**Russian - United States
Environmental Restoration Workshop**

April 11 - 18, 1993

Richland, Washington

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Prepared by the U.S. Department of Energy

Richland Operations Office

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Executive Summary

The Russian - United States Environmental Restoration Workshop, held in Washington, D.C., and Richland, Washington, from April 5 through 18, 1993, was the first extended collaborative information exchange between the U.S. Department of Energy (DOE) and Russian scientists at the site level. In addition to the Russian scientists, workshop participants included scientists and staff from DOE, Pacific Northwest Laboratory (PNL), Westinghouse Hanford Company (WHC), the U.S. Environmental Training Institute (USETI), universities, and the private sector.

The first week (April 5 through 10) of the workshop took place in Washington, D.C., where the Russian and U.S. participants were presented with a U.S. perspective on environmental restoration and remediation issues from representatives in DOE and the U.S. Environmental Protection Agency (EPA). The second week (April 11 through 18) occurred in Richland, Washington, where the participants were presented with site-specific environmental restoration and remediation issues related to Hanford Site cleanup. This report is a compilation of the presentations, discussions, and experiences shared during the second week of the workshop in Richland, Washington.

The primary goals of the workshop were to 1) provide a general overview of DOE's experience in environmental restoration, followed by focusing on site-specific examples at Hanford; 2) initiate and develop contacts between the Russian institutions and nuclear sites; 3) learn about the Russian nuclear waste issues and possible lessons learned; and 4) establish a model for conducting international exchanges through a team approach.

During the workshop, it became apparent that in addition to the goals listed above, the information exchange:

- illustrated the similarities between the Russian waste sites (e.g., Mayak) and the Hanford Site
- highlighted the need for a Hanford/Russian team approach to conducting environmental restoration
- identified technologies for possible transfer to other countries
- identified future private sector and commercial development opportunities
- promoted international goodwill.

Lessons Learned

The overriding message that all participants shared was the need for more international information exchanges such as this workshop. In addition, the following summary highlights other important lessons learned during this workshop.

Joint Partnerships

The participants stressed the urgent need to establish a joint partnership to address some of the world's most challenging environmental problems. In addition, because of the similarities between the Hanford Site and the Mayak Site, the possible future exchange of information and technology between these two sites was discussed.

Remediation Goals

Workshop participants stressed the need to provide cheaper, faster, and safer cleanup of waste sites. Some of the ideas for achieving this goal included sharing information on existing technologies at each site and developing mutually beneficial innovative technologies.

The Russians believe Hanford is generally cleaner than their sites and do not see the need for such low limits. This statement is based on the results of their medical histories, health data, and studies conducted on public exposures from their past accidents. Their data indicate much higher levels of exposure for incidence of cancer and other diseases, suggesting a threshold effect.

Open Communication

Three major ecological challenges face Russians at this time: 1) rehabilitation of the territory due to the contamination from the defense era, 2) cleanup of waste similar to that at Hanford, and 3) completion of a full characterization of the inventory of wastes.

As part of the solution process, the participants discussed the need to accurately communicate to the public the environmental challenges. Participants discussed the development of compatible communication tools that could be presented in both English and Russian languages.

Conclusion

As a result of the success of this workshop, a high level of interest and enthusiasm exists among the Hanford and Russian environmental specialists to establish a formal scientific partnership for the remediation and restoration of nuclear waste sites.

This workshop is important to DOE because increased awareness in DOE programs will improve the chances of foreign groups identifying their own technologies that can support DOE goals. By showcasing key DOE priorities and the Hanford Site, the visibility of Hanford and DOE needs will be greatly enhanced. Also, as the former republics of the Soviet Union gain access to resources to restore their environments, DOE and Hanford could provide some of the technologies needed. It is also anticipated that Russian interaction with the private sector may provide a foundation for identifying future private sector opportunities and commercial development.

This workshop paved the way for future collaborative work with our Russian counterparts in environmental restoration and waste management activities. It also provided an exciting opportunity for many organizations of the Tri-City area in Washington State to work together and share their experiences with Russian scientists who are beginning to confront the scope of remediation activities in their countries.

Acknowledgment

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Russian Delegation Biographical Information

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Mr. Drozhko is the Deputy Chief Engineer at the Mayak Production Association. His previous experience is managing radioactive wastes. In 1982, he was a technical science candidate. Mr. Drozhko graduated from the Moscow Physical Engineering Institute in 1971.

Dr. Albert Seminovich Aloy

Dr. Aloy is in charge of the laboratory at the V.G. Khlopin Institute in St. Petersburg, Russia. In the near future, he will be collaborating with Mayak Production Association in Chelyabinsk on high-level waste management and the new reprocessing plant RT-2 near Krasnoyarsk. Dr. Aloy completed his doctorate at the Institute of Inorganic Chemistry in 1972. His expertise is in the field of vitrification.

Dr. Serguei Mikhailovich Tchesalov

Dr. Tchesalov is the vice-president for the Commonwealth of Independent States Environmental Planning Group, Inc. From 1987 to 1992, Dr. Tchesalov worked in the scientific and industrial hydrology division at the Ministry of Construction and the Academy of Sciences. He also worked in the Ministry of Health's hydrogeologic laboratory from 1983 to 1987 after teaching at Moscow State University (1971 to 1983). He received his doctorate of geology from Moscow State University in 1976.

Vladimer Meerovitch Gelis

Mr. Gelis is in charge of the laboratory at the Institute of Physical Chemistry of the Russian Academy of Sciences. He was a junior scientific worker from 1970 to 1982 and a senior scientific worker from 1982 to 1988. He was appointed head of the laboratory in 1989. Mr. Gelis completed his physics-chemistry education at Mendeleev's Chemical Technology Institute.

Guennady Romanov

Mr. Romanov is the head of the Experimental Research Station at the Mayak Production Amalgamation. Mr. Romanov has experience in radioecology, radiation dosimetry, emergency planning, mitigation, restoration of environments, and agricultural radioecology. He attended Urals Polytechnical Institute and was a technical science candidate in 1971.

Dr. Oleg Kedrovsky

Dr. Kedrovsky is the chief engineer at the Department of Atomic Energy at the Industry and Technology Institute in Moscow. He has previous experience in engineering ethology, waste disposal, and radiation safety. Dr. Kedrovsky also has taught at the Geological Academy of Russia on hazardous waste disposal and remediation of the environment. He received a degree in mining engineering from the Mining Institute in St. Petersburg, Russia.

Igor Khodakovsky

Mr. Khodakovsky is the chief research scientist at the Vernadsky Institute of Geochemistry and Analytical Chemistry. During the past 10 years, he has represented the Russian Academy of Sciences in international organizations such as IAGC, CODATA, and IUPAC. He is currently studying in the Geological Department at the Moscow University.

Alexandre Vasilievich Komerov

Mr. Komerov is the department head of the All-Russian Research Institute of Chemical Technology in Moscow. He received his master's degree in chemistry in 1969 from the Moscow Chemical Technology Institute.

Dr. Valery Alexander Mironenko

Dr. Mironenko is a professor at the St. Petersburg Mining Institute and corresponding member of the Russian Academy of Sciences. He has 30 years of experience in engineering and research work in hydrogeology, as well as 20 years experience as a professor of hydrogeology. He has a Ph.D. in hydrogeology and engineering geology from the Mining Institute in St. Petersburg.

Dr. Valeriy Romanovskiy

Dr. Romanovskiy has been the department head at the V.G. Khlopin Radium Institute in St. Petersburg since 1969. Also, he will be working with the high-level waste management group at Mayak in Chelyabinsk. Dr. Romanovskiy received his PhD in physical chemistry from the Technology Institute in St. Petersburg. In the near future, he plans to apply new skills toward remediation in the Ural region.

Dr. Viktor Glebovich Volkov

Dr. Volkov is the technical director of the Russian Research Center. He has spent 20 years at the Kurchatov Institute of Atomic Energy. Dr. Volkov also participated in the cleanup of the Chernobyl accident in 1986.

Dr. Igor Sobolev

Dr. Sobolev is the general director of the RADON amalgamation production site near Moscow. He has training in radioactive waste management and attended the Moscow Geological Institute.

Vera Pavlovna Kolosova

Ms. Kolosova is a special correspondent for the State Television and Radio Company "Ostankino" in Moscow. In 1986, she became a member of the Russian Journalists' Union. She received her degree in journalism from Moscow State University. In 1990 and 1991, Ms. Kolosova was a participant in the cultural and ecological conference "Vozrozhdenie," sponsored by the Russian Union of Cinematographers.

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Introduction

The first U.S. Department of Energy (DOE) Russian - United States Environmental Restoration Workshop was held on April 5 through 15, 1993. The first week (April 5 through 18) of the workshop took place in Washington D.C., where the Russian and U.S. participants were presented with a U.S. perspective on environmental restoration and remediation issues from representatives in DOE and the U.S. Environmental Protection Agency (EPA). The second week (April 11 through 18) occurred in Richland, Washington, where the participants were presented with site-specific environmental restoration and remediation issues related to Hanford Site cleanup.

The following report is a compilation of the presentations, discussions, and experiences shared during the workshop at the Hanford Site in Richland, Washington. The primary purpose of the workshop was to 1) provide a general overview of DOE's experience in environmental restoration, followed by focusing on site-specific examples at Hanford; 2) initiate and develop contacts between the Russian institutions and nuclear sites; 3) learn about the Russian nuclear waste issues and possible lessons learned; and 4) establish a model for conducting international exchanges through a team approach.

Considerable networking was promoted during the workshop to encourage future interactions with the Russian counterparts. A philosophy of teamwork and openness was applied during the workshop by the DOE site contractors and other community stakeholders to accomplish this networking. Included after each American presentation were questions and answers. As documented in this report, the questions asked by the Russians and the answers given by the Americans were directly transcribed. For the Russian presentations, questions were asked by the Americans and answered by the Russian presenters.

Now that the Cold War is over, the DOE and its contractors envision this initial exchange as the first of many interactions between Russian and American scientists. Efforts such as this workshop demonstrate the commitment of both countries toward solving global waste management problems.

Russian - United States Environmental Restoration Workshop

**Sunday, April 11, 1993
Richland, Washington**

Welcoming Ceremony

The Russian delegation arrived at 11:40 a.m. on Sunday at the Pasco Airport in Pasco, Washington, and were greeted by the U.S. coordinators and functional supporters. The delegates were then transported by bus to the Red Lion Hanford House hotel in Richland. At the hotel, the U.S. coordinators and Russian delegates had a brunch, followed by informal conversations and introductions. During brunch, Mr. Michael Hagood spoke about the logistics of the workshop, the week-long agenda, and the itinerary.

The Russian delegation transferred to the Washington State University at Tri-Cities atrium at 4:00 p.m. to attend a welcoming ceremony, sponsored by DOE. Opening remarks were conducted by Mr. John Wagoner, manager of the DOE Richland Operations Office; Dr. William Wiley, director of Pacific Northwest Laboratory; and Dr. Ralph DiSibio, vice-president of Westinghouse Hanford Company. Closing remarks were conducted by Mr. Steve Stein of Pacific Northwest Laboratory.

Mr. Wagoner and Mr. Stein explained that exchanges such as this workshop provide the Americans and Russians with an opportunity to recognize and discuss face to face the environmental problems that confront the global community. As they explained, while this initial exchange is only a small step toward characterizing and providing solutions to our problems, it is an essential and extremely important step. Now that the Cold War era is over, the DOE and its contractors envision this activity will be the first of many interactions between Russian and American scientists. They also emphasized that the focus during the week would be a hands-on perspective on how DOE and its contractors are approaching challenges at the Hanford Site. For example, increased communication with the public, the media, and government officials reflects the new openness of DOE. Efforts today are being made to involve the public in decisions about waste management and cleanup. DOE is committed to cleaning up the legacy of contamination at its defense production sites, but has found that existing technologies are not always adequate to do the job; therefore, this exchange will focus on existing and future technologies to do the job.

Environmental Restoration

Monday, April 12, 1993
Richland, Washington

Introduction to Hanford's Environmental Restoration Program

Mr. Wayne Johnson, Westinghouse Hanford Company, introduced the topics of the day and presented a brief overview of the cleanup process at Hanford. Mr. Johnson described the problems encountered at Hanford, where contaminants are located, how contaminants migrate in the environment to different receptors, and specific examples of cleanup and remediation techniques. He stated that the previous Hanford mission on defense production has changed to a new mission devoted to environmental restoration and remediation. He stated that during Hanford's past 50 years of operation, 5.6 million curies of radionuclides have been discharged to the environment. Mr. Johnson proceeded to discuss the major locations on the Hanford Site and the major focus for cleanup. The movement of the groundwater to the Columbia River is the primary focus in the high plateau region. The surplus reactors are the primary focus along the river. The middle of the Site, the 200 Area, is the primary focus for most waste sites and is the center of processing. In the 300 Area, the primary focus is the fuel fabrication facilities. For aqueous wastes, there are 1100 sites at Hanford that need to be addressed. These sites consist of solid wastes, underground storage tanks, and unplanned releases. Mr. Johnson concluded with a brief summary on the magnitude of the solid waste and radioactivity problems in these areas at Hanford. The presentation was followed by questions from the Russian delegation and answers provided by the presenter.

Question: "How large is the vadose zone for the groundwater (from surface to saturated level)?"

Answer: "120 meters deep."

Question: "Where exactly are the 5.6 million curies being discharged to or originating from?"

Answer: "The total activity release above is to the environment and tanks at the subsurface level."

Question: "How much of the above total activity is disposed into the open area at Hanford?"

Answer: The presenter did not know.

Question: "Of the 1100 sites needing cleanup, how is the radioactivity divided?"

Answer: "The sites, which contain aqueous wastes, are divided into 1) solid wastes, 2) underground storage tanks, and 3) unplanned releases. In addition, the wastes are regulated. The wastes are further divided into mixed, solid, radioactive, and hazardous wastes. Cribs contain the low-level waste and the tanks contain the high-level wastes."

Question: "Could you describe the details on the cribs (soil column disposal)?"

Answer: "The large ponds contain cooling water discharged from the facilities, and this is low-level waste. The tanks contain high-level waste from the processing facilities."

Question: "In the figures, what is the maximum radioactivity at these sites?"

Answer: "Backgrounds range from 10 to 20 microroentgens per hour. Information on the activity breakdown of the 5.6 million curies can be collected if you would like."

Question: "What is the pH of these cribs, ponds?"

Answer: "All discharges are neutralized prior to entering these sites."

Question: "What is the volume of cooling water received?"

Answer: "12 million gallons per day."

Question: "What is the size of the ponds?"

Answer: "44 acres; 2 meters deep in the middle."

Question: "What is the hydrolization on the bottom?"

Answer: "Infiltration rate?"

Question: "Yes, what is the speed rate?"

Answer: "10 gallons per 1 square foot per day through sandy soil."

Question: "What is the end result of the cleanup? How clean is clean?"

Answer: "This is a sociopolitical, as well as a technical environmental issue. There are no definitive answers or numbers."

Question: "What is the dollar amount for this cleanup?"

Answer: "20 to 50 billion dollars for 30 years."

Question: "During the coming days, besides what we have already seen in open literature, how much new information do you have?"

Answer: "Since most information is already in the literature, we want to share our experiences and technologies and benefit from your experiences."

Question: "What's the connection between the geological and environmental services?"

Answer: "They are united services at Hanford."

Question: "Should you mention the Tri-Party Agreement now?"

Answer: "Yes, the regulatory environment governs progress and where the priorities lie."

Local Television News Station Interview

A brief television news interview with Eugene Drozhko, the Russian Delegation Leader, was conducted following the first presentation. Igor Khodakovsky, one of the Russian delegates, served as interpreter during the television interview. The following questions were asked by the television reporter and answered by the Russian delegation leader.

Question: "First, let me welcome you here on the occasion of this historic scientific training effort. While you are here, there are probably many things that you hope to learn from our experiences. Likewise, there are many things you can probably teach us. What are your first impressions of this program so far?"

Answer: "I think the program has gotten off to a very good start. We have only sat through the first morning session, but we are pleased. I also thought last night's reception with all the VIPs in attendance to greet us and wish us well was very impressive."

Question: "What do you hope to learn at Hanford?"

Answer: "By exchanging American and Russian interests and hearing reports from both sides, perhaps we can begin to develop solutions together."

Question: "Regarding our common problems, how do you see the importance of working together being realized?"

Answer: "This workshop is a very good idea, a very good beginning. The Cold War is finished; therefore, we can begin an open, friendly exchange. This indicates good hope for the future. This openness is important, particularly if you look at the similarity in problems between Hanford and our Mayak site; problems with nuclear reactors, groundwater, soil contamination, risk management, and waste management."

Question: "Can we solve these problems by working together?"

Answer: "Of course. We can also minimize the costs of decisions. We have some experience you have not; you have experience we don't. There would be much more efficiency in our combined efforts. For example, the vitrification processes at the Savannah River Site are of interest to us. While Russia has technologies and experience you could use, we need to begin thinking about joint decisions."

Question: "It seems that the urgency of this kind of scientific exchange is enhanced because of the recent Tomsk explosion."

Answer: "Indeed, this accident has shed new light and urgency on the problem and the need for a joint scientific approach to addressing problems and working toward better management."

Question: "Do you think the government will be pushed into action faster?"

Answer: "Yes."

Question: "Do you have any other comments or remarks you'd like to make?"

Answer: "I think this workshop is invaluable. And I've always wanted to visit Hanford. Also, I would like to establish a direct relationship between Hanford and Chelyabinsk. I intend to give specific proposals at the end of our trip. Prior to now, these were super secret cities. Now we have the opportunity to solve problems together in a cost-effective way."

Hanford's Hydrogeologic and Contaminant Setting

Mr. Karl Fecht, Westinghouse Hanford Company, presented Hanford's geologic setting and activities currently being conducted on the Site. Since the 1940s, there have been extensive hydrogeologic investigations coupled with well drilling and laboratory studies conducted at Hanford. The Site is underlaid by three major geologic units: 1) at the lowest level is the Columbia River basalt group that erupted from fissures adjacent to the Site boundary; 2) the Ringold formation, which is a fluvial sand, silt, and gravel sequence and the primary saturated interval of interest; and 3) the Hanford formation, which is comprised of loose sand and gravel, and forms the vadose zone beneath the Site.

Question: "What is the thickness of Ringold?"

Answer: "The maximum thickness is 300 meters."

Question: "What kind of rocks are in the Ringold formation?"

Answer: "Partially cemented fluvial sand silts and gravels cased into the region by the ancestral Columbia and Snake Rivers."

Question: "Define the term silts?"

Answer: "Silts are very fine grains/elastic sediments as a result of glacial flood deposits whereby multiple ice dams failed."

Mr. Fecht continued with a discussion of the wastes stored at the subsurface. He presented a geologic cross section (east to west) of the Hanford Site. The vadose zone, which is the unsaturated area between the surface to the groundwater, is 100 meters in the deepest part of Hanford (200 Areas). A water table map was presented. The critical recharge to groundwater at Hanford is 10 times more than the natural recharge. The natural recharge to the river is 2×10^{-2} cubic meters per second. A discussion about radionuclides in the groundwater followed.

Question: "Could you explain the graph?"

Answer: "The red color represents strontium, primarily at N Springs and Gable Mountain pond which are no longer used; the yellow color represents uranium which is from the fuel fabrication facilities."

Question: "What depth are the injection wells?"

Answer: "Injection wells go to groundwater and contain strontium, cesium, and plutonium. The depth is 250 feet."

Question: "What standards do you have on tritium?"

Answer: "20,000 picocuries per liter, which is the drinking water standard."

Question: "What is the concentration of cesium and strontium to the river?"

Answer: The presenter did not know.

Mr. Fecht proceeded with a discussion on the hazardous substances in the groundwater, such as nitrate, chromium, fluoride, cyanide, chlorinated hydrocarbons, and carbon tetrachloride. The presentation concluded with additional questions and answers.

Question: "What is the concentration of all constituents in the groundwater?"

Answer: "Calcium bicarbonate is the most abundant constituent in the water systems, which is indicative of immature groundwater."

Question: "How many wells on Site?"

Answer: "5000 to 6000 wells. 600 groundwater wells are monitored; 1000 wells are evaluated in the vadose zone near cribs and tanks."

Question: "What is the velocity movement to the river?"

Answer: "1 meter per day along the river; in the 200 Areas it is 1% to 10% of the velocity along the river."

Question: "What is the radioactivity movement in the vadose zone and groundwater?"

Answer: The presenter didn't bring any slides on this; however, there are limited data sets and risk assessments on this subject.

Question: "What is the discharge of groundwater to the river? How contaminated is the water?"

Answer: "0.3 cubic meters per second, while the river velocity is about 4000 cubic meters per second. For tritium, 20,000 picocuries per liter is the drinking water standard. The impact of tritium on the river is about 120 picocuries per liter."

Risk Assessment

Dr. Patricia Irving, Pacific Northwest Laboratory, defined objectives for determining risk assessments. The primary objective involves a cost-benefit analysis. Dr. Irving presented a discussion on research and development assessments and risk management. Several phases in these assessments were described. Currently, PNL is working on developing a baseline risk assessment, to be followed by subsequent risks that change over time. The phases in this development involves the public, the worker, and the ecological environment. The phases are comprised of 1) establishing a baseline risk assessment, 2) remediation, and 3) end-state risk. A computer model, called Multimedia Environmental Pollutant Assessment System (MEPAS), is a useful tool for determining the highest public risks at Hanford. The model addresses internal and external risks associated with radiation. The model can

be modified for ecological and health risk changes. The model also is being used in Canada and Mexico. The presentation concluded with questions and answers.

Question: "What is internal radiation?"

Answer: "Ingestion of food (primarily children's ingestion of contaminated soils) and inhalation of contaminated air."

Question: "What is the total number of people evaluated?"

Answer: "The regional population (Hanford population versus Washington State)."

Question: "Is more than one state, country, etc., being included in the model?"

Answer: "No, so far the model is used for particular areas within a site."

Question: "Can incoming quantities which change the program be modified?"

Answer: "Yes, the model can be adjusted. For example, following the Chernobyl accident, input parameters were adjusted."

Question: "In developing the model, are considerations made in environmental data or theoretical data?"

Answer: "A combination of both data is used. The users provide up-to-date data. The program can be manipulated."

Question: "Can original components be transferred from one area to another?"

Answer: "Yes."

Question: "Can we see a demonstration of this?"

Answer: "Yes, we can give you the program. Let's meet on Wednesday evening to show you a demonstration."

Question: "What are the main formal approaches to deciding the environment risks?"

Answer: "Approaches are based on standards of the EPA for human health (a list of 400 chemicals is the legal, formal approach)."

Question: "How is the amount of cancer output determined in the program? Are two control groups (one exposed/one not exposed) used?"

Answer: "Yes."

Question: "How did the average or $1E+06$ factor apply to the state? How many is considered the normal cancer incident rate?"

Answer: "Yes, the normal incident rate is factored in the risk assessment."

Question: "What is the cost of human life data?"

Answer: "We do not have this information yet."

Risk Assessment Methodology

Ms. Lonnie Swenson, Golder Associates Inc., discussed the first risk assessment baseline document. The methodology is reviewed by federal, state, and local governments. She explained the baseline risk assessment to develop acceptable exposure levels is driven by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and that risks are evaluated of residents living near the Site and/or consuming agricultural crops grown in the area. Ms. Swenson discussed the various transport mechanisms and dose models used. She presented two dose model types: a threshold and a nonthreshold dose model. If the risks are greater than a million, then the data are reviewed more carefully. Ms. Swenson summarized the Hanford baseline risk assessment. She explained that from this information, government managers decide what to clean up, and that ultimately, politics decide cleanup rather than the risks. The presentation concluded with questions and answers.

Question: "Looking at the graph of Hanford risks versus the public, how are the toxic numbers determined?"

Answer: "Numbers are determined by the slope factors on how toxic a substance is; radionuclides have numbers for high doses."

Question: "If you state the public as equal to one, what additional risk to the public is from Hanford?"

Answer: "No additional risk because exposures are low, and any given member of the public is not onsite for a long term. Risk doesn't take into account background."

Question: "Of the 1 billion dollars on Hanford risks, is this paid for by the public?"

Answer: "Risks are chosen. The Site is not fully characterized for scenarios which would increase risks."

Question: "I am a fisherman on the Columbia. A certain number is reaching the river. Is the fisherman at risk?"

Answer: "Yes, only if you are fishing all year round. It is calculated (1 kilogram per day, one in a million cancers additional risk) not measured."

Question: "There is a radiophobia in Russia; how does this perception factor get into the model?"

Answer: "Within models, we don't deal with this perception. However, this factor is used in politics and the media, which is interpreted later by the government."

Question: "The model may increase radiophobia?"

Answer: "Yes, we have similar issues here at Hanford."

Question: "Are future generations and genetic problems factored in the model?"

Answer: "No good system exists to evaluate genetic effects. We use cancer data only."

Question: "The pathways of contamination, how do they affect the population?"

Answer: "The Hanford Dose Reconstruction Project is an example of looking at the past releases and effects on populations. We only evaluate past releases with 100-year assumptions on future land use."

Site Characterization of Highly Contaminated Sites

Mr. Mark Buckmaster, Westinghouse Hanford Company, presented a specific example at Hanford on characterizing an operable unit. The 200 BP-1 Operable Unit consists of 10 inactive cribs.

Mr. Buckmaster discussed construction details of the operable unit and the boreholes drilled through the vadose zone in the area. The presentation was followed by questions and answers.

Question: "What year was the drilling made to characterize this site?"

Answer: "Last year."

Question: "What is cable drilling?"

Answer: "A piece of pipe in the ground which is advanced with a pipe casing, removing soil to the subsurface as the pipe is boring the well. In borehole drilling, worker safety is the number one priority. The work is accomplished by supplied air and remote handling to reduce exposure from the soil contamination."

Question: "How long do the people work on this equipment?"

Answer: "1 hour to suit up and 2-hour work shifts, depending on the heat of the day. For samples greater than 10 millirems per hour, each person must wear a gamma dosimeter and account for their time."

Question: "What is the Westinghouse standard for exposure? What did these people get?"

Answer: "2 rems per year. For 1 year, 30 employees totalled 2200 millirems. Six people (health physics, nuclear safety, QA, etc.) were on the job. Once the borehole is completed, then it is backfilled with bentonite clay."

Question: "What is the ground surface elevation?"

Answer: "190 meters above sea level."

Question: "How do you characterize samples during borehole drilling?"

Answer: "Every 25 feet an analysis is done."

Question: "When you analyze samples, do the instruments get contaminated?"

Answer: "Yes."

Question: "Can we look at the design of the sampling equipment?"

Answer: "It is a split tube with stainless steel liners and each sleeve is analyzed. Yes, we will do a demonstration later."

Question: "Is the activity in deeper levels smaller?"

Answer: "Yes, after 20 meters below the surface no activity is detected."

Question: "In your research, the contents you get from the holes, can you tell the activity or integrate over the entire Hanford area? Can you validate the data with historical releases?"

Answer: "Geophysical lateral extents are made for each borehole and are very much the same. The results are higher than historically stated."

Volatile Organic Compounds at the Hanford Carbon Tetrachloride Site

Mr. Richard Cameron, Ebasco Inc., presented a specific example of another Hanford remediation site involving the removal of carbon tetrachloride from the soil. He explained that for soil vapor extraction systems, there are four phases of operation: well-field, processing, treatment, and high-efficiency particulate air (HEPA) filtration. The carbon tetrachloride is driven off and adsorbed by charcoal canisters, an effective but expensive method. The presentation concluded with questions and answers.

Question: "Does the system contain a vacuum system?"

Answer: "Additional air can be introduced into the system at the surface."

Question: "How much carbon tetrachloride was removed?"

Answer: "85 cubic meters of air were removed at the present site. 360 centimeters of water vacuum are used. The past year, greater than 1 metric ton of carbon tetrachloride was extracted. 8 to 35 parts per million can be achieved on newer systems now."

Question: "What is the cost of 1 metric ton?"

Answer: "4,000 pounds of carbon tetrachloride have been removed to date. 2 to 10% still remains to be extracted. The costs are more on the front end than actually doing the job. The last 3 years have cost 9 million dollars."

Question: "What is the total release of radioactivity in the air during extraction?"

Answer: "The only radioactivity is radon from plutonium and americium in the soil."

Question: "What is the cost per depth of contamination?"

Answer: "A calculation on the cost per level needs to be determined on the progress completed as of today."

Remediation of Groundwater: The N Springs Case

Mr. Gerald Chiaramonte, IT Corporation, presented a specific example of groundwater remediation: Hanford's N Springs. Mr. Chiaramonte discussed the results of a cost-benefit analysis to determine the most cost-effective method to remediate groundwater intrusion near N Springs. N Springs consists primarily of strontium-90 and tritium. The highest concentrations are 11,000 picocuries per liter and 250,000 picocuries per liter, respectively. The plume is 180 meters long and 1000 meters wide. A capture zone analysis was made, which resulted in 5 pumping wells (200 liters per minute each) and 11 extraction wells (4,000 liters per minute). A slurry wall was made to slow migration to the river. Mr. Chiaramonte described the slurry wall and showed several diagrams on the side view. The presentation concluded with several questions and answers.

Question: "Are these intrusion wells?"

Answer: "No, they are extraction wells."

Question: "What is a slurry wall?"

Answer: "A mixture of bentonite clay and soil wall used to dam the groundwater and filter the radioactive constituents to slow migration to the river."

Question: "What is the depth of the wall?"

Answer: "30 meters deep, 1.5 meters wide, and 61 meters long."

Question: "Does the slurry wall change the geologic system by increasing the water pressure behind the wall?"

Answer: "The slurry wall creates a zone of stagnation behind the wall. The contaminants tightly adhere to the soil and water flows around the wall."

Question: "If strontium is going through the aquifer all the time, is there strontium behind the wall?"

Answer: "The wall slows the flow and absorbs the strontium. No alternatives have yet been selected. This proposal goes to the public and regulators for approval."

Question: "What happens to the other side of the wall?"

Answer: "As the water level rises and falls, strontium continues to collect behind the wall with water stagnation behind the other side. There is some absorption to the other side but very little."

The session concluded with a road tour of the current remediation areas on the Hanford Site. The delegation drove by the 618-9 Burial Ground (600 Area), 300 Area Process Trenches, 618-11 Burial Ground (600 Area), Old Hanford Townsite (600 Area), White Bluffs Pickling Acid Crib (100 Areas), Sodium Dichromate Site (100 Areas), 100-H Reactor Area, Carbon Tetrachloride Remediation Area (200 West), TRU Burial Ground (200 West), Central Waste Complex, 241-T Tank Farm, 241-TY Tank Farm, TX Tank Farm, 241-S Tank Farm, 241-SX Tank Farm, 241-SY Tank Farm, 200 BP-1,

Grout Facility, Hanford Waste Vitrification Plant new construction site, 241-AW Tank Farm, 241-AP Tank Farm, 242-A Evaporator, 241-C Tank Farm, 241-B, Tank Farm, 241-BY Tank Farm, and 214-BX Tank Farm.

During the tour, the following questions were asked by the Russian delegation and answered by the Americans:

300 Area Process Trenches

Question: "What kind of ground-penetrating radar did you use to locate drums and tanks in the trenches?"

Answer: "Radio-electron techniques."

Question: "What was the source of kerosene in the contaminated groundwater?"

Answer: "From the labs in the mid-1950s. They used it for various processing applications."

Question: "Why was this site chosen?"

Answer: "To avoid leakage into the groundwater. The groundwater level is 20 meters deep here."

Question: "What did you do with the solid waste?"

Answer: "There are two large waste area burial grounds that we will show you."

Question: "What is the level of radiation in this part?"

Answer: "We only found trace uranium. The gamma radiation background is 10 microrems per hour."

Question: "Is the soil ready for farming?"

[Laughter]

600 Area Burial Grounds

Question: "Will all wastes be placed here at the 618-11 burial ground?"

Answer: "We are trying to figure that out."

Question: "What kind of radioactive wastes are here from the 300 Area?"

Answer: "Small amounts of fission product wastes."

Question: "When were they deposited?"

Answer: "In the mid-1960s."

Question: "Is public opinion ready to accept that most wastes here will never leave the Site?"

Answer: "The issue will come up slowly. I don't think they're yet aware of it."

Question: "Do you have economic compensation for the surrounding communities?"

Answer: "This idea is in discussion stages now. It is happening in other parts of the country now, Utah, for example. There is a study under way to determine how much radiation was released from Hanford. Another study will determine increased cancer rates from the radiation. Many people already claim health damage from Hanford operations."

Carbon Tetrachloride Remediation Area/Tank Farms (200 West Area)

Question: "Who makes the instrumentation used here at the carbon tetrachloride extraction site?"

Answer: "TRI."

Question: "Have you detected any plutonium here?"

Answer: "No."

Question: "Can you extract continuously?"

Answer: "Yes, but at 100 parts per million it is not always economical. At that point, we switch to another well."

Question: "Do you pull only vapor, and no water?"

Answer: "There is some condensation."

Question: "Is there any radioactivity in the condensate?"

Answer: "No. The uranium and plutonium are adsorbed onto the soil."

Question: "What is the efficiency of this process?"

Answer: "About 90 to 95 % has evaporated."

Question: "What is the cone of influence?"

Answer: "About a 60-foot radius."

Question: "Where did you find the plutonium?"

Answer: "About 95 % of the plutonium was found in the nonvadose zone."

Question: "What kind of filters are used in the air monitoring doghouses?"

Answer: "Gel filters."

Question: "What is the deepest well?"

Answer: "Near groundwater, about 200 feet."

Question: "Where are the boreholes?"

Answer: "Most are at water level. The deepest is 50 meters where carbon tetrachloride has been detected."

Question: "What is the density of the carbon tetrachloride?"

Answer: "1.59 kilograms per liter; denser than water."

Question: "What other contaminants are present?"

Answer: "Tributyl phosphate and lard oil."

Question: "What do you use for the separation of liquids?"

Answer: "Membrane separation technology. The vapor passes along a vinyl membrane which selectively removes the carbon tetrachloride."

Question: "Is this technology available commercially?"

Answer: "No, at this point it is only being tested."

Question: "In this extraction, how many wells do you use?"

Answer: "Four to eight."

Question: "Have you worked with horizontal drilling?"

Answer: "Horizontal drilling will be tested in June."

Question: "Is the Gelman filter commercially available for use in Chelyabinsk?"

Answer: "Yes."

Question: "How many employees are here at Hanford?"

Answer: "16,000."

Question: "Which way does the wind blow here?"

Answer: "The winds are out of the southwest."

Innovative Technologies

Tuesday, April 13, 1993
Richland, Washington

Mr. Thomas Brouns, Pacific Northwest Laboratory, presented the agenda and itinerary for the day. Mr. Brouns briefly introduced the topics of discussion and provided a summary of current innovative technologies for environmental cleanup.

Large-Scale Remediation

Mr. Mel Adams, Westinghouse Hanford Company, presented an observational approach to general large-scale remediations for cleanup at Hanford. He explained that the major problem is how to clean up the 100 and 300 Areas and transfer/dispose the waste in the 200 Areas away from the river. The remediation is necessary to prevent contamination to the Columbia River. The 100 Areas consist primarily of bulk handling, the 200 Areas consist of in-situ disposal, and the 300 Area consists of volume reduction and processing. Wastes include contaminated soil and those wastes already buried onsite.

Mr. Adams proceeded to present the observational approach which consists of characterizing the waste as it is dug up. He stated that to investigate the waste sites costs more than actually removing the waste. Land use is dependent upon the public and future industrial use. Public use covers a total of 33 million cubic meters, whereas, the industrial use covers approximately 19 million cubic meters. The public wants direct cleanup action. The cost per sample to drill for a sample is approximately \$3500 and another \$1000 for data validation. Methods for sample analysis include ground penetration radar, soil gas chromatography, and remote-controlled excavating equipment. Other equipment used include a concrete profiler for shallow (less than 1 meter) contamination, cranes for river pipeline removal, and soil washing followed by clean backfill. The plan is to transfer high-level waste to the 200 Areas using large bulk containers rather than thousands of drums. Munitions will be shipped to the Army in explosive-proof containers. Other wastes, such as volatile organic compounds (VOCs), have special samplers such as a VOC sampler. All technologies and proposals can be replaced by newer technologies.

Mr. Adams explained that the 200 Areas contain clay or textile-lined trenches for contaminated soil and packages for burial. Large guided mining equipment for movement of soil is used in the large open trenches. Other low-level wastes will be grouted. For usable land in 100 years, the cost to clean up the groundwater, consisting mainly of tritium and nitrates, will be \$40 billion. The estimated cost is \$20 million to move waste from the banks of the river by the year 2018.

Question: "What is the depth of boring or crib for introduction into the groundwater?"

Answer: "The depth of the soil column is 200 feet or 60 meters."

Question: "How deep is it to reach the groundwater for sampling?"

Answer: "Soil and groundwater are 100 feet."

Question: "Explain in more detail this river pipeline removal?"

Answer: "Pipes from facilities that discharge directly to the river bed are to be cut or blanked off, then this pipeline is to be removed."

Question: "Where is waste stored at the bottom of the river?"

Answer: "Will cover in a minute."

Question: "Do you have an indefinite amount of space?"

Answer: "6 square miles or less."

Question: "What is grout?"

Answer: "A cementitious wet mixture like the wall of this building outside."

Question: "What is the volume of groundwater to the river?"

Answer: "It is a large number I don't have, but I can get this information."

Groundwater is much more of a challenge than soil cleanup. It will be necessary for overnight analytical capabilities rather than shipment to offsite laboratories.

Question: "Does this cover a full complex of radioactive and hazardous waste?"

Answer: "Yes."

Mr. Adams continued by stating that no waste shipments will be made to other states. The cleanup of soils will be completed by 2018. All waste will be consolidated in the 200 Areas. The challenges for accomplishing this task include dust control, packaging and transportation of materials, reuse of containers, and getting everyone to agree. This last challenge is the most difficult. The presentation concluded with the following questions and answers.

Question: "Will you evaluate secondary equipment and excess water considered as waste generated during this activity?"

Answer: "The soil washing process will be recycling the water. The contamination will be collected as fine clay components."

Question: "During this activity, what is the volume?"

Answer: "Most of the equipment will be able to decontaminate and some we will dispose of. New equipment for soil washing has just arrived and we will be evaluating the efficiency of this method of separating soil contaminants."

Question: "Are there other areas where soil washing has been used?"

Answer: "Yes, other sites are successful, depending on the type of soil."

Question: "Do you think 90% efficiency of soil separation is good?"

Answer: "Yes, our success will be dependent upon this efficiency."

Question: "An example, if you have 1 meter of plutonium contaminated soil, how much water is used to separate contaminants?"

Answer: "80% to 90% clean soil is expected to be put back into the ground and the water will be recycled."

National Programs for Technology Developments for Environmental Remediation

Mr. Steve Stein, Pacific Northwest Laboratory, presented a brief organizational breakdown of U.S. agencies and DOE programs on remediation. The DOE programs are based primarily on public concern and consist of an aggressive program aimed at avoiding the generation of new waste.

Mr. Stein stated that the goal of DOE programs is to provide safer methods. To accomplish this goal, several integrated programs and demonstrations (e.g., in-situ remediation, robotics, and vitrification) currently are in place. The presentation concluded with questions and answers and a genuinely strong interest in setting up future technical exchanges.

Question: "Can you give an example of environmental-conscious manufacturing?"

Answer: "Electronic components in munitions waste. DOE is currently spending \$300 million per year on technology development."

Question: "Is cost involved in the work/design development and evaluation of technology?"

Answer: "Yes. The following is a breakdown of expenses for DOE: 1) soil washing at Fernald costs \$8 million per year for 5 years of expected operation, 2) thermo tests for the mixed waste landfill at Sandia also cost \$8 million per year, and 3) several other DOE sites fill the remaining balance of costs."

Question: "What criteria are the basis for success?"

Answer: "This is a regulatory process. The end measure of all activities is deployable technology."

Question: "This is a unique approach to each site, what will you propose to help the Russians (technology transfer)?"

Answer: "Everything presented is available to the Russians. The group needs to agree and become partners."

The Russians expressed a strong interest in Hanford as it relates to the connection at Mayak. The Russians would like to leave the workshop with a formal agreement to define this partnership. The September 1993 international meeting in San Francisco, California, will provide the opportunity for contacts.

Innovative Drilling And Access Technologies

Mr. Donald Moak, Westinghouse Hanford Company, presented subsurface intrusive technologies and ways to prevent the movement of contamination in groundwater. Hanford has porous soils enabling contamination to easily be forced into the groundwater. Ways to prevent the movement into the groundwater include the cone penetrometer and ultrasonic drilling, which produces no secondary wastes. Mr. Moak proceeded to describe ultrasonic component failures and what tests have been conducted to date on the Hanford Site. He stated that 11 wells with variable geology have been sonic tested.

Question: "What is the diameter of these wells?"

Answer: "10 inches at the start and 8 inches at the completion of the tests with a depth of 60 to 240 feet deep."

Mr. Moak described the failures at the drill head and bottom of the pipe borehole attachment. The well drilling and associated tests are 50% government funded and 50% contractor funded. A combination is used of field testing, laboratory tests, and computer modeling.

Question: "What about the frequency of the sonic tests on the environment (animals, people, etc.)?"

Answer: "It is of low frequency and a slight tingle sensation can be felt in the area."

Mr. Moak explained that the cone penetrometer is used for softer materials in the soil less than 15 meters from the surface. The cones are left in the ground for monitoring or for injecting air if needed. This process is faster than drilling. Mr. Moak stated that 37 pushes at 5 locations on Hanford have been made to depths of 20-80 meters. No secondary wastes were generated. Work continues to improve the characterization probes of this method. This method is good for horizontal wells and uses minimal fluid.

Another useful method is the ditch-witch test. The maximum length covered by this method is 45 feet. This method is limited because one is unable to control the direction of boring. Two other technologies were described: 1) the pneumatic hammer and 2) the coil tubing unit. The presentation concluded with the following questions and answers.

Question: "What is the velocity of drilling?"

Answer: "The velocity is 2 to 3 times that of absolute drills at 5 to 10 feet per hour."

Question: "Do you like horizontal drilling under cribs, ponds, etc.?"

Answer: "This method produces mud and secondary wastes. It is not a good method. We are looking at other methods."

Question: "We use regular hydraulic methods at 60 to 70 meters and install protective casings. It takes us 6 to 7 hours to drill 50 meters, what kind of geology do you have at Hanford?"

Answer: "Sands."

Application of Technologies

Mr. Robert Henckel, Westinghouse Hanford Company, presented technologies currently used at Hanford for sampling and analyzing groundwater contamination. Extensive analysis and sampling of the groundwater at Hanford exists. Using the observational approach, as described earlier by Mr. Adams, historical data are evaluated to determine exactly where to go with more emphasis placed on field screening. Mr. Henckel described the current trends at Hanford. Sampling and analysis consist of geophysical, chemical, hydrogeological, and radiological characterizations. Geophysical methods for sampling include gas penetrating radar, electromagnetic induction, and seismic reflection, which are all used for finding buried objects. Chemical methods include laboratory analysis, gas chromatography, and mobile laboratories for rapid turnaround. Hydrogeological methods include the SEAMIST, which is an inflatable bladder used in the borehole to collect samples. The presentation was followed by questions and answers.

Question: "What scheme do you use at Hanford--one well for tracer or well to well?"

Answer: "We use the doublet scheme. A single well, 60 meters deep, is used for the first drill followed by multiscreen wells with packing between."

Question: "Any problem with detector sensor contamination?"

Answer: "No problems exist with the detector because it is smaller and fits inside the cone penetrometer. For VOCs, we flush the sample head. For radionuclides, a cover is placed over the sample head and is disposed of if found contaminated during sampling."

Question: "Do you have a special system for calibration? Do you have standards for the United States?"

Answer: "The detectors are shipped offsite for calibration. Yes, there are standards all over the country."

Data Fusion

Mr. Richard Lewis, Pacific Northwest Laboratory, described data fusion techniques currently being investigated at Hanford. This technique is being developed offsite in Maryland for DOE by Coleman Research Corporation. Because the data are difficult to interpret, integration of multiple data sets with three-dimensional interpretations is the preferred technique. Data fusion techniques consist of geo-statistics and geophysical characterizations forwarded to modeling. Mr. Lewis presented a data flow diagram in which the computer model is compared with reality. The final output is a three-dimensional map of the soil output. The first application of this software was the carbon tetrachloride remediation project. The presentation concluded with the following questions and answers.

Question: "Did you use your own mathematical codes or the Coleman Research Corporation's?"

Answer: "Their's which is nonlinear."

Question: "How much did this cost?"

Answer: "\$250,000 for the work station comprised of two parallel computers. \$100,000 for the software and other algorithms."

Question: "Why do you use only local models, is it not compatible with regional models?"

Answer: "It is too heterogeneous at Hanford. Because there are different groups within the same data, different results are obtained. Intercalibration is a concern."

Question: "Who is in charge of this?"

Answer: "I am (Tom Brouns)."

Local Radio Station Interview

A radio news interview with Eugene Drozhko, the Russian Delegation Leader, was conducted during the morning presentations. (Igor Khodakovsky served as interpreter.) The following questions were asked by the radio interviewer and answered by the Russian delegation leader.

Question: "Can you tell us a little about the relatedness of your visit to Hanford and conditions at your own facilities in Russia?"

Answer: "The Mayak and Hanford approaches are very close, sometimes identical. We are interested in, among other things, techniques used to monitor contaminated zones--our approaches are very close in principle. The discussion on risk assessment was very interesting, and we can use this approach with respect to health impacts."

Question: "Our countries are former enemies, now we are talking about working together. What are your feelings now?"

Answer: "Our scientists were never enemies. We are ordinary people also."

Question: "Are you impressed with Hanford?"

Answer: "Yes, of course. I've always dreamed of visiting this Site."

Question: "How is the cleanup at Chelyabinsk progressing compared to Hanford?"

Answer: "It is hard to answer that."

Question: "What do you think of the 30-year cleanup timetable?"

Answer: "We don't yet have a comprehensive plan. We are just starting."

Question: "Is there something you've developed that can be used at Hanford?"

Answer: "Yes."

Question: "Is there anything that surprises you here?"

Answer: "No surprises."

[Russian delegate Vera Kolosova was then interviewed by the same interviewers.]

Question: "What is your role with the group?"

Answer: "I am part of a group that realizes it is important to mutually solve such common problems."

Question: "Are you or will you be filing reports back?"

Answer: "Yes. I'm working on a special program on this project that will be aired throughout the former U.S.S.R."

Question: "What things stand out most in your mind about Hanford?"

Answer: "It is most impressive. The surroundings are pleasant and liveable, not barren and unpopulated like [Russian] sites."

As a journalist, I have learned to read between the lines because so much information has been restrictive. We are radiophobic because you don't know what's truth and what's not."

Question: "Regarding the Tomsk accident, what were your reactions?"

Answer: "Nothing. I did not see the information presented."

Remediation Technologies

Mr. Tom Brouns, Pacific Northwest Laboratory, concluded the session with a discussion of the basic remediation technologies explored at Hanford. Much of the technology development is for treating waste in place. Areas for remediation technology include baseline surface caps which are temporary, slurry walls, groundwater pumping, cryogenic barriers or dams to invade the groundwater, enhanced surface barriers, robotic systems for tank waste retrieval, in-well vapor stripping for VOCs,

stabilization techniques (vitrification glass melters, polymer-based agents for hazardous waste applications rather than high-level radioactive waste), membrane separations, ozonation, and corona destruction. Technologies focus more on treating waste down in the borehole to reduce costs rather than above-surface treatment. No additional questions were asked.

The session concluded with a tour of Pacific Northwest Laboratory facilities including the PNL 324 Building (300 Area North), 325 Building, 337 Building, Sigma V Building (3000 Area), and Mechanical Development Laboratory (3000 Area). The following questions were asked by the Russian delegation during the tour. Answers were provided by the Americans.

Question: "What data can you collect with the cone penetrometer?"

Answer: "Soil samples, water samples, vapor monitoring, rad detection, resistivity in soils, piezometric measurements, and seismic measurements."

Question: "At what pressures do you run the system?"

Answer: "2500 psi."

Question: "Explain how it works."

Answer: "The characterization probe will help characterize the soil. For vapor testing, we draw gases through a teflon filter. On the surface we have gas chromatographs and other sensors."

Question: "How have you used the truck?"

Answer: "In the carbon tetrachloride cleanup and the expedited response action to save money on drilling."

Question: "What are the costs?"

Answer: "Drilling costs \$3000 per meter. It usually takes 1 month to drill a 200-foot hole. Drilling is very expensive because we're dealing with wastes, but even more costly because we're dealing with bureaucracy."

Question: "In your bioremediation work, what limits growth of your microorganisms?"

Answer: "Usually nutrients. Temperature is fairly constant at 15 to 18 degrees Celsius."

Question: "What is the specific degrader?"

Answer: "*Pseudomonas*. We don't add any bacteria."

Question: "What do you do with the microorganisms after they do their work?"

Answer: "We recycle them. The uranium is in the precipitated solution."

Question: "How long do you expect your engineered barriers to last?"

Answer: "Our barriers have to perform up to 10,000 years without maintenance."

Question: "What is the timetable for the use of the robotics arm in helping clean the tanks at Hanford? When will it be functional?"

Answer: "In 6 to 8 years."

Question: "How would you decontaminate this tool?"

Answer: "This is just a prototype to understand the mechanism."

Russian Presentation

Three Russian scientists (Dr. Valdimir Gelis, Dr. Oleg Kedrovsky, and Dr. Valeriy Romanovskiy) described current environmental remediation activities in Russia.

Dr. Valdimir Gelis is a scientist at the Institute of Physics and Chemistry, Russian Academy of Sciences. The institute was founded in 1923. In 1948, the institute began working on the nuclear program in Russia. The institute primarily deals with the reprocessing of waste. There is a large concentration of radiochemists. Today, much of the work is in ion exchange processes.

The institute works with Chelyabinsk-65. At the site, a total inventory of 1 billion curies of waste exists. These wastes include cesium, strontium, and plutonium from purifying mixed wastes. With adsorbent uses, 30 million curies have been isolated from 100-liter columnas. The columnas can be absorbed, resolved, and regenerated. The general scheme is to process trans-plutonium and alchem earth. Zirconate microspheres are used to adsorb rare earths and are a convenient way to bury wastes. The institute is more interested in low-level waste burial. There are 400 million cubic meters of low-level waste in lakes, containing mainly strontium contamination. The institute looked at greater than 100 adsorbents. Dr. Gelis presented a diagram showing a list of adsorbents used. ISMA-3 is the most interesting adsorbent for collecting strontium-90 from the low-level waste in the largest capacity. It is used to remove strontium from the lake sludges. Cesium also is adsorbed. Other adsorbents used contain mainly phosphorous.

Dr. Oleg Kedrovsky is a scientist at the main institute in Moscow. His department is the Institute for Nuclear Explosion for Civil Purposes. This institute deals with uranium mines and processing of fuel. For the last 30 years, the institute has developed storage sites for the nuclear wastes. Liquid wastes are stored in deep geological strata. Since 1982, the institute has been working on solidified wastes and disposal. The highly radioactive waste is stored in the deep strata. Engineered barriers have been evaluated. The most preferred is a geological formation barrier. During the 1980s, many proposals on the storage and burial of wastes were developed. Dr. Kedrovsky presented a European map, pointing out the various regions under investigation. In the northern European region, a high sulfur salt formation exists, and this area has been approved for investigation. In Moscow (RADON) and St. Petersburg, Russia, burial sites have been developed. President Yeltsin considers this industry very important. One year ago, a decree on nuclear wastes was signed into law. Nuclear wastes now must be considered for all of Russia.

The primary stage of this cleanup program is the preparation of the waste. All the waste must be solidified then packed for storage. To gain public opinion, this program is now under the Academy of Sciences. The academy created an expert commission responsible for geological safety.

Dr. Kedrovsky showed examples of waste burial sites. One example of a well repository (20,000 to 30,000 cubic meters deep) showed high-pressure steam generated in the well. At the Mitogram Institute, the practice of well drilling involves two wells (1000 meters deep) adjacent to each other--one for disposal and the other for monitoring as a control well. The Mitogram well site contains 100,000 curies. Another technology is hydrofracturing. This involves mixing mixed waste with concrete and depositing into a well. The largest spent fuel burial is in the northwestern corner of Russia. The deepest well (12 kilometers deep) is on the Kolskey peninsula. The waste is buried in the well and is covered with 2 kilometers of clay with a concrete lid on top. The well is 6 to 8 meters in diameter. All waste is buried below the permafrost layer. The Russians do expect leaching in these areas. The total layer is 300 meters thick. In the summer, there is still a 1.5-meter unfrozen zone.

Dr. Kedrovsky concluded with a diagram of low-level waste and spent fuel from power stations in a burial well. Problems are being experienced with residual heat from the fuel in this zone.

Dr. Valeriy Romanovskiy is a scientist at the Radium Institute in St. Petersburg, Russia. The institute was founded in 1922 to study radioactivity. The institute was introduced into the defense program in the 1940s to provide the technology for the production of nuclear weapons. As Dr. Romanovskiy explained, the task of processing spent fuel during the past 25 years has been discontinued. Work is no longer on the defense program. Instead, the institute now focuses on the management of high-level waste. Forty kilometers from the St. Petersburg site, there are 13 hot cells containing 10,000 curies. The 0.1 kilogram of spent fuel is used in the hot cell for research and development purposes. The site is used to test processes using simulated materials. Results are obtained from the hot cells and then tested on the industrial scale, followed by implementation.

The institute also conducts the solvent extraction process for extracting cesium, strontium, and other radionuclides from spent fuel. The institute works with two radiochemical plants in Chelyabinsk for this process. A new facility will be constructed at the end of this year for processing the accumulated waste from Chelyabinsk. Hanford has equal quantities as Chelyabinsk. There are 200 special tanks storing waste at Chelyabinsk.

Questions of a general interest were solicited from the U.S. audience. No journalistic questions were sought. The Russian presentation concluded with no questions.

Decontamination and Decommissioning

Wednesday, April 14, 1993

Richland, Washington

Mr. Michael Hughes, Westinghouse Hanford Company, presented a brief overview of the decontamination and decommissioning (D&D) activities at Hanford. Currently, there are 100 surplus facilities awaiting D&D. These facilities include the production reactors and the processing plants. More facilities will be added in future years. Mr. Hughes proceeded with showing pictures of the plutonium production reactors, chemical processing plants, and support facilities. Since 1973, greater than 200 facilities, which includes both contaminated and noncontaminated facilities, have been decommissioned. He showed a picture of the 200 East Strontium Semiworks Complex stack demolition. This year, the focus of D&D activities will be on support structures and hot cell work. Examples include the gas recirculation building, exhaust stacks, and filter buildings. Unique requirements will be necessary due to the size and concentrations of contamination. Surveillances and maintenance are performed to maintain the facilities in a safe condition until D&D. Such surveillances also include radiation surveys, general repairs, and cleanup. The presentation concluded with questions and answers.

Question: "From the stack demolition, was there a concern with radioactive dust dispersal?"

Answer: "Near the stack demolition areas, low-level contamination exists and water spraying was conducted during the demolition."

Question: "To what level of decontamination is performed on the stack?"

Answer: "No decontamination was performed on the stack. Cores were drilled into the stack and sampled. The reactors have not been decontaminated yet."

Decontamination and Decommissioning of the Strontium Semiworks Complex

Mr. William Heine, Westinghouse Hanford Company, presented a brief overview of the pilot-scale reprocessing plant: the Strontium Semiworks Complex. The plant was built in 1949 as a pilot plant for REDOX. In 1954, the plant was converted to the PUREX separation process. The plant was shut down in 1956, decontaminated from 1956 until 1961, and retired in 1967. The complex consists of seven major facilities covering 16,000 square feet on a 5-acre site. Mr. Heine showed a sectional view of the main process building, which consisted of three process cells.

Mr. Heine mentioned the five alternatives for decommissioning that were originally investigated: 1) entombment, 2) partial dismantlement followed by entombment, 3) razing to grade level, 4) total dismantlement and removal, and 5) no action (continue in safe storage). The final decision was based upon public input and the regulators. Estimated costs and doses to the workers were evaluated from the various alternatives. The actual alternative chosen for decommissioning included a combination of

partial dismantlement followed by entombment and razing to grade level. To date, costs for this activity have been \$16 million. Upon completion, the total cost is estimated at \$20 million. Costs associated with the regulation of the waste need to be considered. One tank was thought to be empty but contained waste which led to additional costs. The plan is to fill the below-grade cells with concrete and then knock the upper level down. The final stage would include entombment in concrete, followed by burial. Mr. Heine showed a diagram of the final burial barrier placement. The concrete fill will be covered with bottom ash from the Hanford coal-fired power plants and topsoil gravel mix.

The stages of decontamination consisted of deconning the floor first. The floor contained 5000 rads per hour. After the floor was scrubbed, a thin layer of concrete was poured to reduce the level of exposure. Then the side walls were deconned. Following this, the building was dismantled to 10 feet above grade. Concrete was poured into the galleries. All that remained was just the single cell, and fly ash with topsoil was placed on top as part of the burial.

The next stage consisted of dismantling the main process cell. Holes were drilled on top of the cell, and expanding grout, called SMITE (Japanese made), was inserted into the holes. This method causes the concrete to swell and fracture. The method works well in nonreinforcing bar concrete. The plan originally called for the use of explosives, but security and safety precluded its use. The top of the cell was cooled with ice because this activity was conducted in the hot summer. Also, the curing of the grout involves an exothermic reaction which creates the buildup of steam when it dries, causing a blow-out of the material. Curing takes approximately 6 days. The concrete shell cracked, and a backhoe was used to crumble the concrete. Asphalt emulsion was added to the walls to fix the contamination.

The final inventory in the entombment is 4.9 curies of plutonium-239, 3.7 curies of plutonium-238, 0.2 curies of Americium-241, 9000 curies strontium-90, 2.5 tons of lead, and 1.5 tons of lead used for shielding. At the time of burial, no prohibition for lead existed.

Question: "Was the approach to keep everything on the site?"

Answer: "Yes, the site mostly consists of low-level waste. Some high-level waste was shipped to the burial grounds."

Question: "What was the estimated exposure to the workers?"

Answer: "I don't know the total dose received."

Question: "What is the standard dose offsite?"

Answer: "25 millirem per year above background."

Question: "What is the background?"

Answer: "Hanford background is 0.02 millirem per hour."

Mr. Heine described the demolition activity on the main stack for the complex. The Strontium Semi-works Complex main stack is a double-encased stack: concrete on the outer stack and chemical brick on the inside stack. Nine rads per hour of strontium were on the bottom and 100 millirem per hour on the top of the stack. Reverse flow to another temporary stack and sandblasting the inside were the next steps in this activity. This method consisted of a special setup with a sand vacuum system for which the waste was disposed into burial boxes. The radiation level in the stack was reduced to 2-3 millirad per hour of strontium and then sprayed with latex paint.

Three detonations occurred on the inner, outer, and outer backside of the stack. The area was water sprayed. The water spray PVC pipe broke during the detonation, so some dust did get into the air upon ground impact. A trench was constructed to catch the stack as it fell upon the ground. No radioactivity was detected outside the trench, as verified by radiological surveys. After the stack fell in the trench, another 15-foot soil barrier was needed on top to complete the burial.

Three tanks still need to be decommissioned. Each has a 3,000-gallon capacity. A total of 10,300 gallons of sludge are contained in the tanks. The liquid waste was removed and transferred to the Tank Farms' high-level waste tanks. A 1000-gallon, low-level tank was filled with limestone, neutralized, then the waste was transferred to a crib. This tank was filled with grout in 1990. Another concentrator tank, 3 feet in diameter and 30 feet tall, once contained plutonium-bearing waste. This 2000-gallon tank with internal heaters also was transferred to the Tank Farms, where it was verified as being empty. The dose rate was 400 roentgens per hour and still contained 40 to 50 grams plutonium. The tank was filled with concrete. The presentation concluded with the following questions and answers.

Question: "How much strontium came from the stack and what was the volume of sand used in the sandblasting?"

Answer: "I don't know. All the sand went to burial. I think approximately 200 cubic feet of sand were used. The estimated strontium was 30 curies."

324 Hot Cell Decontamination

Dr. Jim Jarrett, Pacific Northwest Laboratory, described the completed activities, technologies used, industry support, and the regulatory concerns for the 324 Hot Cell cleanup. The 324 Building C-Cell cleanup is 100% complete and the B-Cell is 58% complete. Dr. Jarrett presented a diagram of each cell within the 324 Building. The B-Cell is 25 feet long by 23 feet wide by 30 feet high. There is a crane mounted above on a hoist to clean the floor. Contained within the cell is a high-level waste melter with borosilicate glass presses. There is a 12-inch layer of debris on the cell floor with 1.5 million curies of cesium and strontium. Also contained within the building is a 25-foot pilot rack system to be decontaminated and decommissioned. Remote equipment is used to cut up the rack, and the waste will be packaged for disposal. Dr. Jarrett showed actual photographs of the equipment to be used in the D&D activities. Pictures were shown of a remote pneumatic reciprocating saw, circular saw for pipes, manipulators to hold the saw, and remote plasma torch.

Question: "Was there a system used to prevent radiation to the workers during this activity?"

Answer: "Yes, a stainless steel liner was deconned using a caustic foam cleaner followed by a water flush and high-pressure spray to reduce the exposure to less than 100 milliroentgens per hour. Mild steel, with epoxy paint containers and a grout mixture inside, was used to dispose of the waste."

Dr. Jarrett described some of the problems encountered during this cleanup activity. The major problem was the high radioactive environment. There was radiation damage to rubber hoses and excessive HEPA loading. To address these problems, several measures were taken to reduce contamination levels. An electrostatic precipitator to control filter loading was installed. Also, a vacuum system accompanied by robotics was used in the final decontamination. A waste compactor was used to reduce the volume of waste 10 times. A water knife abrasive spray was used on the melter. Mockups were performed before the actual job. Final cleanup consists of a pneumatic clamshell with 24-inch-wide teeth to pick up excess equipment inside. Adjustments will be made to correspond to changes in regulations, and the cost for disposing is expected to increase. There has been support from industry with the cutting instruments, packaging, and transportation needs. An automated dose mapping software will be used ahead of the job. There are written reports on this software in open literature. The presentation concluded with the following questions and answers.

Question: "What is the size of the water knife?"

Answer: "The tip is very small. The width of cut is 2 millimeters. The penetration is 2 to 3 inches thick for metal, 12 inches thick for brick and glass. It is a powerful device. An experiment was performed in which the device cut through glass, brick, and metal combined."

Question: "What is the rate of cut and amount of water discharged?"

Answer: "1 gallon per minute is the maximum water discharged. 1 inch per minute with a 1-inch steel cut is the rate of cut."

Question: "What is the size or dimensions?"

Answer: "A large pump is outside and is the size of this classroom table. The cutting device is 2 feet long by 1 foot wide with a hose attached. The pressure is 65,000 pounds per square inches of water."

Question: "Is there a problem with aerosol release during cutting?"

Answer: "I don't know. We haven't used it in the cell yet."

Question: "What is the melting temperature of the high-plasma torch?"

Answer: "It vaporizes cesium to atmosphere."

REDOX Decontamination and Decommissioning Challenge

Mr. Mark Morton, Westinghouse Hanford Company, presented another example for which D&D will be initiated at Hanford in the near future. Mr. Morton briefly described the history, the status, and the planned D&D activities of the REDOX canyon facility.

Question: "What is REDOX?"

Answer: "Reduction oxidation to isolate plutonium from fuel."

Mr. Morton stated that the REDOX canyon facility is 143 meters long, 25 meters wide, and 40 meters high. There are 18 cells located within the facility. The facility walls are 1.5 meters thick of concrete. Mr. Morton discussed the U Plant canyon adjacent to REDOX. The U Plant canyon is longer and contains 2.75 meters thick of concrete. This canyon facility contains 40 cells, which are remotely operated because of the high dose rates. There is a control room outside the canyon. Mr. Morton presented a cross sectional view of these two canyon facilities.

Mr. Morton explained that a facility characterization is required. Boreholes into the cells will be done to obtain samples. Alternative evaluations have begun. A definitive plan will follow characterization once it is known what is present. Then the risks will be evaluated, followed by schedules. This work is estimated to take 8 to 9 years. Physical decommissioning will begin after this work is completed.

Question: "All paper work, why is there more of this than actual work?"

Answer: "Yes, all this paperwork will lead to an engineering plan. The size of the project will vary the time and schedule."

Mr. Morton briefly summarized the future D&D activities. Work will begin with the clean areas. Then the work will focus on the most contaminated areas. A burial mound cover will be placed over the decontaminated area. This will occur assuming the study confirms this alternative. Cost estimates for this activity include the following: \$25 million for REDOX planning, \$18 million for U Plant planning, \$174 million for REDOX decommissioning, and \$156 million for U Plant decommissioning.

Decommissioning The Hanford Production Reactors

Mr. Robert Miller, Westinghouse Hanford Company, described the future planning stages and decommissioning of the eight reactors built between 1942-1954. The B Reactor, the first reactor built, is 25 meters high. Generally, the eight reactors are graphite moderated, single-pass water-cooled reactors. The neutron thermal flux averages $1\text{E}+14$ per centimeter square second. The graphite stack dimensions are 12.5 meters by 12.5 meters by 10.2 meters high. Mr. Miller presented diagrams on the details of the reactor block construction. The reactor blocks are encapsulated in a 1-inch steel plate.

Mr. Miller described the major alternatives for decommissioning these reactors. Several alternatives include: 1) continue the last 20-year maintenance then cover with an earthen barrier, 2) wait for radioactive decay then dismantle after 75 years, or 3) remove in one piece and bury using a crawler to move to a burial site.

Each of the reactor sites are posted now as deactivated zones. The deferred one-piece removal concept is the preferred alternative. Each reactor block weighs from 9,000 to 11,000 tons. The presentation concluded with a few questions and answers.

Question: "What approach is the most attractive?"

Answer: "The one-piece removal from the river."

Question: "How will you deal with construction and support equipment?"

Answer: "All the equipment will remain there."

Question: "What is the estimated cost by the one-piece method?"

Answer: "\$235 million is the total cost. The crawler by itself is \$20 million. All control rod holes will be welded closed and a structural analysis on the block will be performed before transport."

Decontamination and Decommissioning Technologies

Ms. Cynthia Sundberg, Kaiser Engineers Hanford Company, briefly summarized the future technologies to be used by the DOE. This research is the most expensive undertaking by DOE. Ms. Sundberg discussed the integrated demonstration program of D&D technologies. This program consists of careful planning, an assessment of technologies for industrial or new uses, and recycling or reusing equipment. The general approach of the integrated demonstration program is to reduce costs and worker exposures, by using what is already on the market, and to recycle materials. Seven areas are explored: 1) characterization, 2) dismantlement, 3) decontamination, 4) robotics, 5) regulatory compliance, 6) material evaluation and disposition, and 7) systems evaluation. A needs list should be established. This will be accomplished by a team of experienced people from 17 DOE sites to explore common problems. Then the focus will be on costs and allowing greater recycling of materials, as well as the use of portable systems.

Ms. Sundberg discussed the technologies that will be used for D&D in the next 2 years. Such technologies include portable microwave scabbling, gas phase decontamination, chlorine trifluoride to convert nonvolatile uranium to volatile, and mobile units for sampling. The portable microwave heating has 20 times the power of household microwave ovens. This microwave type operates at 6 kilowatts, 10.6 gigahertz and heats water in concrete to break it up by implosion. The fractured chips are vacuumed and disposed. The presentation concluded with the following questions and answers.

Question: "Do you have pictures of this equipment?"

Answer: "No, the literature presented today is from Oak Ridge."

Question: "Have the noble gas mixtures costs been investigated?"

Answer: "No, this has not been developed for Hanford. No gas diffusion equipment has been tested at Hanford. I don't know the costs."

The session concluded with a road tour of the 600 Area, 105-B Reactor, and 324 Building Hot Cells. The following questions and answers were generated during the tour.

B Reactor

Question: "What were the criteria for the reactor's placement?"

Answer: "A large amount of water, a large amount of electricity, little population, and a large land area."

Question: "When was the B Reactor shut down?"

Answer: "1968."

Question: "When did you switch fuels?"

Answer: "Sometime in the 1940s."

Question: "What did you use to make power adjustments?"

Answer: "Boron thermopiles."

Question: "Were there ever cases of swelling or ballooning of the tubes?"

Answer: "Yes."

Local Television Interview at B Reactor

A brief television interview with the Russian delegation was conducted at the B Reactor. The following questions and answers were generated during the interview.

Question: "What have your impressions been so far of your visit to Hanford?"

Answer: "It is very interesting looking at the first reactor built in the United States. Today we are the first Russians at the first American reactor."

Question: "What goes through your mind when you stand in a place like this?"

Answer: "I think about a long history and a cold war that is finished."

Question (directed to Eugene Drozhko): "Many Americans are curious about Tomsk and Chernobyl. What other dangers exist now in Russia? What is the risk for another serious accident in Russia?"

Answer: "I am not a specialist in nuclear power plants. I am the Director of the Chelyabinsk facility. Tomorrow we will give a paper on this topic. In general, we hope serious accidents will not occur."

Question: "Should the world be concerned? Does the world need Russia's help?"

Answer: "Yes. We've spent many resources with little results. There are also difficult economic situations. Together we can do it."

Question: "Do you have a rough idea of how many buildings in Russia need to be decontaminated?"

Answer: "We have five similar reactors. Any new approach in this field would be useful. Our problems are serious and we need to discuss our solutions together. In the future, we may develop joint technologies, joint approaches."

Question: "In this country we have a great debate regarding cleanup costs. Is there the money in Russia to clean up a site like Hanford?"

Answer: "Of course, we always don't have enough money, but the Russian government has decided to give special money for containment. We need real help from America as well as other countries in the world."

Question (directed to Dr. Serguei Tchesalov): "What's the most striking thing you've seen that can be applied in Russia?"

Answer: "[It is] understanding that you have a special program that creates the approach to address these problems. This will really help in the future for Russia. We can really use your experience."

Question: "How much of a problem do you really think there is in Russia?"

Answer: "In Russia the total amount of problems are about the same as here, but today we start work. [It is] not in all directions like you. We are practically only beginning. We have big economic constraints. It's obvious that we need the experience of the United States. It would be more economic to do it that way."

Question: "I understand that your presence here has special significance for you."

Answer: "Yes. My father was an operator of the first reactor in Russia. When I was a boy he took me with him, and I sat in the operator's chair. Today I now sit in the operator's chair of the first U.S. reactor."

324 Building Hot Cells

Question: "How do you move radioactive material from one cell to another?"

Answer: "Cranes move such materials through a 30-foot high airlock, cell to cell."

Russian Presentation

Three Russian scientists (Dr. Igor Sobolev, Mr. Guennady Romanov, and Dr. Alexander Komerov) presented a brief summary of the environmental remediation activities currently being conducted at the Russian radioactive waste sites.

Dr. Igor Sobolev is the director of the RADON amalgamation production site near Moscow. The RADON site deals with waste generated from radioisotopes, medicine, and hospitals. The RADON site does not deal with reactor spent fuel. The site stores waste generated from the European and Moscow regions, including Kaluga and nine other ancient regions in the former Soviet Union.

There are two directions the site is pursuing: 1) practical waste management, and 2) research. Approximately 70% of the waste is generated in Moscow. The site uses its own transportation of solid and liquid wastes, then treats the waste, and stores in near-surface burials.

Dr. Sobolev stated that the wastes are stored using the classical methods of Western Europe. For medical biowastes, incineration is used. The throughput for this type of waste is 100 kilograms per hour. The fuel used is a liquid fuel poisoned with radioactivity. For liquid wastes, a 150-gram-per-liter salt solution is cemented with the waste. This is called cementation. Also, at low temperatures, natural bitumen is mixed with the waste and is transferred into a lead capsule. In the past 2 years, much of the work is focused on vitrification (borosilicate glass). Microwave heating (1.7 megahertz) has been used with the vitrification. For high temperatures, the Russians use a plasma jet. The resultant ash is in the liquid state and is solidified during the vitrification into glass.

Mr. Guennady Romanov is a scientist at the Mayak site. His primary work has been in the studying of radioactive waste from industrial plants and its impact on the environment.

Mr. Romanov explained that since the Kyshtym accident in 1957, technologies have been developed to evaluate the impacts on the environment and the bio-effects on living organisms. Last year, the Russian Federation State Program was formed for the territory of Chelyabinsk, Kurgan, and Sverdlovsk to maintain a program of environmental monitoring. The contents of this program include risk prevention, radiation monitoring, restoration, and public health. The primary focus has been on groundwater monitoring.

Mr. Romanov presented a brief overview on the categorization of their radioactive wastes. For high-level waste, the total inventory is $550\text{E}+06$ curies and consists primarily of tanks; for medium-level waste, the total inventory is $120\text{E}+06$ curies and consists of Lake Karachai; and for low-level waste, the total inventory is $200\text{E}+03$ curies. In the burial grounds, there is solid radioactive waste covering approximately $500\text{E}+03$ cubic meters. Under Lake Karachai, there is groundwater contamination. The primary source of contamination is from accidents, repositories of high-level/medium-level waste, reservoirs containing liquid low-level/medium-level waste, ground burials of solid radioactive waste,

and contaminated parts of plants. Several causes for accidents include destruction of the waste tanks, accidental floods and dam destruction, radionuclides in land water, and tornadoes.

The greatest population exposure source is the Techa River, because of the 1957 accident. The goal is to decontaminate the site and control the Techa River floodplain. Lake Karachai will have to be liquidated.

Dr. Alexander Komerov is the director of the ecology department at the Ministry of the Russian Federation for Atomic Energy (MINATOM). Dr. Komerov presented three ecological approaches the Russians face at this time: 1) rehabilitation of the territory due to the contamination from the defense era, 2) approaches to similar problems at Hanford, and 3) completion of a full characterization of the inventory of wastes. Recently, a draft law was prepared by the Ministry and submitted to the government. The draft became law and now requires every plant to limit the exposure to the public.

Dr. Komerov presented a brief overview of the status of their program. The Russians completed a site-wide inventory of all their wastes. The wastes totalled 5 billion tons (7.3 billion curies). The Russians are now modeling the dispersion of their wastes, with and without buildings in place. Because the main industrial plants are in the big cities, they are now trying to place strict requirements for disposal. However, these requirements have been difficult to follow. The 1992 market value for control of disposal was 170 billion rubles. Mining and production continues to be a problem. The Russians want to create a norm for disposal of different types of waste. Cleanup will begin when the plants are shut down. The Russians stated that they believed Hanford is generally cleaner than their sites and do not see the need for such low limits. This statement is based on the results of their medical histories, health data, and studies conducted on public exposures from their past accidents. Their data indicate much higher levels of exposure for incidence of cancer, etc., suggesting a threshold effect.

The Russian presentation concluded with the following questions and answers.

Question: "How often does the Techa River flood?"

Answer: "The river flooded greatly from 1949-1951."

Question: "How did you clean up the flood plain?"

Answer: "We are working on different options. First, we must find the source of contamination. Then we will finish our study and decide how to clean up. We are now in the stage of a feasibility study."

Question: "How are you conducting ash disposal by incineration?"

Answer: "We mix the incinerated ash with cement blocks, then transfer to storage."

Question: "The U.S. has heard of plans to backfill Lake Karachai. Is this still the current plan for remediation?"

Answer: "No, Dr. Drozhko will discuss this tomorrow."

Tank Waste Remediation

Thursday, April 15, 1993
Richland, Washington

Mr. Don Wodrich, Westinghouse Hanford Company, presented a brief overview and description of the Hanford waste tanks in the 200 Areas. The Tank Farms consist of 149 single-shell tanks and 28 double-shell tanks. The single-shell tanks were constructed between 1943-1964. The tanks are 20 meters in diameter encased in reinforced concrete. A carbon steel liner is located on the sides and bottom, and 2 to 3 meters of earth is on top of each tank. Of the 149 single-shell tanks, 67 are assumed to be leakers. The tanks contain 136,800 cubic meters of sludge, salt cake, and liquid. The total radioactive inventory is 150 millicuries. There are 16 tanks that are 55,000 gallons, and the remaining are 1-million-gallon tanks. No waste has been added to these tanks since 1980. The grouping of tanks is called a tank farm.

Question: "Do you sample the material inside by chemical analysis?"

Answer: "Yes, each waste has been neutralized with caustic before entering the tanks. We have sampled some of these tanks."

Question: "Do you have ferrocyanide in these tanks?"

Answer: "Yes, some 24 tanks have 150 metric tons total of ferrocyanide. We have sampled some."

Question: "You mentioned sludge, is there any overheating observed?"

Answer: "No, we have not seen overheating in those tanks."

The double-shell tanks were constructed between 1968-1986. All tanks have a 1- to 1.4-million-gallon capacity. These tanks contain mostly liquid, totalling 24 million gallons. None have leaked from the inner tank. Each tank is a concrete structure with a steel lining, with another tank inside. The annular space between the two tanks is approximately 1 meter. Each tank has pipes, called risers, entering them. Mr. Wodrich showed actual photographs of the construction phase of these tanks.

Stress corrosion cracking has been the cause of the single-shell tank leaks. Mr. Wodrich proceeded with showing photographs of the liquid wastes in the tanks and how the levels are measured. The salt is sodium nitrate and as the liquid cools, salt is formed out of the saturated solution. Photographs were shown of sludges in the tanks.

Cesium and strontium were removed from the tank wastes in the 1970s. These radionuclides were double encapsulated in capsules measuring 6.5 centimeters in diameter and 52.1 centimeters long. The cesium was recovered from cesium chloride salts, and the strontium was recovered from strontium fluoride salts.

Question: "Is cesium totally deliquified?"

Answer: "The cesium was poured as molten liquid in the capsules."

Question: "We know that cesium and strontium fluorides are used for commercial applications, what benefit is derived from this?"

Answer: "We lease these capsules to commercial industry and the capsules are used for sterilizing medical supplies."

Question: "Do you profit from selling this?"

Answer: "The capsules are government leased to commercial industry at a low cost. Commercial industry makes a profit."

Question: "Do you plan in the future to use this system for recovering cesium and strontium?"

Answer: "We only plan for waste management disposal not commercial use. The capsules are being returned because of one that leaked."

Mr. Wodrich proceeded with a brief discussion on the current plans for disposing the tank wastes. The cesium and strontium capsules and double-shell tank wastes will be packaged and sent to vitrification for interim storage, and eventually to a geologic repository. The high-level waste will be pretreated, separated, and vitrified. The low-level waste will be immobilized, grouted, and stored in vaults.

There will be many tank farm upgrades. Upgrades will include: 1) decreasing wastes by boiling the water and evaporating, 2) pumping to remove residual liquids, and 3) characterizing the waste to resolve safety issues. The focus is on single-shell tank stabilization. Pumpable liquid has been removed from 105 single-shell tanks, and 44 tanks remain to be pumped. After pumping, the tanks will be isolated and sealed by blanking the pipes to prevent rainwater from entering the tanks. Ninety-eight tanks have been completed, and 51 tanks remain. Also, worker training, maintenance, and operating procedures are being upgraded. Additional new double-shell tanks will be constructed.

Mr. Wodrich discussed the general safety issues, including 24 tanks that contain high flammable gas, 24 tanks that contain an explosive mixture of ferrocyanide, and 8 tanks that contain organic nitrates which may lead to runaway reactions. Mr. Wodrich mentioned that less ferrocyanide is being found than predicted. Some tank wastes have degraded with age. If moisture is present, the waste is not as reactive. Fifty percent water is held in the sludge, even if the free-standing liquid is drained from the tanks.

Question: "Do you have any physical and chemical models? What is the name?"

Answer: "Yes, the person is Dr. Robert Cash, Westinghouse Hanford Company."

Retrieval

Mr. William Miller, Westinghouse Hanford Company, highlighted the significant activities associated with removing waste from the tanks in tank farms. Cost estimates for this activity are billions of dollars. The major problem for retrieval is the equipment that exists in the waste, left over from previous work on the tanks. There are a number of pipes and instruments embedded in the salt cake inside the tanks; this creates a problem with limited movement in the tank during waste retrieval. Several issues for development of retrieval techniques include designs, costs, and scheduling. There are many options for retrieval. Ultimately, the primary objective is to remove as much as possible the waste and surrounding contaminated soil, leaving the tanks in place.

Mr. Miller presented a functional flow diagram for waste retrieval. The single-shell tank slurry waste will be transferred via underground piping to the double-shell tanks.

Question: "Where will you ship the tanks?"

Answer: "We don't know at this point."

Question: "What is the pH of this waste?"

Answer: "The lowest is 8. We operate at greater than 13 to 14. The ferrocyanide waste is 9.5. Reactions occur at temperatures greater than 120 degrees Celsius. The tanks are kept at less than 100 degrees. Also, chelating agents, such as TBP, DTEA, DTHA, are added to the organic nitrate compounds to prevent reactions."

Safety issues also exist. One tank needs water added to cool the tank because the evaporation rate is extremely high. The same amount of water is added every month. This tank was used to recover strontium, and some carried over when the process waste stream was discharged back into the tank during dilution. There is another tank with vapors that make the workers ill. The vapors smell of ammonia.

Question: "How much separation occurs before disposal?"

Answer: "[There are] two reasons to separate: 1) to determine the volume to know how much will go to the repository, and 2) to determine the costs to identify a dollar amount per canister to be buried."

Mr. Miller explained that the pretreatment process will involve retrieving waste from the tanks and separating the waste. This process will include removing cesium from the liquid soluble fraction, destroying the organics and other radionuclides, then transferring to grout. The remaining solids would go to the vitrification process or dissolve sludges, followed by a transuranic (TRU)-waste separation before vitrification. Mr. Miller showed a diagram of the vitrification process to begin operation by the end of the century (year 2000).

He stated that another method involves a water sluicing jet in the single-shell tank which is later pumped to a double-shell tank. There is a concern with this method producing a lot of water in the leaking tanks. An underground barrier under these tanks is necessary. For double-shell tank retrieval, mixing pumps are preferred. A pump is suspended into the tank with water jets to dislodge sludge in the tanks. Suspended solids are pumped out to another treatment and disposal facility.

Robotics and manipulators consist of a base arm with devices at the end of the arm to actually remove waste. A vacuum also is used to suck out the waste on the bottom of the tank. The ultimate plan is to deploy past practice sluicing and manipulatory-based robotic systems. The presentation concluded with questions and answers.

Question: "Where is the intermediate place for putting the waste retrieved from the single-shell tanks?"

Answer: "The waste first is put into the double-shell tanks and is piped directly from the smaller interim double-shell tank. These tanks will be made of stainless steel or carbon steel."

Question: "When you constructed the single-shell tanks, it was for a long time. For the new double-shell tanks, do you plan on a long time? What assurance do you have?"

Answer: "Stress corrosion of the single-shell tank was solved by the double-shell tank design. Eventually, all the waste will be removed."

Waste Separations and Pretreatment

Dr. Ben Johnson, Pacific Northwest Laboratory, presented a brief overview of Hanford tanks, the source of the wastes, and hazards in the wastes. Two strategies were discussed: pretreatment and removal. Dr. Johnson stated that salt cakes are the water-soluble portion of the waste and sludge is the water-insoluble portion. The double-shell tanks contain mostly liquid waste from the single-shell tanks. Approximately 25% is other wastes from neutral processing waste, cladding removal waste, and Plutonium Finishing Plant (PFP) waste.

Hazards in the waste include: 1) fission products from fuel irradiation to produce plutonium; 2) TRU components, consisting primarily of americium and neptunium; and 3) process chemicals with environmental hazards. Dr. Johnson presented photographs of these constituents present in tank waste. The radioactive elements are in the parts per million and are small in comparison to the toxic metals (parts per thousands) and other constituents such as nitrates (50%). The idealized strategy is to encapsulate the fission products and TRU component with eventual storage in a geologic repository. Cleanup could have easily been achieved, but the wastes are not segregated. The clean option will be an aggressive removal of radionuclides from the sludge with intensive separation to yield minimum high-level waste to be vitrified. The decision on these approaches is for the next 5 years.

Question: "How far are these approaches--already in the lab or plant testing?"

Answer: "All steps have been shown in the lab as feasible approaches. These approaches have not been optimized or ready for plant design."

High-Level Waste Vitrification

Mr. Joseph Perez, Pacific Northwest Laboratory, discussed the evolution of melter technologies, beginning in the early 1970s, and the future plans for vitrification. Mr. Perez presented an artist drawing of the future vitrification plant. A flow process diagram was shown to outline pretreatment, feed preparation, ceramic melter feed, and glass production. Also, a brief description of the stainless steel canisters for the glass storage was presented. The offgas steam from the melter is composed of particulates and steam. A wet bed scrubber and water tank with a packed bed is installed to condense steam and remove large particles. This system is followed by a fiberglass mist eliminator and two stages of HEPA filters before final treatment and discharge.

Mr. Perez explained that the commercial glass industry uses horizontally based rod electrodes. The melter was switched from rod to plate electrodes to allow for higher processing rates. However, this design did not provide uniform temperature control. The use of multiple electrode sets within the tank is preferred to allow higher melting temperatures along the floor and glass. This is the basis for Savannah River and Hanford. Four electrodes with electric heaters in the gas space are used for better efficiency. Mr. Perez presented scale drawings on the relative size of this melter. Canisters are rotated beneath the melter. This new design was tested at the West Valley, New York, reprocessing commercial facility. The melter also contains sloping walls with a bottom electrode to allow better control of the precipitate formed. Mr. Perez presented a diagram of this design. This design is now the baseline for Hanford.

Mr. Perez mentioned other improved designs being investigated to allow higher collection. Under evaluation is the high temperature melter (1300 to 1500 degrees Celsius) which provides good glass and allows more waste loading. Another design is the mechanical stirred melter (1100 to 1200 degrees Celsius) in which the first chamber waste is converted to glass with refining heaters before entering the canisters. A combustion melter uses a natural gas, kerosine fuel-injection system to melt waste before entering the furnace. This design promises high production rates. A demonstration on the use was part of the afternoon tour. This design, however, has a high offgas steam and high throughput to impact every system in the plant versus the other types.

Question: "Did you consider microwave heating?"

Answer: "This is being studied for other waste applications. It would be used as a boosting technique. The production rate at the time didn't warrant further evaluation."

Question: "What is the radio-frequency of the Caldwell versus Inconel?"

Answer: "This has not been studied."

Question: "What is the reason for using an organic compound and old waste with decay for the melter?"

Answer: "There is quite a history. Savannah River evaluated nitric, formic acid for mercury removal. We want to control the redox state of the glass (amount of oxygen released). Nickel, manganese, and iron disrupt the process, and this is why we keep slightly reduced glass chemistry. We also looked at sugar and corn starch to reduce formates in the melt."

Question: "What is the feeling about the Russian design (difference in electrodes- Russians use molybdenum, 900-1000 degrees Celsius, versus Inconel in the U.S.)?"

Answer: "Don't know. I have never seen the Russian design. However, Inconel is used because it contains a nickel alloy compatible with borosilicate, and there is very little corrosion."

Tank Waste Sampling

Mr. John Propson, Westinghouse Hanford Company, described the sampling process for the single-shell tanks. A 2.5-centimeter core is taken from the top to the bottom of the tank through existing tank access rivers. A core sampling truck contains a flatbed truck with a rotating platform. A standard drill rig is placed on the platform. This rig is connected to a hollow pipe with a drill bit. The sampler is inserted within this pipe. The sampler is accessed through the riser on top of the tank. Electrical power is supplied by a diesel electrical service trailer. A portable exhauster is attached to the tank to maintain a negative pressure on the tank. The samples are placed in a rack of shielded canisters and sent to the laboratory for analysis.

Mr. Propson presented a diagram of the sampler inside a drill string. An actual model was displayed. Mr. Propson described each part of the sampling system. The piston rod is held in a fixed position while the sampler housing is pushed into the waste to a depth of 48.3 centimeters. Then the sampler is stopped, the piston rod is pulled, and a spring tension closes a valve on the bottom of the sampler. The samples are pulled and placed in a shipping cask. The sampler is taken apart at the laboratory in a hot cell. Various tanks will require 1 to 22 samples. The drill string is removed from the tank and moved to the next tank.

Several photographs of samples taken were shown. One example showed that the sample material on the bottom was darker and harder than the top. Also, a picture of the truck was shown. Several questions and answers followed.

Question: "How many real samples have you experienced?"

Answer: "I've watched two samples to date."

Question: "How many samples have been done to date?"

Answer: "Approximately 70 core samples have been taken."

Question: "Is the sampler used only once then disposed or reused?"

Answer: "Yes, the sampler is disposable. It is more expensive to decon the sampler than to build a new one."

Question: "Do you have a report on the sample characterization?"

Answer: "Yes, a report exists on the physical, chemical, and radioactive properties."

Question: "Can we see such sampling now?"

Answer: "No, it is down now for 3 weeks."

The session concluded with a brief tour of the 200 East Area, Grout Facility, Waste Encapsulation and Storage facility, and Tank Farms.

Russian Presentation

Three Russian scientists (Dr. Eugene Drozhko, Dr. Igor Khodakovsky, and Dr. Valeriy Mironenko) presented a brief overview on the remediation activities at their radioactive waste sites.

Dr. Drozhko is a scientist at the Mayak site in Chelyabinsk. In 1946, Chelyabinsk-65 was founded, which is the unofficial name. In 1948, the first uranium graphite reactor began operation. This reactor has been operating 5 years less than Hanford. Dr. Drozhko presented a geographic map of the Chelyabinsk site in the Ural region. The Mayak site has 14,000 workers. The site is involved with reactor production, radioisotope production, chemical processing, and tank farms. In 1949, the first radiochemical plant became operable. Through bad decisions, there have been many problems with contaminating the environment. The low-level waste is directly discharged into the Techa River. The technology to control this is not sufficient. There is also a medium-level waste management problem. The estimated contamination of low-level waste is 76 million curies. Most of the medium-level waste is discharged directly to Lake Karachai. Authorities recognize the level of waste to the river is high and await decisions to reduce and cleanup this waste. The focus now is to constrain the discharge of these wastes to the river and reservoirs.

Dr. Drozhko presented an aerial view of Lake Karachai, an artificial reservoir for receiving the highest quantity of waste. There are groundwater radionuclides present under the lake. The explosion of one vessel tank in 1957 at Kyshtym has contributed the highest contamination. The total amount in Lake Karachai is 120 million curies. The concentration increases around the lake during the dry season. In 1967, a rare tornado dispersed contamination in the area. Five percent of the total radionuclide inventory is from industrial activities.

Dr. Drozhko showed a diagram of the large zone of strontium contamination from the Kyshtym disaster. The area is mostly contaminated with cesium and strontium. The population dose to the Techa River villages was high. Some villagers received 170 rem, while some other workers and villagers received 57 rem. The current situation requires special measurements. The most dangerous area on site is Lake Karachai.

Dr. Drozhko explained that the near-term plan is to cover the lake with concrete blocks and stone in 1995. The total contamination in the groundwater under the lake is estimated to be 4 million cubic meters wide and 10 kilometers square. The focus is on planned measures to localize movement of contamination in the groundwater to the river. Special equipment for drainage will be installed. The contaminated waters will be pumped to change the regime of movement in order to stop the flow in some direction. Two-dimensional transport models have been prepared. The experimental problems will be compared to the calculational problems. Plans are being developed for a three-dimensional model. The trend is to move the contamination upward. Graphs showing the change in level of activity over time were presented. The total volume of all the reservoirs in the area is 380 million cubic meters. The total radioactivity, excluding Lake Karachai, is 20 kilocuries.

Current activities include developing equipment to remove rain from the reservoirs. Hydrobarriers will be set up to decontaminate the water. There are also contaminated marshes near the reservoirs, which mainly contain strontium. A detailed characteristic inventory of the contaminated area exists, and the Russians now want to isolate the area.

Dr. Igor Khodakovsky presented a brief summary on the meteorological problems and the prospects of future joint Russian-U.S. evaluations for cleanup. Verification of the Russian data and risk assessments will be required by this venture. Criteria and special equipment will have to be developed for remediation activities. Also important is the development of laboratory systems.

Dr. Valeriy Mironenko discussed the general problems of groundwater contamination in Russia. In Russia, this is a major crisis. Dr. Mironenko is a scientist at the St. Petersburg Mining Institute. It is the oldest institute in Russia. In fact, it is 3 years older than the United States. Dr. Mironenko works in the hydrogeological division. The general geographic areas were discussed. The main problem is in gathering information. There is a legislative side and a nonlegislative side. For this reason, trial and apparition approaches are necessary. Field tests need to be compared to observations. Examples include vertical well construction with tracers and then observations at another well along the same vertical for movement. The most preferred method is the observation injection well with tracers, whereby one well is an injection type and one well is a pumping type. Preliminary results are being prepared for evaluation.

Dr. Mironenko stated that a universal law exists for ponds and basins: these units leak. Flow conditions are best understood by chemical tracers. One field test showed how the flow rate of groundwater was calculated using two wells 100 meters apart. The tracer was introduced into one well during July. The tracer did not show up in the second well until September. An example of a community

problem indicated that the source of contamination was not from the tritium and nitrate site deposit, but actually from the biological nitrates generated by the community. There are basically two models to use: good ones and ones that work. The Russians believe that all processes and supervision should be made by the same group. Models require observation feedback. Regional and local modeling should be as one system of modeling. Artificial barriers are intended to work for 10,000 years. The Russians have 30 years experience in storing waste. The Russian presentation concluded with the following questions and answers.

Question: "Is there still wildlife in the lakes at Chelyabinsk?"

Answer: "At Lake Karachai last year, underground algae and seaweed have appeared."

Question: "Has the contamination of the Techa River affected other rivers downstream?"

Answer: "Yes, there is a dilution process in the next river. The next river is $1\text{E-}12$ curies per liter for cesium."

Question: "Any waste in Lake Karachai exposed during dry periods?"

Answer: "In 1967, when there were a lot of open beaches, the total area had more contamination on the ground. Now there are no open beaches. The level has changed. The beaches have silts now."

U.S. Environmental Laws and Public Involvement

Friday, April 16, 1993
Richland, Washington

U.S. Environmental Laws and the Hanford Cleanup Agreement

Mr. Paul Day, Director of the Environmental Protection Agency (EPA), Region 10, presented an overview of the roles of EPA and Washington State as regulators in the Hanford cleanup. The two regulators share projects and work as a team. Each are different enforcement authorities. Three parties (the EPA, DOE, and state) made a voluntary agreement known as the Tri-Party Agreement. This balance of enforcement works with the DOE for determining solutions to Hanford Site problems. There are 26 years left on the agreement. The presentation concluded with the following questions and answers.

Question: "What is the final outcome or fate of this agreement?"

Answer: "This agreement only addresses cleanup. Future land uses will be discussed later today."

Question: "If cleanup is accomplished in 30 years, will someone be able to build onsite?"

Answer: "DOE still owns and operates the land."

Question: "At this time, is federal money used?"

Answer: "Yes, we have different cleanup goals."

Question: "What is the water supply of Richland?"

Answer: "The Columbia River downstream."

Question: "Who does the water sampling?"

Answer: "The Richland municipal authority and Pacific Northwest Laboratory."

Question: "Does the city of Richland have its own landfill?"

Answer: "Yes, it is the same as landfills across the country."

Evolution of Public Involvement in the U.S.

Mr. John Burk, Westinghouse Hanford Company, presented a brief overview on Hanford's communication with the public. There is much public participation at Hanford. This participation is a process for making sure the fears and values of people involved with the Hanford cleanup are made open to the public. The public is anyone affected or believes is affected by decisions made at Hanford. A question raised by technical managers is why we are doing public involvement? There are two answers to this question. Some decisions are required by law and regulation, while other decisions can actually be

implemented. The easy part is making technical decisions. The difficult part is implementing those technical decisions. Members of the public can reject that decision.

Mr. Burk commented that public involvement is relatively new in this country. Through the 1950s, it was known that if the government made the decisions, the people accepted them. A change was seen in the 1960s because of the Vietnam War. Some groups have become sophisticated in finding ways to delay the operation and cleanup of Hanford. One way toward success has been the use of media to focus on the negative aspects and obtaining political support. Another way is the effective use of the court system.

Question: "Could any complaint come from any individual or group?"

Answer: "Yes, complaints are submitted to the government and operating officials. One can register their complaints with the state, members of Congress, the NRC, and court system."

Involving the public with Hanford decisions includes listing the solutions and choosing the right solutions to the problems. Mr. Burk summarized the Hanford Future Site Uses Group and ways to involve the public by: 1) large formal hearings, 2) large public meetings, 3) workshops, 4) advisory group meetings, 5) phone calls, and 6) one-on-one meetings.

Question: "Once the public participates, how do you proceed to resolution?"

Answer: "Ideally, you would like to have a consensus for which everyone agrees on an issue. DOE is the decision maker. It is easy to move ahead if there is a consensus. The courts look favorably on public involvement."

Question: "How do you work with those who are opponents?"

Answer: "Advisory groups are often set up to address strong opponents. More radical groups have realized that we all need to get involved in order to solve our problems."

Question: "In general, in Russia we have problems with those who live near a power plant versus those who live far, do you have that problem?"

Answer: "Those who live near a power plant are usually more comfortable than those who live far away."

Question: "We saw two areas near Hanford where the nuclear power plants are not complete, why?"

Answer: "The people here would very much like to see these plants start up. The effort to build and complete the old ways which industry knows best no longer applies. Laying out this process is the bulk of public involvement. This doesn't mean everyone will agree, but the process is seen as legitimate and not necessarily the decision. An example is the Bonneville court case, where the judge let public involvement proceed but saw the process as good and the outcome for implementation was different."

Question: "The Japanese specialists are developing and reprocessing fuels for the future. The Japanese are achieving an advantage in this area, what do you say about this?"

Answer: "It is a concern for me; however, the technology is licensed to them by the U.S. and other countries. It is disturbing that they can advance and implement a program and we [U.S.] cannot. The fact is Americans aren't used to utilizing technology."

Public Outreach at Hanford

Mr. Gary Petersen, Pacific Northwest Laboratory, and Ms. Glenna Moulthrop, Westinghouse Hanford Company, both described the public involvement in recent years at Hanford. Since 1943, the states of Washington, Oregon, and Idaho have been very interested in how much radiation has been released from Hanford. In 1987, four major universities in Washington and Oregon appointed 16 members of the public to be on a technical steering panel. In addition, the Indian Nations also appointed members to look at how much radiation has been released and its impact on the public.

Beginning in 1943, an historical record search has been conducted to see what amounts of radiation have been released to the environment. Mr. Petersen presented a grid map showing the areas of study and locations of the Indian Nations. Also included was the flow of the Columbia River. Public meetings have been held to tell the public the results of such a study. This particular study will be completed next year. Computer programs will be available to show the impact on people located in the grid areas. How much radiation released can be reconstructed on a daily basis.

Individuals aged 50 years old, who were raised as children near Hanford, are very interested in the impact on them. These people are called "downwinders." The wind usually travels west to east. This is one of the more public involvement programs we have.

Question: "What is the trust level of the population on this panel?"

Answer: "The trust level is very high. There are groups active against this effort who attend these meetings."

Question: "Do these opponents talk about modeling?"

Answer: "The opponents do speak up and ask questions and receive answers. They do believe the modeling will be correct. The panel is responsible for telling the public what will be done. Pacific Northwest Laboratory does the data gathering."

Question: "What percent of the Superfund is used for this study?"

Answer: "\$25 million to date. The total over the 6-year period is expected to be \$20 to 30 million and comes from the federal agency. The public directs the money expenditures."

Ms. Moulthrop described Westinghouse Hanford Company's participation in the public involvement and outreach. Westinghouse is getting to know the new stakeholders very well by this process. The public needs to participate in the technical decisions. Public outreach is a relationship building. There

are various ways to build this relationship by: 1) focus groups, 2) public workshops, 3) citizen advisory groups, and 4) people-people discussions. By sponsoring local public groups, a whole range of options can be looked at. This will provide a meaningful public involvement and also will provide the information the public wants to have.

Public information needs to be objective and not to sell any biased technical solution. A variety of programs exist to accomplish this objective: 1) Hanford's Speakers Bureau (500 different people pass through the bureau any given month); 2) public tours (300 visitors per month); 3) regular meetings; 4) newsletters; 5) fact sheets, brochures, and video tapes; 6) symposiums; and 7) public workshops.

Public and Regulatory Acceptability of Innovative Technologies

Ms. Gretchen McCabe, Pacific Northwest Laboratory, discussed three approaches for studying public involvement with technical acceptability. The three approaches include: 1) 40 Hanford stakeholders will identify the criteria, 2) the criteria will be used to evaluate specific technologies, and 3) the effort will be duplicated nationally to identify the acceptability issues of stakeholders at other DOE sites. Ms. McCabe described the Hanford stakeholders and presented the list of 40 representatives.

Question: "Are these people selected?"

Answer: "No. 300 invitations are sent out and 40 responses were received. One-on-one interviews were conducted, and representatives from the 40 stakeholders were determined by choice of the stakeholders."

Criteria were presented to the stakeholders concerning public interests. As part of Phase 1, a computer model, called perspective technology communication system (PROTECH), is available for maintaining a current listing of technologies. A demonstration was on display during the session. Technologies, such as the carbon tetrachloride demonstration, were on display. The model was developed because the public wanted a more comprehensive list of calculated, expected, and routine operational activities. The efficiency is determined by how effective the technology and costs are. The focus now is on what the land be used for after cleanup. Also, the model is a method of keeping a track record and comparing the technologies with regulatory objectives for compliance. Hanford has been fortunate in gaining trust in the stakeholders. It is hoped that this trust will be carried over to Phase 2.

Question: "Do you have a list of new technologies in computer form?"

Answer: "Yes, I have all technologies from drilling, etc. to remediation."

Question: "Do you use technical language or public language for communication?"

Answer: "We use simpler language for the public. For every technology, every person fills out a profile in simple English."

Question: "What level of education is it geared for?"

Answer: "At the high school level."

Question: "What about the Indian language level?"

Answer: "They speak English."

Question: "Do you have any reports on your work? Have you conducted any survey polls?"

Answer: "Yes, I have a report here. No surveys or polls have been conducted at Hanford yet."

Public Involvement Experiences at Hanford: Northwest Citizens' Forum and Future Site Uses Working Group

Ms. Patricia Hale, Westinghouse Hanford Company, described lessons learned from two recent experiences on public involvement at Hanford. As she described, we now recognize that citizen advisory groups can make better decisions. This approach reflects the true values and concerns of the people. The efficiency and credibility are improved by this outcome. It is more efficient working with small groups representing a larger interest group of people. Ms. Hale explained that a well-formed group can bring instant credibility. If the people are seen as credible by this process, then the process is viewed as credible. Today at Hanford there are two successful groups: the Northwest Citizens' Forum and the Future Site Uses Working Group. A third group is being planned.

Ms. Hale presented a brief summary on the makeup of the two groups and the lessons learned. The Northwest Citizens' Forum was formed in 1986 to aid in determining how the defense wastes should be treated and disposed. The forum consisted of 26 members from Washington, Oregon, and one Indian Nation. The forum was chaired by the president of Gonzaga University. The forum looked at a range of options. All meetings were open to the public. A final report was published with several recommendations that eventually influenced DOE's final decision.

The Future Site Uses Working Group was formed to determine how the land will be used once cleanup is completed. This group was twice the size of the former forum group and represented a broader spectrum of interests. The group was chaired by the president of Eastern Washington University. The final report was issued December 1992. The report recommended the overall strategy for the Site's final cleanup. Several recommendations were determined by what the land will be used for in the future.

The development of a third new citizens' forum will involve the lessons learned from the previous two groups. Such lessons learned include: 1) including all affected or believe affected interests; 2) discussing the problem and not the solution; 3) providing information and access to the information; 4) setting clear tasks and realistic, achievable schedules; and 5) trying not to control the group outcome but to use the results of the group. In this way, the group will not feel their energies are wasted.

Ms. Hale concluded with four strategies for a successful group. The four strategies are: 1) determine who is affected, 2) target interactions to them, 3) listen more than talk, and 4) use the results of the group.

Question: "Welcome to Russia! What type of people were selected in the group? How did you select them?"

Answer: "We talked to every major type of audience. We then focused on the interests rather than the individuals. We looked for a broad range of views-education, professional level, etc. Independent facilitators chose the group. Generally, there were already leaders within the groups represented."

Question: "Is this not democratic or subjective?"

Answer: "That is a problem. Democratic is for law and election into government. This isn't either; therefore, it is a group formed from those who responded and wanted to be represented."

The session concluded with three small group discussions on how to talk about risk to the public, how to work with the news media, and how to use public involvement tools and approaches in decision making.

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