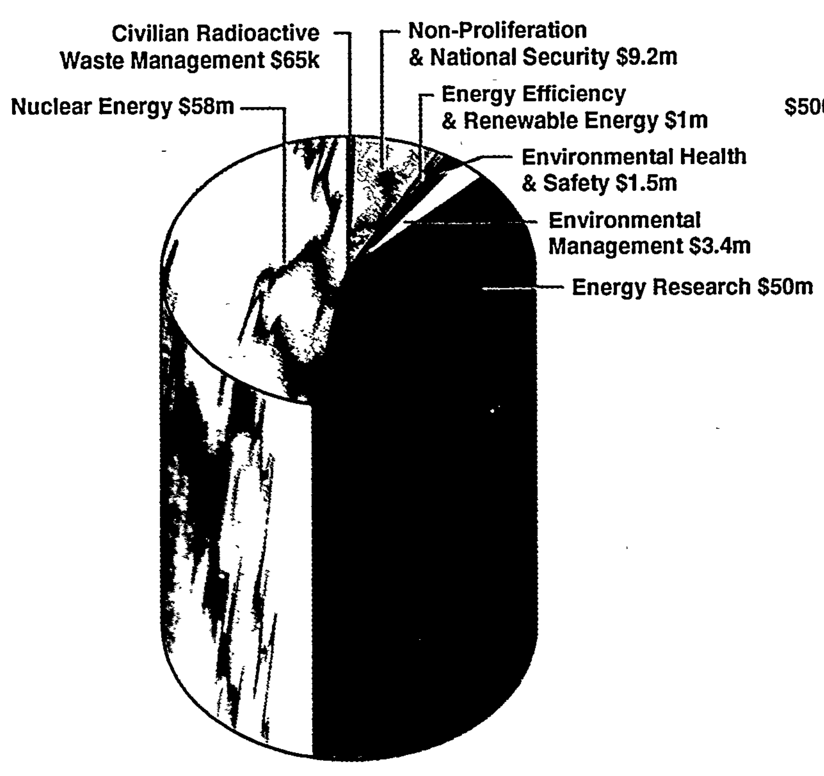
With the end of the Cold War, DOE has the opportunity to benefit from developments in FSU technology that augment and complement its own technology development program. At the same time, the FSU benefits from a cooperative technology development program, by acquiring desperately needed resources from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

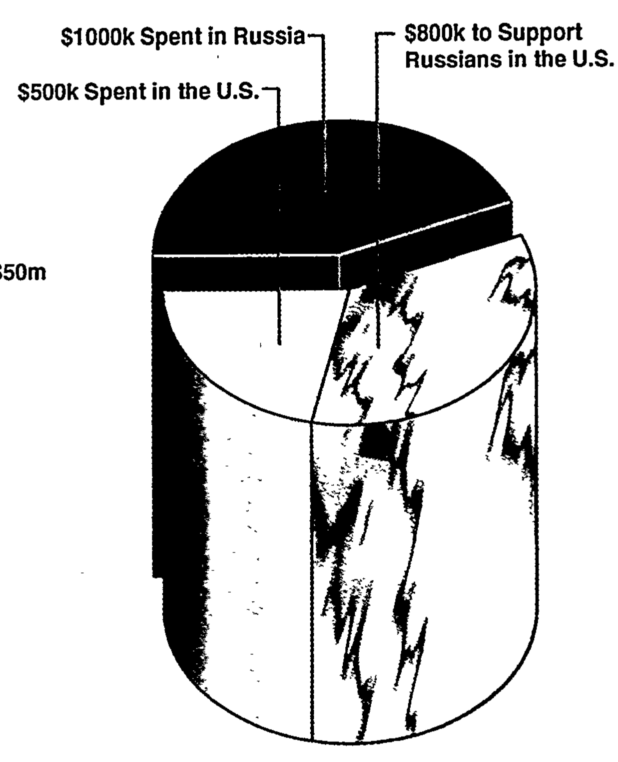
DOE Objectives

- Identify and access FSU 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./FSU needs
- Increase private sector opportunities in the area 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. found the FSU critically lacking in funds necessary for the research and development of new technologies to address environmental cleanup requirements. FSU scientists, struggling with hyper-inflation and salary cuts, found themselves to be highly marketable abroad. Although DOE is not funding the development of FSU infrastructure, it can assist in curtailing the exodus of scientists by using and employing their knowledge on co-operative projects conducted in Russia. By contracting with FSU scientists, the U.S. will benefit financially from a highly leveraged labor force, and the FSU will benefit politically and fiscally.





Environmental Situation

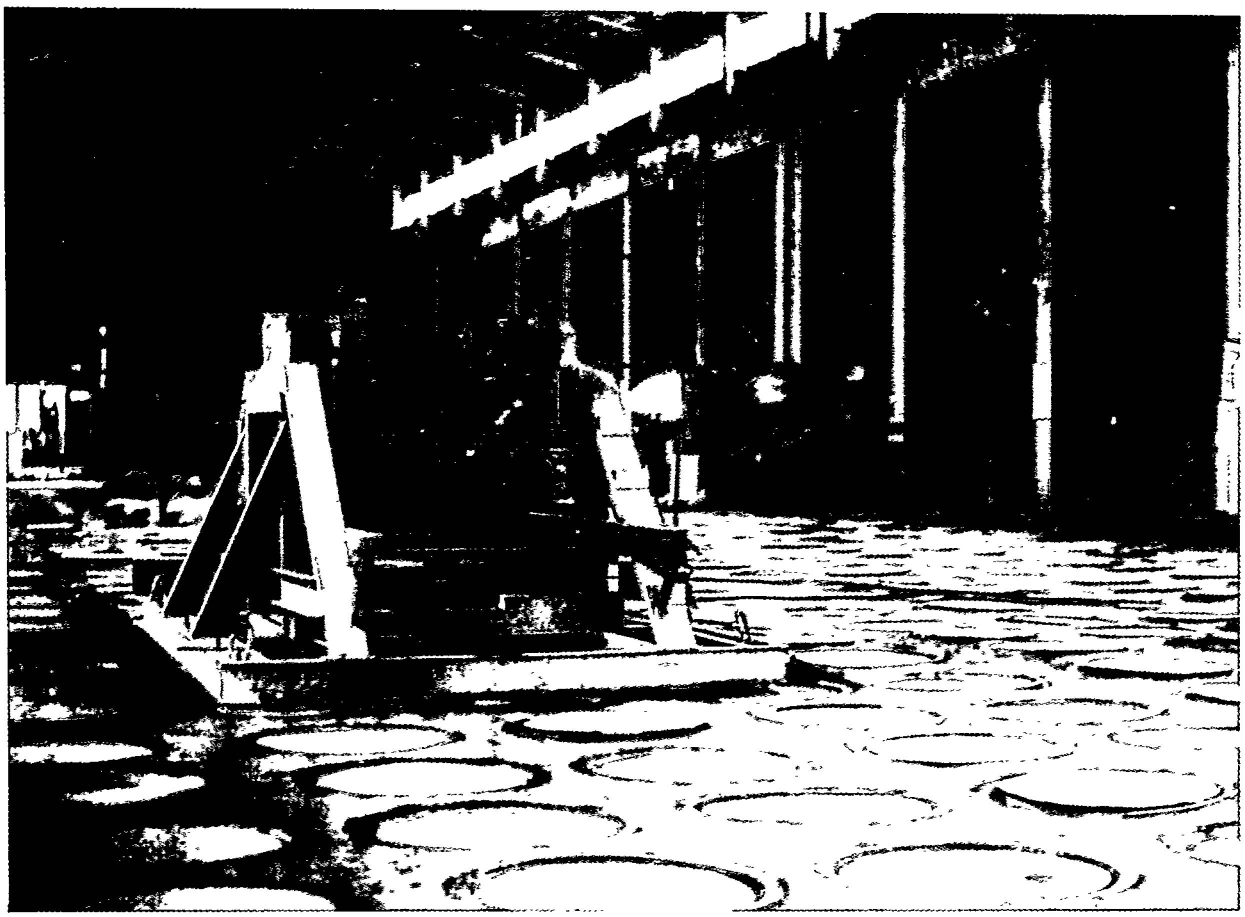
General Problems

In the wake of the collapse of the Soviet Union and with the end of the Cold War, the U.S. and FSU are coming to terms with the environmental legacy and by-products resulting from the arms race. Many dangers are posed by current conditions and results of past practices, including 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 DOE and FSU Complexes

DOE has approximately 4000 contaminated sites covering tens of thousands of acres replete with hazardous or radioactive waste, soil, or structures. It has more than 250,000 cubic meters of transuranic waste and millions of cubic meters of low-level radioactive waste. In addition, DOE is responsible for thousands of facilities awaiting decontamination, decommissioning, and dismantling. Consequently, EM faces major technical, planning, and institutional challenges in meeting its expanded environmental responsibilities while controlling cost growth.

The FSU also operates a vast radioactive waste complex. Accidents at reprocessing sites and discharge of radioactive waste into the environment have caused significant environmental damage. Increasing public concern and international scrutiny have resulted in environmental restoration and waste management issues receiving greater emphasis and attention.



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 such an 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.

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 U.S./FSU cooperative programs that work towards resolving the environmental problems each country faces. It must be stressed that the best solution to environmental contamination from the weapons complexes in both countries involves working together and sharing technologies. The FSU is unique in that past practices offer an unprecedented opportunity to learn certain aspects of contaminant migration and conduct integrated demonstrations, to the mutual benefit of both countries. This, in fact, is the intent of the work being done by DOE and organizations within the FSU.

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 FSU institutes that are applicable to EM needs. This process allows the U.S. to evaluate the qualifications and credentials of key FSU scientists, as well as the potential interest in and likelihood of success of cooperative technology development programs at relatively low risk. The four phases of the process are described in the figure at right.

Technology evaluation & development process

Phase I

- $5-10k contract with Russian organization
- Verify fiscal accountability
- Test technical capability of organization

Phase II

- Experimental research program
- Let larger scale contract $50-150k
- Negotiate protection of intellectual property rights

Phase III

- U.S. testing of Russian technology

Phase Iv

- Technology transfer, and commercialization

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 the FSU and assists in the development of business, legal, and contractual relationships with FSU institutes, while leveraging U.S. labor investment at a ratio of 30:1. All technology development projects conducted in the FSU must assist in DOE's domestic cleanup mission. Several different contractual arrangements were evaluated to demonstrate that subcontracts with FSU 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 the FSU 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.

All money sent to Russian institutes in the form of contracts is transferred via wire transfer through DOE. 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/private company overhead costs. Russian scientists are paid based on the submission of monthly progress reports and other deliverables.

CASE STUDY: Khlopin Radium Institute

A technology development project was begun in August 1992 to establish the integrity of contract mechanisms and technical approach to be used by the Khlopin Radium Institute. 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 scientists' exchanges and major workshops were conducted to trade experience and knowledge, and support contract discussions. For the past two years, the Khlopin Radium Institute 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 HLW. Current tasking includes dynamic testing of the Russian technology at the Idaho National Engineering Laboratory (INEL) for HLW separation, searching and testing of new reactants, and processing and presentation of the Russian methods for analysis, (see Separations Section, Project 1).

Key Concepts

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

Intellectual Property Rights Protection

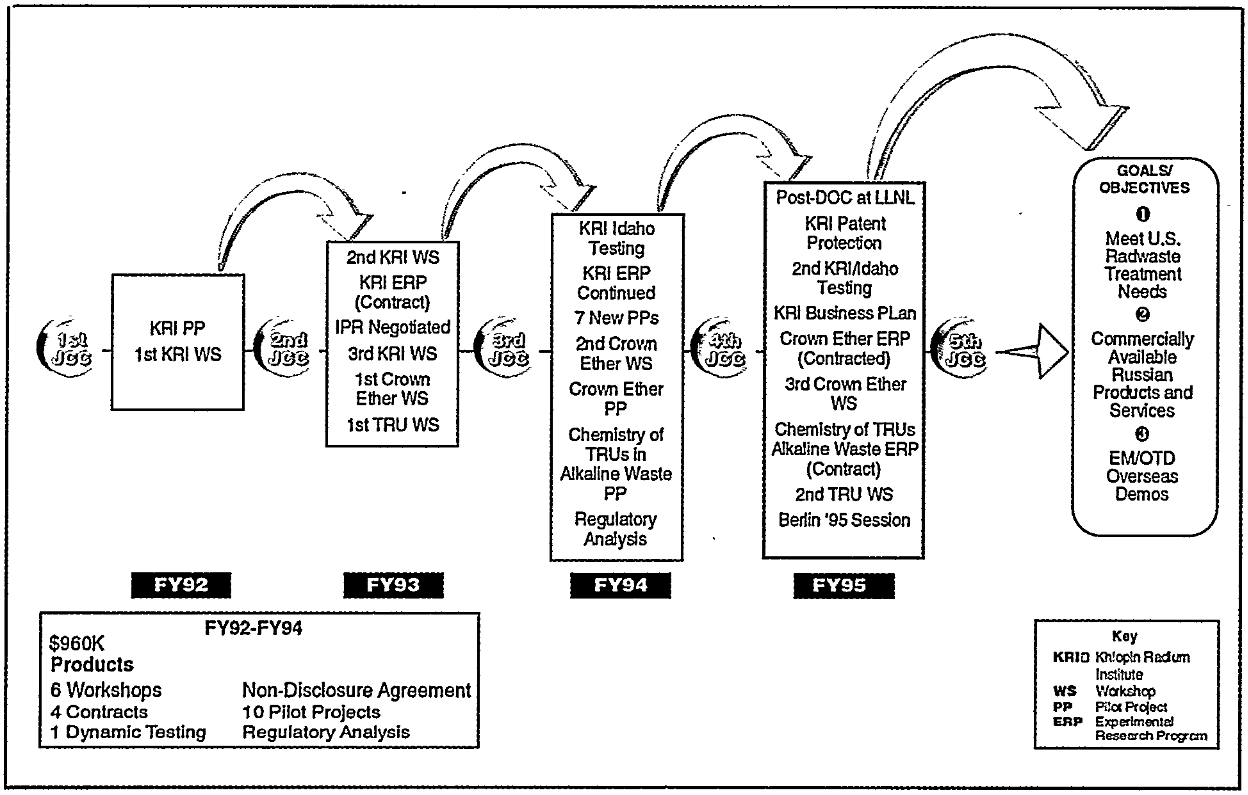
Since this project was the first to involve intellectual property concerns, a significant effort was undertaken to include protection of intellectual property rights and proprietary data rights within contractual documents. Prior to entering into contracts with FSU institutes, DOE had to resolve the issue of intellectual property rights. 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" Intellectual Property Rights protection language. When negotiating a contract with the Khlopin Radium Institute, two of the key areas addressed were limited technical data rights and issues dealing with pre-existing data. Limited technical data rights or pre-existing data or knowledge (i.e. any pre-existing knowledge held by the Russians prior to entry into the contract) can only be used by DOE in terms of evaluating the project being conducted under the 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 of the scope of the contract, then the U.S. must enter into a licensing agreement with Russia. DOE is currently investigating filing U.S. patents on behalf of the Russian Institute to further ensure the protection of the cobalt dicarbollide technology.

Technical Projects

JCCEM: Separations

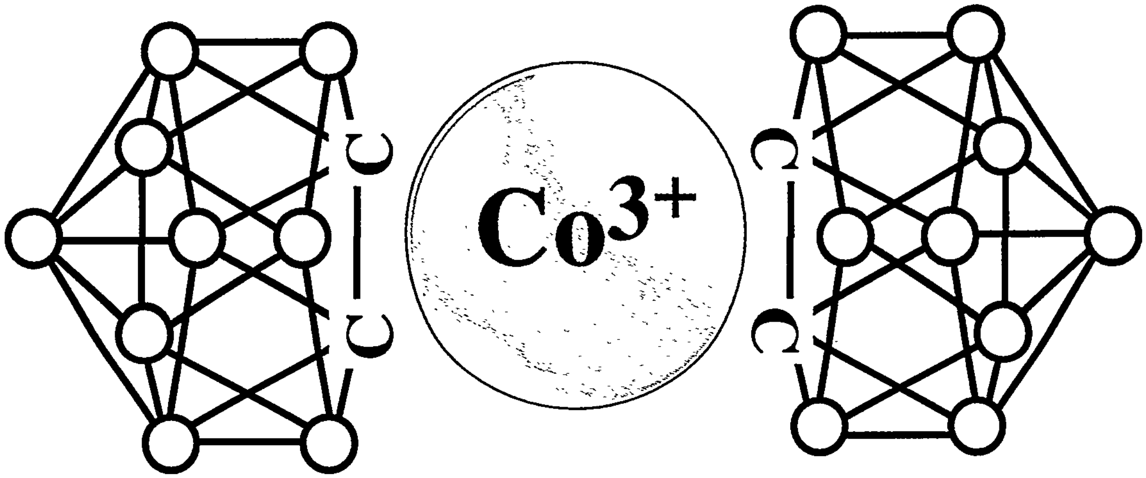
To achieve its mission, DOE must develop innovative technologies rapidly and in accordance with applicable regulations. The mission of the Office of Technology Development is to direct an aggressive campaign for applied research and development to resolve major technical issues and quickly advance EM's cleanup program. In addition to research and development activities in the U.S., efforts have been made to access international technology and experience.

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.

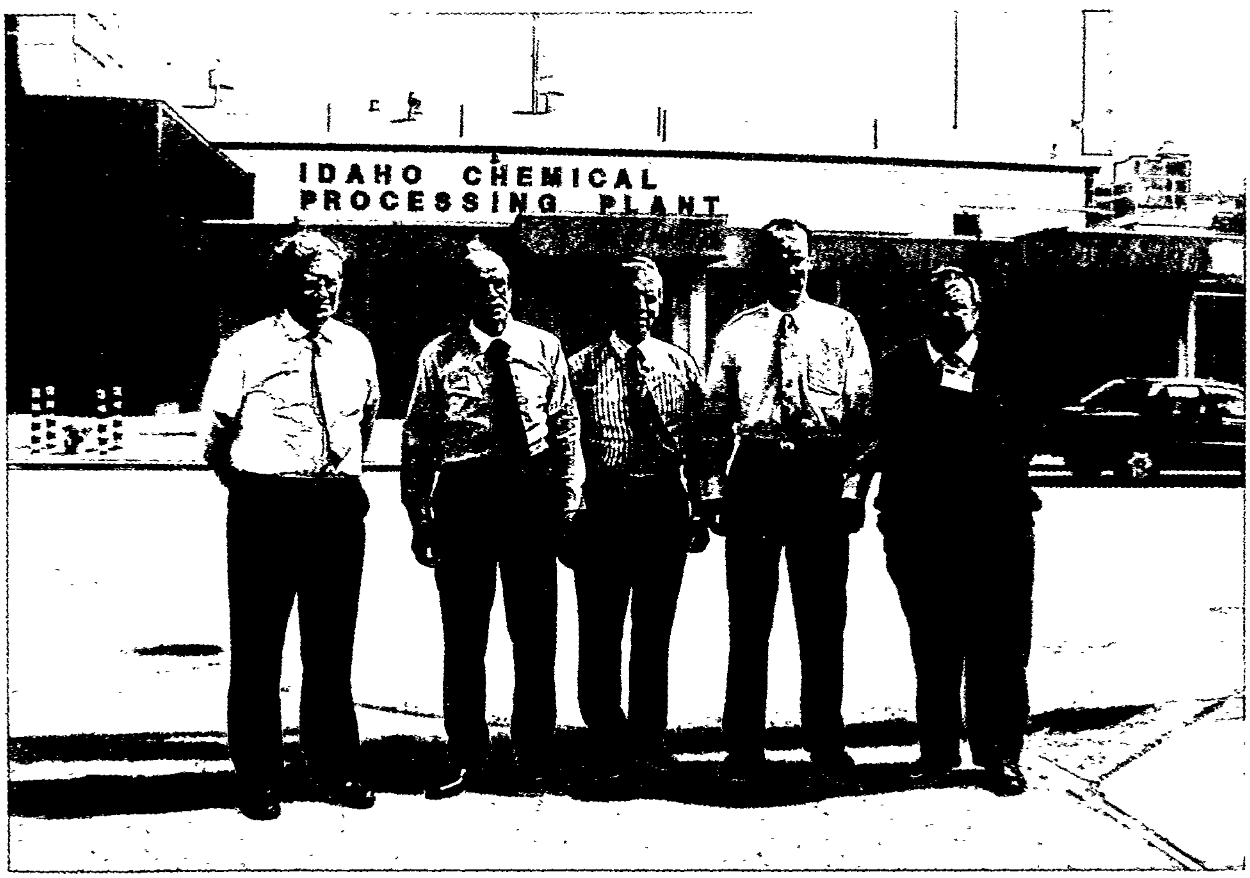


Project 1: Cobalt Dicarbollide

In Fiscal Year (FY) 1993, DOE initiated an experimental research program with the Khlopin Radium Institute 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. Data were 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.



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 Russia and Czechoslovakia, 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 and solvent are mixed and dispersed, the cesium or strontium contaminant moves from the solution to the solvent. The



Scientists from the Khoplin Radium Institute participate in Colbalt 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

Russian and American scientists discuss separations experiments at INEL

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 (or any foreign group), 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 other former eastern bloc countries, and 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

Using Crown Ethers for Removal of Long-Lived Radionuclides and Toxic Metals from Low- and High-Level Radioactive Wastes

In FY 94, the DOE initiated a project with the Russian Institute of Chemical Technology, in conjunction with "IN-

FORM-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. The final report for this project is available upon request.

This project has been expanded in FY 95 to address the "Application of Extraction Technology Using Crown Ethers for Removal of Cesium from HLW on the Acid Side." For FY 95, 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 INEL; and
- Test and optimize the proposed solvent extraction systems on aqueous solutions simulating INEL waste.

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 five research projects:

- ***Recovery of ^{137}Cs from HLW by Sorption Technique with Copper Ferrocyanide:*** Tasks include: documenting Russian experience in application of copper ferrocyanide-based sorbents for the recovery of ^{137}Cs from HLW solutions, performing the set of batch experiments with HLW simulants (to be provided by INEL), and performing the set of column flow tests with HLW simulants;
- ***Research in the Field of Actinide and Technetium Redox Reactions and the Development of Techniques for their Stabilization in Particular Oxidation States in Alkaline Media:*** Taskings include: performing a systematic study of the interaction of neptunium(IV) and plutonium(IV) with O_2, O_3, MnO_4^-, $S_2O_8^{2-}$, $Fe(Cn)_6^{3-}$, FeO_4^{2-}, CrO_4^{2-} ClO^-, and BrO^- in 0.5 - 14 M NaOH, examining the possibility of Np(V) and Pu(V) oxidation by O_2 in pure alkaline solutions and in the presence of complex forming anions, determining ionic forms of Tc in 0.5 - 14 M NaOH in the presence of N_2H_4, NH_2OH, SO_3^{2-}, and other reductants, investigating the kinetics of Np(V), Pu(V) and Am(V) reduction by N_2H_4, NH_2OH, SO_3^{2-}, etc., in the alkaline media of different composition, and studying Tc(V) and Tc(IV) oxidation by O_2, O_3, MnO_4^-, ClO^-, and BrO^- in 0.5 - 14 M NaOH.
- ***Co-Precipitation of Actinides (IV), (V), and (VI) from Alkaline Solutions:*** Tasks include: determining reagents prospective for the co-precipitation of transuranium elements from alkaline solutions by the method of appearing reagents, investigating alternative ways for conversion of selected reagents from soluble forms to precipitates in alkaline media of different compositions, and investigating the behavior of Np(V), (IV) and Pu(V), (VI) in solutions with various NaOH concentrations in the course of the formation of $Mn(OH)_2$, $Fe(OH)_3$, etc. from soluble compounds;
- ***Determination of Hydroxo Compounds Np(IV) - (VI), Pu(III) - (VI), Am(III) - (VI) and Tc(IV), (V) Solubility in 0.5 - 14 M NaOH Solutions:*** Tasks include: determining the solubility of Np(IV) and Pu(IV) hydroxides in 0.5 - 14 M NaOH in conditions excluding formation of Np(V) and Pu(V), studying the effect of complexing ions on the solubility of Np(IV) and Pu(V) hydroxides in reducing conditions, developing experimental techniques for preparation of hydrated and dehydrated Tc(IV), (V) oxides using different reducing agents, and studying the "aging" process of Tc(IV), (V) hydroxides in 0.5 - 14 M NaOH and its effect on their solubility, and
- ***Radiolysis of Actinides and Technetium in Alkaline Media:*** Tasks include: studying the radiolysis of alkaline and carbonate-alkaline solutions of penta- and hexavalent neptunium, and studying the influence of g- radiation on the oxidation of Tc(IV), (V) and the reduction of Tc(VII) in alkaline aqueous solutions.

JCCEM: Site Characterization and Contaminant Transport

The Chelyabinsk site, in the southern Ural Mountains of Russia, presents an unfortunate but unique opportunity to study the 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 (MLW) were directly discharged into the Techa River. After 1951, MLW's 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, they form a database that 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.

Chelyabinsk Field Study:

In FY 94, a team of DOE/EM scientists and engineers participated in a two-week field sampling at the Mayak Site in Chelyabinsk. As a result of the FY 94 field work, technology development projects have been initiated with the Siberian Chemical Combine, Hydrospetzgeologiya (HSG), and the Mayak Production Association to perform site characterization and contaminant migration studies of the Mayak and Tomsk sites.

A final report detailing the technical results of the September 1994 Field Study will be distributed at the 5th JCCEM.

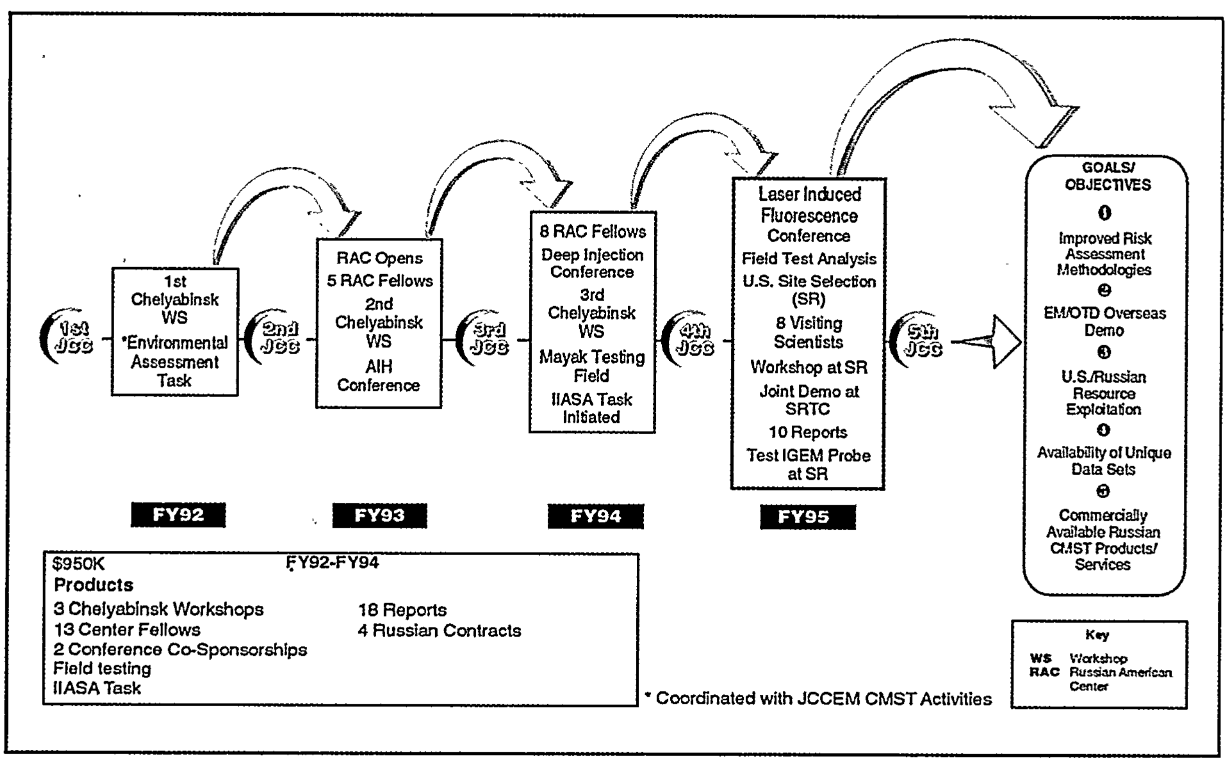
'95 Technical Focus

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
- Chelyabinsk-65
- Krasnoyarsk-26

4. Visit to Pacific Northwest Laboratory to study U.S. Models



Russian Report List

EM sponsored research resulted in the publication of the following contamination transport reports:

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 Reservoirs 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	Russian Academy of Sciences, Moscow
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To order reports listed, contact Elizabeth Flage, EM52.1, at (301) 903-7955

Project 1: PNL Contaminant Transport Modeling

Currently, the JCCEM is managing characterization projects on behalf of EM at the Tomsk and Mayak Sites. In conjunction with 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 Site Characterization and 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. In addition, the September 1994 Mayak Site Field Study will be completed and a report on its results presented.

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 modelling and evaluation of the effectiveness of existing waste injection strategies. Missing data will be synthesized from existing data sources and site understanding.

Project 2: Characterization Demonstration

During the Third Environmental Remediation Course this year, the site characterization group was presented information on environmental data collected and reported at the Savannah River Site. The strategy for cost-effective characterization is based on site screening methods, understanding geochemistry, and linkage of sampling plans to a unified conceptual model of site geology and groundwater/surface water hydrology. Advances in groundwater modeling were also presented, and SRS coordinated a day of field sampling in the seepline zone near Indian Grave Branch to locate the distal end of a tritium plume near K Reactor. The Savannah River Ecology Laboratory, which co-hosted the site characterization group, discussed its advanced analytical methods and molecular scale modeling, as well as radioecology studies. The Russians discussed their work in areas of drilling, geophysics, radioecology, and deep well injection.

Project 3: Western Siberian Basin

EM is working with the Pacific Northwest Laboratory (PNL) to develop three-dimensional numerical models of the hydrogeology and potential contaminant migration in the West Siberian Basin. DOE uses such models to evaluate the potential for risk from contaminated U.S. sites, and to design mitigation strategies for them. Studies of the West Siberian Basin, which contains the largest amounts of surface and subsurface radioactive contaminants on earth, provides an excellent opportunity to verify and validate DOE models and modeling strategies using decades of data from full-scale experiments. In this model verification and validation effort, PNL's objectives are to enhance DOE-developed contaminant migration models, and to determine future environmental and human impacts given the releases that have occurred to date in the West Siberian Basin and the waste management practices still in use there.

Tasks include: 1) quantifying the regional hydrogeology of western Siberia to define the boundary conditions for determining the hydrology and contaminant migration at the contaminated sites, as well as long-term contaminant migration pathways; 2) quantifying the local hydrogeology of the Mayak, Tomsk, and Krasnoyarsk defense production sites and evaluate their potential contaminant release scenarios and migration pathways; and 3) quantifying contaminant migration from and potential health effects at these sites for specific contaminant releases and compare results with Russian monitoring data over the past thirty years.

JCCEM: Mixed Waste Treatment/Vitrification

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: Applications of Catalysts to Treatment of Mixed Waste Off-Gases

In FY 94, the Boreskov Institute of Catalysis and DOE initiated a technology development project to evaluate "Applications of Catalysts to Treatment of Mixed Waste Off-Gases." Selective Catalytic Reduction (SCR), using ammonia as a reducing agent, is currently a preferred method of treating NO_x in off-gases. The advantages of SCR over methods such as wet scrubbing are compact design, low maintenance, absence of gas cooling requirements, and absence of secondary wastes. Any further improvements in catalyst design would lower the costs, improve their resistance to poisons, expand their ability to promote oxidation/reduction in mixtures such as NO_x/CO, and increase their mechanical strength. An additional requirement of catalysts for use in California is that the catalyst formulations meet the California Land Ban disposal restrictions. The Boreskov Institute of Catalysis formulated and shipped a new iron/chromium/zinc oxides monolith honeycomb catalyst with improved mechanical strength and higher activity, as well as a Honeycomb Catalyst Testing Unit to Lawrence Livermore National Laboratory as a result of their past work together. Initial testing of this catalyst has been completed and its performance in NO_x destruction has exceeded expectations.

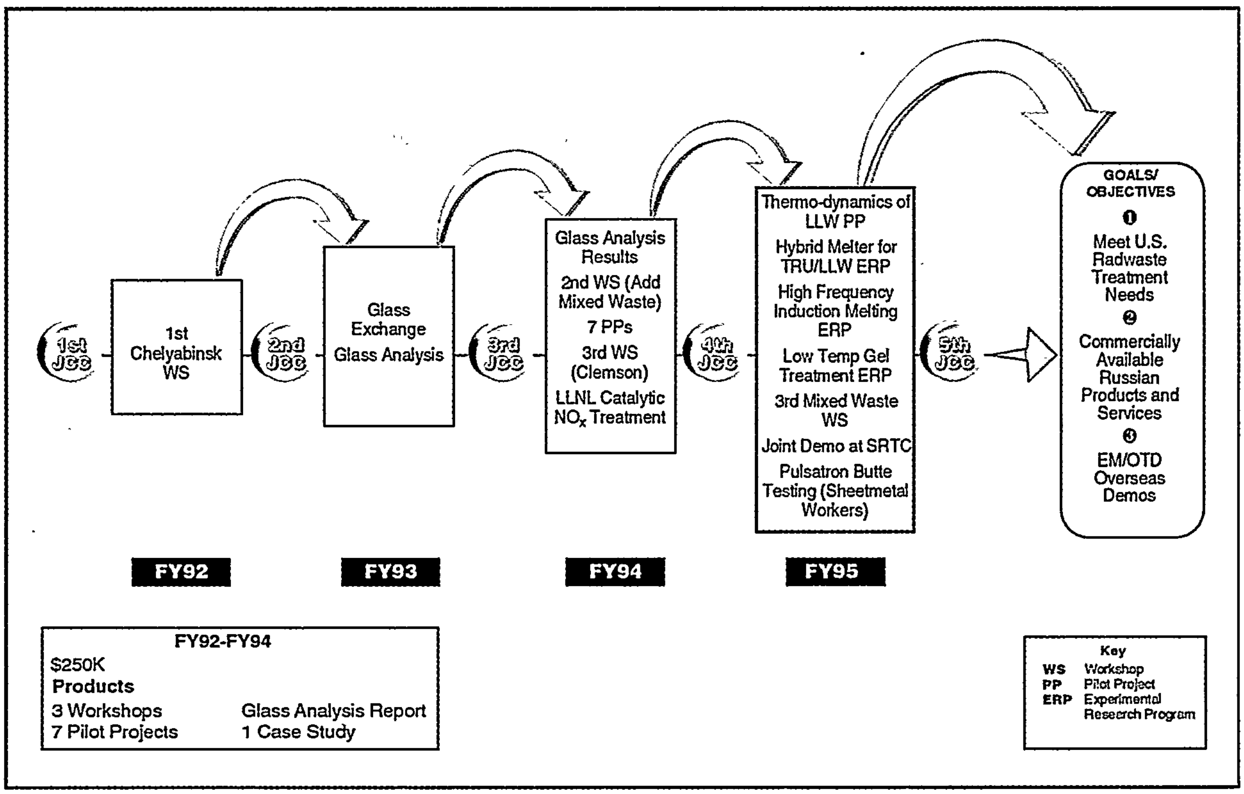
Two FY95 tasks are involved with "Applications of Catalysts to Treatment of Mixed Waste Off-Gases:"

- A technology development project involving "DeNO_x Catalysts for Improved Off-Gas Treatment." This activity will generate baseline data for NO_x reduction catalysts and development of a rapid (accelerated) catalytic activity testing method. Preparation of modified (improved) monolithic honeycomb catalysts (8 samples: 75 x 75 x 150 mm) for eventual transfer to and testing at LLNL will be initiated; and
- Three reports discussing state-of-the-art details of the following waste treatment technologies: 1) photocatalytic decomposition of hazardous volatile organic compounds via heterogeneous gas-phase catalysis; 2) wet catalytic oxidation of organics by molecular oxygen; and 3) decomposition of hazardous chlorinated organic compounds via catalytic hydrogenation.

Project 2: Designing and Manufacturing a Pilot-Scale Apparatus for Reprocessing Solid Mixed Radioactive Waste — Plasmatron with Induction Cold Crucible Melter (PICCM)

EM has contracted with the Russian Institute for Chemical Technology and the PLASTECH Corporation to provide a pilot-scale apparatus suitable for experimental research on reprocessing and vitrification of solid mixed radioactive waste by means of induction and plasmochemical melting in the cold crucible. The PICCM apparatus will be capable of operation in a continuous mode due to the continuous feeding by solidified mixed waste through the special loading system, stable controlled melting, discharge of the mineral slag to the water-cooled tank, and the formation of metal ingots by means of the movable bottom. The pilot-scale system will consist of the following:

- Plasma-induction cold-crucible melter (PICCM);
- Power supplies for the inductor and plasmatron;
- Vacuum system;
- Water-cooling system;
- Monitoring and control system; and
- Cold pot — diameter: 200mm.



Under this Agreement, the Russian side will maintain ownership of the equipment and provide the equipment for test and evaluation in the designated U.S. laboratory. The U.S. side includes the Savannah River Laboratory and the Georgia Institute of Technology, where the melter will be installed. This team will support the costs of assembly and testing of the equipment according to a specified cost schedule. Tasks include:

- Providing the design specifications for the pilot system apparatus;
- Completing the design drawings for PICCM (Summary Report);
- Assembly and subsystem testing of the standard equipment;
- Assembly and subsystem testing of Plasma-Induction Furnace and non-standard auxiliary units;
- Full system testing of the PICCM in the Russian research institute;
- Shipment of the apparatus and auxiliary units to the U.S. laboratory;
- Installation, adjustment, testing and start-up of the PICCM in the cooperating U.S. laboratory; and
- Second (optional) phase of development if initial testing is successful.

Project 3: Solidification of Radioactive Wastes by High Temperature Adsorption of Metals with Inorganic Porous Matrices

EM has engaged the Russian Institute of Chemical Technology (INFORM-ATOM) to compile a written review of the Russian experience for the technology and apparatus for solidification of radioactive wastes by the method of high-temperature adsorption of metals with inorganic porous matrices. In addition, this project will examine the solidification of transuranium elements by the methods of high-temperature sorption of radionuclides onto silica gel using surrogate and radioactive solutions on a laboratory scale.

Project 4: Recovery of Noble Gases from Electronic Scrap via Metal Melt Extraction by Means of Induction Furnace

In this project, INFORM-ATOM is undertaking a written review of Russia's and other countries' experience in the implementation of pyro-metallurgical methods for recovery of gold and silver from electronic components. This will include:

- Investigation into the preparation of the electronic scrap for pyro-metallurgical processing to preclude a loss of noble metals, and the hazardous influence of decomposition products of organic materials inherent in electronic components, as well as information regarding tests of various types of furnaces and the application of various metal extractants;
- Identification and reporting on the potential application of the Russian technology of melting in the induction furnaces with cooled pots for the specific problem of gold and silver recovery into copper and lead matrices from the electronic scrap to be supplied by DOE;
- Testing and optimization of the proposed extraction by the metal melt of copper using the electronic scrap that will also be supplied by DOE. Test results will include data on: 1) single-stage extraction and the subsequent conversion of iron, nickel, and other key metals inherent in electronic components into slag; 2) a level of extraction of gold and silver into the metal extractant; and 3) losses of gold, silver and metal extractant; and
- Evaluation of test results, recommendation of a technical flow sheet for further testing, and identification of potential problems and possible solutions.

Recent progress reports indicate that a review of the available experience in the United States, England, Germany, Sweden, and Russia is underway. In addition, an experimental melting technique in the furnace with a cold crucible is being developed. Finally, preliminary experiments on lead and copper melting in the induction furnace are being conducted.

Project 5: Simulation of Thermodynamic Properties of Melts and Glasses in the System Na2O-CaO-SiO2

The Thermex Corporation is undertaking experimental research on "Simulation of Thermodynamic Properties of Melts and Glasses in the System Na_2O-CaO-SiO_2." This project includes the following tasks:

- Critical analysis of data from the book *Thermodynamics of Silicates*, by V.I. Babushkin, G.M. Matveyev, and O.P. Mchedlov-Petrosyan;
- Comparison with data obtained from the (Russian) Institute of Silicate Chemistry as well as with data reported by Neudorf and other authors;
- Familiarization with the Morris computer program, from the University of Missouri-Rolla; and

- Calculation of activities and chemical potentials of the oxide components of the soda-lime silica system.

JCCEM: High-Level Waste Tanks

Project 1: Krasnoyarsk 26 Tanks:

EM has engaged the Integrated Mining Chemical Company (IMCC) of Krasnoyarsk, Russia to undertake research toward "Development of Equipment for Extraction of Radioactive Pulps and Cakes from Storage Facilities in Krasnoyarsk-26 and Hanford." Tasks include:

- Developing technical documentation of the equipment for stirring, extraction, and transmission of slurries from storage facilities with a volume of 3,000 m^3, revision of the hydromonitor for stirring slurries in tanks, placing a complete set of hydromonitors and hydroelevators in storage tanks and assembling pipelines to transmit slurries to the place of processing preparation, and development of a pump to extract slurries for the final stage of cleaning out the storage tank;

- Manufacturing prototype units for stirring and extraction of slurries and their assembly in storage tanks, manufacturing a complete set of hydromonitors and assembly in the storage tank;

- Manufacture and assembly of a pump in the storage tank; and

- Performance test of units and equipment for extraction of slurries with real radioactive wastes, testing of the unit for extraction of slurries (with a complete set of hydroelevators and hydromonitors), and testing of the pump under conditions of cleaning out the storage tank.

A technical exchange workshop will be held in January 1996, in Augusta, Georgia to determine the next steps for the tank retrieval program.

JCCEM: Scientist Exchanges

Project 1: Environmental Remediation Course

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 FSU 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.

The Second Environmental Remediation Course for Russian scientists was held in Washington, D.C. and Oak Ridge, Tennessee, in August 1994. The first week presented an overview of the Federal Government's programmatic role regarding environmental restoration and remediation from representatives of DOE and other U.S. government agencies. The second week highlighted technologies and activities at the Oak Ridge site with respect to approaches to the restoration of contaminated sites.

The Third Environmental Remediation Course was held in Washington, D.C., Oak Ridge, Tennessee, and Savannah River, South Carolina, in June 1995. This course concentrated on technologies being developed in the Mixed Waste Focus Area and the Site Characterization crosscutting program. The course objectives included the following:

- Providing an overview of technical programs and projects in mixed waste treatment, site characterization and contaminant transport, and risk communication and public participation;

- Developing opportunities for Russian scientists to network with their peers in DOE laboratories, universities, and in private industry;

- Introducing the Russian scientists to national, regional, and local perspectives on environmental management;

- Enhancing two-way interactions, with emphasis on creating joint business ventures; and

- Developing follow-up mechanisms, such as electronic mail communications and/or other resources to support continuing collaborations and future exchanges.

In addition, this course is intended as a "model" that may be transported and used with other countries and organizations. Following the two-week course, the Russian participants observed characterization and mixed waste technology demonstrations at the Savannah River Site.

June 1 & 2: Washington, D.C.

Overviews on Department of Energy Programs with Russia in the area of Environmental Restoration and Waste Management were given by:

- International Policy Office;
- Office of Environmental Health and Safety;
- Office of Public Accountability; and
- Office of Environmental Management.

June 3-14: Oak Ridge, Tennessee

Overviews and technical demonstrations at Oak Ridge were presented in the following areas:

- Environmental Restoration of Soils and Groundwater;
- Decontamination and Decommissioning of Nuclear Facilities;
- Innovative Technology Development and Deployment;
- Tank Waste Remediation and Management;
- Risk Assessment;
- GIS and Aerial Platform Overview;
- Water Processing and Disposal Program;
- In-Situ Soil Heating;
- Mixed Waste Programs;
- Environmental Education; and
- Public Involvement and the Regulatory Process.

June 15-22: Savannah River Site, SC

At Savannah River, the delegation was divided into two groups according to individual expertise: characterization and mixed waste. The characterization group reviewed U.S. developments in monitoring technologies, made presentations on Russian characterization techniques, received an overview of the Savannah River Ecology Lab, and had tours of the Defense Waste Processing Facility, the Consolidated Incinerator Facility, and the Saltstone Facility.

The mixed waste group began the third week with a demonstration at the Clemson University Vitrification Research Center. At Clemson, Russian scientists gave presentations on such topics as "Nobel Metals Recovery" and "Hybrid Melter Systems." At the Savannah River Site, Russian and American scientists exchanged technical information on mixed waste processing, with the talks cited below:

- Silica Gel Processing;
- Immobilization of Specific Isotopes and Off-gas Control;
- Developing Glass Compositions to Meet Waste Disposal and Process Requirements;

Participants and sponsors of the 3rd Environmental Remediation Course in Oak Ridge, Tennessee, June, 1995

A delegation of 14 Russian scientists spent 3 weeks learning and sharing technical information during the 3rd ER course in Oak Ridge and Savannah River.

- Air-nitric Acid Oxidation of Solid Organics;
- Thermal Dynamics of Glass Melts; and
- Stabilization of Low-Level Radioactive Wastes.

Project 2: Technical Exchange Workshops

The EM Office of Technology Development program managers have played a very active role in pursuing technical exchanges with their Russian counterparts. The workshops listed below are 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	June 1993	Berkeley, California
Cobalt Dicarbollide Separations	April 1994	Idaho Falls, Idaho (first Idaho testing)
Contaminant Transport	May 1994	Berkeley, California
Crown Ether Workshop	August 1994	Gatlinburg, Tennessee
Tank Remediation Workshop	August 1994	Miami, Florida
Cobalt Dicarbollide Separations	July 1995	Idaho Falls, Idaho (second Idaho testing)
Radiochemical Processing	August 1995	Los Alamos, New Mexico
Contaminant Transport	November 1995	Washington, D.C.
Tank Retrieval Workshop	December 1995	Augusta, Georgia
Mixed Waste	January, 1996	Idaho Falls, Idaho
Decontamination and Decommissioning	TBD	

Project 3: University and Laboratory Exchange

In 1994, four Russian graduate students began 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 will be employed as research assistants at INEL. 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.

Idaho State University Students, (from left) Dmitri Drozhko, Oleg Tolstikhine, Irina Glagolenko, and Pavel Medvedev.

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 extensive knowledge of electrokinetic remediation of sites contaminated with heavy metals (lead, mercury, cadmium, etc.), radioactive species (^{137}Cs, ^{90}Sr, ^{60}Co, etc.), and anionic species (nitrates, sulfates, etc.). An extensive portion of the FSU 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 DOE, 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 solubilized uranium through the silty clay soil. Other Oak Ridge 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.

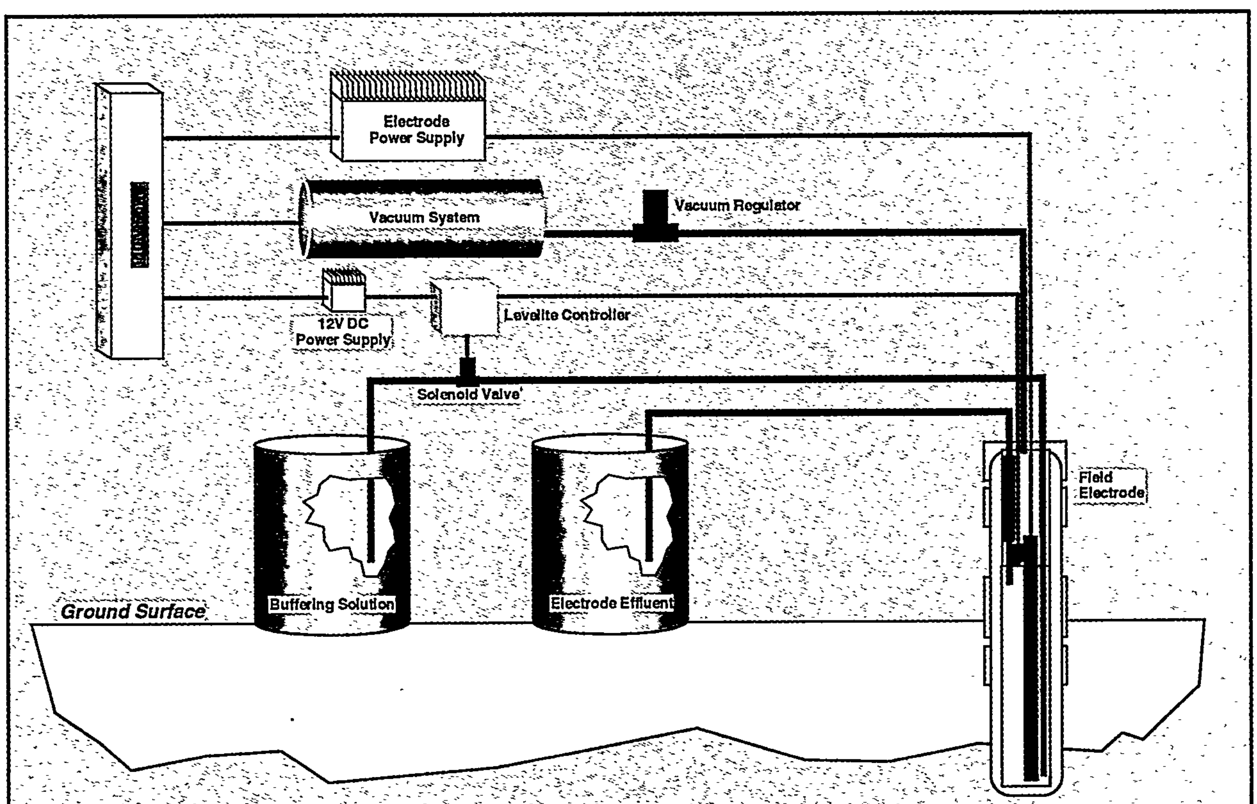
HAZWRAP personnel have visited sites in Russia where electrokinetics have been used to remediate uranium contamination from soil. In addition, four teams of Russian electrokinetic experts travelled to the U.S. during 1994 for short visits to meet and work with their U.S. counterparts on small samples of soil from the K-25 Site at Oak Ridge. Laboratory-scale testing has been completed and preparations are underway to accommodate pilot-scale demonstrations during FY 95 on contained quantities (approximately 1 ton) of uranium-contaminated soil from the K-25 Site.

Project 2: Siberian River Sampling

EM supported a DOE/Naval Research Laboratory Russian Joint Environmental Expedition to Characterize the Chemical and Nuclear Source Terms in Siberian Facilities and Rivers in the summer of 1995. The objective of the task was to investigate and measure both the chemical and readionuclide source terms and potential pathways from land-based sources in the Siberian watersheds of the Ob and Yenesei Rivers that discharge into the Kara Sea.

Project 3: Application of U.S. Models: RESRAD and MEPAS

The introduction and delivery of two types of computer codes to Russia, RESidual RADioactivity (RESRAD) and Multimedia Environmental Pollutant Assessment System (MEPAS), provides an opportunity to assess environmental contamination and risks to human health, while offering significant cost savings by avoiding unnecessary cleanup. The RESRAD computer code was developed at the Argonne National Laboratory for the purpose of calculating site-specific guidelines for assessing the degree of contamination at a given location. For the purposes of code validation and verification, it is necessary to compare the results of RESRAD calculations with results from other



Electrokinetic process for Soil Remediation codes and results from actual sites. Interaction with scientists from the FSU will permit comparison of predicted code results with actual experience in contaminated areas. These activities will help confirm that the code is scientifically valid and adequately protects public health. The issue of cost reduction is closely linked to domestic regulatory code acceptance. In 1993, DOE spent over $1 billion for the cleanup of radioactively contaminated soil and debris. With the regulatory acceptance of the risk-based standards established using RESRAD, DOE could recognize significant cost savings from avoiding unnecessary soil cleanup.

MEPAS, developed at PNL, serves as a means to estimate the impact of released contaminants on the environment and human health. The model was developed to rate DOE sites and their potential hazard from release of contaminants. MEPAS calculates a 'Hazard Potential Index" (HPI) for a site by gathering and assessing risk factors associated with various scenarios. Population exposure is determined by evaluating contaminant transport through four means:

- groundwater;
- surface water;
- overland flow; and
- atmosphere.

In addition to magnitudes, the system provides information on the type, time, and location of impacts. These risk-based indicators provide a basis for assigning priorities to environmental problems, and MEPAS has been used to prioritize potential problems related to different sites.

MEPAS is applicable to a wide range of potential environmental problems involving various stages of problem characterization. The system handles problems involving radionuclides and chemical carcinogens as well as non-carcinogens, any of which can originate from landfills, stacks, pipes, and other sources. MEPAS can be operated with contaminant source-term data obtained during the early stages of problem investigation, allowing it to be applied in a preemptive manner to a variety of environmental problems and locations. A technical exchange workshop will be held in November 1995 in Washington to discuss the FY 96 course of work for the JCCEM site characterization and contaminant transport projects.

Project 4: Tulane/Xavier

Under a grant from DOE, the Tulane/Xavier Center for Bioenvironmental Research (CBR) has established a cooperative research program with The Institute of Radioecological Problems of the Academy of Sciences of Minsk, Belarus (IRPB). In January 1994, a graduate student from the IRPB was enrolled in a Ph.D. mechanical engineering degree program at the Engineering School at Tulane University. He brought a Chernobyl data set, which is currently being applied to contaminant transport modeling codes. Research involves two projects: 1) the transport of radionuclides in marsh and forest fires; and 2) the transport of radionuclides in the Iput River which flows through the "Bryansk Cesium Spot," one of the most heavily contaminated regions in the FSU. Two graduate students from Minsk are currently enrolled in Ph.D. programs, and are analyzing the data using computer simulations to see if they are applicable to the situation in Belarus.

Fossil Energy Memorandum of Cooperation

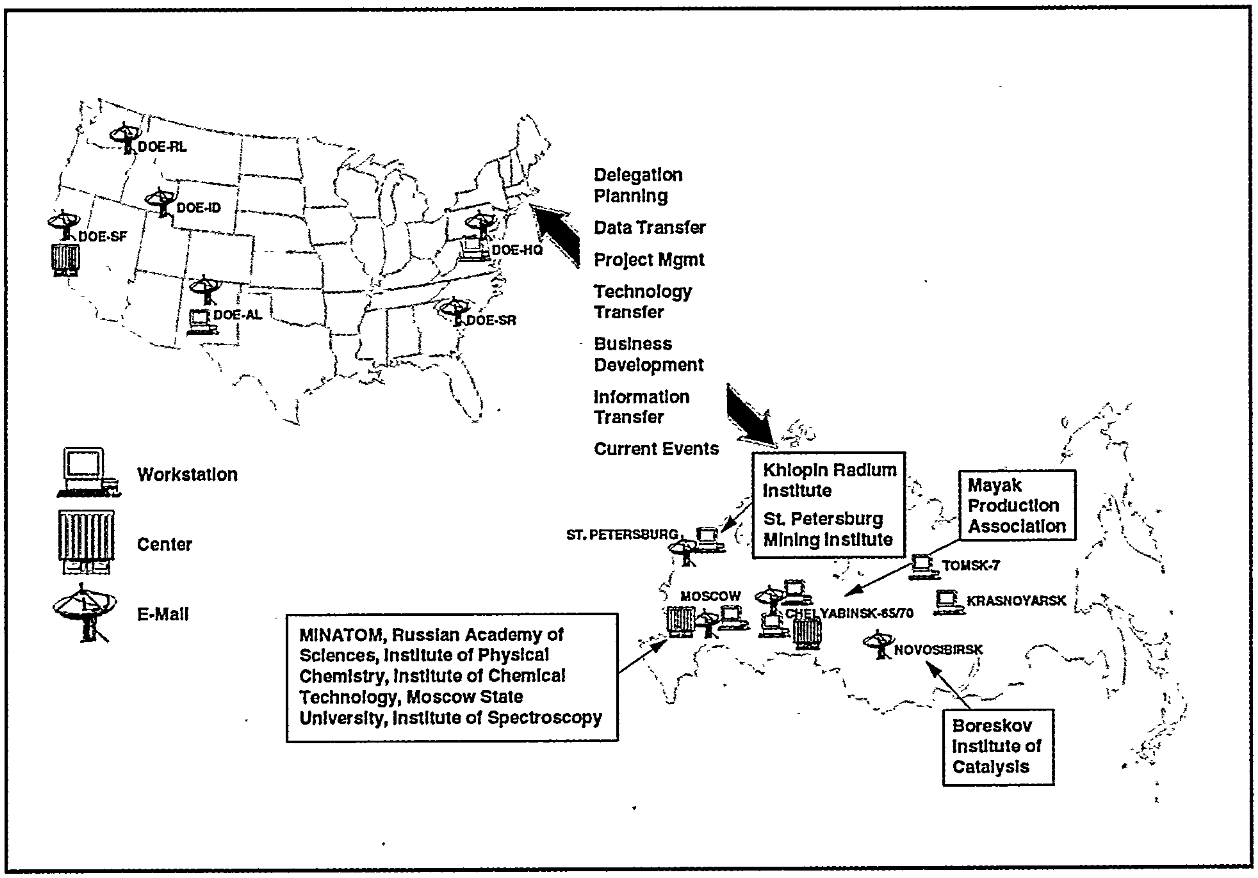
On June 17, 1992, DOE and the Russian Federation Ministry of Fuels and Energy signed an "Agreement on Scientific and Technical Cooperation in the Fields of Fuels and Energy." The purpose of this MOC was to establish cooperative activities in the areas of fossil energy, related technologies, and associated economic developments to advance the common interests of the parties and their industries in the environmentally acceptable and economic use of fossil fuels and technologies. Article II, Section 3, states areas of cooperation applicable to EM: "Environmental assessment, protection, and remediation techniques and procedures considering all aspects of fossil fuel utilization."

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 the FSU 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: Sun Microsystems Workstations

EM, in partnership with Sun Microsystems and Sandia National Laboratory, has provided Russian scientists with the hardware and software capability to collect, display, and analyze hazardous and radioactive contamination within their borders, and to identify appropriate cleanup technologies from the U.S. and other countries. The first system was delivered to Russia in August 1993, and is located at the Mayak Production Association in Chelyabinsk, Russia. Additional systems have been delivered to the Khlopin Radium Institute in St. Petersburg and to the Russian Academy of Sciences. EM also has established electronic mail links to facilitate communication with a variety of Russian institutions involved in EM-cooperative projects. This network enables a continuous information flow concerning FSU science in general, and specific data regarding contaminant transports and health effects, in particular. EM is investigating locations for establishing additional workstations at other key FSU locations.



Project 2: EM Moscow Office For The Office Of Technology Development

The Office of Technology Management (EM-50), will establish an Environmental Management Coordination Office in Moscow, Russia to provide technical management support to EM program managers on Russian-related projects and to facilitate greater communication between U.S. and Russian environmental organizations. The purpose of the EM Moscow Office is to reduce the management and travel costs associated with administering EM's Russian initiatives.

CHARTER:

The EM Moscow Office will assist EM program managers, especially focus group leaders, with the planning, implementation, administration, and oversight of project work being conducted in Russia to address EM needs in environmental restoration and waste management (ERWM). The types of projects that the Moscow Office will support include U.S./Russian ventures in ERWM science and technology cooperation, international technology transfer, and international coordination. The EM Moscow Office shall also assist EM-50 to identify EM-related technologies for application in the United States, facilitate technology transfer between U.S. and Russian organizations, and establish an information center to promote U.S. and Russian scientific exchange.

Dr. Frank, Rebecca Keen, and Dr. Mikerin at the 4th JCCEM in Moscow

FUNCTIONS:

The EM Moscow Office functions that will carry out the above charter include:

1. Administrative management related to progress reporting, technical reviews, in-country logistics, bilingual (English/Russian) translation, and operation of a technical information clearinghouse;
2. Close coordination with EM program managers, especially EM-50 and 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 research and development and to facilitate greater ERWM technical and scientific exchange; and
5. Contract management related to proposal solicitations, contract tracking, and auditing.

Routine Moscow Office Activities and Commitments:

- Technical Reviews: The EM Moscow Office will participate in technical and project reviews as assigned by EM-50;
- Reviews of Status Reports: Comments on Russian project status reports prepared by the Russian Principal investigators will be provided to EM-52 for distribution to the relevant EM program managers;
- Weekly Highlight Report: A brief narrative report in bullet form will be prepared to summarize significant EM Moscow Office activities;
- Monthly Reports: End of the month performance input will be provided to the support services contractor (in the proper format and with the appropriate Activity Tracking System (ATS) documentation) detailing past support, projected activities, and deliverables prepared;
- Solicitation Reviews: Input and assistance will be provided to EM-50 in preparing and broadcasting open solicitations to the Russian scientific community for ERWM technical proposals. Guidance will be given to Russian Principal Investigators in developing technical proposals (format, structure, etc.) for EM-50 review. All Russian proposals will collected by the EM Moscow Office and sent to the appropriate EM program manager(s). Additionally, semi-annual reviews of Russian environmental studies will be conducted to identify opportunities for new project development;
- Contract Tracking and Auditing: EM project funds will be monitored, to ensure the funds reach their appropriate destination, are applied to the proper activities as directed by EM-50, and produce the intended milestones and deliverables;

- Communications: General and project specific interface will be established between the EM Moscow Office, EM program managers, and the Russian Ministries and Institutes to convey EM scientific/technical needs, translate priorities, and develop stronger working relationships between EM and Russian environmental experts. Publications, briefings, and public communiques will be developed in accordance with EM-50 direction to communicate joint U.S./Russian environmental activities. Translators and interpreters will be provided as needed;

- Information Collection and Dissemination: An information clearinghouse will be established to collect, store, and manage the most current ERWM data/information that may be accessed by the Russian Principal Investigators for use in executing their projects. Appropriate databases will be developed and maintained to facilitate data organization and retrieval;

- Workshop / Conference / Meeting Coordination: Logistical and administrative support will be provided to aid EM-50 in planning, organizing, and executing in-country U.S. delegation visits, Russian foreign travel, and Russian project workshops and meetings; and

- Training and Scientific Exchange: The EM Moscow Office will act as the in-country point of contact for the EM Student/Scientist Exchange Program. The office will collect, review, and transfer student/scientist resumes to the appropriate EM program manager, and will provide comment and recommendations, as appropriate, on the selection of participants in the program. The office will support EM-50 implementation and assessment of the program's progress.

5th International Conference on Radioactive Waste Management and Environmental Remediation: ICEM '95

EM sponsored and participated in the September ICEM '95 in Berlin, Germany. ICEM '95 was the fifth biennial global information exchange to examine solutions to radioactive waste management and environmental remediation problems. Over 700 scientists, engineers, project directors and managers, and business representatives from more than 40 countries were in attendance. ICEM '95 sponsors solicited approximately 115 papers from Central and Eastern Europe. The conference's four parallel program tracks were:

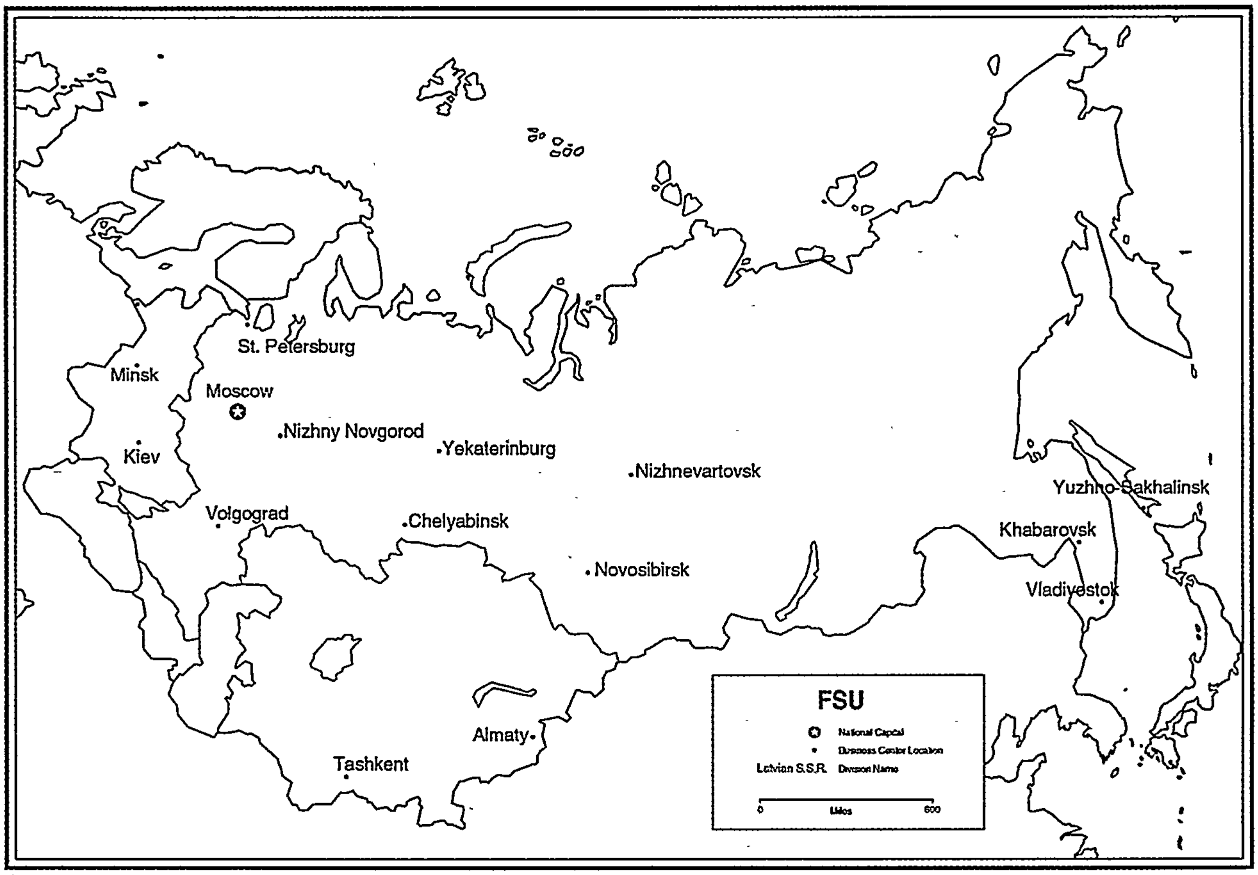
- Low-/Intermediate-Level Waste Management;
- HLW, Spent Fuel, and Nuclear Materials Management;
- Environmental Remediation and Facility D&D; and
- Major Institutional Issues in Environmental Management.

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 the FSU. 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:

> *environmental business centers should be established in the states which offer promising market opportunities for U.S. environmental goods and services and the Far East of the FSU. 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.*

Locations of the centers are shown in the figure on the following page.

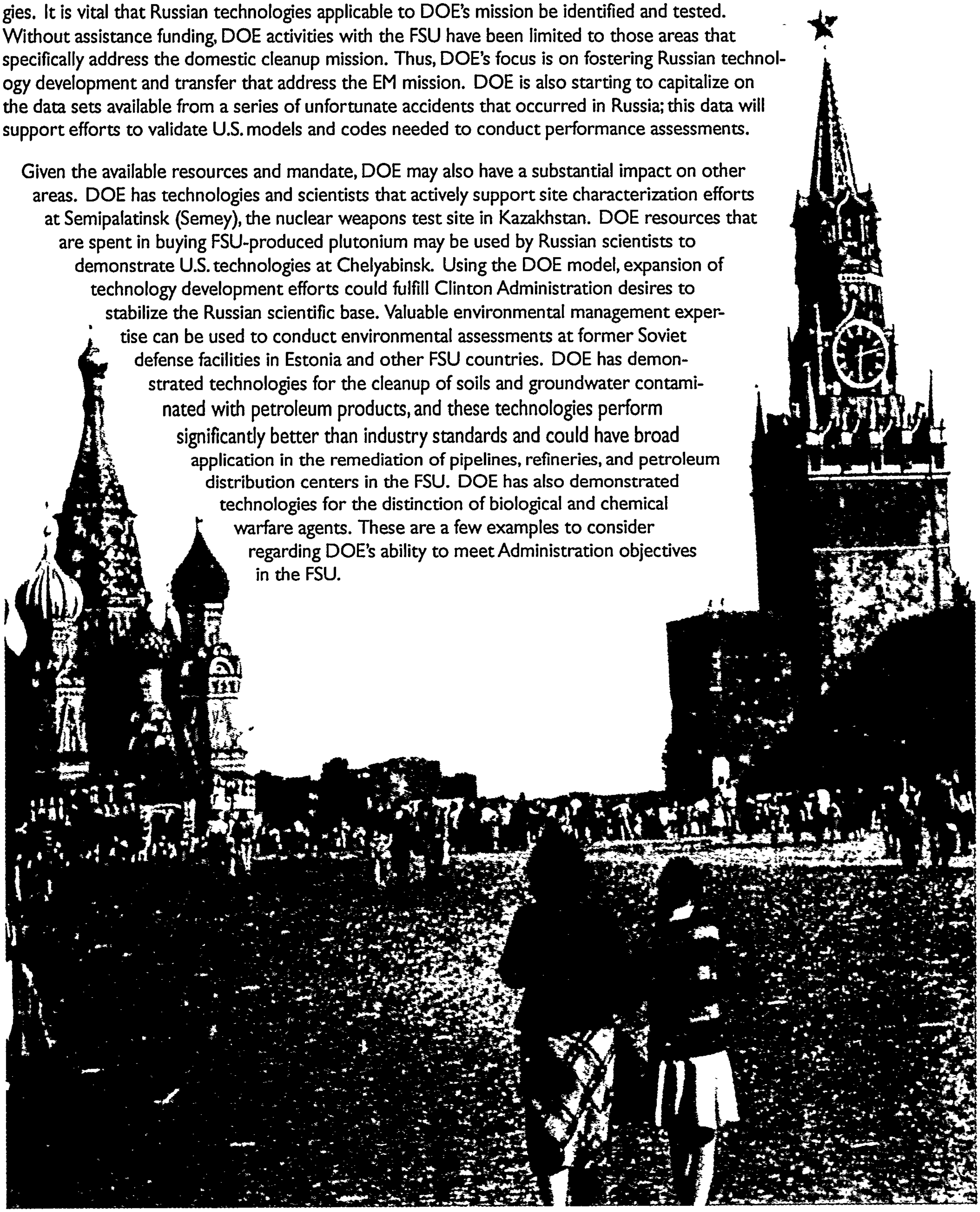


American Business Centers

Future Actions/Conclusion

DOE and MINATOM will continue to confirm their commitment to implementing the MOC, and the existing programs will be continued and enhanced in the area of contaminant transport modeling and separations technologies. It is vital that Russian technologies applicable to DOE's mission be identified and tested. Without assistance funding, DOE activities with the FSU have been limited to those areas that specifically address the domestic cleanup mission. Thus, DOE's focus is on fostering Russian technology development and transfer that address the EM mission. DOE is also starting to capitalize on the data sets available from a series of unfortunate accidents that occurred in Russia; this data will support efforts to validate U.S. models and codes needed to conduct performance assessments.

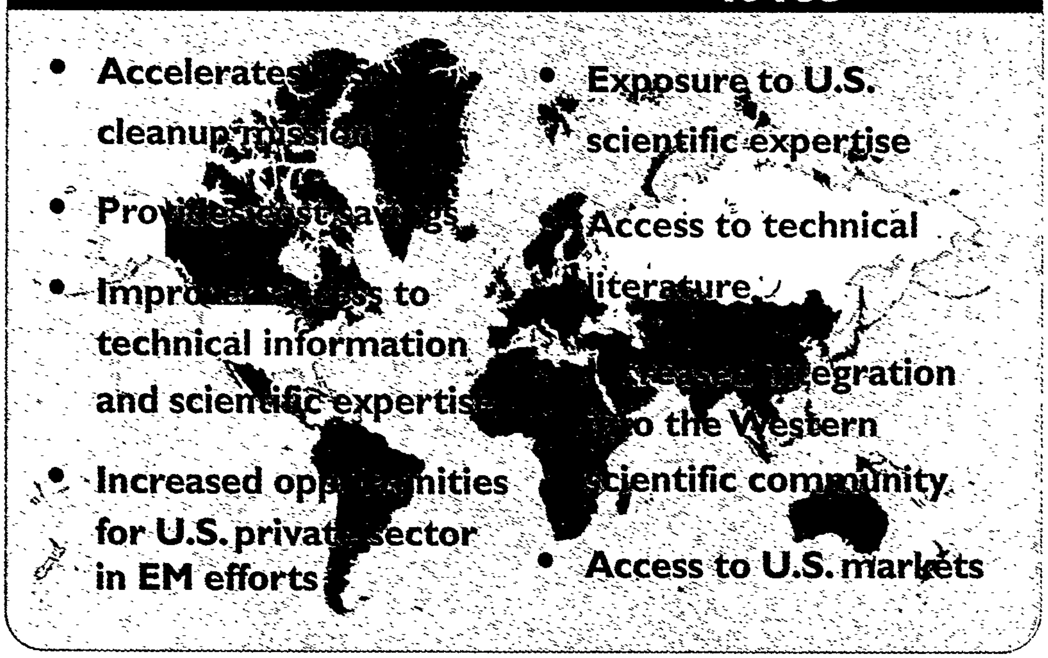
Given the available resources and mandate, DOE may also have a substantial impact on other areas. DOE has technologies and scientists that actively support site characterization efforts at Semipalatinsk (Semey), the nuclear weapons test site in Kazakhstan. DOE resources that are spent in buying FSU-produced plutonium may be used by Russian scientists to demonstrate U.S. technologies at Chelyabinsk. Using the DOE model, expansion of technology development efforts could fulfill 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 FSU 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 the FSU. DOE has also demonstrated technologies for the distinction of biological and chemical warfare agents. These are a few examples to consider regarding DOE's ability to meet Administration objectives in the FSU.



JCCEM Program Costs

(Figures in $000s)

Program Area	FY92	FY93	FY94	FY95	Totals
Separations	0	500	460	335	1295
Contaminant Transport	0	300	650	300	1250
Mixed Waste- Vitrification	50	70	130	315	565
Underground Storage Tanks	0	0	0	50	50
Scientist Exchanges	110	280	280	500	1170
Tech ID and Workshops	220	405	870	650	2145
Program Support	15	115	145	150	425
Totals	395	1670	2535	2300	6900



To U.S.

- Accelerates [illegible] cleanup mission
- Provides cost savings
- Improved access to technical information and scientific expertise
- Increased opportunities for U.S. private sector in EM efforts

To FSU

- Exposure to U.S. scientific expertise
- Access to technical literature
- Increased integration into the Western scientific community
- Access to U.S. markets