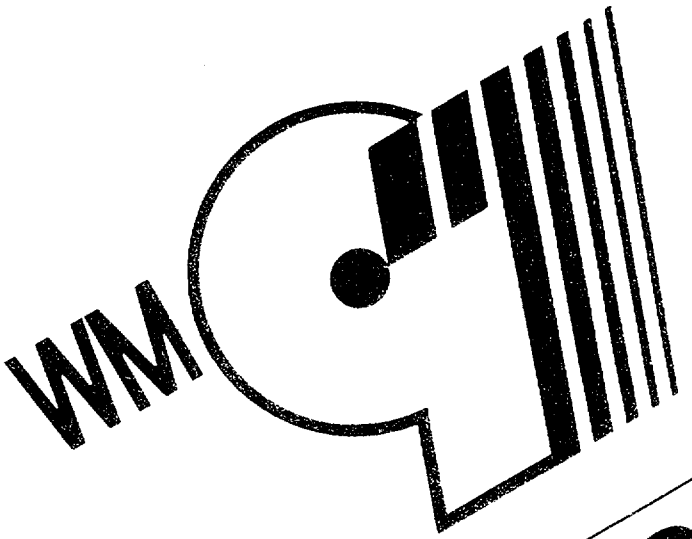

ABSTRACTS

as of February 3, 1997

"HLW, LLW, Mixed Wastes and Environmental Restoration — Working Towards A Cleaner Environment"

Hosted and sponsored by the University of Arizona, also sponsored by the American Nuclear Society, the U.S. Department of Energy, New Mexico State University and the Waste-management Education and Research Consortium (WERC), and the American Society of Mechanical Engineers. The conference is organized in cooperation with the International Atomic Energy Agency

. . . *and* **ER'97**

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All papers received by February 3, 1997 will be available on CD and mailed to all registrants in May, 1997.

SESSION 1-PLENARY

LEVERAGING RESOURCES ACROSS DOE SITES FOR FASTER AND MORE ECONOMICAL CLEANUPS

Lee A. McIntire
President
Bechtel National, Inc.

ABSTRACT

Leveraging resources across DOE sites means sharing resources, avoiding duplication, and taking advantage of technology irrespective of where it was invented. Historically, DOE's numerous sites have been operated like independent silos; however, with the evolving mission of these sites and with more focus on cleanup rather than on production, opportunities for leveraging resources are right in front of us. Two factors that allow for resource leveraging are the DOE's Contract Reform initiatives and the entry of firms like ours into this growing market — firms that have the experience to integrate activities at multiple sites, leveraging the resources of those sites to create more business opportunities for the customer at that site, for other customers in our business, and, most importantly, for our employees. We will meet the challenge of faster and more economical cleanups by taking advantage of the human potential at these sites, motivating people, and creating a vision for the future. Only through working together will we, the contractor community, labor, and DOE, achieve our goal of "doing more for less."

SESSION 2-MULTINATIONAL REPOSITORIES

INTERNATIONAL REPOSITORIES - PERSPECTIVE FROM A COUNTRY WITH A SMALL NUCLEAR PROGRAMME

C. McCombie, H. Issler
Nagra
5430 Wettingen, Switzerland

ABSTRACT

Discussions on the pros and cons of international repositories have taken place in different technical and non-technical groups and organisations over a long period of time. Almost always, however, the debate is immediately dominated either by political considerations or by economic arguments. The former can lead to those countries developing their national systems to explicitly reject possibilities for accepting foreign wastes since such plans can make local acceptance of repository projects more difficult. Financial arguments can lead small, waste-producing countriesto seek collaboration aimed at reducing specific disposal costs or can encourage large countries with low population densities to look for business opportunities.

Currently national opinion (public and political) often seems to favour dedicated national facilities although the potential advantages of collaboration are apparent to technical or economic specialists.

Before the relative merits of national vs international disposal can be seriously discussed by any country, the basic feasibility of implementing a national repository must be considered. The requirements are a good sound concept and the technology to implement this, a suitable geologic setting and adequate financial resources to drive the programme. In Switzerland, a long-term R&D programme has developed adequate technology, the siting issue for HLW is still being studied but looks promising and costing studies indicate that the unit costs, although very high, can, if necessary, be financed by the generators of nuclear electricity.

Current official Swiss strategy for HLW disposal includes evaluation of both alternatives, national facility or an international repository. This strategy is determined, on the one hand, by the uncertainties in the future availability of international options and, by the other hand, by the long time horizons before a final decision becomes necessary. The immediate goal is to convince all relevant bodies (implementers, regulators and public) that safe deep disposal is indeed feasible in Switzerland. In the long intervening period before a HLW repository becomes necessary towards the middle of next century, ample time is available for participating in joint preparatory projects and for evaluating potential international repository prospects.

GUIDELINES FOR INTERNATIONAL DISPOSAL OF RADIOACTIVE WASTES

John W. Bartlett
S. Cohen & Associates, Inc.
McLean, Virginia

ABSTRACT

This paper discusses the incentives for an international approach to disposal of radioactive wastes and the means by which it might be accomplished. The incentives focus on the need for cost effectiveness, minimization of environmental impacts, and potential limitations of availability of disposal sites. Implementation should be led by the diplomatic community, and should build on the now extensive world-wide experience concerning selection and characterization of candidate disposal sites, and on existing, in-use technologies for all operations except disposal. The initiative could come from a group of nations which has commitments to nuclear power but no current disposal programs. Nations such as France, Sweden, and the United States, which do have ongoing disposal programs, can provide support for the concept, expertise, and venues for implementation.

SESSION 3-STATUS OF LLRW/MIXED WASTE COMPACTS AND STATES-I

WARD VALLEY 1996 - SCIENCE GONE SOUTH

Richard F. Paton
Vice President
American Ecology Corp.
Boise, Idaho
James A. Shaffner, P.E.
Manager, Southwestern Compact Region
US Eocology Inc.
Rocklin, California

ABSTRACT

The Ward Valley Land transfer impasse is a prime example of the dilemma that results when political ideology is substituted for scientific method in a public policy debate. In the face of scientific face, pleas by knowledgeable scientists and doctors and to the economic detriment of California, the Clinton administration has steadfastly refused to transfer a small parcel of land in the Mojave desert to California for low-level radioactive waste disposal facility. The administration has chose to listen instead to a small group of Hollywood activists, championed by senator Barbara Boxer, who refuse to let facts get in the way of their anti-nuclear ideology. In taking this position, Clinton has demonstrated that he is willing to jeopardize the economy of our biggest state as well as the health and well being of thousands fo people suffering from lifethreatening diseases - all to mollify the interests of a few well-heeled contributors. In so doing, he is thwarting the implementation of a federal law - one which he helped create when he was governor of Arkansas - and doing so at taxpayer expense.

This paper chronicles the efforts, throughout 1996, by the Clinton administration to thwart the land transfer necessary for completion of the Ward Valley project. With the most tenuous of excuses Depuly Interior Secretary John Garamendi called for additional tests and studies following. all the while, the advice of anti-nuclear activists instead of credible government experts. The administration's pattern of continual delay in this process has recently prompted Governor Pete Wilson to act. The paper concludes with recent initiative on the part of project proponents to reverse delaying tactics by the federal government through legal action.

WARD VALLEY AND THE LOW-LEVEL RADIOACTIVE WASTE POLICY ACT

Alan D. Pasternak, Ph.D., Technical Director
California Radioactive Materials Management Forum
Post Office Box 1638
Lafayette, California 94549-1638

ABSTRACT

It is now over three years since September, 1993 when the California Department of Health Services, California's Agreement State Agency, certified the Environmental Impact Report (EIR) for the proposed Ward Valley low-level radioactive waste (LLRW) disposal project and issued a license to US Ecology, Inc. to construct and operate the Southwestern Compact's first regional disposal facility. But there is still no project.

It is over a year since January, 1996 when California's courts completed judicial review and upheld the Department's regulatory decisions to issue the Ward Valley license and to certify the EIR. But still no project. The last major administrative action required before the Ward Valley project can move from proposal to reality is a sale of federal lands to the State of California for use as the site of the Southwestern Compact's first regional disposal facility. But since taking office in January, 1993, the Clinton Administration has refused to complete the Ward Valley land sale. The Administration and the U.S. Department of the Interior have offered a series of excuses for not completing the land sale and have called for one study after another.

A mix of science and politics affects Ward Valley decisionmaking, especially decisions related to the land sale. A favorable National Academy of Sciences review, completed in May, 1995, has not been sufficient to persuade the Administration to proceed with the land sale. In February 1996, Interior called for more another year's delay, more tests at Ward Valley, and a second Supplemental Environmental Impact Statement (SEIS). The so-called "Garamendi Exercise" (after Depuly Interior Secretary John Garamendi who has been DOI's spokesman on Ward Valley for the past year-and-a-half) has no basis in science, lacking even the support of Interior's own U.S. Geological Survey, and gaining only the grudging cooperation of the U.S. Department of Energy. This latest study is, at best, a delaying tactic to postpone a decision and, at worst, an effort "to study the project to death," in the words of the San Jose Mercury News.

On January 31, 1997, California Governor Pete Wilson, saying his "...patience with these tactics of delay is now exhausted,..." announced the filing of a lawsuit in federal court by the California Department of Health Services seeking to compel the Ward Valley land transfer. The Governor also announced that the state would proceed with confirmatory testing as recommended by the National Academy of Sciences report. (The NAS had recommended additional tests during construction and operation of the disposal facility, but Interior has demanded the tests be done before the land sale.)

SESSION 4-MARKET DRIVEN RECYCLING

FERNALD'S LIFE CYCLE ANALYSIS OF RECYCLE OF RADIOACTIVELY CONTAMINATED STRUCTURAL METAL

Katherine L. Yuracko, Michael J. Gresalfi
LMER
Bob Lehrter
FDF
Peter Yerace
DOE-FN
Igor Komarikov
UT

ABSTRACT

During the past five years, a number of U.S. Department of Energy (DOE) funded efforts have demonstrated the technical efficacy of converting various forms of radioactive scrap metal (RSM) into useable products. From the development of accelerator shielding blocks, to the construction of low level waste containers, technology has been applied to this fabrication process in a safe and stakeholder supported manner. The potential health and safety risks to both workers and the public have been addressed. The question remains: do the benefits of fabricating products from RSM outweigh the costs? The DOE Fernald Environmental Management Project (FEMP) has developed a methodology based on life cycle analysis to evaluate the costs and benefits of recycling and reusing RSM, rather than disposing of this RSM in an approved burial site. This paper presents the life cycle analysis conducted to determine whether the DOE Fernald site should recycle some of the radioactively contaminated structural steel from the Plant 4 D&D project.

RECYCLING OF AECL'S CONTAMINATED STAINLESS STEEL FUEL BASKETS AT MANUFACTURING SCIENCES CORPORATION

Pauline Hartwig, Decommissioning Services
Wayde Gutzman, Decommissioning Radiation Protection Supervisor
Waste Management and Decommissioning Operations
AECL
Chalk River Laboratories
Chalk River, Ontario, Canada K0J 1J0
Michael Byrne, Product Manager, Decontamination and Recycling Services
Charles D. Nichols, Manager Survey, Transportation, and Waste Processing
Manufacturing Sciences Corporation
Oak Ridge, Tennessee 37830

ABSTRACT

The decommissioning of the NRX research reactor at AECL Chalk River Laboratories (CRL) included the removal of 200 stainless steel fuel transfer baskets from the spent fuel bays in late 1995. The baskets, which weighed approximately 8000 kg, were surface contaminated with both alpha- and beta/gamma-emitting radionuclides, but had not been activated or volumetrically contaminated.

A decision matrix was used to evaluate the options for the storage and disposal of these baskets, including two proposals for the recycling of the baskets. The evaluation was based primarily upon potential for future cost avoidance, contamination, dose, cost, volume reduction, and generation of secondary wastes. Recycling at Manufacturing Sciences Corporation (MSC) was chosen as the preferred method for the disposition of the baskets.

A radiological analysis of the baskets was conducted, and the inventory of radionuclides estimated. The baskets were shipped to MSC in Oak Ridge, Tennessee, in March of 1996. The shipment was classified as Radioactive Materials, Class 7 Dangerous Goods, Surface Contaminated Objects (SCO-II). The shipment required two 72.5 m^3 marine shipping containers. Based on external gamma dose rate, the shipment was classified as Radioactive Yellow. Regulatory approval for the shipment, including an export permit, was obtained from the Atomic Energy Control Board (AECB).

After acceptance at MSC, the baskets were given an initial treatment in the chemical decontamination bath, and then sectioned using plasma cutting in the receiving area for special shipments. The sectioned baskets were then sent for chemical decontamination, and monitored to identify material that met the applicable criteria for free release to the open metals market. About 4% of the material was free released. The remaining contaminated stainless steel will be melted in MSC's vacuum induction furnace and formed into ingots. The ingots will be rolled and used to manufacture stainless steel drums. The volumetric contamination level of radionuclides in the manufactured drums will be determined. The containers will be returned to AECL prior to June of 1997.

RECYCLING OF METALS IN PRACTICE - COMMERCIAL EXPERIENCE

Steve Lorenz, Manager - Radwaste, ComEd and Frederick Gardner, CHP,
National Waste Management Corporation.

ABSTRACT

The development of recycling techniques for radioactive metals has led to the availability of products for use by commercial companies and utilities. These products include shielding blocks, boxes and drums for radioactive materials and components for specialized applications. RSM is also recycled into non-nuclear applications for general recycling as scrap, particularly for high value metals like nickel, copper, aluminum and stainless steel.

The paper describes the commercial experience of nuclear utilities in the generation and management of RSM, based on a 1997 survey of roughly half of the industry. Recommendations for future uses and potential applications of recycled metals will be discussed. The results of this study indicate that the industry has been recycling RSM to the scrap market for decades and that development of a commercial RSM products industry will be largely based on the cost of RSM products.

SESSION 5-THE IMPACT OF PUBLIC PARTICIPATION ON POLICY & DECISION MAKING

THE ENVIRONMENTAL MANAGEMENT ADVISORY BOARD AND THE DEPARTMENT OF ENERGY: A PARTNERSHIP THAT WORKS

James Melillo
USDOE
Gregory Evans
Coleman Research Corp.

ABSTRACT

The January 1992 announcement by the Department of Energy** creating the Environmental Restoration and Waste Management Advisory Committee (EMAC) made it the first Federal agency with "landlord" responsibilities to establish a Department level, external advisory body to assist it in meeting its environmental cleanup responsibilities at the various weapons complex facilities around the Country.

What precipitated this action? What was the Department trying to accomplish by creating the EMAC? How successful has the effort been? How has it evolved? These are the questions this paper will endeavor to answer. It will do so, by first examining the circumstances at the Department of Energy (DOE) that created the need for a high-level citizens' advisory board. Next, it will report on the process by which the first committee members were selected, the relationship of the Committee to DOE, and some of the early successes and shortcomings of the EMAC/DOE partnership.

With this as a base, the evolution of the EMAC to its present configuration as the EM Advisory Board or "EMAB" and DOE's experience in managing with the EMAB as an integral part of the policy setting process will be examined. The paper will conclude with a look at theeffectiveness of the EMAB as a catalyst in helping the DOE Environmental Management Office succeed in its mission.

THE IMPACT OF PUBLIC PARTICIPATION ON CONTRACTOR SELECTION

Gail Rymer
M4 Environmental Management Inc.
1009 Commerce Park Drive • Oak Ridge, TN 37830

ABSTRACT

Over the past decade, environmental regulations have changed to recognize the role the public plays in determining how to best deal with hazardous waste. The public's demand for a voice in the decision-making process and a rejection of decisions that are mandated by outside interests have led to a change in the way companies and government are doing business.

The field of risk communications has emerged to assist in dealing with issues and concerns raised by the public where a company or government agency has low credibility. The research and applied knowledge outline how companies must approach communities to effectively reach solutions that meet the expectations of the public while allowing for the company to be successful in its business endeavors.

THE NEVADA TEST SITE ENVIRONMENTAL IMPACT STATEMENT PUBLIC PARTICIPATION

Frank Di Sanza
DOE/NV EM
EIS Transportation Study
Earle Dixon
CAB Technical Advisor
Don Elle
DOE/NV EPD, EIS Project Manager
Jim Henderson
BN, EIS Contractor Project Manger
Paul Richitt
UNLV CORE ProgramCarrie Stewart
PAI, EIS Contractor Project Manager

ABSTRACT

The Nevada Operations Office recently completed a site-wide Environmental Impact Statement for the Nevada Test Site and off-site locations within the state of Nevada. This EIS was two years in the development and cost about 10 million dollars to produce. Several innovative approaches were taken in the areas of public participation. This paper presents the approaches utilized and the results in the following subject areas:

- Public Participation Issues
- Public Comment on the Implementation Plan
- Transportation Meetings
- Rural Meetings
- Community Advisory Board Participation
- Partnering with the University of Nevada Las Vegas
- Coordination with the State of Nevada
- Native American Involvement
- Advertizing Informal Public Hearings with a Single Consistent DOE Interactive Voice Internet, e-mail, and 1-800 Number Access

The overall conclusion is that meaningful public participation takes time, innovation, hard work, and commitment.

SESSION 6-POLLUTION PREVENTION/WASTE MINIMIZATION

SAVANNAH RIVER SITE'S GENERATOR SET-ASIDE FEE — NOT JUST ANOTHER CHARGEBACK SCHEME

Sherri Johnson
U.S. Department of Energy
Savannah River Operations Office
P.O. Box 616
Aiken, South Carolina 29802
Keith Stone
Westinghouse Savannah River Co.
P.O. Box 616
Aiken, South Carolina 29802

ABSTRACT

The Savannah River Site (SRS) is one of three Department of Energy (DOE) Operations Offices demonstrating the feasibility of a unique and innovative waste generator financial chargeback system. During 1996, the SRS Generator Set-aside Fee initiative provided funding and a mechanism to implement 14 waste minimization projects that will result in a reduction of 1,900 cubic meters of hazardous and radioactive waste and a annual cost savings of $4M. The SRS Generator Set-aside Fee concept has relevancy, and is directly transferable, across the federal government and the commercial sector.

Unlike traditional DOE chargeback systems which are based on waste generators bearing all or a portion of waste management treatment, storage and disposal costs, the Set-aside Fee is a generator surcharge that is pooled and used to fund fast payback waste minimization projects. Generators are "taxed" a small percentage of actual waste management costs for each type of hazardous and radioactive solid waste they generate. The collected fees are combined into a reserve account and reallocated to the generators who propose waste minimization projects offering the largest waste and cost reduction benefit to the SRS.

The Generator Set-aside Fee has passed the litmus test at SRS, will be expanded to additional DOE facilities in 1997, and most notably, can be directly incorporated in any larger industrial operation - government or commercial! This paper will detail the Set-aside Fee process, necessary support functions, and lessons learned from implementation at SRS.

MANAGING THE WASTE MINIMISATION PROGRAM OF THE ATOMIC WEAPONS ESTABLISHMENT, ALDERMASTON, ENGLAND

George Wall
Hunting-Brae Ltd., UK

ABSTRACT

The paper briefly describes the Atomic Weapons Establishment (AWE), its recent contractorisation and the new arrangements for funding its work. It then outlines the United Kingdom national and thence the company Waste Management strategy and the key role that Waste Minimisation plays in them both. It highlights the main elements of the company Waste Minimisation Program with particular emphasis on those techniques that worked and those that did not. Finally it shows the results achieved to date and our targets for the future.

UTILIZING COMMERCIAL BEST PRACTICES -THE KEY TO SUCCESS OF THE SAVANNAH RIVER SITE WASTE MINIMIZATION PROGRAM

David A. Zigelman
Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808

ABSTRACT

The Savannah River Site (SRS) Solid Waste Division (SWD) has partnered with a number of commercial nuclear power plants in order to directly implement utility best practices as a means of improved treatment, storage and disposal of low-level radioactive waste. Initial focus of this effort has been on the implementation of an aggressive waste minimization program.

Through a series of benchmarking visits and technical exchanges, SRS has implemented changes to work practices and material/product specifications that have resulted in substantial cost savings and extension in the life of on site disposal facilities. Although these work practices have proven highly successful at commercial nuclear plants over the past several years, their direct large scale application at Savannah River was unique to the Department of Energy (DOE) Nuclear Complex.

In Fiscal Year 1996 (FY 96), Savannah River has realized a storage/disposal space savings and cost avoidance of 175,000 cubic feet and $17.7 million, respectively for its low-level radioactive, transuranic, mixed and hazardous waste streams. The SRS has won a 1996 White House "Closing the Circle Award" for these pollution prevention program accomplishments. This award is the pre-eminent Federal Government recognition in the pollution prevention/waste minimization arena.

The accomplishments of the Savannah River pollution prevention/waste minimization program clearly demonstrate the direct applicability of commercial power plant initiatives to cost reduction efforts at DOE facilities.

THE CLEAN SALT PROCESS (CSP) FOR MINIMIZATION OF HANFORD TANK WASTE

David J. Swanberg, Phong M. Nguyen
SAIC
Joan Young
BDM
Waste Policy Institute Team

ABSTRACT

The Clean Salt Process (CSP) can reclaim useful chemical products from alkaline tank waste at Hanford and other DOE sites substantially reducing the volume of waste for disposal. DOE's tank wastes are primarily sodium salt solutions once the radionuclides and HLW solids are removed. At Hanford, the waste contains an estimated 60,000 metric tons of sodium, most of which is recoverable as clean sodium nitrate salt. Tests with actual waste produced clean sodium nitrate (2 pCi/g residual radioactivity) that was released from the laboratory as non-radioactive material.

In the CSP, clean nitrate salts are selectively crystallized and separated from contaminatedsolution. Overall decontamination factors > 10^8 have been demonstrated with actual waste. For production implementation, a multi-stage CSP plant, placed downstream of cesium ion exchange, will produce clean salt suitable for commercial re-use. The preferred end use for the recovered salt is in the production of explosives.

RCRA regulations encourage recovery of useful products from waste. DOE's Office of Environment, Safety and Health has developed criteria for free release of materials with very low levels of residual radioactivity. Other possible end uses of Clean Salt do not require RCRA or DOE exemptions. These require additional processing but are still economically attractive.

The Clean Salt Process needs to be demonstrated at a larger scale. This will generate performance data and design parameters to support an accurate cost/benefit analysis. Radiation dose impact and ALARA analyses should be performed to establish deminmus radioactivity levels for the recovered material.

RADIOACTIVE SOIL AND ASPHALT WASTE A POLLUTION PREVENTION CASE STUDY

Dr. Shoou-Yuh Chang, PE, and Jeff Knight, EIT
NC A&T State University
Department of Civil Engineering
Greensboro, NC 27411
Susan R. C. Michaud, and Darrell Daugherty
Lockheed Martin Energy Systems
Oak Ridge National Laboratory

ABSTRACT

During a nine year span, 1986-1994, the Oak Ridge National Laboratory (ORNL) shipped for disposal, 1,020,000 kg of low level radioactive waste soils and asphalt. A Pollution Prevention Opportunity Assessment (PPOA) was performed on this waste stream to develop improved waste reduction and pollution prevention alternatives to lower the volumes of wastes being generated at the ORNL facility.

It was determined through the PPOA that a total of 670 B-25 boxes had been used for disposal. The average cost of disposal was $9,000 per B-25 box, therefore $6,030,000 was spent on B-25 box handling and disposal. In the nine year period the average weight shipped per B-25 box was 1,424 kg. Theoretically, each B-25 box could be shipped with 3,760 kg of waste materials.

Using the average shipment weight it was determined that on average 47% of the B-25 box space was empty. Reasons for the empty space included soil moisture contents, clumping of soils, rocks, and other factors which prohibited complete filling of the B-25 boxes. Realistically, it was determined the B-25 box could be filled to 85% capacity.

Using the techniques of the PPOA several alternatives were developed to enhance the B-25 box disposal program. One option would have the site utilize a designated Quality Control Inspector to monitor waste handling and shipments. Option two would require purchase of a portable vibrator to be used to maximize filling of B-25 boxes. Option three would require the site purchase soil drying apparatus and other equipment to remove moisture from the soils prior to shipment.

Recommendations included Options one and two to maximize the effectiveness of the B-25 box loading and shipment program for radioactive waste soils disposal. After costs for capital outlays and payroll expenses, it was estimated the site could obtain an annual savings of $100,768. Efforts were being incorporated into site procedures which would minimize shipments of B-25 boxes unless they were being filled to capacity or to a capacity that would increase cost savings and thereby reduce disposal costs to the ORNL facility.

SESSION 7-RADIOACTIVE WASTE MANAGEMENT PROGRAMS

THE ENVIRONMENTAL LEGACY OF NUCLEAR WEAPONS PRODUCTION IN THE UNITED STATES

Donald C. Habib
Project Performance Corporation
Steven Taub
U.S. Department of Energy
Office of Environmental Management, Office of Strategic Planning and Analysis

ABSTRACT

The National Defense Authorization Act of 1995 required the Department of Energy to submit a report to Congress describing all waste streams generated during each step of the complete cycle of nuclear weapons production in the United States, including estimates of the amount of waste generated and an analysis of the characteristics of each

waste stream. To meet this requirement, the nuclear weapons production process was divided into eight general processes: mining, milling, and refining uranium; isotope production (enrichment); fuel and target fabrication; reactor operations; chemical separations; component fabrication; weapons operations (including assembly, disassembly, and maintenance); and research, development, and testing. In consultation with Congressional staff, DOE broadly interpreted "waste streams" to include four distinct elements: waste, contaminated environmental media, surplus facilities, and materials in inventory. Information was then compiled from existing sources in two areas: current and past activities at each site managed by DOE, and data on the environmental legacy present at each site. Using this information, the inventories of waste, media, facilities, and materials were categorized among the eight nuclear weapons production steps and nonweapons activities. The environmental legacy from nonweapons programs were grouped as either supporting the naval nuclear propulsion program or "other." Though other analyses have described and quantified the Department of Energy's waste legacy, this is the first analysis of the origins of the environmental legacy of nuclear weapons production and includes waste, media, surplus facilities, and materials in inventory. The formal results of this analysis are to be released in a Report to Congress on the origins of the nuclear weapons environmental legacy.

RADIOACTIVE WASTE MANAGEMENT STATUS IN CHINA

LUO Shanggeng
China Institute of Atomic Energy, Beijing
ZHAO Yaming
National Environmental Protection Agency, Beijing

ABSTRACT

This paper describes the Chinese radioactive waste management status including the relevant authority organization and their responsibility, policy regulation and safety standards, radioactive waste predisposal, discharge, disposal and remediation actions, etc. as well as the future strategy.

RADIOACTIVE WASTE MANAGEMENT PRACTICE IN THE REPUBLIC OF BULGARIA

Guentcho Guentchev, Krassimira Ivanova
Governmental Committee on the Use of Atomic Energy for Peaceful Purposes
69 Shipchenski Prokhod Blvd., 1574 Sofia, BULGARIA
Tihomir Guentchev
Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences
72 Tzarigradsko Shaussee Blvd., 1784 Sofia, BULGARIA

ABSTRACT

Republic of Bulgaria is situated in the South-Eastern part of Europe. It is a little country with area of 111,000 square kilometres and population about 9 millions. The capital of the country is Sofia with population of 1million. Bulgaria is an ancient country. It has been established in 681 A. D.

Bulgarian nuclear power programme started in the late sixties when an agreement was reached with the former Soviet Union to supply pressurised water reactors for electricity production with a thermal capacity of 1350 MW and electricity generation capacity of 440 MW(e). The first stage of the programme includes construction of 4 units in NPP Kozloduy well known presently as WWER-440. In fact nuclear energy development in Bulgaria began in 1970 with construction of first two units (1 and 2) for a period of 6 years.

The second stage includes next two units (3 and 4) which were completed in 1981 and 1982, respectively. They are the same type and they have the same parameters as units 1 and 2, but they are provided with improvement of safety systems.

The third stage is from 1987 to 1991 and it includes units 5 and 6. They are constructed according a completely different concept from WWER-440 reactors. Each of them is equipped with new generation reactor - WWER-1000 with 1000MW(e). The unit 5 started its operation in 1987 and unit 6 - in 1991. NPP Kozloduy is situated on the right bank of Danube river.

The power plant total has installed 3760 MW(e) capacity and it is of a significant national and regional importance. The average annual electricity production is 12-14 billion kWh, which covers about 40% of the country's electricity demands.

The second foreseen NPP will be located on the right bank of Danube near town of Belene. The construction of first unit of Belene NPP began in 1985 with WWER-1000 Russian design type reactor again. In 1990-1991 the construction was stopped because of different reasons including financial ones.

RADIOACTIVE WASTE MANAGEMENT IN MYANMAR

Mr. Maung Maung Tin
Scientist
Atomic Energy Department
Myanma Scientific and Technological
Research Department
Myanmar

ABSTRACT

Although Myanmar is a non-nuclear country, uses of ionizing radiation, radioisotopes and radioactive sources to some extent for health, social and economic benefits have been started since late 1950's in Myanmar. The main sources of radioactive wastes are mainly from hospitals that use short-lived radioisotopes for nuclear medicine purposes. Spent seal sources are generated from the application of radioactive sources in medical diagnosis, treatment and agricultural research. Management of radioactive wastes in Myanmar including collection, treatment, conditioning, packaging and storage are presented. Status of IAEA model project entitled "INT / 9 / 143- Upgrading Radiation Protection and Waste Management Infrastructure", in Myanmar are also described. Systematic handling of radioactive waste in Myanmar, leads discharge of radioactive waste to the environment to be kept as low as reasonably achievable (ALARA).

GERMAN APPROACH TO ALPHA BEARING WASTE DISPOSAL

Peter W. Brennecke, Georg Arens, Almut Hollmann
Bundesamt für Strahlenschutz, Salzgitter, Germany

ABSTRACT

According to the German approach to disposal, all types of radioactive waste have to be disposed of in a repository constructed and operated in deep geological formations only. This especially includes radioactive waste containing transuranic elements and other alpha emitters. Such waste originates in particular from reprocessing of spent fuel elements, basic and applied research and development work as well as from uranium enrichment and fuel element fabrication.

In Germany, the Bundesamt für Strahlenschutz (BfS, Federal Office for Radiation Protection) is legally responsible for waste disposal. For the safety assessment of a repository it is required to demonstrate that the protection objectives of disposal in the operational and post-closure phase of a repository are fulfilled. With respect to possible releases of long-lived radionuclides in the post-closure phase, the barrier functions of the site-specific geological formations have in particular to be investigated and evaluated, among other things, by means of radionuclide-specific sorption and desorption experiments.

Disposal of alpha bearing waste is predominantly envisaged for the Konrad and Gorleben repository projects. The results of the Konrad site-specific safety assessments have been converted into a system of waste acceptance requirements covering the disposal of radioactive waste with transuranic elements and other alpha emitters. As to the emplacement of such waste, an assessment of the disposability shows that all respective waste packages with negligible heat generation can basically be emplaced in the planned Konrad repository. In addition, for the disposal of all types of radioactive waste including alpha bearing waste the Gorleben repository project is still under investigation.

PAST AND CURRENT R&D PROGRAMME FOR WASTE DISPOSAL IN BELGIUM

B. Neerdael, G. Volckaert, A. Sneyers
SCK•CEN, Mol, Belgium

ABSTRACT

Disposal of properly conditioned long-lived radioactive waste in geological formations is the most promising and realistic option in this respect. The R&D programme on geological disposal for high-level and long lived waste was initiated in Belgium in 1974 by the Research Centre for Nuclear Energy (SCK•CEN). A deep Tertiary clay formation, the "Boom clay", present under the Mol-Dessel nuclear site, was selected as a candidate host formation for experimental purposes; the research programme and assessment studies were therefore developed according to a site-oral least formation-specific approach, without however anticipating the conclusions of a more detailed site selection procedure.

The current R&D programme is mainly focused on site characterization (mechanical, physico-chemical, and hydrogeologic properties) and waste packages (characterization and compatibility in clay). Performance assessment studies lead to the identification of R&D priorities for the running research programmes on the different components of the disposal system. Rather early in the programme (1980) an underground laboratory was constructed in the clay at the Mol site at a depth of 223 metres. The underground laboratory was intended to evaluate the technical feasibility of such a construction and to become an in situ facility for performing tests in close to real conditions within the HADES (High Activity Disposal Experimental Site) project.

Understanding the basic phenomena which control the retention and/or mobility of radionuclides in the clay is a key issue in this research programme. According to the reference multi-barrier disposal concept, sufficient knowledge and reliable information are required on items as various as the definition of the source term, the performance of the near field, the geological environment, etc. This paper will review the main results of previous research, the priorities granted to current research activities and the evolution of present programme issues. The same methodology is now considered for studies on the direct disposal of spent fuel.

SESSION 8-STATUS OF LLRW/MIXED WASTE COMPACTS AND STATES-II

SITING IN THE NORTHEAST COMPACT: AN UPDATE ON THE VOLUNTARY PROCESSES IN CONNECTICUT AND NEW JERSEY

Janice Beatson Deshais, Esq.*
Executive Director
Northeast Interstate Low-Level Radioactive Waste Commission

ABSTRACT

On June 10, 1991, three candidate sites for a low-level radioactive waste (LLRW) disposal facility were announced by the Connecticut Hazardous Waste Management Service (CHWMS), the quasi-public agency responsible for site selection. The three sites were selected as part of a traditional "decide-announce-defend" siting process. This process relied on statewide screening, analysis of scientific data and a strong effort by the CHWMS to explain the reasons for the selections and the need for an LLRW disposal facility in the state.

The residents of the three candidate site towns immediately raised their desire to refuse an LLRW disposal facility in their "backyard" against the State's responsibility to provide for LLRW management. Within a short time, this debate included vigorous opposition, political involvement, and little or no opportunity for effective dialogue with the candidate towns. Within a year, legislation was passed that terminated the siting process.

New Jersey, Connecticut's Compact partner, was also pursuing a traditional siting approach and its siting agency, the New Jersey LLRW Disposal Facility Siting Board (Siting Board), and was close to announcing its own candidate sites. During the debate in Connecticut, New Jersey's Siting Board reevaluated its own siting program and later decided to suspend its efforts to review other siting alternatives.

The CHWMS considered siting methods and prepared a voluntary siting process in response to its legislative mandate. Following its analysis of the Connecticut experience and siting alternatives, the New Jersey Siting Board did the same. Under these plans, a facility will only be located where a community volunteers to serve as host.

Many challenges to siting in the Northeast Compact region make a voluntary plan more appropriate, including geology, population and various public and governmental perceptions of LLRW and the perceived risks involved with its generation and management. Voluntary siting has begun in both states. The CHWMS and the NJ Siting Board have made progress in the implementation of these plans. In addition, factors such as the challenges to siting a facility for LLRW disposal have lead the CHWMS to explore the concept of assured storage as an alternative to traditional disposal.

* The opinions and conclusions stated in this paper are those of the author and do not necessarily reflect the policy or decisions of the Northeast Interstate Low-Level Radioactive Waste Commission or its member states.

A LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE IN TEXAS WILL IT BECOME A REALITY?

Lee H. Mathews
Texas Low Level Radioactive Waste Disposal Authority

ABSTRACT

Texas was first commissioned by state law in 1981 to site, finance, construct, operate and close a disposal facility for low-level radioactive waste generated in the state. Because of a lack of political support and judicial challenges, the Texas Low-Level Radioactive Waste Disposal Authority (the Authority) was unable to effectively proceed with its work until 1991 when the Texas Legislature designated the siting area.

Following the legislative action, the Authority was able to identify and characterize a site in Hudspeth County, Texas that appears to meet all the requirements of state and federal law. The facility's safety will be enhanced by the use of belowgrade modular concrete canisters for waste disposal. Some local and regional opposition to the license application has arisen, and these concerns will be addressed in the ongoing adjudicative hearings. License issuance is expected in early 1998.

The Texas-Maine-Vermont compact pending before Congress may be approved in 1997, but with or without the compact, Texas will continue to pursue a license for a low-level radioactive waste disposal facility.

EXPANDING LLRW USER/GENERATOR ISSUES VIA THE INTERNET: ACURI. COM

John R. Vincenti, Kenneth L. Miller, M.S., J. Wayne McIntire,
James O. Brumfield, Ph.D.

ABSTRACT

Communicating information in the age of the electronic systems has grown tremendously. The Internet has enabled the Appalachian Compact Users of Radioactive Isotopes (ACURI) Association to provide a broader and more timely service via its homepage (http://www.acuri.com.) This paper will outline the development of the ACURI Association's home page on the Internet. ACURI uses an index system to provide a wide range of information to its members and the interested public, press and political leaders on issues related to the need for disposal and Pennsylvania's development of a volunteer site to dispose of LLRW in the Appalachian States. The Appalachian compact states includes: Delaware, Maryland, Pennsylvania and West Virginia.

The ACURI homepage, which began in early 1996, is being piloted by ACURI's Executive Secretary and Webmaster, John R. Vincenti. Board members (both utility and non-utility representatives) have provided input into the development of the page, as well as the day-to-day management of the web site. This paper will discuss some of the challenges of developing and maintaining a web page.

In late 1995, ACURI began to investigate the feasibility and benefits of the use of the Internet system of communication. ACURI is made up of users of radioactive materials and generators of low-level radioactive waste (LLRW) within the Appalachian Compact states. These states include Delaware, Maryland, Pennsylvania and West Virginia. ACURI has represented the interests of over 1,000 licensees and permit-holders of radioactive materials and those who generate LLRW since November 1989 when the Association was incorporated in the Commonwealth of Pennsylvania.

The ACURI Board of Directors authorized the Executive Secretary of the Association to research the subject and report on the following topics:

- Overview and capabilities of the Internet
- Related costs in comparison to the ACURI Newsletter and other forms of communication
- A plan or outline of how the website would be developed (organized) and managed

THE USE OF PROBABILISTIC PERFORMANCE ASSESSMENT AND TECHNICAL CRITERIA IN EVALUATION FOR THE ILLINOIS LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY

Paul Corpstein, Michael Henry
Chem-Nuclear Systems
Ralph Stein, Mark Brightman
Golder Federal Services, Inc.

ABSTRACT

The Illinois Low-Level Radioactive Waste Task Group has developed technical site selection criteria which address geographic, geologic, seismologic, hydrologic, and other scientific conditions best suited for a low-level disposal facility. The Illinois State Geological and Water Surveys will screen the entire state to identify 10 or more locations that appear likely to meet the Task Group Criteria based upon readily-available, pre-existing data. Chem-Nuclear will then evaluate these locations to select three sites that appear promising for development of a low-level waste disposal facility.

Chem-Nuclear will develop additional criteria that focus on those site features relevant to the design and operation of a safe disposal facility. The criteria will be placed in Safety/Licensing, Environmental and Operational categories and each criteria will be further identified as Mandatory, Avoidance, or Preference. Mandatory criteria define characteristics or conditions a site must possess in order to be selected. Avoidance and Preference criteria define conditions which are less or more desirable for the siting of a disposal facility. These are comparative in nature and can only be applied to areas which meet both the Task Group criteria and Chem-Nuclear mandatory criteria. Chem-Nuclear has developed a preliminary list of approximately 40 criteria and a more refined and comprehensive set will be developed in parallel with the Survey's statewide screening effort.

Criteria Application Statements will be developed which identify the technical evaluations and analyses which will be performed to demonstrate compliance with the Task Group and Chem-Nuclear criteria and the data needed to complete these analyses. The criteria will be applied in a logical sequence to ensure the efficient elimination of less favorable areas and selection of three sites likely to be suitable for the development of the ILLRWDF. Chem-Nuclear's process will apply Task Group and Chem-Nuclear criteria in a staged manner to disqualify clearly less promising lands, progressively bank lands for possible future consideration, and identify promising areas that have a higher likelihood of meeting all site selection criteria for further study. Preference will be given to volunteer locations that appear to meet applicable requirements, and are not less promising than other locations being considered.

Probabilistic performance assessment analyses will be used throughout site selection and characterization to help develop site selection criteria, focus data collection programs, identify sites more likely to meet the performance objectives and support the license application. A probabilistic approach is being used to address the inherent uncertainties associated with some of the properties and processes which affect the long term performance of a LLRWDF.

Probabilistic performance assessment examines the ILLRWDF performance as three components: the engineered barrier system (EBS), the geosphere, and the biosphere. Performance assessment models consisting of a conceptual EBS design located within several generic geosphere systems will be used to help identify favorable site features and these results used in the development of the Chem-Nuclear criteria. After initial screening, probabilistic performance assessment models will be developed for each specific area that shows significantly different site characteristics. The likelihood that an area will be able to meet the performance objectives will be a significant factor in deciding which areas should be retained. As more site specific data is collected the performance assessment models will be refined and the results used, in combination with technical data regarding compliance with criteria, to select the three sites to propose to the Task Group.

SESSION 9-MANAGING URANIUM RECOVERY, FACILITIES AND WASTES

AN OVERVIEW OF THE U.S. NUCLEAR REGULATORY COMMISSION'S URANIUM RECOVERY PROGRAM

Joseph J. Holonich, Chief
Uranium Recovery Branch
Office of Nuclear Material Safety and Safeguards
Daniel M. Gillen, Assistant Chief
Uranium Recovery Branch
Office of Nuclear Material Safety
and Safeguards

ABSTRACT

This paper provides insight into the U.S. Nuclear Regulatory Commission's uranium recovery program. It specifically focuses on the reclamation and cleanup of abandoned uranium mills and uranium mills currently undergoing reclamation. In this paper I discuss issues facing NRC regarding the ultimate cleanup of byproduct material as defined in Section 11e.(2) of the Atomic Energy Act. This is essentially the byproduct material produced from the processing of ore primarily for its uranium or thorium content.

REGULATORY APPROACH TO SOIL CLEANUP VERIFICATION AT DECOMMISSIONING URANIUM MILL SITES

Dr. Elaine S. Brummett
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission

ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC), Division of Waste Management, has recently delineated policy and developed staff guidance regarding uranium mill site decommissioning activities. These activities are primarily related to soil cleanup and verification, because usually mill buildings are buried in the tailings pile. The policy calls for streamlining the confirmatory survey process by putting more emphasis on inspection of licensee performance. To support this approach, staff guidance was developed in the form of a detailed generic decommissioning inspection plan. Where possible, the inspection program staff is involved at the beginning of decommissioning activities, so that deficiencies can be identified and corrected early. Use of the decommissioning inspection plan provides a means to gain confidence in the licensee's performance and to document the evaluation that performance.

The licensee's performance is also considered during review of decommissioning plans by the licensing program staff. When evaluating proposed new methods, or new approaches to site-specific problems, staff must ensure that compliance with the regulations can be demonstrated by the licensee. Staff considers data and policy developed in the U.S. Department of Energy program for abandoned mill sites to assist with some of these evaluations. Implementation of both aspects of this regulatory approach to decommissioning allows staff to reduce their confirmatory survey effort and allows licensees to comply with applicable standards in a cost-efficient manner.

REMEDIATION OF URANIUM-CONTAMINATED SOIL USING THE SEGMENTED GATE SYSTEM AND CONTAINERIZED VAT LEACHING TECHNIQUES: A COST EFFECTIVENESS STUDY

Mark Cummings, Steven R. Booth
Environmental Technology Cost-Savings Analysis Project (ETCAP)
Energy and Environmental Analysis Group
Technology and Safety Assessment Division
Los Alamos National Laboratory
Project Manager: Steven R. Booth
LA-UR-96-2663 December 1996

ABSTRACT

An innovative, two-stage process for the remediation of uranium-contaminated soils was successfully demonstrated at Los Alamos National Laboratory's (LANL) Technical Area 33 (TA-33). The first step in the treatment process reduced the volume of the contaminated soilusing the Thermo Nuclean (a division of the Thermo NUtech company) Segmented Gate System (SGS). This technique applies the use of radiation detectors to separate clean soil from contaminated soil as it moves along a conveyor belt. Contaminated soil is diverted to a separate storage bin to await further processing, while uncontaminated soil is returned to its original location. From the 218 cubic yards of soil excavated from the test site at TA-33, only 7 cubic yards were found to contain uranium contamination above the criterion release limit, yielding an initial waste volume reduction of 97%.

The second step in the remediation was removal of the uranium from the 7 cubic yards of remaining soil using the containerized vat leaching (CVL) process developed at LANL. Borrowing techniques from the mining industry, the uranium was solubilized and collected in solution. Once recovered in the liquid phase, the uranium was subsequently removed from solution using an ion exchange resin. Thus, by applying the combined SGS/CVL processes, the total volume of radioactive waste at TA-33 was reduced from 218 cubic yards of contaminated soil to approximately 30 gallons of leachate solution and resins. In addition, the recovered commercial-grade uranium may be resold to recover some of the costs of operation. The current price of uranium is $14.80/lb (Uranium Exchange Company, 1996).

A cost effectiveness analysis was performed comparing the above two-stage treatment process to conventional excavation, containerization, and internment (dig and haul). Results showed that while the cost of remediating the small volume of soil at TA-33 was slightly more expensive than using the baseline treatment method, significant cost savings can be realized using SGS/CVL when treating greater volumes of soil, assuming that the contaminated soil must be shipped to a permitted facility such as Utah's Envirocare. However, if LANL's Area G is an acceptable alternative to the permanent disposal of low-level radioactive waste (LLRW), then there is little economic incentive to treating LANL waste via SGS/CVL because of the low cost of onsite disposal, particularly for small volumes of soil. (Since the original release of this report in September 1996, LANL management has decided to no longer accept construction waste, demolition waste, or suspect soil at Area G due to limited capacity and uncertain lifetime of the disposal facility. This makes cost comparisons with onsite disposal at Area G less applicable at this time.)

COMPARISON OF ACID AND BASE LEACH FOR THE REMOVAL OF URANIUM FROM CONTAMINATED MEDIA

Martine C. Duff, Caroline F. V. Mason, J. A. Musgrave, and Frank Dunfrund[‡].
Chemical Sciences and Technology Division,
Los Alamos National Laboratory (LANL), Los Alamos, NM 87545.
[‡] U.S. Army, Yuma Proving Ground (YPG), Yuma, AZ 85365.

ABSTRACT

Over the past few years, several different leaching schemes have been developed for the removal of uranium from contaminated media such as soil. Studies using sulfuric acid (H_2SO_4) and carbonate leach solutions (with or without an oxidative prelreatment) have been proposed. These solutions have been used on environmental sites with varying degrees of success. However, at few of these sites have both acid and base leachings been evaluated using the same set of criteria. The lack of comparative studies on acid and base leaches has created confusion over the relative merits of the two approaches. A comparison of selected acid and base leaches with several U-contaminated soils will be discussed. Discussion will be given with supporting data on relative U removal efficiencies for each leach solution and the other leached elemental concentrations. Conclusions of our research will assist in the decision-making processes concerned with the remediation of U-contaminated media. Preliminary studies suggest the removal efficiency of soil U for each leach solution varies with the nature of the U contamination in the soil. It is likely the form(s) of soil U such as reduced species, absorbed species and mineral forms influence the solubilization of U by the leaching agents.

CAN A LARGE ENVIRONMENTAL RESTORATION PROJECT REALLY FOLLOW ALL OF THE RULES? EXEMPTIONS AND VARIANCES IN THE UMTRA PROJECT

Robert E. Cornish
U.S. Department of Energy, Environmental Restoration Division
P.O. Box 5400
Albuquerque, NM 87185-5400

ABSTRACT

The Uranium Mill Tailings Remedial Action (UMTRA) Project, a 1.45 billion dollar project to stabilize uranium mill tailings and remediate structures built with them, is nearing completion. The successful completion of this project would not be possible without exemptions and variances from a number of federal regulations. The Department of Transportation provided an exemption from regulations which, if followed verbatim, would have precluded the economical transportation of uranium mill tailings on public highways. The Department of Energy (DOE) provided exemptions from parts of 10 CFR 835 regarding radiation dose assessments for radon and radon daughters, and radiological controls on tailings in inaccessible spaces in vehicles. The Environmental Protection Agency has allowed a variance involving the measurement of radon flux to the atmosphere from completed tailings disposal cells. In addition, it was necessary to use liberal interpretations of certain DOE Orders (under the process called "graded approach"). This paper describes how these measures eliminated many costly and wasteful actions that would have been required by a literal interpretation of the regulations. Other remediation projects should avail themselves of opportunities to alter their regulatory environment.

RELATIONSHIPS BETWEEN CONTAMINANT INVENTORY AND CONTAMINATED VOLUME AT VARIOUS HISTORIC LOW-LEVEL RADIOACTIVE WASTE SITES IN CANADA

C. H. Clement, D. M. Huffman
Low-Level Radioactive Waste Management Office
Atomic Energy of Canada Limited
1595 Telesal Court, Suite 700
Gloucester, Ontario, Canada
K1B 5R3

ABSTRACT

This paper examines the volumetric inventory distribution of contaminated materials at various historic low-level radioactive waste (LLRW) sites in Canada. This distribution shows what fraction of the contaminant inventory is in what fraction of the waste volume irrespective of cleanup or segregation criteria. As well, the volumes of material at the sites are examined with respect to selected criteria.

Five historic radioactive waste sites in Canada are examined in detail. In each case, a large fraction of the contaminant inventory is found in a relatively small fraction of the volume. As well, only a small fraction of the material, ranging from approximately 25% to less than 1% at the various sites, exceeds regulatory limits which would require a licence (for radioactive contaminants) or disposal as hazardous waste (for chemical contaminants).

Segregation of excavated material based on future disposal criteria may lead to significantly reduced interim storage and final disposal costs since each fraction of the waste can be treated in a manner appropriate to its potential hazard. The more expensive treatments can be reserved for a relatively small volume of the most contaminated material, while less expensive methods can be applied to the remainder.

RISK REDUCTION AND COST-EFFECTIVENESS IN THE UMTRA PROJECT

Robert E. Cornish
U.S. Department of Energy
Environmental Restoration Division, P.O. Box 5400, Albuquerque, NM 87185-5400.
Mark L. Miller
Roy F. Weston, Inc.
6501 Americas Pkwy NE, #800, Albuquerque, NM 87110
C. Beth Pomatto
Jacobs Engineering Group Inc.
2155 Louisiana Blvd. NE, #10,000, Albuquerque, NM 87110

ABSTRACT

The Uranium Mill Tailings Remedial Action (UMTRA) Project, a 1.45 billion dollar project to stabilize uranium mill tailings and remediate structures built with them, is nearing completion. Several times during the project, the 24 UMTRA Project sites were ranked according to the health risks they presented to the public. There was an attempt to remediate the higher risk sites first, but it was not practical to remediate all of the sites in sequence strictly according to health risk. The most cost-effective remediations were at

Salt Lake City, Utah, and Grand Junction, Colorado, where tailings piles were removed from the centers of cities. The remediation of structures built on tailings, or built of materials containing tailings, was more cost-effective than the remediation of the other tailings piles. The remediation of several of the UMTRA Project tailings piles was predicted on the basis of a priori calculations to yield negative benefits; remedial action was expected to kill more people through construction accidents than would be saved during the next 100 years through reduced radiation exposure following remedial action. The calculated public health benefits of remedial actions changed through the years as radiation risk factors shifted. As the project nears completion and the actual costs are known, more accurate cost-effectiveness calculations can be made.

SESSION 10-REGULATORY COMPLIANCE FOR HIGH LEVEL AND TRANSURANIC WASTES

BACKGROUND ON 40 CFR PART 197 ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR YUCCA MOUNTAIN

Raymond L. Clark
Captain, U.S. Public Health Service
Office of Radiation and Indoor Air (6602J)
U.S. Environmental Protection Agency
Washington, D.C. 20460-0001

ABSTRACT

The Energy Policy Act of 1992 (EnPA) directed the Environmental Protection Agency (EPA) to set "public health and safety standards for protection of the public from releases from radioactive materials stored or disposed of in the repository at the Yucca Mountain site." It also directed EPA to contract with the National Academy of Sciences (NAS) to "conduct a study to provide [to EPA]...findings and recommendations on reasonable standards for protection of the public health and safety...."

The Agency received the NAS Report, entitled Technical Bases for Yucca Mountain Standards, on August 1, 1995. The report provided many findings and recommendations for the technical issues involved in the rulemaking and clear separation of policy issues from technical issues.

Upon receipt of the NAS Report, the Agency began preparation of the proposed standards. This included holding public meetings, a comment period on the NAS Report, establishing official dockets and an information file, establishing several means of electronic communication, and meeting with many stakeholders. Comments on the NAS Report have been compiled and are being considered as the Agency proceeds. Selected comments are discussed in detail.

The National importance of this project has brought about extensive discussions within the Agency. It is currently planned to propose the standards this Spring.

TRU WASTE CHARACTERISTICS AFFECTING COMPLIANCE OF THE WASTE ISOLATION PILOT PLANT WITH 40 CFR 194.24(b)

M. S. Y. Chu, H. W. Papenguth, C. T. Stockman, Y. Wang, R. F. Weiner
Sandia National Laboratories[12]
G. Basabilvazo
U. S. Department of Energy

ABSTRACT

This paper presents some features of DOE's demonstration of compliance with the EPA regulation of the Waste Isolation Pilot Plant (WIPP). Performance of the WIPP as a repository requires that releases to the accessible environment not exceed the limits of the regulation 40 CFR Part 191(1) either when the WIPP is undisturbed, or if there is intrusion into the repository by drilling. This paper addresses only the cumulative radionuclide release limits, and does not address individual or groundwater dose limits of 40 CFR Part 191. The radioisotopes that may influence repository performance are Pu-239, Pu-240, Pu-242, Am-241, U-233, U-234, Th-229, and Th-230. Other waste characteristics and waste components that have a significant impact on repository performance are waste shear strength; the solubility of plutonium and americium compounds in the waste; iron that reduces the actinides to less soluble oxidation states and corrodes to produce hydrogen gas; cellulose, plastic, rubber, nitrate, and sulfate, that microbes can metabolize to methane to increase gas pressure and that can form colloidal particles; humicmaterials that form colloidal particles; nonferrous metals that prevent increases in actinide solubility by binding with organic ligands in the waste.

UTILIZING PEER REVIEWS IN SUPPORT OF THE WIPP COMPLIANCE CERTIFICATION APPLICATION

John A. Thies

ABSTRACT

The U. S. Department of Energy (USDOE) will submit the Waste Isolation Pilot Plant (WIPP) Compliance Certification Application (CCA) to the U. S. Environmental Protection Agency (USEPA) in October, 1996. The WIPP CCA must demonstrate that transuranic (TRU) radioactive waste can be safely received and disposed of in a deep geological disposal system (repository) at the WIPP site in accordance with the safety criteria defined by the USEPA in Code of Federal Regulations, Title 40, Part 191 (40 CFR 191). The WIPP TRU waste repository is scheduled to open in 1998, which will make it the nation's first deep geologic repository and the world's first deep geologic repository for long-lived radioactive waste. To comply with applicable regulations, DOE sponsored independent Peer Reviews of critical program elements.

EVALUATION OF THE LONG-TERM INTEGRITY OF WIPP

Lokesh Chaturvedi, William W.-L. Lee, Matthew K. Silva,
Thomas M. Clemo and Robert H. Neill
Environmental Evaluation Group
7007 Wyoming Boulevard NE, Suite F-2
Albuquerque, NM 87109

ABSTRACT

An evaluation of the U. S. Department of Energy's (DOE) assessment of the long-term performance of the Waste Isolation Pilot Plant (WIPP) shows that several issues need to be resolved. The DOE Compliance Certification Application for WIPP disqualifies certain features, events, and processes on the basis of regulatory exemption without sufficient justification. Probabilities of some events are under estimated. Certain critical input parameters in calculations are chosen without sufficient justification or based on apparently erroneous assumptions. It is recommended that DOE address and resolve these scientific issues to justify the conclusions regarding the long-term integrity of WIPP.

THE CHALLENGE OF BUILDING A TRANSURANIC WASTE INVENTORY FOR THE WASTE ISOLATION PILOT PLANT

R. Stroud, R. Bisping
Department of Energy-Carlsbad Area Office, Carlsbad, NM
P. Drez
Drez Environmental Associates, Albuquerque, NM
S. Chakraborti, D. Bretzke, J. McCann
Science Applications International Corporation, Albuquerque, NM
J. Harvill
Advanced Sciences Incorporated, Albuquerque, NM

ABSTRACT

The U. S. Department of Energy (DOE) is in the process of providing regulatory submissions to State/Federal agencies, which if approved, will allow DOE to dispose of transuranic (TRU) waste in the Waste Isolation Pilot Plant (WIPP), a deep geological repository near Carlsbad, New Mexico. All the regulatory submissions require an inventory of the TRU waste expected to be shipped to and disposed of in the WIPP. The Transuranic Waste Baseline Inventory Report (TWBIR) is the document developed by DOE to satisfy the need for such inventories.

The primary purpose of the TWBIR is to provide data to be included in the Sandia National Laboratory/New Mexico (SNL/NM) performance assessment (PA) processes. Besides supporting regulatory submittals, the TWBIR also supports other DOE programs for providing the total DOE TRU waste inventory. Therefore, the TWBIR includes information on the total DOE TRU waste inventory, including nondefense, commercial, PCB-contaminated, and buried TRU wastes.

The TWBIR establishes a methodology for grouping wastes of similar physical and chemical properties from across the DOE TRU waste system into a series of "waste profiles." The TWBIR uses waste stream information provided by the DOE TRU waste sites. Each waste stream is defined in a waste stream profile and has been assigned to a Final Waste Form by the DOE TRU waste sites.

The WIPP anticipated (stored and projected) inventory of TRU waste is defined as the sum of retrievably stored waste plus currently projected TRU waste volumes. The anticipated inventory for contact-handled (CH)-TRU waste is not sufficient to fill the maximum CH-TRU disposal inventory for WIPP (5,950,000 cubic feet or ~168,500 cubic meters). "Scaling" has been developed as a means for SNL/NM to model the impacts of a full repository. Scaling has not been applied to the RH-TRU inventory since the sites have reported sufficient RH-TRU waste to fill the remote-handled (RH)-TRU disposal inventory (250,000 cubic feet or ~7,080 cubic meters).

The TWBIR also estimates the WIPP disposal inventory in terms of 12 waste material parameters (e.g., iron-based metal/alloys, cellulosics, plastics, etc.) and additional packaging materials that have been identified by SNL/NM as necessary for PA. The waste material parameters in the waste stream, site-specific, and WIPP waste profiles are expressed on a weight/volume (kilograms per cubic meter) basis. Radionuclide information scaled to fill the WIPP repository is also provided for PA analyses.

COMPLIANCE WITH GROUND WATER PROTECTION REQUIREMENTS AT THE WASTE ISOLATION PILOT PLANT (WIPP)

John S. Hart
John Hart and Associates, P.A., Albuquerque, New Mexico
Barbara J. Graves
Ark Environmental Services, Albuquerque, New Mexico

ABSTRACT

This paper reports work performed by the Westinghouse Electric Corporation under prime contract DE-AC04-86AL31950 with the U.S. Department of Energy (DOE).

The DOE must demonstrate that the Waste Isolation Pilot Plant (WIPP) may be operated and closed in compliance with the provisions and requirements of U.S. Environmental Protection Agency (EPA) standard 40 CFR Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes[1]. Part 191 includes Subpart C, which provides environmental standards for ground water.

This paper reports DOE's progress in demonstrating that the WIPP complies with the provisions of Subpart C of Part 191. This work includes a determination of whether any underground water body near the WIPP meets the definition of an underground source of drinking water (USDW), as defined in the regulation. In performing this determination it was necessary for the DOE to develop criteria to be applied to water quality and quantity data from wells located near the WIPP. The determination also required a review and

summary of relevant literature pertaining to ground water quality and quantity in the study area. The DOE criteria and their bases are described and conclusions of the data review are summarized. As a result of this work, the DOE has concluded that USDWs may be located within the WIPP land withdrawal area (LWA) and to the east of the LWA and that a USDW is located about one mile to the southwest of the LWA boundary.

In addition, the DOE performed bounding analyses of the potential impacts to USDWs from releases of radionuclides from the WIPP repository under undisturbed conditions. The transport pathway to the accessible environment and predicted releases are described. Resulting concentrations and doses are compared to the National Primary Drinking Water Standards. Based on this work, the DOE has documented that the WIPP will comply with the ground water protection provisions of Subpart C of 40 CFR Part 191.

Information presented in this paper summarizes part of Chapter 8 of the WIPP Compliance Certification Application[2] (CCA) which was prepared by the DOE and submitted to the EPA on November 29, 1996. The CCA provides documentation to the EPA and other interested parties that the WIPP will comply with the requirements of 40 CFR Part 191.

SESSION 11-REGULATORY & TRANSPORTATION MANAGEMENT CONSIDERATIONS

COMMENTS ON THE IMPLEMENTATION OF RECENT AMENDMENTS TO DOT REGULATIONS CONCERNING THE TRANSPORTATION OF RADIOACTIVE MATERIALS

Richard W. Boyle, Fred D. Ferate II
Office of Hazardous Materials Technology
Research and Special Programs Administration
U. S. Department of Transportation

ABSTRACT

On September 28, 1995, a final rule was published in the Federal Register which introduced changes to the Department of Transportation (DOT) regulations pertaining to the transportation of radioactive materials, in order to bring them more closely into conformance with International Atomic Energy Agency regulations. The effective date of the changes was April 1, 1996, with the exception of the Radiation Protection Program (RPP) requirements, for which the effective date is October 1, 1997. The DOT changes were published in coordination with the Nuclear Regulatory Commission (NRC), which published the new revision of their packaging and radioactive material transportation regulations on the same date.

Changes which may impact the waste management community are changes in A1 and A_2 values, changes in shipping paper, marking and labeling requirements, the use of SI units, and the elimination of fissile classes. Changes which will probably have a significant impact are the introduction of industrial packagings, the addition of a new category called Surface Contaminated Objects (SCO), the introduction of LSA and SCO groups, and the RPP requirements for shippers and carriers of radioactive material. DOT and NRC are jointly preparing guidance for the shipment of LSA and SCO materials. DOT is preparing guidance for the implementation of the RPP requirements.

In this presentation the concerns with respect to the RPP requirements will be discussed. This is of particular interest because some transporters have decided, on the basis of the RPP requirements as they stand, to no longer carry radioactive materials, or to no longer carry less-than-full-truckload amounts. There will also be a brief discussion of some of the other changes in the DOT regulations.

A PERSPECTIVE ON TRANSPORTATION REGULATIONS FOR LOW SPECIFIC ACTIVITY (LSA) MATERIAL AND SURFACE CONTAMINATED OBJECTS (SCO)

Robert J. Lewis, John R. Cook, Earl P. Easton
Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission

ABSTRACT

Revisions to domestic regulations for transportation of radioactive materials became effective on April 1, 1996, and have affected the shipment of Low Specific Activity (LSA) Material and Surface Contaminated Objects (SCO). To clarify some technical uncertainties and ensure that licensees properly implement the revised requirements, the U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission are jointly preparing regulatory guidance for LSA and SCO transport.

The guidance will present examples of acceptable methods for demonstrating compliance with the revised rules. Some of the ideas being investigated for inclusion in the pending guidance are discussed in this paper. Under current plans, the guidance will be issued for public comment prior to final issuance in 1997.

TRANSPORT OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE IN GERMANY

F. Nitsche
Bundesamt für Strahlenschutz
U. Alter
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

ABSTRACT

The transport of low and intermediate level radioactive waste has to be performed in compliance with the modal transport regulations for road and rail in Germany which are consistent with the Regulations for the Safe Transport of Radioactive Material of the International Atomic Energy Agency (IAEA), Safety Series No. 6 (As Amended 1990). The main criteria for such shipments of low and intermediate level waste resulting from these transport regulations will be described regarding waste classification, waste limitation and waste packaging. Based on this regulatory framework an overview on the low and intermediate level waste shipments in Germany will be given taking into account different types of waste packages and different modes of transport for the main transport routes between nuclear power plants, conditioning facilities, interim storage facilities and the final repository.

A waste package has finally to be shipped to the repository. Therefore the described waste package criteria resulting from transport regulations will be discussed in relation to waste acceptance requirements resulting from disposal. In Germany such waste acceptance requirements exist for the Morsleben and Konrad repository. By comparing these criteria with transport criteria some conclusions can be drawn regarding limitations and optimizations of waste package concepts as well as consistency of regulatory requirements. Such considerations seem to be necessary to optimize waste management processes from the conditioning to the final disposal, including transport.

Finally some aspects of the latest revision and future development of the IAEA Transport Regulations, Safety Series No. 6 will be given in respect to low and intermediate level waste transport. This process needs input from waste management activities to keep the IAEA Transport Regulations up to date based on practical needs and to ensure the high level of safety for waste shipments also in the future.

LEGAL PRECEDENTS REGARDING USE AND DEFENSIBILITY OF RISK ASSESSMENT IN FEDERAL TRANSPORTATION OF SNF AND HLW

Dr. E.J. Bentz, Jr., C.B. Bentz, and T.D. O'Hora
E.J. Bentz & Associates, Inc.
Alexandria, Virginia
Dr. S.Y Chen
Argonne National Laboratory
Argonne, Illinois

ABSTRACT

Risk assessment has become an increasingly important and essential tool in support of Federal decision-making regarding the handling, storage, disposal, and transportation of spent nuclear fuel (SNF) and high-level radioactive waste (HLW). This paper analyzes the current statutory and regulatory framework and related legal precedents with regard to SNF and HLW transportation. The authors identify key scientific and technical issues regarding the use and defensibility of risk assessment in Federal decision-making regarding anticipated shipments.

REQUIREMENTS FOR RECORDS AND REPORTS RELATED TO SAFEGUARDS FOR GEOLOGICAL REPOSITORIES

A. Fattah
International Atomic Energy Agency
Department of Safeguards
P.O. Box 100, A-1400 Vienna, Austria.

ABSTRACT

Safeguards are essentially a technical means of verifying the fulfilment of political obligations undertaken by States in concluding international agreements relating to the peaceful uses of nuclear energy. The technical objective of safeguards is the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection. The technical conclusion is a statement in respect of each material balance area of the amount of material unaccounted for over a specific period, giving the limits of accuracy of the amounts stated. Agency safeguards is, therefore, based on material accountancy activities which are undertaken by the facility operator to establish the quantities of nuclear material present within different areas and changes in those quantities within defined periods. The main features of the Agency Safeguards System are facility design review and verification, examination of accounting and operating data, accounting reports and inventory verification.

Final disposal of spent fuel will accumulate extremely large inventories in a disposal site creating along-term proliferation risk. Safeguards for spent fuel disposal in geological repositories, therefore, have to be continued even after the repository has been backfilled and sealed. The effective application of safeguards must assure an unbroken continuity of knowledge that the nuclear material in the repository has not been diverted for an unknown purpose. For effectiveand efficient application of safeguards, the Agency requires vital information on facility design and operation. Part of the required information will also flow from the other obligations, e.g. safety, waste disposal, environmental protection, etc.. An integrated approach to document all required information will be an advantage to all concerned. Safeguards confirmation that the material has not been diverted established by confirmation of integrity of containment can also ensure that safety criteria has not been breached.

The basic safeguards approach for a geological repository will consist of continuous Design Information verification (DIV) and application of integrated safeguards verification system for inventory verification. DIV constitutes an important safeguards measure during excavation, construction and operational phase. It should confirm the integrity of the repository area and detect any/all undeclared activities, inter alia, the presence of sensitive equipment and tunnelling in the vicinity of the repository. DIV is a flexible and continuing process as the repository design will change during excavation. The diversion strategies could involve not only the excavations of the repository, but also the surface facilities, the surrounding geology and adjacent mine workings.

As part of records keeping the facility has to maintain records of the content and location of each spent fuel container. The IAEA and the State should retain all safeguards rel-

evant documentation and information (i.e. records of the complete inventory of nuclear material and/or previous operations of the repository) deemed necessary. These records should be kept for at least as long as safeguards exist for the nuclear material in the repository.

SESSION 12-SPENT FUEL AND PLUTONIUM MANAGEMENT

A MULTI-PURPOSE CANISTER SYSTEM FOR DOE-OWNED SPENT FUEL

K.A. Niemer, C.R. Witt, C.N. Lindner
Chem-Nuclear Systems, Inc.
R.T. Haelsig, S.R. Streutker, G.L. Clark
Packaging Technology, Inc.

ABSTRACT

A multi-purpose canister (MPC) based system has been designed for storage, transport, and potential disposal of DOE-owned spent nuclear fuel (SNF). This DOE MPC system was adapted by team members that developed the MPC system designed for commercial SNF. The DOE MPC system is comprised of four basic system components: an MPC assembly, a storage unit, a transfer cask, and a transportation cask. Each of the system components can be used with the others in a variety of ways to satisfy current and future DOE facility requirements. The benefits of an MPC system for management of commercial spent fuel have been demonstrated by DOE/OCRWM and others. These benefits are directly applicable to DOE-owned spent fuels, and provide a mechanism for integrated management of all types of spent fuel by DOE.

Technical issues addressed in the development of the DOE MPC include the characteristics of candidate fuel and the differences between DOE SNF and commercial fuel. To demonstrate the adaptability of the commercial MPC design for DOE SNF, this paper considers the Advanced Test Reactor (ATR) and Material Test Reactor (MTR) fuel assemblies in storage at the Idaho National Engineering Laboratory (INEL), and the Savannah River Site (SRS). The DOE-owned fuel was adapted to the commercial MPC design by utilizing individual fuel canisters. These canisters each hold one ATR or MTR fuel assembly, and fit within the existing MPC-44B basket assembly. Fuel canisters are stacked three-high within the basket's guide tubes for a total of 132 fuel assemblies per MPC. Engineering analyses have been performed to demonstrate the feasibility of the MPC system adapted for DOE-owned fuel.

While the adaptability of the MPC to DOE-owned fuel has been demonstrated, significant design issues remain to be addressed. These issues are a function of the characteristics of the fuel to be managed, and decisions concerning potential treatment of DOE-owned fuel prior to final disposition. The use of fuel canisters to contain individual fuel assemblies can facilitate the decision-making process by alleviating certain design issues, and providing a means to simplify the fuel treatment process. Further benefits could be obtained through an MPC system optimized for various DOE fuel types. Additional study should be pursued to fully demonstrate the logistical, technical, and economic advantages of an MPC system for DOE-owned spent fuel.

PRELIMINARY CALCULATIONS OF RADIONUCLIDE RELEASE AND TRANSPORT FROM A REPOSITORY FOR SPENT NUCLEAR FUEL IN SWITZERLAND

J. Schneider and P. Zuidema
Nagra, Switzerland
P. Smith
Safety Assessment Management Limited, UK
P. Gribi and M. Niemeyer
Colenco Power Consulting AG, Switzerland

ABSTRACT

The results of a preliminary modelling study of radionuclide release and transport from a hypothetical Swiss repository for spent nuclear fuel are presented. The spent-fuel inventory is based on a consideration of the anticipated arisings from nuclear power generation in Switzerland. A part (at least) of these arisings will be reprocessed, with the resultant vitrified high-level waste returned to Switzerland. The decision as to whether to reprocess the remainder of the arisings is currently left open. Reprocessed waste has been considered in detail in an earlier study and the present paper is limited to the direct disposal of spent fuel. A repository concept, models and data for the release and transport of radionuclides are presented. Key uncertainties are identified, such as the evolution of redox conditions in the near field. Radiolysis may result in oxidising conditions near to the fuel surfaces, but model results show that, provided oxidising conditions are confined within the bentonite buffer surrounding the waste canisters, calculated doses are low and are insensitive to the exact position of the redox front. Higher doses are calculated in the extreme case of a redox front extending into the host rock, but, even in this case, the Swiss regulatory guideline of 0.1 mSv a^{-1} is not exceeded. Finally, first calculations for the direct disposal of mixed-oxide fuels are presented.

SPENT FUEL MANAGEMENT AT THE "RA" RESEARCH REACTOR

Z.Vukadin, I. Plečaš, S.Pavlović
Institute of nuclear sciences -"Vinča"
Reactor Department
Radiation Protection Department
P.O.Box 522, Belgrade, Yugoslavia

ABSTRACT

This paper describes the irradiated fuel management practice at the RA reactor and the present status of the spent fuel storage, as well as some of the main results of the recently performed investigations. More than 6000 fuel slugs (metal uranium) with an initial enrichment of 2% and about 900 fuel slugs (uranium oxide dispersed in aluminum matrix) with an initial enrichment of 80%, discharged from the reactor core for the 25 years of the RA reactor operation, are located in an auxiliary spent fuel storage pool. Approximately 200 tons of stagnant water in the pool has received almost no attention to the water chemistry since 1960. Recent investigations indicate that most of the uranium metal fuel is leaking. The condition of the spent fuel storage at the RA reactor is, unfortunately, a good example of what can happen with irradiated fuel that is stored in inappropriate conditions. It is also, a good example why the importance of irradiated fuel management has to be increased.

CEA SPENT FUEL: REPROCESSING & STORAGE'S MANAGEMENT

Dominique Caramelle
CEA (Commissariat à l'Energie Atomique)
BP 6 - 92265 Fontenay-aux-Roses Cédex FRANCE
Bernard Bastianelli, François Boussard, Alain Milesi
CEA (Commissariat à l'Energie Atomique)
BP 1- 13108 St Paul Les Durance Cédex FRANCE
Gilles Polydor
CEA (Commissariat à l'Energie Atomique)
BP 171 - 30207 Bagnols sur Cèze FRANCE
Guy Christin
CEA (Commissariat à l'Energie Atomique)
91191 Gif sur Yvette FRANCE

ABSTRACT

Since 1995, CEA has implemented a three point cleansing plan. One of the three points is the removal and the reprocessing of a wide range of spent fuels stored in different facilities in Saclay, Grenoble and Cadarache nuclear research centers. This paper presents the solutions worked out and carried out by the Commissariat à l'Energie Atomique (CEA) for each type of fuel and highlights more specifically the removal, conditioning and packaging of the Natural Uranium Graphite GAS (UNGG) spent fuel stored for over 25 years in two pools in Cadarache Nuclear research center.

DEVELOPMENTS IN THE SWEDISH ENCAPSULATION PLANT PROJECT

Kristina Gillin and Tommy Hedman
Swedish Nuclear Fuel and Waste Management Co, SKB
Box 5864
S-102 40 Stockholm, Sweden

ABSTRACT

The Swedish Nuclear Fuel and Waste Management Co, SKB, presently owns and manages a final repository for radioactive operational waste (SFR), a central interim storage facility for spent fuel (CLAB) and a transport system. The remaining parts of the Swedish system for handling nuclear waste, i.e. an Encapsulation Plant and a Deep Repository for spent fuel and other long-lived wastes, are now being planned.

The disposal canisters, which the spent fuel will be encapsulated in, have an inner cast insert for mechanical strength and an outer copper canister for corrosion resistance. At present, SKB is conducting research and testing of manufacturing methods for both the cast insert and the copper canister. So far, two complete full-size canisters have been manufactured using two different methods: extrusion and forming from rolled plate.

Encapsulation of spent fuel in disposal canisters will take place in an Encapsulation Plant, which is planned to be built as an extension to the existing CLAB facility. The plant is designed for an annual output of approximately 210 canisters. Construction is intended to begin in the year 2000 so that the first fuel can be encapsulated in 2007. At a first stage the plant will only encapsulate spent fuel but preparations are made for the later addition of equipment for treating core components.

In the Encapsulation Plant the fuel is first identified and measured in pools. The fuel assemblies are then brought up, out of the water, to a handling cell where they are dried and placed in a disposal canister. Next, the canister is transferred to another station where the air in the cast insert is exchanged with argon and the steel lid is bolted to the insert. At a welding station, a copper lid is welded to the copper canister with electron beam welding. In the next station the weld is inspected using ultra sonic and X-ray techniques and the weld area is machined. When a canister has passed the non-destructive testing it is transferred to a station for monitoring and, if necessary, decontamination. Finally, the canister is brought to a buffer store for filled canisters where it awaits shipment to the Deep Repository.

In order to test the very crucial sealing operations, SKB is presently building a Canister Laboratory in the town of Oskarshamn, where part of an old shipyard has been purchased for that purpose. The main parts of the laboratory are the welding and non-destructive testing operations, although there are plans to also test and demonstrate other parts of the encapsulation process. Welding trials in the Canister Laboratory will commence in 1998.

MOX CONTRIBUTION TO THE SOLUTION OF WEAPONS PLUTONIUM DISPOSITION

G. LEBASTARD
President and Chief Executive Officer
COMMOX
Director International Business Reprocessing Branch COGEMA
2 et 4 rue Paul Dautier 78140- Velisy Villacoublay
J. C GUAIS
Vice-President COGEMA, Inc.
7401, Wisconsin Avenue Bethesda, Maryland 20814- USA

ABSTRACT

Increasing interest has been shown throughout the world in the management and disposition of excess weapons plutonium. Many alternative solutions have been proposed, and the U.S. Department of Energy has begun preparation of a Programmatic Environmental Impact the high energy value of fissionable material, this presentation addresses what we consider to be the most valuable and viable alternative - the use of plutonium from weapons in mixed uranium-plutonium oxide (MOX) fuel to generate electricity in existing operating Light Water Reactors (LWRs).

The arguments that support this conclusion are related to:

Non-proliferation

The assessment of proliferation resistance and the actual performance of the MOX industry in Europe clearly favor MOX utilization in LWRs compared to other alternatives.

Control of inventories

Current operation of European LWRs, which utilize about a one-third core load of MOX fuel per reactor, already results in a decrease in the total quantities of plutonium generated by European commercial nuclear reactors. The development of a MOX fuel program in the U.S. could eliminate the declared excess stock of weapons plutonium within a decade from its inception.

Environmental impact

In a world where the recycling of industrial products is widely accepted, the recycling of nuclear materials is consistent with the goals of environmental protection.

Proven technology

An efficient technology for recycling plutonium has been applied in France since the early 1980s. This technology has led to the construction of several MOX fuel fabrication plants, the largest and most recent of which is the COGEMA Melox plant, which will reach 100 trim per year by 1997 and will then be adjusted to reach 210 triM/year in 2000. The MOX program of Electricité de France (EDF) currently included 8 reactors and will be expanded to 28 reactors by the end of the century. At that time, Europe will have over 50 reactors utilizing MOX fuels and Japan will be starting upon a large commercial recycling program, also.

This unique, extensive experience could be made available to help develop an expeditious, cost effective disposition program for excess weapons-grade plutonium.

SESSION 13-POSTER-LLW

NEW DATA FOR LOW LEVEL AQUEOUS WASTE TREATMENT BY PRECIPITATION

C. N. Turcanu, V. Spanu, V. Kuncser and G. Filoti
Institute of atomic Physics, P.O. Box MG-6, RO-76900
Bucharest-Magurele, Romania

ABSTRACE

As a part of the program carried out in ROMANIA for the management of non-fuel cycle radioactive waste, and experimental study has been performed on the Low Level Aqueous Waste (LLAW) treatment products. The study was focused on LLAW treatment products obtained by chemical precipitation using iron hydroxide, calcium phosphate and copper ferrocyanides process.

Starting from twelve series of samples prepared in various experimental conditions, it was shown by Mössbauer Spectroscopy and XRD that the composition and structure of the final products strongly depend on process parameters i.e. reagent composition and concentration, the order and the rate of addition, the ageing time, etc. Important effects on the decontamination factors were evidenced even at minor changes of the process parameters.

WATER CLARIFICATION OF THE N REACTOR SPENT FUEL STORAGE BASIN AT THE HANFORD SITE

Theodore D. Anderson (BHI), James B. Duncan (WHC), Julian E. Laurenz (CHI)

ABSTRACT

The N Reactor fuel storage basin holds approximately 1 million gallons of radioactively contaminated water along with debris and hardware remaining from reactor operations which ceased in 1989. The water contains dissolved and suspended solids, varying levels of algae and bacteria, and suspected chelated colloidal metals. The bottom is covered with a layer of sediment averaging about one inch deep. Equipment and debris are to be removed and the sediment isolated in the North Cask Pit associated with the Basin. After removing debris, equipment and sediment, the water will be transported to the Hanford 200 Area Effluent Treatment Facility (ETF), the sludge will be sent to the Hanford Tank Farms and the basin stabilized for subsequent decommissioning.

Water clarity is important to basin operations for the removal of equipment, debris and sediment. In the years since shutdown, clarity has varied from good to quite turbid. In March 1996, an aggressive campaign was begun to identify and treat causes of turbidity in Basin water. Testing and measurement equipment was procured, and a formal system of water treatment begun. Initial problems with algae and bacterial growth were solved and recommended pH and chlorine levels established and maintained. Although clarity improved, it was irregular and insufficient. Arigorous approach was then instituted to find appropriate water treatment chemicals to coagulate and flocculate turbidity inducing materials which likely include chelated colloidal metals. It was recognized that because of the complexity of the water chemistry, the specific treatment selected was likely to be unique. A further challenge in reducing turbidity is that the water must be treated in-situ within the confines of the basin walls while debris and equipment removal activities are proceeding.

Approximately 60 jar tests were carried out to determine effective polymer combinations and dosages. Coagulation and flocculation polymers Cat Floc TL™ and POL-E-Z™ were identified as being efficacious to the reduction of turbidity and rendering a high shear flocculent at nominal concentrations of 50 and 10 ppm respectively. A small bench scale model, using a high shear pump, was constructed using inline mixers to enhance charge neutralization and flocculation. Over 45 bench tests allowed optimization of polymer concentrations to 40 and 5 ppm using solutions of 5% and 1% respectively as well as providing a basis for selecting equipment to treat the Basin water.

Equipment is being modified and/or procured to treat Basin water in the fall of 1996. Among other issues remaining to be addressed are the acceptability of the polymers and degradation products to the Effluent Treatment Facility and theTank Farms as well as the effects on the safety basis of any redistribution of radionuclides resulting from the water treatment.

AN APPROACH TO LOW-LEVEL LIQUID RADWASTE TREATMENT BY ION EXCHANGE

Sung Paal YIM, Kil-Jeong KIM, Joon-Hyung KIM
Korea Atomic Energy Research Institute
Nuclear Environmental Management Center
P. O. Box 105, Yusong, Taejon, 305-600, Korea
Jong-Kil PARK, Myung-Jae SONG
Korea Electric Power Research Institute
#103-16, Munji-Dong, Yusong, Taejon, 305-380, Korea

ABSTRACT

The interest to low-level liquid radwaste treatment by ion exchange is increasing in Korea. A project to develop an ion exchange process has been performed in cooperation of Korea Atomic Energy Research Institute (KAERI) with Korea Electric Power Research Institute (KEPRI). As a part of this project, the ion exchange method has been applied to treat low-level liquid radwaste stored at RWTF. This paper presents the applicability of the ion exchange approach to treat liquid waste, and demonstrates the laboratory and pilot scale test at RWTF.

RECYCLE AND REUSE OF URANIUM AS A NONMETALLIC SHIELDING MATERIAL

Alexander P. Murray, Steven M. Mirsky, and Stephen J. Krill, Jr.
Science Applications International Corporation (SAIC),
20201 Century Boulevard,
Germantown, Maryland 20874

ABSTRACT

Depleted uranium (DU) exists at many nuclear fuel cycle facilities around the world. DU is a byproduct from enrichment operations, and, while not a waste, no country currently has plans for large-scale recycle and reuse of DU. This paper presents several potential uses of DU, andconcludes that any significant reuse requires a high density form, typically over 8 g/cc. Dense, nonmetallic forms of DU as shielding represents the most significant reuse opportunity. This paper presents a new, integrated, large-scale approach for producing such shielding. The approach accepts the DU as either the hexafluoride, oxide, or the metal, and produces a dense, uranium dioxide based shielding material using an internal precipitation technique. Waste streams and quantities have been estimated. Designs and layouts for the manufacturing facility have been generated. The paper presents preliminary cost information for several plant designs with capacities of 5,000 to 30,000 tonnes (U) per year.

The paper determines that shielding requirements for SNF represent the largest potential application and would easily consume the existing inventory of DU in the United States. The conversion process does not require unusual reagents and equipment, and all input and construction materials are available from existing and established markets. The paper estimates similar size and waste disposal volumes as experienced by existing, fuel fabrication plants, even though the DU throughput is twenty-times larger. The economic analyses clearly demonstrate the economies of scale achieved by larger plants, allowing finished product cost of $5-6 per kilogram of dense DU dioxide. The use of DU in SNF containers pays for the processing costs. The paper concludes that this represents a cost effective approach for using the stored inventory of DU in an environmentally compatible manner.

ECOLOGICAL PROBLEMS CONNECTED WITH KEEPING OF WASTES OF CONVERSION OF URANIUM ORE

A. Komarov, V. Krotkov, J. Nesterov, V. Shatalov, V. Larin, N. Bezzubov
All-Russian Research Institute of Chemical Technology

ABSTRACT

In the process of conversion of uranium ore are formed waste (tails), contain radioactive materials in amounts of greater, than in natural objects and so they are make for specially equip with storage of wastes. Storage of wastes are potentially dangerous from the

ecological standpoint, particularly after the completion of usage's - how shows a practice in this time weakens a checking for the condition storage of wastes, is break safe mode, begins not authorized using an ore materials. All this creates a certain danger for the population and surround natural ambiance and requires a taking the special measures for the reason waste localization's and their reliable storage. There is an experience to preservations of storage of wastes. In the domestic practice for reducing their influence on the natural ambiance and health of population.

DEVELOPMENT OF NEUTRON POSITION SENSITIVE DETECTOR AND APPLICATION TO THE MINIMIZATION OF UNCERTAINTIES IN LOW LEVEL WASTE MEASUREMENTS

J-P. Coulon, L. Solvery, J. Loridon , J.Romeyer-Dherbey
CEA-DRN-DER-SSAE, Centre d'Etudes de Cadarache
13108 Saint Paul Lez Durance, France
A. Gabriel
EMBL / ILL, 20 avenue des martyrs BP 156
38 042 Grenoble Cedex, France

ABSTRACT

A comprehensive program is in progress for the development of non destructive techniques for the characterization of low level transuranic wastes. It is performed at CEA-CADARACHE, with the realization of several experiments to optimize performances of each measurement cell components (interrogating fluxes, counting blocks and electronics, backgrounds reduction). Simultaneously, developments are made on complementary measurement systems and soft-wares allowing a characterization of the package matrix and an inner localization of the nuclear material.

This paper reports the development of a multiwire proportional helium 3 detector used to characterize the spatial distribution of the heavy nuclide masses and activities in radioactive wastes drums. The detector was designed to be placed in an existing device (PROMETHEE). It was fabricated at the European Molecular Biology Laboratory in Grenoble. The active detection area of the position sensitive prototype was 100 mm x 960 mm which is quite large. Exhaustive Monte Carlo code MCNP 4A calculations show that the total neutron counting efficiency of the position sensitive detector is similar to the former experimental setup made of seven ^{3}He one meter active length tubes. Moreover, a study of counting efficiency and spatial resolution (FWHM) on the large size detector will be presented in this paper.

Preliminary tests on a small size prototype (one wire, active detection area: 200 mm x 10 mm) have shown a spatial resolution (FWHM) of 25 mm which is excellent for our applications.

PLASMA ARC CENTRIFUGAL PROCESS FOR RADIOACTIVE ASH TREATMENT

Rosemarie Atabek
CEA (Commissariat à l'Energie Atomique)
BP 6 - 92265 Fontenay-aux-Roses Cédex, France
Hubert Massit, Jean-Pierre Turchet
CEA (Commissariat à l'Energie Atomique)
BP 1- 13108 St Paul Les Durance Cédex, France

ABSTRACT

The Commissariat à l'Energie Atomique (CEA) is actively interested in high-temperature processes for treating a variety of solid radioactive wastes. The Plasma Arc Centrifugal Furnace (PCF) developed by RETECH Inc., USA, forms the basis of the PLASMARC®[2] melting facility installed in FRANCE at CADARACHE for treatment of radioactive wastes. The results obtained with the PLASMARC®[2] (designated CEA[1]) on incinerator ash vitrification are presented with emphasis on the behavior of Co and Ce tracers and on the off-gas treatment optimization

INCINERATION TREATMENT TESTS FOR SPENT SOLVENT IN JAERI'S REPROCESSING TEST FACILITY

Shogo Okane, Kazutoshi Miyajima
Takeo Mimori Japan Atomic Energy Research Institute, Ibaraki, Japan

ABSTRACT

JAERIs Reprocessing Test Facility (JRTF) had been operated from 1968 to 1969. The first PUREX reprocessing test of spent fuel in Japan was carried out successfully by reprocessing the spent U/A1 metal fuel from Japan Research Reactor 3 (JRR-3) and about 200g of Pu was recovered.

The reprocessing facility was officially shut down in 1970. About 70 m^3 of Liquid waste was generated from the tests, and the treatment of this liquid was started in 1982. The design and manufacture of the treatment apparatus for the spent solvent (30%TBP-dodecane) had been carried out from 1992 to 1993. 1.7 m^3 of spent solvent had been treated from 1994 to 1995. The treatment technology for spent solvent was developed by JAERI under a contract with the Science and Technology Agency.

The treatment system of spent solvent consists of two parts; a washing apparatus and an incineration apparatus. The washing apparatus removes Pu from spent solvent by washing with alkaline solution. The incineration apparatus incinerates the washed spent solvent Incineration ash is solidified in cement, canned, and stored at the JAERI's Radioactive Wastes Treatment Facility (JWTF).

Using the washing apparatus , the spent solvent is mixed with 0.3 M-sodium carbonate (1:1) and stirred up in the waste washing tank. After settling, the mixed solution is separated into washed spent solvent and spent washing solution , then the spent washing solution including almost Pu is treated by flocculation process and sludge solidification process. The capacity of washing treatment is 10 L/batch.

Using the incineration apparatus, the washed spent solvent including a little Cs, Sr and Pu is mixed with calcium octylate (1:1.1) and stirred up, and incinerated at 1100° C. Propane gas is used for the ignition of the mix solvent. As the off-gas is cooled by cooling air, the temperature of the off-gas at the outlet of incinerator is less than 550°C. The incineration ash is collected by a honeycomb ceramic filter. The off-gas passing through the ceramic filter is cooled to be less than 250°C. The off-gas is released to the atmosphere after passing through the HEPA filter. The incineration ash is collected using ceramic filter and recovered after cooling it for a whole day, and solidified with cement. The incineration capacity is 3.1L/h, and the cementation capacity is about 4kg/batch.

As the results of these treatments, the following items were proved.

- Pu decontamination factor by washing treatment is from 1200 to 3200.
- Through the recovery of each batch for ash varies slightly, the total amount of recovered ash is approximately equivalent to the calculated value.
- According to qualitative analysis of the incineration ash, more than 95% of it was calcium phosphate.
- The addition of 10% n-dodecane improve incineration efficiency.
- Washing treatment and incineration treatment are safe and efficient.

QUANTUM-CEP® PROCESSING SPENT ION EXCHANGE RESINS FROM NUCLEAR POWER PLANTS

Ron Sills, Myron Kaczmarsky
Molten Metal Technology
Al Castagnacci
Duquesne Light Company

ABSTRACT

Quantum-CEP® is an innovative and proprietary technology developed by Molten Metal Technology, Inc. which can process radioactive and mixed waste streams to decontaminate and recover resources of commercial value while achieving significant volume reduction and radionuclide stabilization. The technology has been commercialized in the government and commercial radioactive markets. A Q-CEP® facility, wholly owned by Molten Metal Technology, located in Oak Ridge, Tennessee, processes low-level radioactive spent ion exchange resins (IER) from commercial nuclear power plants.

In the Q-CEP®-IER commercial facility, radioactively contaminated IER is ground, dried and fed to Catalytic Processing Units (CPU) which contain a molten metal (iron) bath, operating at 1320-1650 °C (2400-3000°F) and 2-11 bar (10-150 psig). The dried resin together with gaseous co-feeds (oxygen, natural gas and nitrogen) are injected into the CPU. The spent IER dissociate and dissolve into their elemental intermediates. The process provides high efficiency destruction and conversion of organics with simultaneous capture of radioisotopes in a stable form for long-term storage. Organic constituents of the IER are converted to decontaminated gases (primarily hydrogen and carbon monoxide) which have sufficient energy value as fuel to be reused on-site. Non-volatile radioisotopes (^{55}Fe, ^{60}Co, ^{54}Mn) remain in the metal bath as the final stable form. Radioisotopes such as ^{134}Cs/^{137}Cs, which are volatile, evolve in the process gas and are captured in concentrated form for long term storage using a trap in the gas handling train. The solidified bath, with the volatile radioisotope trap, is shielded and shipped to a disposal site.

This paper presents campaign results from processing spent IER, from Duquesne Light Company's Beaver Valley Power Station. These results demonstrated the commercial viability of the facility by processing 7700 kg (17,000 lb) dry resin, and achieving key performance objectives including injection rates of greater than 0.04 kg/s (5 lb/min) and a campaign length of 7 days.

The Q-CEP® facility provides a commercially available, cost effective alternative to the nuclear power industry for disposing of low level radioactive spent IER. Key highlights of the process include high destructive efficiency of resin, recovery of organic material as decontaminated product gas, the safe and stable capture of radionuclides in a self-shielding final form, and significant volume reduction.

MELT PROCESSING OF RADIOACTIVE WASTE: A TECHNICAL OVERVIEW

M. Eric Schlienger, Joanna M. Buckentin & Brian K. Damkroger
Sandia National Laboratories
Albuquerque, New Mexico

ABSTRACT

Nuclear operations have resulted in the accumulation of large quantities of contaminated metallic waste which are stored at various DOE, DOD, and commercial sites under the control of DOE and the Nuclear Regulatory Commission (NRC). This waste will accumulate at an increasing rate as commercial nuclear reactors built in the 1950s reach the end of their projected lives, as existing nuclear powered ships become obsolete or unneeded, and as various weapons plants and fuel processing facilities, such as the gaseous diffusion plants, are dismantled, repaired, or modernized. For example, recent estimates of available Radioactive Scrap Metal (RSM) in the DOE Nuclear Weapons Complex have suggested that as much as 700,000 tons of contaminated 304L stainless steel exist in the gaseous diffusion plants alone. Other high-value metals available in the DOE complex include copper, nickel, and zirconium. Melt processing for the decontamination ofradioactive scrap metal has been the subject of much research. A major driving force for this research has been the possibility of reapplication of RSM, which is often very high-grade material containing large quantities of strategic elements. To date, several different single and multi-step melting processes have been proposed and evaluated for use as decontamination or recycling strategies. Each process offers a unique combination of strengths and weaknesses, and ultimately, no single melt processing scheme is optimum for all applications since processes must be evaluated based on the characteristics of the input feed stream and the desired output. This paper describes various melt decontamination processes and briefly reviews their application in developmental studies, full scale technical demonstrations, and industrial operations.

EXAMINATION OF WASTE GLASS AND OFF-GAS CHARACTERISTICS FROM VITRIFICATION IN A PLANNED LLW TREATMENT FACILITY IN KOREA

Ung-Kyung Chun, Kwansik Choi, Jung-Kwon Son, and Myung-Jae Song
Korea Electric Power Research Institute

ABSTRACT

The Republic of Korea is showing interest in using vitrification as a means of managing low level radioactive waste produced from her pressurized-water reactors (PWRs). KEPRI, in coordination with its partners, will design, construct, and erect a pilot plant using data from orientation tests. In the development of the final objective, the establishment of an industrial vitrification installation plant in the Republic of Korea, it is necessary to have the harmful effects of the final waste form to the environment minimized. To insure that the entering waste has been properly treated, then the characteristics of the final waste form must be understood. This leads to the topic and objective of this paper, the examination for the characteristics of the waste after vitrification.

One of the major goals of the project to be undertaken by KEPRI is to obtain good characteristics in the final waste forms after treatment. The final treated waste will be comprised basically of two parts: the final vitrified product and the off-gases resulting from the vitrification process. The purpose of this paper is to give an overview of the examination for the waste characteristics of waste glass and off-gas that will be undertaken by KEPRI and its partners. This includes descriptions of certain aspects of the overall technical scope of the project and available testing/analysis procedures and equipment. A brief overview of the orientation tests and pilot planttests to be performed is given. In addition, various future analysis tests for waste glass characteristics and off-gas characteristics examination is discussed. KEPRI's investigation and understanding of the waste by-products' characteristics will hopefully lead to the optimization of the resulting waste products to minimize any negative impact on the environment resulting from these by-products.

COLD CRUCIBLE VITRIFICATION OF RADIOACTIVE WASTE

Igor Sobolev, Serguei Dmitriev, Fedor Lifanov, and Vadim Tarasov
RADON - Moscow Scientific and Industrial Firm
Robert Judovits and James Mayberry
Foster Wheeler Environmental Corporation.

ABSTRACT

Vitrifying radioactive waste is an effective technology for immobilizing radioactive constituents and converting the waste to a manageable form. Conventional vitrification systems employ melters with internal electrodes and refractory linings. A new system, developed by RADON of Moscow, uses inductive-heated melters, eliminating the need for the refractory and internal electrodes. This"cold crucible" vitrification process allows for higher melt temperatures without the concern of refractory and electrode corrosion. The higher melt temperatures means that wastes can be incorporated into a variety of glass and crystalline matrices. This advanced technology is capable of solving many of the U.S. Department of Energy's waste management challenges.

PILOT-SCALE TREATABILITY TESTING OF THE IN SITU VITRIFICATION TECHNOLOGY AT THE BROOKHAVEN NATIONAL LABORATORY - CHEMICAL/ANIMAL PITS AND GLASS HOLES AREAS

Brett Campbell, Geosafe Corporation
Dale Timmons, Geosafe Corporation
Dr. James Brower, BNL

ABSTRACT

Pilot-scale treatability testing of the In Situ Vitrification (ISV) technology was performed on a simulated pit in the chemical/animals area of the Brookhaven National Laboratory (BNL) site. The testing was conducted as a part of an evaluation of feasible alternatives for remediating the Chemical/Animal Pits (Pits) and the Glass Holes (Holes) within OU-1 at BNL. This paper presents the results of the pilot-scale testing on the simulated pit and an assessment of full-scale remediation of the site using the ISV process. The findings are pertinent to DOE buried waste applications throughout the Weapons Complex.

A total of 31 Pits and 20 Holes have been identified by non-intrusive means at the BNL site. The Pits were active from the late 1950's to 1966. The materials disposed in the Pits consisted primarily of laboratory chemical wastes and animal carcasses used for research. The bulk of the materials is believed to be acids and bases although other chemical species are suspected to be present in the Pits; however, no known records exist. It is estimated that 1,540 cubic meters of chemical- and short-lived, low level radioactive-contaminated animal carcasses were dumped in the Pits. The Glass Holes were active from 1966 to 1981 and were used for the disposal of rinsed laboratory glassware and chemical containers. Disposed materials reportedly included acids, bases and other assorted laboratory chemicals. A test excavation of one of the holes revealed significant quantities of intact bottles containing unknown liquids. The excavation also revealed the presence of small quantities of drums ranging from 5 to 55-gal in size.

Based upon the findings of the test excavation, a simulated pit was designed for pilot-scale ISV testing. The purpose of the test was to evaluate the effects of inclusions (partially liquid-filled bottles and miscellaneous debris) on the treatment performance of the ISV technology. The test pit was designed to be representative of the actual pits and holes based upon the findings of the test excavation. Sampling and monitoring of the process was performed prior to, during, and after treatment to fully evaluate the effectiveness of the ISV treatment process.

The primary challenge to processing of this site by ISV was posed by the presence of liquid-bearing sealed containers. Thus, the test was designed to confirm Geosafe's belief that the buried waste materials could be treated without adverse effects on the safety and efficiency of processing. In addition, a study of the general soil chemistry indicated that the site soils are low in monovalent alkali cations (Na^+, Li^+ and K^+), which as a general rule, need to be within the 2 - 5 wt% range for efficient ISV processing. Thus, slight adjustment to the soil chemistry was made to raise the alkali content into the ideal range. The addition of alkali material to the simulated pit material only also permitted the evaluation of whether the shape of the resulting melt could be controlled by selective adjustment of the soil.

Evaluation of the test results provided the following results:

- The test demonstrated that a mixture of BNL site soils containing sealed containers with liquids and miscellaneous debris can be treated by ISV to produce a durable vitrified mass.
- Treatment of 236 bottles and four cans containing 10 volume percent organic and other liquids was performed without difficulty or adverse impact on the ISV treatment processing.
- It was demonstrated that a minor soil chemistry adjustment could be made be made to allow initiation of melting and production of a chemically durable product. It was determined that melting did occur selectively in areas containing the additional alkali material.

The disposition of radionuclide surrogates placed in the simulated pit was evaluated to determine their retention within the melt and vitrified product. Retention efficiency is the amount of radionuclide surrogate retained in the vitrified product. Retention efficiencies obtained from this test were excellent, ranging from 99.97% for cesium to greater than 99.998% for strontium.

Analyses of the vitrified block demonstrated that nearly all of the radionuclide surrogates remained within the vitrified product. TCLP leach testing performed on the vitrified material resulted in very low levels of leachable surrogates. Geosafe believes that the vitrified product attained at the site will be typical of other ISV products, which are typically superior to high level waste glasses relative to radionuclide retention and leaching resistance.

Analyses performed on post-test surrounding soil samples indicated nosignificant increase in any of the surrogate contaminants present in the pit.

Evaluation of potential alternatives for the site is being performed based upon the following criteria: 1) protection of human health and the environment, 2) compliance with ARARs and other criteria, advisories, and guidance, 3) long-term effectiveness and permanence, 4) reduction of toxicity, mobility, or volume through the treatment, and 5) short-term effectiveness. Geosafe believes that the test results indicate ISV processing promises the maximum possible attainment of these criteria.

The conclusions of this test are significant in regards to the potential application of the ISV technology to other DOE buried waste applications. Further evaluations of the test results are continuing in regards to the selection criteria mentioned above.

A BASIC STUDY ON ALTERNATIVE TECHNOLOGY FOR DOE TANK WASTE OF LLW -COMBINATION PROCESS OF DENITRATION OF $NaNO_3$ AND SLAG CEMENT SOLIDIFICATION

T.Sasaki, K.Suzuki
Oarai Nuclear Research Center
JGC Corporation
2205 Naritacho Oaraimachi
Ibaraki 311-13 Japan
M. Kiyomoto, Y. Karasawa
Kayatone Research Laboratory
Nippon Kayaku Co. Ltd.
219 Iwahana Takasaki
Gunma 370-12 Japan

ABSTRACT

This study investigates a combination process consisting of denitration and cement solidification for the treatment of DOE tank wastes which contain large amounts of sodium nitrate and low-level radioactivity. In the treatment process, sodium nitrate in DOE tank waste is first converted to another sodium salt during denitration, and the sodium salt is finally solidified with an alkali activated slag cement (AASC). Sodium sulfate in several sodium salts appears to be the most feasible for the combination process, because the sodium sulfate content in the form solidified with AASC was nearly equal to the content of tank waste in the vitrified glass products.

This paper reports results of denitration and AASC solidification, and discusses the basic process of the combination.

DEVELOPMENT OF BENTONITE-SAND MIXTURE INCORPORATING GRAVEL

Masafumi Hata, Toshikazu Yamada, Nobuhiro YADA
Kysyu Electric Power Co.
Yukiya Hirata, Jun Imai, Koichi Yabuuchi
Radioactive Waste Management Center
Eizou Fukazawa, Kazuo Taira, Toshiyuki Tanaka
Technical Research Institute
Japan

ABSTRACT

A bentonite-sand mixture incorporating gravel has been developed as a backfilling material which can be utilized in radioactive waste disposal facilities. This material takes advantage of the swelling properly of bentonite and the skeleton formation effect of gravel. It also has very low permeability and high bearing capacity. In addition, it can be made at a lower cost than the ordinary bentonite-sand mixture without gravel due to its lower content of costly bentonite.

This report examines the permeability of the bentonite-sand mixture incorporating

gravel in laboratory tests with parameters of bentonite mixture ratio and gravel size. The permeability of the material mixed using a forced type mixer with twin horizontal shafts of a concrete plant and compacted by vibration rollers was observed in field tests by varying roller vibration force and material water content.

The results are summarized as follows:

1) A series of the laboratory tests has confirmed that the hydraulic conductivity of an appropriate bentonite-sand mixture incorporating gravel is in the order of 1x 10^{-11}m/s, which is sufficiently low for a backfilling material for radioactive waste disposal facilities. To achieve the same permeability in a bentonite-sand mixture without gravel, the bentonite content must be much higher.
2) In the field tests, the bentonite-sand mixture incorporating gravel could be compacted sufficiently and achieved an average dry density which is nearly equal to maximum dry density achieved in the laboratory tests.
3) The average permeability of the field compacted mixture which was mixed homogeneously using a forced type mixer with twin shafts was nearly equal to that in the laboratory tests.
4) The increase in permeability of the mixture with a lowered water content was not as significant in the field tests as in the laboratory tests.

A PROTOTYPE SYSTEM FOR CEMENTATION PROCESS

Luiz Carlos Alves Reis & José Rodrigues Batista
Centro de Desenvolvimento da Tecnologia Nuclear - CDTN
Comissão Nacional de Energia Nuclear - CNEN

ABSTRACT

The Nuclear Technology Development Center - Centro de Desenvolvimento da Tecnologia Nuclear/CDTN is one of nuclear research centers of the National Nuclear Energy Commission - CNEN. The CDTN was created in 1952 and is engaged in research and development of activities related to nuclear fuel cycle, radioisotope production, materials science, environment control, radioprotection and waste management. In the CDTN Waste Management Program, the cementation process was established to solidify the radioactive wastes generated at the Center and received from other Institutions.

A 200 liter cementation batch system was designed and built by CDTN research workers. The cemented products obtained in the operation of the 200 liter system are good, but the paddle used was not the best indicated by the literature. So it was defined to design a new paddle and to make some tests to verify homogeneity of the final product, in order to have, in less time, a best final homogeneous product.

To save money and to make possible a large number of tests, a prototype cementation system for 20 liter was designed and built at the Center. In this prototype the flow rate of cement/additive and waste can be varied according the test to be performed. The power and dimensions of the components were decreased proportionally to the 200 liter cementation plant. Two paddles were constructed in order to compare the performance on the product homogenization. One of them is similar to the existing in the 200 liter system and the other was the model recommended by the literature.

After the experimentation, the best paddle will be installed in 200 liter system and others operation parameters could be improved such as homogenization time, speed of the mixer and so on.

DEVELOPMENT OF Ci CONTENT DETERMINATION TECHNOLOGY IN VARIOUS KINDS OF DRUMMED RADIOACTIVE WASTES USING A NON-DESTRUCTIVE METHOD APPLICABLE FOR NUCLEAR POWER PLANTS IN KOREA

DuckWon, Kang and Kyoung Rock, Park
Korea Electric Power Research Institute
Radiation Safety Group

ABSTRACT

Various kinds of radioactive waste streams, such as ion exchange resins, water, compacted paper trash, rolls of stacks of air handling filters and solidified waste are produced at nuclear power plants in Korea. These wastes are packed into the drum at the radwaste building and temporarily transferred to a temporary storage building. Several kinds of drums are used for radioactive waste packing at nuclear power plants in Korea. However, estimation of nuclides and their activities in the drummed radioactive waste is still difficult and unreliable. Nuclear act of Korea requires low and intermediate level radioactive waste generated at nuclear power plants prior to transportation to permanent disposal sites to be known in detail. Individual historical records of the radioactive waste should contain information about the activities of nuclides, total activity and the type of waste in the drum. Consequently, with the incorporation of gamma spectroscopy, a fully automated nuclide analysis system which can accurately evaluate the nuclide and activity in the drum was developed. The activities of the representative g-emitters (Cs-137, Co-60) which are mixed with several materials in the drum were measured by this system. Then appropriate scaling factors were used to assay the activities of nuclides which could not be directly analyzed by this system. The scaling factors were determined by a computer program developed in Korea. The validity of the scaling factor was checked through comparison with several experimental results of local samples taken from real waste streams. Demonstration drums with similar geometries to real waste drums were used for proving the reliability of Ci content determination in this system. It was performed by putting the standard sources (Co-60, Cs-137) into demonstration drums. In the results, the measurement errors were less than 30% in the various demonstration drums. Therefore, measurements of real radioactive waste drums gave us good results for the homogeneous and non- homogeneous wastes generated at Kori (the name of a place in Korea) nuclear power plant in Korea.

QUALIFICATION PROTOCOL OF CAST IRON CONTAINER FOR SUBSURFACE DISPOSAL

M.H. Plouzennec, D. Feron, R. Atabek
CEA (Commissariat à l'Energie Atomique)
BP 6 - 92265 Fontenay-aux-Roses Cedex, France
M. Tachon
CEA (Commissariat à l'Energie Atomique)
bp 171 - 30207 Bagnols-sur-Cèze Cedex, France
J. Corcos
ANDRA (Agence pour la Gestion des Déchets Radioatifs)
1-7 rue Jean Monnet, 92265 Chatenay-Malabry Cedex, France

ABSTRACT

This paper presents the results of a qualification program developed to characterise theperformances of a cast iron container submitted to subsurface disposal environmental conditions with a particular attention to the corrosion resistance experiments.

Corrosion tests are performed at 40°C in a synthetic water representative of a concrete interstitial pore water.

The two materials of the container, cast iron and steel are studied separately.

Pitting corrosion sensibility is evaluated by means of cycling polarisation in the anodic field following ASTM G61 norm. Crevice corrosion specific tests are also performed.

Results demonstrate that the corrosion rates of cast iron are low in concrete water (less than 10 $\mu m.y^{-1}$) and localised corrosion and crevice corrosion could be considered as negligible.

NEVADA TEST SITE WASTE ACCEPTANCE CRITERIA CHANGES

Susan K. Krenzien, Rebecca M. Guertal,
Hazardous and Medical Waste Services, Inc. (HAZMED),
Wendy A. Griffin
U.S. Department of Energy, Nevada Operations Office
Brian K. Perkins
Bechtel Nevada

ABSTRACT

The Nevada Test Site currently accepts low-level radioactive waste for disposal from fifteen facilities. The "Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements" (NVO-325, revision 1), has been revised to the "Nevada Test Site Waste Acceptance Criteria" (NTSWAC). The NTSWAC edits the criteria to include federal, state, operational, safety, and Department of Energy requirements only. The revision also incorporates the use of waste profiles, a three-year audit cycle, and a more flexible program for Low Volume Generators. Implementation of the NTSWAC will streamline the approval of waste streams for disposal.

RESULTS AFTER TEN YEARS OF FIELD TESTING LOW-LEVEL RADIOACTIVE WASTE FORMS USING LYSIMETERS

John W. McConnell, Jr., Robert D. Rogers
Idaho National Engineering Laboratory
P.O. Box 1625, Idaho Falls, Idaho 83415
Julie D. Jastrow
Argonne National Laboratory, Argonne, IL 60439
William E. Sanford
Colorado State University, Fort Collins, CO 80523
Steven R. Cline
Oak Ridge National Laboratory, Oak Ridge, TN 37831
Terry M. Sullivan, and Mark Fuhrmann
Idaho National Engineering Laboratory
P.O. Box 1625, Idaho Falls, Idaho 83415

ABSTRACT

The Field Lysimeter Investigations: Low-Level Waste Data Base Development Program is obtaining information on the performance of radioactive waste forms. These experiments were recently shut down and have been examined in accordance with a detailed waste form and soil sampling plan. Ion-exchange resins from a commercial nuclear power station were solidified into waste forms using portland cement and vinyl ester-styrene.

These waste forms were tested to (a) obtain information on performance of waste forms in typical disposal environments, (b) compare field results with bench leach studies, (c) develop a low-level waste data base for use in performance assessment source term calculations, and (d) apply the DUST computer code to compare predicted cumulative release to actual field data. The program, funded by the Nuclear Regulatory Commission (NRC), includes observed radionuclide releases from waste forms in field lysimeters. The purpose of this paper is to present the experimental results of two lysimeter arrays after 10 years of operation, and to compare those results to bench test results and to DUST code predictions of releases using recently developed partition coefficients. This paper discusses soil and waste form sampling in which vertical cores were removed from the lysimeter soil columns for laboratory characterization. Those samples will be analyzed for radionuclide movement from the waste forms and through the soil columns. Further analysis of soil cores taken to define the observed upward migration of radionuclides in one lysimeter is also presented.

STATISTICAL EVALUATION OF ENVIRONMENTAL MONITORING PROGRAMS AND DATA FOR LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITIES

Vern Rogers and Robert D. Baird
Rogers & Associates Engineering Corporation
P.O. Box 330
Salt Lake City, UT 84110-0330

ABSTRACT

The license application process for a low-level radioactive waste disposal facility requires that a preoperational monitoring program be implemented to determine natural background levels of potential contaminants and other natural conditions at the facility site. Data from preoperational monitoring are used to evaluate the facility's environmental performance as it begins operations. To ensure that the preoperational data serve as an adequate baseline for performance assessment, (1) data variability, distributions, and trends must be characterized, (2) regulatory-based detection limits must be identified, (3) appropriate treatment of lower-than-detection-limit values must be established, and (4) the overall statistical validity and adequacy of the preoperational and operational monitoring programs must be determined. Incorrect baseline data or inadequate program requirements, if left unaddressed, could result in remedial actions being triggered unnecessarily. For example, if not accounted for, data trends attributable to random variation or seasonal changes could unnecessarily trigger remedial actions. Deficient baseline data or monitoring requirements also could lead to action levels being set too high and thus allow contaminant releases to be overlooked. A general approach has been developed and applied to a specific site to determine the statistical validity and adequacy of preoperational monitoring programs and necessary data characteristics.

AN EXAMPLE OF RADIOACTIVE WASTE TREATMENT SYSTEM OPTIMIZATION USING MULTI-OBJECTIVE LINEAR PROGRAMMING

Jin Yeong Yang and Kun Jai Lee
Department of Nuclear Eng., Korea Advanced Institute of Science and Technology,
Kusong-dong, Yusung-gu, Taejon, 305-701, KOREA
Kyung Yeong Yoo and Hee Geun Kim
Korea Power Electric Research Institute,
Munjidong, 103-16, Yusung-gu, Taejon, 305-380, KOREA

ABSTRACT

Many nuclear power plants concentrate their efforts to the improvement and modification of their radioactive waste treatment system. Those needs are divided into development of new technology and development of operation efficiency. Concerned with the second need, we made use of a mathematical procedure which utilized a goal programming, and through it the optimal operation plan of the radioactive waste treatment system has been derived.

The ultimate object of our study is to minimize the release of radioactive material into the environment and to maximize the treatable amount of the generated wastes. In planning the practical operation of the system, however, the operating cost, process economics and technical flexibility must also be considered.

For dealing with these multiple criteria decision making problems, we used a goal programming which is a kind of multi-objective linear programming. This method requires the decision maker to set goals for each objective that one wishes to attain. A preferred solution is defined as the one which minimizes the deviations from the set goals.

As a result of the optimization, the optimal state of the system operation is derived.

HEALTH RISK AS A DECISION TOOL IN LOW-LEVEL WASTE HANDLING PROJECTS

James E. Goss, P.E.
H&R Technical Associates, Inc.
151 Lafayette Drive, Suite 220,
Oak Ridge, Tennessee 37830
J. Michael Singleton, P.E.
H&R Technical Associates, Inc.
151 Lafayette Drive, Suite 220
Oak Ridge, Tennessee 37830

ABSTRACT

In this era of shrinking budgets and emphasis on cost-effective cleanups, health and safety risk is an increasingly important factor in deciding among alternative waste-handling and remediation actions. This presentation describes a project in which a DOE site used worker and public health impacts as a decision tool and thereby succeeded in gaining waivers from specific regulatory requirements. DOE was thus able to choose a less costly alternative without compromising worker or public safety.

A key to the successful use of risk assessment as the basis for project and regulatory decisions is the development of reasonable assumptions concerning basic risk factors associated with the project. Historically, a common technique for health and safety risk assessment was to use highly conservative assumptions to ensure that all risks were bounded and to reduce assessment costs. Often, if the risks were found to be acceptable when these conservative assumptions were used, the assessment ended at that point. Paradoxically, this conservative approach sometimes led to misleading and unrealistically conservative results that left stakeholders and regulators with erroneous perceptions of the risk to the public, leading to more expensive cleanup projects with little real risk reduction. In the risk assessment described in this presentation, Monte Carlo techniques were used to quantify unknown values and thereby more accurately characterize health and safety risks.

At the DOE Site discussed in this presentation, the Federal Facility Agreement (FFA) requires that waste systems handling liquid low-level radioactive waste be doubly contained and equipped with leak detection systems. However, some short sections of piping that are embedded in concrete shield walls are single-walled and thus do not meet the FFA requirement. The health risk to the public from postulated leaks from the pipes as they now exist was compared with the health risk to workers in modifying the pipes. State and federal regulators used the results of this comparison as the basis for a waiver of the double containment regulatory requirement for the sections of pipe in question.

As the use of health and safety risk assessment as a decision tool increases, health and safety professionals must recognize the need to present risk models that more closely reflect the actual risks associated with operation (or failure) of a process or project and that are perceived by regulators and the public as reasonable.

PRELIMINARY SAFETY ASSESSMENT OF SHALLOW LAND BURIAL OF RADIOACTIVE WASTE AT SERPONG SITE.

Erwansyah Lubis
Radioactive Waste Management Technology Center,
Serpong, West Java, Indonesia.

ABSTRACT

A radiological performance assessment has been conducted for low and intermediate level radioactive waste disposal for Serpong site- The DOSWASTE-92 computer code was used to evaluate doses throughout a variety of environmental pathways. The operations time is determined for 20 years and after 30 years of post-operation the migrations of the radionuclide is begun. The Exposure to the critical groups near facility boundary were calculated based on unit disposal concentrations of 4.44 E+13 Eq of each radio nuclide postulated to be present. The maximal concentrations for safe disposal were calculated based on the limitation dose for the public, 500 uSv per year. The results showed that the dose received by the critical group from groundwater well near boundary for Sr-90 and Ni-63 were 2.6 uSv and 8.4 E-06 uSv per year. The disposal of Sr-90 and Ni-63 were 2.8 E+23 Bq and 8.8 E+15 Bq individually. The migrations time to the groundwater well of 100 m from the facility is 704 years for Sr-90 and 3889 years for Ni-63. These disposal rates of Sr-90 is 100 times higher than its planning. These analysis results give the information that the dose received by the critical groups with disposal of 4.44 E+13 Bq for Sr-90 will give the dose around 0.52% from limitations dose.

CONCEPTS OF RADIOACTIVE WASTE MANAGEMENT IN THAILAND

Pathom Yamkate
Waste Management Division
Office of Atomic Energy for Peace
Chatuchak, Bangkok, Thailand

ABSTRACT

The paper describes the sources and types of radioactive wastes arising in Thailand. The regulation as well as the classification for the management of radioactive waste is demonstrated. Inventory and the projection for a certain period of time in the future is also summarized.

LOW-AND INTERMEDIATE-LEVEL RADWASTE DISPOSAL IN CHINA

Wang Xian De
Beijing Institute of Nuclear Engineering (BINE)
P.O.BOX 840, Beijing, China, 100840

ABSTRACT

The present development and relevant policy of waste disposal in China are briefly presented. The characteristics and package of waste are also described. Regional disposal was determined as the national policy for low-and intermediate-level radwaste because of the nuclear facilities and owners of radwaste are distributed centrally in several regions of China. Disposal of wastes in under ground and above ground have been adopted as the main manner for low-and inter mediate-level radwaste. Two repositories named Northwest and Beilong are under construction. Mainfeatures of those repositories are described in the paper.

DEVELOPMENT OF A QUALITY ASSURANCE SYSTEM AT THE RADON REGIONAL CENTERS

Helen Mikolaitchouk
Atomaudit Ltd., Kiev, UKRAINE

ABSTRACT

The RADON State Corporation was established in the former Soviet Union in the middle fifties to manage radioactive waste generated out of the nuclear fuel cycle. The Corporation included regional waste treatment and disposal centers with the principal center located in Zagorsk (now - Sergiev Posad) in the Moscow region.

All the regional centers were constructed according to a standardized design and were considered to include treatment and conditioning facilities (at least, an incinerator and a cementation facility) along with the following disposal facilities:

- Near-surface vaults of reinforced concrete (bottom and walls cast-in-situ and prefabricated covering slab) for disposal of low- and intermediate level solid waste.
- Near-surface stainless steel reservoirs of 200 m³ enclosed in reinforced concrete cast-in-situ for temporary storage of liquid radioactive waste.
- Near-surface storages for disposal of spent radiation sources (stainless steel cylinders enclosed in concrete cast-in situ with curved charging pipe of 108 mm diameter). As a matter of fact, after the USSR breakdown Ukraine inherited six regional centers, only one of them having the full line of the above-mentioned facilities.

While the former USSR norms and regulations contains requirements as for a quality assurance program for Nuclear Power Plant Operators, no such requirement was established for radioactive waste management. However, while all the regional centers being licensed by the newly formed regulatory body during 1993-1994, a development and implementation of a Quality Assurance Program (QAP) was established as a mandatory requirement with license conditions.

HISTORICAL IMPACT OF WASTE MINIMIZATION ON COMMERCIAL LOW-LEVEL WASTE DISPOSAL REPOSITORIES

David V. LeMone
Department of Geological Sciences
University of Texas at El Paso
El Paso, Texas 79968
Lawrence R Jacobi, Jr.
Texas Low-Level Radioactive Waste Disposal Authority
7701 North Lamar, Ste. 300
Austin, Texas, 78752

ABSTRACT

Low-level waste minimization technology has changed the volumetric character of the commercial low-level radioactive waste stream. The shift to lower volumes since 1980 has resulted in significant economic and environmental gains. The relatively lower anticipated volumetric quantities of the commercial operational low-level wastes can be handled with relative ease in the proposed state and compact low-level radioactive waste repositories.

Conversely, the future streams generated from decommissioning wastes will require careful planning in order to avoid logistic and storage problems in the form of increased volumes as well as the generation of non-standard sized waste packages. Another area of future consideration will be the tracking of the radiometric content of the waste not only for content, but also for source. Historical commercial low-level curie content indicates an inverse relationship with volumetric data. Accurate data will be necessary for efficient repository planning and operation. Historical data developed by the DOE waste stream is of little comparative value to the analysis of the commercial low-level waste stream.

In the interim period between the lower volume operational streams and the higher volume future decommissioning waste streams, the developing state and compact low-level repositories will have to restructure their volume and/or radioactivity charges to guarantee the economic stability of the system and ensure the current and future operational integrity of the repositories.

INFILTRATION CONTROLS AT THE SHUTDOWN LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY AT WEST VALLEY, NY

T. L. Sonntag, M. R. Weishan, D. D. Miller
New York State Energy Research and Development Authority

ABSTRACT

The New York State Energy Research and Development Authority (NYSERDA) has completed three projects designed to reduce or eliminate water accumulation in the state-owned, shutdown, commercial, low-level, radioactive waste disposal area (SDA) at West Valley, New York. Results to date have shown that these projects have successfully reduced water infiltration into the disposal trenches, which has minimized the potential for a release of leachate from the disposal area and reduced leachate generation.

Currently, NYSERDA is working to develop a long-term management strategy for stabilizing and closing the SDA. This process is expected to take several years before site closure activities can begin. As implementation of any final closure option will require treatment of the trench water in the SDA, limiting further water accumulation will significantly reduce the final closure costs.

This paper discusses our experiences leading to selection and implementation of three different technologies, particularly their effectiveness at reducing water accumulation.

ELECTROKINETIC DEMONSTRATION AT SANDIA NATIONAL LABORATORIES: USE OF TRANSFERENCE NUMBERS FOR SITE CHARACTERIZATION AND PROCESS EVALUATION*

E. R. Lindgren
Sandia National Laboratories, Environmental Restoration Technologies,
Albuquerque, NM 87185-0719
E. D. Mattson
SAT-UNSAT Inc., 12004 Del Rey NE, Albuquerque, NM 87122

ABSTRACT

Electrokinetic remediation is generally an in situ method using direct current electric potentials to move ionic contaminants and/or water to collection electrodes. The method has been extensively studied for application in saturated clayey soils. Over the past few years, an electrokinetic extraction method specific for sandy, unsaturated soils has been developed and patented by Sandia National Laboratories. A RCRA RD&D permitted demonstration of this technology for the in situ removal of chromate contamination from unsaturated soils in a former chromic acid disposal pit was operated during the summer and fall of 1996. This large scale field test represents the first use of electrokinetics for the removal of heavy metal contamination from unsaturated soils in the United States and is part of the US EPA Superfund Innovative Technology Evaluation (SITE) Program.

Guidelines for characterizing a site for electrokinetic remediation are lacking, especially for applications in unsaturated soil. The transference number of an ion is the fraction of the current carried by that ion in an electric field and represents the best measure of contaminant removal efficiency in most electrokinetic remediation processes. In this paper we compare the transference number of chromate initially present in the contaminated unsaturated soil, with the transference number in the electrokinetic process effluent to demonstrate the utility of evaluating this parameter.

TRIAL BURN OF LOW LEVEL WASTE PRODUCED FROM RADIOISOTOPE USERS IN DEMONSTRATION-SCALE INCINERATOR

Jeong-Guk Kim, Hee-Chul Yang, In-Tae Kim, and Joon-Hyung Kim
Korea Atomic Energy Research Institute
P.O. Box 105, Taejon Yusong, Taejon, Korea 305-600
Min Baek
Radiation Safety Division, Ministry of Science and Technology
1, Jungangdong, Kwachon, Kyunggi, Korea 427-760

ABSTRACT

The low level wastes produced from radioisotope users were incinerated in a demonstration-scale incineration process to study the behavior of radionuclides. These wastes have been collected from radioisotope users by Korea Radioisotopes Association, and stored in Korea Atomic Energy Research Institute, however, this management system will be changed sooner or later. The major nuclides in these wastes were iodine-125 and technetium-99m. The trial incineration of the combustible wastes that had passed more than 2 years since generation resulted in volume and weight reduction factors of 250 and 30, respectively, with no detectable radioactivity at stack emission. A simulated waste with a I^{131} labeled sodium iodide of 74 MBq was also incinerated. The specific activities of ashes from the baghouse filter system and afterburning chamber were 370 and 24 times as high as that of incinerator bottom ash, which shows that a major portion of radioiodine melts or vaporizes at incineration temperature and gets away from the incineration chamber, then condenses while passing through the subsequent off-gas treatment system. The decontamination factor of this incineration process for iodine-131 nuclide, defined as the ratio of the radioactivity of the feed waste to the radioactivity released at stack, was an order of 10^5.

SESSION 14-WEST VALLEY PLANT (WVDP) AND SAVANNAH RIVER PLANT (DWPF) VITRIFICATION OPERATIONS

HIGH-LEVEL WASTE VITRIFICATION - A REALITY

Stephen P. Cowan, Ralph E. Erickson, Ted W. McIntosh, and Kenneth G. Picha, Jr
Department of Energy, Office of Environmental Management
Robert E. Lawrence
West Valley Nuclear Services Co., Inc.

ABSTRACT

This paper addresses the successful initiation of radioactive vitrification processing at the Defense Waste Processing Facility (DWPF), Savannah River Site in Aiken, South Carolina, and the West Valley Demonstration Project (WVDP) Vitrification Facility in West Valley, New York, and provides a Department of Energy-Headquarters (DOE-HQ) perspective on these accomplishments.

Most countries that have produced high-level waste (HLW) from reprocessing nuclear fuel have selected or are evaluating borosilicate glass as a final waste form. Differences in storage tank systems, along with other influences, have led to variations in melter system design throughout the international community. Nevertheless, stainless steel-canistered borosilicate glass is the waste form of choice of all current producers. Differences in types of spent fuel reprocessed at Savannah River compared to West Valley have led to different approaches to glass-forming chemical addition preparation and consequently to contrasts in specific detail for process control and waste form qualification. The review and approval employed by the DOE-Office of Environmental Management (DOE-EM) has been similar for both projects and has facilitated acceptance in both cases of the process control methodology by the DOE-Office of Civilian Radioactive Waste Management (DOE-RW).

In similar fashion, the difference between the Savannah River and West Valley site mission, facility layout and use, and quantity of waste has led to divergence in vitrification facility design, construction sequence, and startup testing approaches between the two sites. In each case, however, facility and staff operational readiness has been demonstrated through production of a nonradioactive waste form, using HLW simulants representative of the site's waste inventory, that performs better than the required stability/leach resistance test criteria imposed by DOE-RW, and through extensive startup testing of the respective facilities. The Office of Waste Management (EM-30), supported by RW and the Office of Environmental Safety and Health (DOE-EH), as well as other EM groups, has been actively involved in each phase of these readinessdemonstrations and evaluations. In addition, the Nuclear Regulatory Commission (NRC) has been actively involved during the WVDP readiness activities.

Startup and continuing radioactive operation of the Savannah River and the West Valley vitrification facilities are key accomplishments in achieving DOE's risk reduction and cost management commitments to the taxpayers and stakeholders. Two such startups within a short time frame bring to fruition important elements of the DOE cleanup mission and demonstrate the can-do attitude and ability of the Headquarters, Field Offices, Site Offices, and contractor teams involved.

VITRIFICATION OPERATIONAL EXPERIENCES AT THE WEST VALLEY DEMONSTRATION PROJECT

Paul J. Valenti, James Paul, and R. Scott Roberts
West Valley Nuclear Services Co., Inc.

ABSTRACT

A primary objective of the West Valley Demonstration Project (WVDP), located at the former nuclear fuel reprocessing plant at West Valley, New York, is to solidify the high-level radioactive waste stored in underground tanks into a form suitable for transportation and disposal. Vitrification has been chosen as the method of solidification. This paper discusses the process techniques applied, describes the operational experiences, and pre-

sents results available from the recently initiated radioactive campaign. Construction of the Vitrification Facility was completed in 1995.

PERFORMANCE OF THE WEST VALLEY DEMONSTRATION PROJECT VITRIFICATION SYSTEM

David K. Ploetz
West Valley Nuclear Services Company, Inc.

ABSTRACT

The construction of the Vitrification Facility (VF) at the West Valley Demonstration Project (WVDP) site in West Valley, NY, was completed in 1995. After nonradioactive testing with simulated waste, the VF was put into radio-active operation in July 1996. Design glass production rates of approximately 30 kilograms per hour were achieved shortly after the start of radioactive operations. The available operating experience is outlined for the vitrification process flowsheet, including high-level waste mobilization and transfer, melter feed preparation, glass production in the slurry-fed ceramic melter, off-gas treatment, and canister handling.

RADIOACTIVE WASTE GLASS PRODUCTION AT THE WVDP

Vijay Jain and Steven M. Barnes
West Valley Nuclear Services Company, Inc.
West Valley, NY 14171-0191

ABSTRACT

The immobilization of the high-level wastes (HLW) into a stable and nondispersible form using vitrification was successfully initiated at the West Valley Demonstration Project (WVDP) in July 1996. Since then, several batches of the HLW stored in a carbon steel tank (8D-2), each approximately 2,000 gallons, have been transferred from the Waste Tank Farm (WTF) and vitrified into a stable canistered waste-form. Tank 8D-2 in the WTF contains a single HLW that is a blend of washed PUREX sludge, Cs-loaded zeolite, and neutralized THOREX waste. The vitrification process is designed to meet the Waste Acceptance Product Specifications (WAPS) to strictly control HLW processing from its transfer to its eventual disposal in a geological repository. The HLW transferred from Tank 8D-2 is mixed with the glass-forming chemicals and fed to a joule-heated melter at 1150° C. The glass is then poured into stainless steel canisters. After the canisters have cooled, they are welded, decontaminated, andstored on site for eventual disposal. To ensure process reliability and that the canistered waste-form complies with all WAPS requirements, the batch-to-batch variability of the transferred waste and the variability associated with the sampling and analysis were analyzed and compared with the WAPS. In the following sections, the vitrification process is discussed based on the process data collected to date, and an assessment is provided of the canistered waste-form properties relative to the WAPS requirements.

DEFENSE WASTE PROCESSING FACILITY RADIOACTIVE OPERATIONS PART I OPERATING EXPERIENCE

David B. Little, James T. Gee and William M. Barnes
Westinghouse Savannah River Company, Aiken, SC 29808

ABSTRACT

The Savannah River Site's Defense Waste Processing Facility (DWPF) near Aiken, SC is the nation's first and the world's largest vitrification facility. Following a ten year construction program and a 3 year non-radioactive test program, DWPF began radioactive operations in March 1996.

This paper presents the results of the first 9 months of radioactive operations. Topics include: operations of the remote processing equipment, including a discussion of their unique design requirements, remote processing equipment reliability, and decontamination facilities for the remote processing equipment. Key equipment discussed includes process pumps, tele-robotic manipulators, infrared camera, Holledge™ level gauges and in-cell (remote) cranes. Information is presented regarding equipment failures and related lessons learned. The erosion and corrosion evaluation of the remote equipment at the conclusion of the DWPF test program is also discussed, with special emphasis on agitator blades and cooling/heating coil wear.

DEFENSE WASTE PROCESSING FACILITY RADIOACTIVE OPERATIONS PART II GLASS MAKING

Joe T. Carter, Ken J. Rueter, Jeff W. Ray, and Ofia Hodoh
Westinghouse Savannah River Company, Aiken, SC 29808

ABSTRACT

The Savannah River Site's Defense Waste Processing Facility (DWPF) near Aiken, SC is the nation's first and world's largest vitrification facility. Following a ten year construction period and nearly 3 year non-radioactive test program, the DWPF began radioactive operations in March, 1996.

The results of the first 8 months of radioactive operations are presented. Topics include facility production from waste preparation batching to canister filling.

DEFENSE WASTE PROCESSING FACILITY RADIOACTIVE OPERATION PART III - REMOTE OPERATIONS

William D. Kerley, William M. Barnes, and Paul D. Hughes
Westinghouse Savannah River Company, Aiken, SC 29808

ABSTRACT

The Savannah River Site's Defense Waste Processing Facility (DWPF) near Aiken South Carolina is the nation's first and world's largest vitrification facility. Following a ten year construction period and nearly three years of non-radioactive testing, the DWPF began radioactive operations in March 1996.

Radioactive glass is poured from the joule heated melter into the stainless steel canisters. The canisters are then temporarily sealed, decontaminated, resistance welded for final closure, and transported to an interim storage facility. All of these operations are conducted remotely with equipment specially designed for these processes.

This paper reviews canister processing during the first nine months of radioactive operations at DWPF. The fundamental design considerations for DWPF remote canister processing and handling equipment are discussed as well as interim canister storage.

SESSION 15-ADVANCED ENVIRONMENTAL EDUCATION BY DESIGN APPLICATION

WERC ENVIRONMENTAL DESIGN CONTEST AN INNOVATIVE APPROACH TO SOLVING REAL WORLD PROBLEMS

Abbas Ghassemi and Ron Bhada, WERC
J. Derald Morgan, Dean of Engineering, NMSU
PO Box 30001, Dept. WERC, NMSU
Las Cruces, NM, 88003

ABSTRACT

Environmental Science and Engineering is an important element of all aspects of life throughout the world and is consequently being offered at universities. The WERC Environmental Design Contest offers many students interested in the environmental arena an opportunity to compete, communicate, develop a network and earn award money while solving a real world environmental problem. This contest is in its seventh year and is successful in bringing together, in one location, top environmental students and professionals. The contest exposes the participating students to real world problems and challenges in the environmental field. Participating universities represent states from across America as well as Mexico. For the first time, a team from United Arab Emirates University will be competing as a part of the Oregon State University team.

For the 1997 Contest, teams may elect to participate in one or more of three separate tasks. The students are provided with the task information during their Fall semester and spend the following months working on their design. The participating teams must consider not only the technical and economic issues associated with remediation but also address all regulations, health and other issues associated with the particular task. The teams must address the public communications aspect of their proposed solution. Many of the participating universities use this contest as a senior level design class.

In addition to mileage, prize money is also provided in a variety of categories to the contestants. 1996 prize and travel expenses awarded to the participants totaled nearly $60K. The last half day of the contest is filled with anticipation as the judges make their final decisions. The morning of the final banquet, WERC hosts a Job Fair which caters to the participating students. Trophies and awards are announced during the final banquet.

TREATMENT OF HAZARDOUS AND RADIOACTIVE WASTE IN UNDERGROUND STORAGE TANKS USING IN-SITU VITRIFICATION

Thomas F. Seacord
Graduate Student
Department of Civil and Environmental Engineering
Clarkson University, Potsdam NY 13699-5710 USA

ABSTRACT

An interdisciplinary student design team produced a conceptual design and project plan for the safe and cost effective treatment of hazardous and radioactive wastes which reside in four different underground storage tanks. To treat these wastes, it was decided that an ex-situ treatment would cause unnecessary risk of exposure to radiation and hazardous chemicals. For this reason, in-situ vitrification (ISV) was chosen to treat the site. ISV offers protection to workers and the environment while it stabilizes contaminants that are not destroyed or sent into the off-gas treatment system, minimizes wastes, and remains cost effective. Legal and regulatory requirements were identified and actions were taken for compliance. Legal and regulatory requirements included: community relations, OSHA training for workers, environmental regulations for off-gas treatment and leachate analysis, and disposal of secondary waste from the off-gas treatment system. Overburden soil was added or taken way from the site of each tank to provide adequate shielding from radiation while achieving optimum conditions for vitrification. A health and safety plan was produced which provided for optimal worker and community safety by monitoring radiation levels and establishing an emergency action plan. A community relations plan was implemented early in the design process. A sample community was assembled and accepted the proposal of using ISV. Their concerns were identified and incorporated into the design. A plan for communication was established which involved meetings, brochures and an 800 number to provide further information and address concerns. An economic assessment and business plan indicated that ISV was far superior to ex-situ treatment and disposal noting that disposal costs alone were greater than the entire ISV operation.

PROPOSAL FOR THE REMOVAL AND TREATMENT OF RADIOACTIVE VEGETATION

Christopher Doten, Jennifer Meehan, Dr. Ron Crawford, Dr. Wudneh Admassu*
*Department of Chemical Engineering
University of Idaho
Moscow, Idaho 83944-1021

ABSTRACT

In 1995 the Waste-management Education & Research Consortium put forth a task that required an ex-situ primary treatment of radiologically contaminated vegetation (Task III). This task involves the removal and treatment of 40,000 cubic yards of radioactive vegetation containing 60% pine trees, 20% hardwood trees, and 20% grasses and shrubs. In

order to accomplish this task, the proposed design will utilize equipment from the forest product industry to harvests the vegetation and reduce the waste's volume using reverse burn gasification, and use cementation or vitrification to stabilize the final product.

The harvesting process uses five major pieces of equipment: a feller/buncher with a shear typecutting head that cuts down trees and leaves them in bunches, a forwarder that collects the tree bunches and hauls them to a central location, an all-purpose chipper that chips smaller vegetation and hauls it to a central location, a waste recycler that grinds the waste, and trucks with trailers that gather the waste and haul it to the volume reduction facility. The volume reduction process uses reverse burn gasification to trap the radionucleotides contaminating the waste in a triple reverse burn char matrix, a low grade activated carbon. This char material absorbs the radionucleotides and prevents them from escaping the reactor while the remaining waste is reduced to ash. Gasification, a versatile process that can be used on radioactive sludges, liquids and contaminated soils, reduces the volume to approximately 2% of the original waste. After the volume reduction a simple process such as cementation will be used, which will increase the volume to only 5% of the original waste, or vitrification which is a viable alternative can be used as a final stabilization step that can be done cost effectively at the facility.

This design will handle the waste treatment process efficiently and economically while minimizing the risk to the environment, employees, and surrounding communities. It also addresses the regulatory, legal, health, and safety requirements. Overall, the design creates a format for an efficient and cost effective process that effectively removes and treats the vegetation reducing the volume by 95%.

A PROTOTYPE DESIGN FOR CONTAMINATED FILTER REMEDIATION AND STABILIZATION

Vincent R. Fusconi, Daniel G. Marshall, and Clinton P. Richardson
Department of Mineral and Environmental Engineering
New Mexico Institute of Mining and Technology
Socorro, New Mexico 87801

ABSTRACT

Currently, the Department of Energy (DOE) stores 100's of metric tons of mixed transuranic (TRU) waste forms at its many facilities throughout the country. One such waste form, a spiral wound polypropylene filter contaminated with hydraulic oil, carbon tetrachloride, plutonium, and chromium, was the basis of Task II at the 6th annual Waste-management, Education and Research Consortium (WERC) environmental design contest held April 21-25 1996 in Las Cruces, New Mexico.

Storage space for radioactively contaminated materials is limited and costly, making environmentally sound reduction of volume the focus of this design. Several opportunities for reuse of materials were projected in initial design stages and represent the scope of the actual project. Polypropylene, separated and distilled CCl_4, decontaminated oil, and recycled packagingare all recovered by this process. An in-depth research of legal parameters shaped all aspects of the process with focuses on waste characterization, worker training and safety, emergency planning, and also packaging, storage and transportation of waste. A business plan was outlined to project an actual cost estimate: public relations guidelines were also created to inform potentially affected communities. The following paper outlines the work performed by New Mexico Tech's (NMT) Task II team.

CONTINUOUS RADIONUCLIDE (CS, SR) REMOVAL FROM CONTAMINATED VEGETATION

Nick Abate, Geoff Courtin, Michelle Wright, Christy Anderson, Richard Mead
Terese Gabocy, Mark Bailey, John Bier, Sherisse Smelser, Brenda Thomas
MWB NSULTING
University of New Mexico
Albuquerque, NM

ABSTRACT

A radioactive waste unit (e.g. seepage basin) has vegetation growing in the sediments and in the immediate area of the designated waste unit. The vegetation at this site has absorbed radioactive cesium and strontium. The purpose of this report is to present the MWB Consulting design team's solution with supporting discussions regarding the proposed removal and subsequent remediation of the vegetation at this site.

To defoliate the area efficiently and effectively, a selective harvesting procedure is employed. The thrust of MWB Consulting team's design is to treat the in situ contamination by a continuous replenishment plan that ensures the ongoing integrity of the environment and ecosystems, and minimize the exposure to the workers and the general public.

Strontium and cesium are removed by a combination of physical processes dominated by pressurization and ion exchange. A slurry of wood pulp and vegetation is fed to a three-stage counter-current decantation station comprised of mixing tanks and decanter centrifuges. The final wood product is 20% water by weight and is clean enough to be processed at a municipal landfill or be used as mulch. The water by-product of the process contains 99.99% of the radionuclides in solution. This stream will be acidified with nitric acid and will run through an ion exchange column. An ion exchange process was selected to remove cesium and strontium from the liquid effluent because of the high removal efficiency and waste reduction opportunity. The stream exiting the last ion exchange column contains a high amount of organic material. In order to reuse the water, this stream is evaporated to leave an ionic resin and the water is recycled.

Re-planting and harvesting will occur until the radiation in the vegetation reaches the safe limit of 1.37 mrem/day (or 500 mrem per year.) The remedial action for the existing 40,000 cubic yards will take approximately 7.5 years based on a continuous process running 24 hours per day with a projected up-time of 240 days per year. A structure for the processing plant will be built 200 feet from the containment area allowing for safe and easy transport of the contaminated material.

Costs associated with this design solution are approximately $29.2 million. Radiation dose rates from the vegetation are estimated to be 40-60 mrem/hr. Exposures will be reduced by remote handling, shielding, administrative procedures and prolective and monitoring equipment applying any and all ALARA principles. Communlty relations policies will be based on the view that the contamination is in a forest. MWB Consulting has identified sectors of the public most likely to be affected by the remedial action and has tried to predict their responses in making further community relations decisions.

HARVESTING, STEAM PERCOLATING & COMPOSTING RADIOACTIVE FLORA

Minal D. Pagedar, Dr. David A. Rockstraw
Dept. of Chemical Engineering, New Mexico State University.

ABSTRACT

HALF LIVEs has developed a complete processing solution to the remediation problem posed by Task 3 of the 1996 WERC Design Problem. The team's goal to minimize the additional use of chemicals and not generate additional waste resulted in a unique desig. Size reduction of vegetation is an important feature for enhanced heat and mass transfer for the removal of contaminants. Steam is used to strip the radionuclides of highly soluble salts through percolation down the column. Continuous percolation of steam aides in decontamination and concentrating the salts in reboiler. Composting of the decontaminated flora converts the organic matter to C_n2 and a valuable horticultural amendment or a stable landfill cover. The test results showed only 1.09mg/Kg of Cs and 272 mg/Kg of Sr in the treated flora.

MAGNETICALLY STABILIZED FLUIDIZED BED-NEW TECHNOLOGY FOR REMEDIATION OF CONTAMINATED SOILS, SLUDGES AND LIQUID WASTES

Lisa Clemen: and Goran Jovanovic
Department of Chemical Engineering
Oregon State University, Corvallis, OR 97331

ABSTRACT

Oregon State University WERC-Task-Force has developed a unique and innovative engineering approach toward cleaning up liquids, sludges, and contaminated soil type wastes. The extensive contamination by heavy metals, hydrocarbons, chlorinated biphenyls, and in some cases radio nuclides has presented a great challenge for developing effective engineering methods for remediation of soil, sludges, and contaminated liquids. Existing technologies often fall short of productive remediation due to stringent requirements and high expectations while trying to comply with free release CERCLA regulations. This work represents an effort to enhance our engineering options in dealing with a variety of clean-up situations and requirements.

As a result, the use of a magnetically stabilized fluidized bed (MSFB) is envisioned to remove particularly targeted or an array of contaminants from liquids and sludges containing mixtures of different above mentioned contaminants. MSFB incorporates high mass transfer and high conversion rate characteristics of packed beds, in addition to excellent characteristics of fluidized beds like: low pressure drop, and the ability to process solids. A magnetically stabilized fluidized bed is the addition of a magnetic field to the traditional fluidized bed. Fluidized particles contain a ferromagnetic material which can be magnetized while in the magnetic field. Magnetized ferromagnetic particles create inter-particle magnetic forces which act to control the dynamic behavior of fluid and solids for the purpose of increasing or controlling the intensity of multiphase contact. Magnetic field strength, fluid velocity, particle composition, percentage of solids in the sludge, and fluid viscosity are all adaptable operating parameters. The MSFB has been shown to have robust operating characteristics and to have enhanced mass transfer capabilities up to 75% while efficiently remediating sludges of 20-30% solids.

The MSFB technology is based on the custom made fluidizing particles containing ferromagnetic material and additional active substances like adsorbents and catalysts. Ferromagnetic particles act as platforms for a multitude of active substances that can be tailored toward a variety of specific applications/tasks. For example, our research indicates that the use of OSU-Sorb-2R particles can be successfully implemented for simultaneous adsorption and catalytic decomposition of hydrocarbons in sludges.

SESSION 16-NEW DIRECTIONS IN DOE'S WASTE MANAGEMENT PROGRAM

EVOLUTION OF THE ENVIRONMENTAL MANAGEMENT TEN-YEAR PLAN INITIATIVE

Patrice Bubar
U.S. Department of Energy,
EM-35
19901 Germantown Road
Trevion 2 Building
Germantown, MD 20874
Eugene Schmitt
U.S. Department of Energy,
EM-70
1000 Independence Ave., SW
Forrestall Building
Washington D.C. 20585
Douglas Tonkay
U.S. Department of Energy,
EM-35
19901 Germantown Road, Trevion 2 building
Germantown, MD 20874

ABSTRACT

The Environmental Management (EM) Program has developed a Ten-Year Plan based on a vision that cleanup at most sites can be achieved in a decade, with some remaining waste streams (primarily high-level waste and transuranic waste) at a few sites. The Plan sets forth specific time tables and costs, restructuring most work in projects that contribute directly to achieving the cleanup of the site to the desired end state. The Plan builds on previous strategic planning, such as the Baseline Environmental Management Report, taking advantage of breakthrough opportunities to achieve the vision.

The new vision and Ten-Year Plan are guiding strategic thinking and decision making. The Plan will serve as a baseline to monitor progress throughout the next decade. Each EM site is currently developing a Ten-Year Plan, which collectively will make up the National Ten-Year Plan. The National Ten-Year Plan will provide a cross-cutting program view.

This paper discusses the origin and evolution of the Ten-Year Plan initiative from a Headquarters perspective. Next steps include further implementation of the integrated strategic planning, budgeting, and management system of which the Plan is a cornerstone. The Plan will be revised, as needed, to reflect future budget and scope changes.

RE-ENGINEERING DOE WASTE MANAGEMENT

James A. Turi, Jane M. Talarico, Phillip E. Hill
U.S. Department of Energy

ABSTRACT

DOE Waste Management's Re-Engineering Project is working to change the Department's paradigm for waste management. The focus of this change is the waste generators. In a re-engineeried world, waste generators will have to pay for the treatment, storage and disposal waste management service provider.

How waste management services are provided will also change. Sites will have to compete with each other and private industry for waste generator business. The mission programs will have the option of taking over, from the Office of Environmental Management, the operation of the waste management services at their landlord sites for newly generated waste.

These changes recognize that centrally-planned, command-and-control economies are inherently costly, and not as responsive to their cutomers as "free market" economies. Re-engineering is about introducing "free market" forces, i.e., competition and "enlightened self-interest" into the DOE community to reduce the amount of waste generated, and to drive down the cost of waste management services. This paper. discusses the Re-Engineering Project's evolution, achievements, and future direction.

PRIVATIZATION AS AN ENVIRONMENTAL MANAGEMENT BUSINESS STRATEGY

Kimberly A. Chaney and Jeffrey A.Williams
U.S. Department of Energy; Office of Waste Management
Washington DC 20585

ABSTRACT

In 1989, the Department of Energy established the Environmental Restoration and Waste Management Program, now called the Environmental Management (EM) Program, to consolidate ongoing activities and accelerate efforts to deal with inactive nuclear and non-nuclear production facilities and sites and the accumulated waste, contamination, and materials resulting from 45-years of weapons development and production. Roughly eight years later, the program has tripled in size and assumed responsibility for stabilization and consolidation of nuclear material and spent fuel; maintenance, surveillance, and deactivation of surplus facilities and site infrastructure at all inactive DOE sites; as well as the traditional waste management and environmental restoration activities. The EM program is one of the largest environmental stewardship programs in the world, with over 150 sites in about 30 states and Puerto Rico.

As EM-programmatic responsibilities grew, so did the financial requirements necessary to accomplish the mission while maintaining public and worker safty and compliance, and minimizing impacts to the environment. With an almost $6 billion budget in Fiscal Year 1996, and total cleanup projections ranging from $235-270 billion over a number of decades, better, faster, cheaper became a mandate. Privatization of activities promises to get work done more efficiently. This paper will describe privatization "EM-style". It will define what EM means by privatization, benefits to be achieved, status of major efforts, and lessons learned.

WHAT'S NEW IN DEPARTMENT OF ENERGY LOW-LEVEL WASTE MANAGEMENT -- THE DEFENSE BOARD, RISK, PERFORMANCE, AND STAKEHOLDER ISSUES

Martin Letourneau, Julie Ayres, U.S.Department of Energy; Kirk Owens, Derek Widmayer, Science Applications International Corp.; and Brandt Meagher, Lockheed Martin Idaho Technologies

ABSTRACT

In 1990, the Defense Nuclear Facilities Safety Board (DNFSB) identified that the Department of Energy's (DOE) radioactive waste management Order, 5820.2A, did not adequately address DOE's radioactive waste management activities. As a result, an effort to revise the Order was initiated in 1991. In September, 1994, the DNFSB issued Recommendation 94-2, Conformance with Safety Standards at Department of Energy Low-Level Waste and Nuclear Disposal Sites, which further identified problems with DOE's radioactive waste management system specific to low-level waste (LLW). DOE has embarked on an integrated effort to address these concerns through a broad-based systems engineering based effort. Since September 1996, DOE's efforts to address the DNFSB concerns and the efforts to revise the radioactive waste management Order have been fully integrated. Through these efforts, DOE is emphasizing the need to establish a sound technical basis for its radioactive waste management activities and requirements, the need to focus on risk, the role of performance based requirements, and opportunities to address stakeholder concerns. This paper focuses on how DOE is addressing these challenges while capitalizing on its opportunities to address risk, performance, and stakeholder issues.

NOW, WHAT DOES DOE DO WITH IT? RESULTS OF THE FINAL WM PEIS

David Hoel
U.S. Department of Energy
K. Cornelius, J. Loving, and C. Mueller
Argonne National Laboratory
F. Skidmore
Louis Berger and Associates

ABSTRACT

The U.S. Department of Energy (DOE) published the Draft Waste Management Programmatic Environmental Impact Statement (WM PEIS) in September 1995 and will publish the Final WMPEIS in early 1997. The WMPEIS examines the potential environmental impacts and costs of managing DOE's radioactive and hazardous wastes over the next twenty years (40 years for HLW storage). A 5-month public comment period, which included public hearings in 18 different locations, produced over 5000 public comments. The changes made as a result of these comments include more up-to-date site-specific waste inventory projections; a reevaluation and expansion of cumulative impacts which better integrate predicted impacts from other DOE programs; clarification of various transportation issues; and revised, more comprehensive evaluations of environmental justice and privatization considerations. This paper summarizes these changes, and the final results of the WM PEIS analyses. The factors and criteria which the Department will use to identify preferred alternatives and the status of the subsequent decision-making process and related public involvement activities are discussed.

THE OFFICES OF ENERGY RESEARCH AND DEFENSE PROGRAMS APPROACH TO WASTE MANAGEMENT RE-ENGINEERING

Arnold M. Edelman and John A. Marchetti,
Offices of Energy Research end Defense Programs
U.S. Department of Energy, Washington, D.C. 20585

ABSTRACT

The Office of Environmental Management (EM), through it's Re-Engineering of Waste Management will change the way waste is managed within the Department of Energy. The Officesof Energy Research (ER) and Defense Programs (DP) are working together to assure a "smooth" transition of waste management responsibility and accountability back to their respective organizations. With early planning combined with open communication among headquarters, field, and site offices, a smooth transition will evolve and provide the foundation for a more cost effective, efficient, and less bureaucratic waste management program for the Department.

Both ER and DP have established Waste Management Transition Working Groups to help define how a true "environmental efficient" goal, that will incorporate pollution prevention, waste minimization and waste management will be achieved.

This paper discusses the current approaches being undertaken by ER and DP and describes the issues, barriers, and potential options for resolution.

SESSION 17-MIXED WASTE PROGRAMS AND ISSSUES

THE MIXED WASTE FOCUS AREA: STATUS & ACCOMPLISHMENTS

J. E. Conner
U.S. Department of Energy
R. E. Williams
Lockheed Martin Idaho Technologies
Idaho Operations Office

ABSTRACT

The Department of Energy (DOE) established the Mixed Waste Characterization, Treatment, and Disposal Focus Area (MWFA) to develop and facilitate implementation of technologies needed to meet the Departments commitments for the treatment of mixed low-level and transuranic wastes. The Idaho National Engineering Laboratory (INEL) has been identified as the Lead Organization for the technical management of the Focus Area and began operations in February of 1995 utilizing capabilities, expertise, and resources from across the DOE Complex.

The MWFA's mission is to provide acceptable technologies that enable implementation of mixed waste treatment systems developed in partnership with end-users, stakeholders, tribal governments, and regulators. The MWFA will develop, demonstrate, and deliver implementable technologies for treatment of mixed waste within the DOE complex. Each DOE site facility that generates or stores mixed waste has prepared a plan, the Site Treatment Plan (STP), for developing treatment capacities and Wearing that waste. Agreements with state regulators have resulted in Consent Orders (COs) providing enforceable milestones for achieving treatment of these wastes.

The Mixed Waste Focus Area has been organized and is operating. Waste Type Managers (WTMs), located within the EM organizations that own the wastes and representing sites with the major mixed waste inventories and/or problems have been given the charter to provide primary direction to the technology development and demonstration tasks. This arrangement maximizes the tie between technology developers and end-users. A technical baseline has been developed and forms the basis of the Fiscal Year 1997 budget submittal. The program has a strong and active Regulatory and External Liaison Unit dedicated to ensuring industry, university, and tribal and public stakeholder participation, input, and acceptance. The regulatory element's role includes the identification of regulatory, requirements for technology development activities and the coordination of efforts to effect multi-state participation in the acceptance of demonstration protocols.

For Fiscal Year 1996 the Mixed Waste Focus Area has achieved a high degree of program integration and technical defensibility by creating a sound, integrated infrastructure and by implementing system engineering practices. An Integrated Program Schedule has been developed and kept current. Technical defensibility has been strengthened by defining the requirements for the technology deficiencies in Technology Development Requirements Documents (TDRDs). An aggressive quick-wins program has been initiated and implemented.

The goal of the Focus Area's strategy is to continuously target the highest priority customer needs. Building on our FY-96 successes, planned activities for FY-97 include:

1. An evaluation of the DOE Complex's mixed waste technology development needs and to proactively plan for the orderly dose-out of the program. Prior to closure the MWFA will enable treatment of at least 90% of the Complex's mixed waste, one of the major milestones for the program.
5. Address high priority technical deficiencies critical to customer needs through technology demonstrations on actual wastes.
6. Use the regulatory resource to engage regulators early in the TD process to gain their participation in defining requirements and strategies. Within the TD process take steps to increase the commercialization potential of MWFA technologies.

BROAD SPECTRUM PROCUREMENT FOR PRIVATIZATION OF MIXED WASTE TREATMENT

Katherine L. Yuracko, Stanton W. Hadley, Michael I. Morris
LMER
Richard D. Korynta
DOE
Clemence M. Noakes, Fred H. Miller
LMES

ABSTRACT

High costs projected for mixed low-level waste treatment, coupled with decreasing U.S. Department of Energy (DOE) budget profiles, have led the DOE Oak Ridge Operations Office (OR) to investigate innovative methods for reducing the costs of mixed waste treatment. Because estimates indicate that the cost of waste treatment can be reduced through increased private sector competition, DOE-OR has initiated a major privatization initiative for private sector treatment of mixed low-level wastes. A Broad Spectrum Procurement has been initiated to establish treatment contracts for certain mixed low-level waste streams at the Oak Ridge Reservation (ORR) for which DOE does not have existing treatment capability. Because DOE-OR recognizes the benefits that such a procurement will offer other government sites needing mixed waste treatment, these contracts will be made available across the government.

A preliminary analysis of the relative economics of private sector treatment of Broad Spectrum Procurement mixed wastes versus treatment in a government-owned, contractor-operated facility in Oak Ridge has been performed based on currently available data. All of the options that were examined included disposal at a commercial mixed waste disposal site. The results suggest that for some mixed wastes, selecting the private sector option would result in lower costs to the government.

Major steps towards accomplishing the Broad Spectrum Procurement have already been completed: candidate mixed wastes at seven DOE sites have been identified, classified according to treatment categories, and prioritized for treatment. Based on consideration of waste chemical and physical properties, the wastes have been divided into multiple treatment categories. These treatment categories form the basis for much of the cost analysis, and will comprise the basis for the solicitation. Subdividing the wastes into these treatment categories is anticipated to result in additional cost savings resulting from greater competition; this is because the bidding will be open to many more companies, both large and small, than would be possible with a single comprehensive procurement.

The present scope of the broad spectrum national procurement would allow treatment of approximately 40 million kg of waste from across the DOE complex. It is anticipated that there will be multiple vendors and multiple awards made. The contract is of national interest for two reasons: wastes from throughout the DOE complex may be treated under the broad spectrum contracts; and the procurement will promote establishment of commercial treatment for a "broad spectrum" of mixed waste.

PUBLIC PARTICIPATION IN A DOE NATIONAL PROGRAM: THE MIXED WASTE FOCUS AREA'S APPROACH

Richard Kimmel, Manager, Regulatory and External Affairs
Mixed Waste Focus Area
U.S.Department of Energy, Idaho Operations Office
Roger Scott, Tribal and Public Involvement Resource Team Leader
Mixed Waste Focus Area
Lockheed Martin Idaho Technologies Co.

ABSTRACT

The authors describe the Mixed Waste Focus Area's approach to involving interested Tribal and public members in the mixed waste technology development process. Evidence is provided to support the thesis that the Focus Area's systems engineering process, which provides visible and documented requirements and decision criteria, facilitates effective Tribal and public participation. Also described is a status of Tribal and public involvement at three levels of Focus Area activities.

COMPARISON OF THERMAL, NONTHERMAL AND ENHANCED NONTHERMAL MIXED WASTE TREATMENT SYSTEMS

C. R. Cooley, W. J. Quapp, C. Biagi, W. E. Schwinkendorf, T. E. Bechtold, G. L Anderson, G. D. Knight
Nuclear Metals, Inc.

ABSTRACT

The U.S. Department of Energy Office of Science and Technology has been sponsoring a series of studies of integrated mixed waste processing systems to identify technology development needs. The studies have included 20 systems based on using high temperature processes (Thermal) for organic destruction. In addition, five systems have been evaluated that used low temperature processes (Nonthermal). Two hybrid systems have also been evaluated which combine the low temperature organic destruction with vitrification of residues. This paper summarizes the results from these studies.

SOME NUCLEAR SAFETY REGULATORY ASPECTS ON THE USE OF NITRIC ACID FROM THE HANFORD PUREX SEPARATION PLANT, USA, IN THE MAGNOX REPROCESSING PLANT OF BRITISH NUCLEAR FUELS PLC, SELLAFIELD, CUMBRIA,UK.

Graeme Thomas
HM Inspector
HM Nuclear Installations Inspectorate
HSE Nuclear Safety Directorate
Bootle, Merseyside
UK

ABSTRACT

The safety of nuclear installations in the United Kingdom is regulated by Her Majesty's Nuclear Installations Inspectorate (NII), a part of the Health and Safety Executive (HSE), using a largely non-prescriptive licensing system. This paper follows on from the overview of the UK Regulatory system for licensing nuclear facilities given previously at WM'96, and describes the practical implementation of regulatory control as carried out by a typical NII inspector, in considering a proposal from a licensee and arranging for appropriate assessment in order to determine that the licensee's safety case is adequate in advance of the proposed change taking place. The example described relates to the processing of acidic liquors, arising from the reprocessing operations carried out in the Purex Separation Plant in Hanford, USA, in the Magnox reprocessing plant of British Nuclear Fuels plc (BNFL) at Sellafield in the UK.

THE RESIDUALS ANALYSIS PROJECT: EVALUATING DISPOSAL OPTIONS FOR TREATED MIXED LOW-LEVEL WASTE

Robert D. Waters and Marilyn M. Gruebel
Sandia National Laboratories
Joel T. Case, Martin J. Letourneau
U.S. Department of Energy

ABSTRACT

For almost four years, the U.S. Department of Energy (DOE) through its Federal Facility Compliance Act Disposal Workgroup has been working with state regulators and governors' offices to develop an acceptable configuration for disposal of its mixed low-level waste (MLLW). These interactions have resulted in screening the universe of potential disposal sites from 49 to 15 and conducting "performance evaluations" for those fifteen sites to estimate their technical capabilities for disposal of MLLW. In the residuals

analysis project, we estimated the volume of DOE's MLLW that will require disposal after treatment and the concentrations of radionuclides in the treated waste. We then compared the radionuclide concentrations with the disposal limits determined in the performance evaluation project for each of the fifteen sites. The results are a scoping-level estimate of the required volumetric capacity for MLLW disposal and the identification of waste streams that may pose problems for disposal based on current treatment plans. The analysis provides technical information for continued discussions between the DOE and affected States about disposal of MLLW and systematic input to waste treatment developers on disposal issues.

MAINTAINING COMPLIANCE WITH THE ROCKY FLATS' SITE TREATMENT PLAN (STP) WITHIN BUDGETARY CONSTRAINTS "THE STP REBASELINE"

Patrick M. Arnold
Alan R. Hohl
Joseph D. McKaig
Rocky Mountain Remediation Services, LLC

ABSTRACT

Rocky Flats Environmental Technology Site (RFETS) received a Compliance Order from the State of Colorado on October 3, 1995, approving with modifications the radioactively contaminated hazardous (mixed low level [MLL]) waste strategies outlined in the RFETS Proposed Site Treatment Plan (STP)[1] and committing the Department of Energy (DOE), Rocky Flats Field Office (RFFO) to actions that will achieve compliance with the Resource Recovery and Conservation Act (RCRA) land disposal restriction (LDR) regulations covering the hazardous portion of mixed wastes presently stored at the site. The STP was submitted to the State of Colorado per the mandates of the Federal Facility Compliance Act of 1992 (FFC Act) and was the result of an iterative process between the DOE, the lead regulatory agency from the State of Colorado, and local stakeholders. The STP presented a baseline LDR-compliant implementation approach that was heavily reliant on onsite treatment via expensive capital treatment systems.

With the change to an Integration and Management Contractor (IMC) at RFETS came new strategies for the safe but accelerated deactivation, cleanup, and closure of the Site. A new Rocky Flats Vision and a formal Rocky Flats Cleanup Agreement (RFCA)[2] have been negotiated and signed by the DOE, the Colorado Department of Public Health and Environment (CDPHE), and the Environmental Protection Agency (EPA). The Rocky Flats Ten-Year Plan[3] and the Integrated Site Baseline (ISB)[4] have been developed to plan the projects necessary to ensure the safe and accelerated cleanup and closure of the Site. Given the new RFETS strategies and the severely constrained DOE funds available for waste treatment and disposal, the original STP baseline strategy using onsite treatment systems became unworkable. Rebaselining STP planning and implementation activities and integrating them with Site priorites became an imperative.

The STP Rebaseline methodology was developed by the Site's waste management contractor, Rocky Mountain Remediation Services (RMRS); the methodology includes the development of waste form-to-primary and contingency options, waste form prioritization via a tiered arrangement, and development of 3-year and 10-year work plan targets and milestones. Onsite and offsite primary and contingency treatment options agreed upon by DOE, RFFO and the CDPHE will maximize treatment flexibility while achieving the objectives of the FFC Act. The STP Rebaseline's goals of reducing treatment and disposal costs and accelerating scheduled completion while providing protection of human health and the environment appear achievable. DOE, RFFO submitted the Proposed STP Rebaseline, Final Draft, to the regulator's for review and comment on January 9, 1997. Subsequent to incorporation of regulator comments, a formal public comment period will occur, pertinent public comments will be addressed and incorporated, and the STP Rebaseline will be issued as a formal Revision to the original STP Compliance Order. It is anticipated that the formal Revision will be in effect by April 1997.

SESSION 18-HIGH LEVEL & TRANSURANIC WASTE PACKAGING AND TRANSPORTATION

DEVELOPMENT OF A HIGH-CAPACITY CASK FOR HIGH-LEVEL RADIOACTIVE WASTE (HAW)

A. R. Cory, R. T. Benbow
British Nuclear Fuels plc
Risley, Warrington, Cheshire, UK

ABSTRACT

High-level waste is generated as a product of reprocessing, being a product of the chemical process that is unusable for recycling into new fuel. BNFL has stored such waste at Sellafield in liquid form for about 40 years. Whilst most of the waste generated at Sellafield is a product of the UK nuclear industry, an increasing quantity is generated as a result of reprocessing fuels from Japan and Europe. Since 1976, contracts signed with overseas customers have included the return of the waste product to the country of origin.

The waste, or residue has to be incorporated in a stable form to facilitate safe and convenient re-export. BNFL has constructed a plant at Sellafield to embed the residue in a stable glass matrix. BNFL's vitrification plant came on stream in 1992, and has continued to expand its capacity. Feedstock is drawn from the highly active waste storage tanks and concentrated by evaporation. The concentrated product is mixed with glass powder, or 'frit' at high temperature in a 'calciner' before canning in stainless steel containers. The containers are sealed by a robotic welding process and consigned to a specially constructed store, cooled by natural air circulation.

After a period in storage during which time the activity and heat generated have decayed to acceptable levels, those containers selected for re-export are remotely loaded into a cask designed for either transport, ordual-purpose transport & storage, depending on the requirements of the individual customer. In practice, residues destined for Japan are carried in a transport cask, which is re-used after unloading into a shielded store in Japan. Most residues destined for Europe will be stored in the cask in a repository. In both cases this storage is regarded as an interim measure, where 'interim' can mean a 40-50 year period preceding final disposal.

BNFL has designed casks to suit each requirement. The cask servicing the dual-purpose transport & storage requirement is the latest to be designed, and is the subject of this paper. The degree of optimisation of the key cask features is very high - in other words the design is very efficient in its use of materials to allow maximum payload at minimum weight.

TN 81, THE NEW TRANSPORT STORAGE CASK FOR THE RETURN OF HIGH ACTIVITY WASTES FROM REPROCESSING

Bernard Lenail and Vincent Roland
TRANSNUCLEAIRE
Paris, France

ABSTRACT

The TN 81 is the new dual purpose cask for high level vitrified waste from reprocessing. This new generation cask is another step in the recycling optimization. It accepts the higher neutron sources from reprocessing of higher burnup LWR spent fuel and shorter cooled vitrified high level wastes. It uses containment and shielding options, that are fully validated through the experience which Transnucléaire has gathered on the TN 28, TS 28 and TN 24 casks during the last ten years. It also complies with ICRP 60 neutron quality factor. The TN 81 accepts 25% more heat power within the same dimensional and weight limits as the current casks and almost the double of the dose rate contributing isotopes. This competitively priced cask will be available by 1999. Initially aimed at the German and the Swiss market, its features and versatility make it a worthy candidate for other needs in terms of transport and interim storage of high level wastes.

WASTE MANAGEMENT: TOWARDS A STANDARDIZATION OF BACK-END FUEL CYCLE PACKAGES

Ph. PRADEL
Deputy Director, Reprocessing Branch
COGEMA
2 et 4 rue Paul Dautier 78140- Velisy Villacoublay

ABSTRACT

Since a few years, COGEMA has developed a policy of waste management optimization in the back-end fuel cycle which takes benefit from the La Hague plants' experience. First of all, the choice of Reprocessing-Conditioning-Recycling Strategy instead of direct disposal of spent fuel minimizes the final radiotoxicity of ultimate residues.

Furthermore, the cost optimization of final disposal facilities requires the development of advanced technology achieving reduced volumes and standardized packages characteristics.

This policy, as implemented by COGEMA, is an important milestone in the set up of the advanced waste management that will be applied at La Hague by the 2000. From then on, the total volume of long lived residues from reprocessing will be less than 0.5m³/t of U, corresponding to an approximate volume reduction ratio of more than 4 comparing to the direct disposal present estimations (about 2m³/t).

The standardization of packages will be achieved by the Universal Canister Strategy (UCS) which applies to all type of wastes (technological wastes, vitrified fission products and compacted hulls and end-pieces).

Vitrified residues currently fabricated at La Hague plants are placed in a specified stainless steel container, the so-called << glass canister >>. Specifications for vitrified residues have been approved by international Safety Authorities (Japan, Germany, Belgium, Netherlands, Switzerland and France) promoting this canister to an universal standard. The Universal Canister Strategy will be based on this well established standard.

By the 2000, a new facility currently trader construction will provide a compacting process for hulls and end-pieces as well as for technological wastes. Hulls and end-pieces will be mixed with technological wastes for compaction. Rounds of compacted wastes will be placed without immobilization matrix in the Universal Canister in order to standardize handling and future disposal.

External dimensions of the Universal Canister are those of the canister for vitrified residues (diameter = 430 mm, total height = 1335 mm). Material and internal fittings may vary according to the type of residues contained. The little dimensions of the package as well as a limited weight are attractive features for handling and transport.

So, the Universal Canister will package all types of residues and will facilitate handling, transport as well as final disposal. For example, the design of the repository will be simplified with boreholes or galleries of the same dimensions, and the device to handle the containers in the storage will be reduced to one pliers system.

By an adapted management of interim storage of high ßy activity packages, less constraining thermal characteristics could also be obtained and could allow to reduce the repository size.

THE TN 24 DUAL PURPOSE CASK FAMILY FOR SPENT FUEL: FACTUAL EXPERIENCE AND TRENDS FOR FUTURE DEVELOPMENT

B. Kirchner
Transnucléaire

ABSTRACT

As the policy for the spent nuclear fuel is not yet clearly defined in several important countries, a number of nuclear electricity generating Utilities have adopted a 'wait and see' attitude and need means to interim store increasing quantities of spent fuel for long time periods.

Among the various systems offered for interim storage of spent fuel, dual purpose metallic casks present a high safety level associated with a maximum flexibility, while being always competitive for Utilities which want to follow safety rules based on a wide international consensus and which are operating a small number of nuclear power reactors.

The paper will encompass three main stages covering the design, manufacture and operation of various TN 24 forged steel casks that have been tailored to different types of LWR spent fuel.

Design: How to accommodate the different batches of spent fuel assemblies present in a given reactor pool taking into account the various shielding needs and interface criteria will be addressed.

This approach will provide means for an optimization of the spent fuel management strategy.

Manufacture: Combination of industrial partners around a forgemaster and a boilermaker in order to produce casks within a tight time schedule, with strict application of Quality Assurance rules, under the best price conditions and with the maximum benefits for local industry will be described by means of several examples.

Operation: Examples of cask operation will be reported.

As a conclusion, some statements will be proposed about how to balance safety concerns with economical considerations while selecting among the various interim storage systems offered.

CASTOR V - THE PACKAGE SYSTEM FOR TRANSPORT AND STORAGE OF SPENT FUEL ASSEMBLIES

Dr. R. Diersch, Dr. G. Dreier, H. Stelzer
GNB mbH
Gesellschaft für Nuklear-Behälter mbH
Hollestraße 7a
D-45127 Essen, Germany

ABSTRACT

GNB Gesellschaft für Nuklear Behälter mbH has a long term experience in developing casks for the transport and storage of spent fuel assemblies. A main type of casks built by GNB is the CASTOR type made of ductile cast iron GGG 40. All design criterias including all tests according to the IAEA regulations as a type B(U) Fpackage (IAEA) and the acceptance criterias for the German storage sites are fulfilled by the CASTOR V casks family which has been shown by calculational analysis and by analogue evaluations on the base of experiments.

The most modern high capacity casks of the CASTOR V type family have been developed for transport and long term interim storage of 19 PWR and 52 BWR spent fuel assemblies. The new casks of the CASTOR V type family are, according to the decay time of approx. 5 years and the number of fuel assemblies to be put in the cask, called CASTOR V/19 and CASTOR V/52. The development of another cask basing on the same design will be finished in 1997. This cask will be able to transport and to store 21 short PWR spent fuel assemblies.

The initial enrichment of the fuel elements to be transported and stored in the CASTOR V casks may be up to 4.6 wt-% U_{235} and the burn up values may increase up to 65 GWd/Mg_{HM}. MOX fuel assemblies may also be transported and storaged in CASTOR V casks.

Because of the similar cask bodies of the CASTOR V family it was possible to minimize the time for the acceptance of the casks during the licensing procedures. The mechanical and thermal layout of the CASTOR V family are the main foci of this report.

CERTIFYING CONTAINERS FOR TRUPACT-II SHIPMENT USING FLAMMABLE GAS HEADSPACE MEASUREMENTS

Sinisa M. Djordjevic
L. Richard Spangler
Benchmark Environmental Corporation
Michael J. Connolly
Lockheed-Martin Idaho Technologies Company

ABSTRACT

Four U.S. Department of Energy-Carlsbad Area Office (DOE-CAO) initiatives in progress are designed to increase the portion of transuranic (TRU) waste that can be shipped in the Transuranic Package Transporter-II (TRUPACT-II). Although these initiatives will substantially increase the percentage of drums that can be shipped, a portion of the waste will still exceed current container decay heat limits and cannot be shipped using the current methodology required in the Safety Analysis Report for the TRUPACT-II Shipping Package.

The average concentration of flammable gases in TRU waste containers is approximately 0.05 percent based on headspace sampling of over 1,000 vented containers at the Idaho National Engineering Laboratory (INEL) and the Rocky Flats Environmental Technology Site (RFETS). These low concentrations indicate that actual levels of flammable gases are only a fraction of the permissible limits. The reason for this is that the decay heat limits are based on the assumption that the highest flammable gas generating material is receiving all the radiation and generating all the flammable gas. In reality, only a small fraction of the worst-case material will be irradiated. An alternate method of certifying containers that is not based on this extremely conservative assumption is needed.

This paper provides the rationale for sampling the waste container headspace for flammable gases as an alternative method of certifying TRU waste containers for shipmentin the TRUPACT-II. This paper provides background information, a summary of the proposed methodology, and a scope of work. The scope of work includes methodology and code development, experimental testing to establish flammable gas leakage rates from TRU waste containers, analyses, documentation, and a presentation to the U.S. Nuclear Regulatory Commission (NRC). The proposed method will increase the potential for shipping more waste containers more promptly to the Waste Isolation Pilot Plant (WIPP) and would apply to all waste. The proposed methodology would reduce the number of TRUPACT-II shipments, thereby reducing risks and costs associated with waste repackaging or treatment and disposal.

TN GEMINI: A TYPE B (U) PACKAGING FOR WASTES

A. Froment
TRANSNUCLEAIRE
9, rue Christophe Colomb
75008 PARIS
Y. Rouquette
COGEMA
2 Rue Paul Dautier
78141 VELIZY VILLACOUBLAY

ABSTRACT

Alpha wastes are generated in fuel cycle facilities such as those involved in reprocessing, in manufacture of mixed oxide fuel, and by research laboratories. As concerns transport, a large quantity of these wastes cannot be considered as Low Specific Activity (LSA) material, and some of them are combustible: if a significant amount of material has to be transported, then a Type B packaging is required. The TN GEMINI container has been developed by COGEMA and Transnucléaire to achieve this goal.

The TN GEMINI is a parallelepipedic packaging with a rear door allowing an horizontal loading. It is similar to an ISO 20 ft sea container in terms of total weight, size, handling devices and tie-down capability. It provides a large internal volume (4.5 x 2 x 1.8 m) available for a 5.8 Mt payload with a 30 Mt total gross weight. The TN GEMINI enables the transport of alpha wastes in drums (forty 200 liter drums or sixty 118 liter drums). The maximum fissile contents have been set at 370 g of plutonium.

This container fulfills the requirements for B(U) packages according to the International Atomic Energy Agency (IAEA) regulations. In addition, it also allows full compatibility with standard transport/loading equipments and does not require any stringent protection measures.

Our presentation will (1) give a general description of the TN GEMINI container and its contents; (2) briefly outline the main phases of its design and manufacture; (3) illustrate the operational features of the TN GEMINI container.

TRANSPORTATION AND STORAGE CONSIDERATIONS FOR TREATED WASTE FROM THE PLASMA HEARTH PROCESS

Lawrence J. Slate
SAIC, 545 Shoup Avenue, Idaho Falls, Idaho 83402-3575

ABSTRACT

This paper documents the established transportation and final storage regulations that will affect the slag waste form generated by the Plasma Hearth Process (PHP). The established transportation and storage regulations applicable to the PHP slag waste form are the Transuranic Package Transporter-II (TRUPACT-II) and the Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC). The following is a summary of the limitations imposed by these two regulations that impact PHP treated wastes:

- Waste Content
- Gross Weight
- Fissile Content
- Decay Heat

This study illustrates how each of the above limitations are applicable, which are likely to beexceeded by the treated PHP slag waste form, and recommends those limitations that should be reevaluated so the Department of Energy (DOE) can most effectively use the waste form stabilization and volume reduction offered by the PHP system.

SESSION 19-UTILITY WASTE MANAGEMENT

IN-SITU GAMMA SPECTROMETRY OF RESIN LINERS - AN APPLICATION USING A CADMIUM TELLURIDE DETECTOR

A. Husain and C. Breckenridge
Ontario Hydro Technology, Canada

ABSTRACT

Intermediate level waste from Ontario Hydro's nuclear program consisting principally of bulk resin and filters are stored in above-ground structures or in in-ground containers (IC). As part of a characterization program, an in-situ technique was developed to gamma assay bulk resin waste contained in 3 m^3 carbon steel liners and stored within 18 m^3 (IC-18s) and 12 m^3 in-ground containers (IC-12s). The technique is based on the use of a cadmium telluride detector which has a resolution intermediate between those of commonly used germanium and sodium iodide detector systems. Application of the in-situ technique (the detector was lowered to various depths to assay selected liners) demonstrated that scans can be performed without incurring a significant dose expenditure in fields as high as 5R/h without the use of a collimator and in higher fields if a collimator is employed. Detector efficiencies for the liner source were derived using efficiency data for planar sources and calculations based on Microshield code. Activity of principal gamma emitting radionuclides such as Co-60 and Cs-137 obtained in this manner can be combined with data on scaling factors to quantify the total activity in the resin. Based on the experience gained, it is concluded that the CdTe detector system should be generally applicable for assaying other intermediate level waste packages where the objective is to determine principal radionuclides present rather than a detailed characterization of gamma activity.

FRENCH CODES FOR THE ASSESSMENT OF DIFFICULT-TO-MEASURE RADIONUCLIDES IN LOW LEVEL SOLID WASTES AND IN CONTAMINED REACTOR MATERIALS

C.Leuthrot and K.Chevalier J.P. Ghysels and P.Ridoux
Commissariat à l'energie atomique Electricité de France
CEA/DRN- CE CADARACHE EDF/SEPTEN

ABSTRACT

The long-lasting nature and toxicity of some of the radionuclides contained in low level process wastes or in dismantled reactor materials have received in France particular attention relative to their final disposal. Typical radionuclides are ^{90}Sr, ^{129}I, ^{99}Tc, and actinides. These nuclides are predominately pure ß or α emitters and can normally not be measured with the laboratory equipment used in nuclear plant facilities.

Most of the utilities use scaling factors for evaluating the difficult-to-measure (DTM) isotopes.The scaling factors (SF) are determined by relating the concentration of the DTM isotope to the concentration of an easy-to-measure «tracer» (principally ^{60}Co or ^{137}Cs). Except for the nuclides which have the same physico-chemical behaviour, such as $^{59}Ni/^{60}Co$ and $^{63}Ni/^{60}Co$, the problem of the SF is their unconstancy and dispersion. Generic SF applicable on all PWR plants and for all fuel cycles are in most cases very difficult to obtain specially if small data sets exists.

The acquired knowledge at CEA on the physico-chemical behaviour of fission products, actinides and corrosion products in the french PWR's primary circuit and the EDF feedback in this field allowed to work out assessment models for the DTM radionuclides in the primary water as well for these which are deposited on the primary circuit surfaces. These estimates allow to predict the long lived isotopes retained by the filter and the resins of the primary water purification system. These filter and demineralizers constitute normally the major part of EDF's low level waste activity which is periodically shipped to the near surface disposal centers in France.

AFFECT OF FUEL DEFECT ON SCALING FACTORS AT DIABLO CANYON POWER PLANT

Clint Miller
Pacific Gas and Electric
Waste Management 97

ABSTRACT

At Waste Management '96 we presented a paper on the derivation of constant scaling factors at Diablo Canyon Power Plant. These scaling factors were base on nine years of operating data from each of the two units at the site. In 1994, a fuel defect in Unit 2 was identified. This was only the second cycle in which either unit had operated with a fuel defect.

This paper will discuss the affect on our scaling factors due to the fuel defect. Samples of cleanup resin and cartridge filters were obtained from Unit 2 to determine if the scaling factors had to be altered. The results, as expected, indicated that the constant scaling factors previously derived were still valid. The use of the Sample Analysis Program software made this evaluation quick and simple.

In addition, operation with a fuel defect offered an opportunity to obtain actual conservative analytical results for Tc 99 and I 129. Historically, analysis by commercial laboratories had never identified Tc 99 or I 129 in any sample from Diablo Canyon. The use of LLDs values for these nuclides in waste characterization imposed gross conservatism which can adversely affect disposal site performance evaluations.

Samples of resin and cartridge filters from Unit 2 were sent to Battelle PNNL for Tc 99 and I 129 analysis using mass absorption spectrometry (MAS). These results have enable us to deriveconstant scaling factors for Tc 99 and I 129 which are orders of magnitude below such factors previously derived from LLD values. The sampling and derivation of these scaling factors was less expensive than the cost of commercial computer codes which derive Tc 99 and I 129 from reactor coolant samples.

CONDENSATE PREFILTRATION FOR THE COMISION FEDERAL DE ELECTRICIDAD LAGUNA VERDE NUCLEAR PLANT UNITS 1 AND 2

Ing. Narcisso Beyhrut, Comision Federal de Electricidad
Larry Campo, Raytheon Nuclear Company
Donald Gardner, Raytheon Nuclear Company
Craig Knauss, Raytheon Nuclear Company
Edward Taylor, Raytheon Nuclear Company

ABSTRACT

The Comision Federal de Electricidad (CFE), in keeping with good ALARA practices through source term reduction and radioactive waste minimization, has decided to implement condensate prefiltration at the Laguna Verde Nuclear Plant (LVNP), a twin unit boiling water reactor, located near the city of Vera Cruz, Mexico. Unit 1 began operation in July 1990 and Unit 2 in April, 1995.

The main objective of implementing condensate prefiltration is to reduce the iron content of the condensate at LVNP to the EPRI guideline of 2 ppb or less. Reducing the amount of iron in condensate is expected toprovide the following benefits:

- Reduce solid radwaste disposal cost: Condensate resins are projected to last up to three years with prefiltration. Currently resins are changed out once per cycle.
- Reduced new resin cost: Since resins are projected tolast about three times longer, the cost of new resins will be reduced.
- Reduce liquid radwaste generation: Backwashing of resins to remove trapped particulate will not be necessary.
- Reduced liquid radwaste processing cost: With reduced liquid radwaste generation, processing costs will also be reduced.
- Reduce station man-REM: Reduced levels of iron in the reactor feedwater results in fewer activation products.

WASTE TREATMENT CENTER FOR THE NUCLEAR POWER PLANT BOHUNICE SLOVAKIA

W. Stich
NUKEM GmbH
63755 Alzenau
Germany
M. Köver
from SE-VYZ Slovenské elektrárne, A.S.
91931 Jaslovske Bohunice
Slovakia

ABSTRACT

The nuclear power plants in the eastern European countries and in the states of the former USSR are today faced with significant waste problems. In the Republic of Slovakia, for example, with 2 operating VVER reactors at the site of Bohunice - V1 and V2 - and 2 more under construction at Mochovce, the systematic and safe disposal of nuclear waste is generally not solved.

Some promising concepts, facilities for treatment of liquid waste, are not in operation today. Bitumization in 200 litre drums, the chosen method, is actually not accepted as a waste container for final storage.

An additional problem exists at the site of Bohunice from the disabled reactor A1, where same reactor fuel and a large amount of liquid and solid waste, with unusual physical and chemical properties as well as activity, is stored under unacceptable conditions.

In 1992, the Slovak utility SE (Slovenské Elektrárne) decided to realize the Waste Treatment Center (BSC-RAO) at Bohunice in order to avoid the threatened shut-down of the nuclear plants due to overfilling available waste storage capacity and also to solve the A1 problem. NUKEM was the selected contractor for design and construction of the waste treatment facilities.

CONTAINERIZATION AND SHIPMENT OF LARGE CONTAMINATED METAL COMPONENTS DURING DETROIT EDISON'S FERMI II FIFTH REFUELING OUTAGE

David G. Pettinari - Detroit Edison
James Radomicki - Frank W. Hake, Inc.

ABSTRACT

The Detroit Edison Company recently completed a turbine retrofit project at their Fermi 2 Nuclear Power Station. The goal of the retrofit project was to replace components damaged during a past turbine failure. A critical element to an on schedule completion of the project was the handling and packaging of the replaced components. Detroit Edison, Frank W. Hake, Inc. and Hake Associates developed a joint plan for containerization of all replaced contaminated components associated with the project. The plan was designed to serve the needs of the outage management group (absolute minimal in plant handling), the radioactive waste group (complete enclosure of all components in strong tight containers) and the railroad carrier (an effective tie down scheme designed to safely secure a 180 ton, completely enclosed turbine rotor for rail shipment). Based in part on the successful execution of the handling and packaging of the replaced components, the retrofit project was completed without impact to refuel the outage critical path duration.

SESSION 20-WIPP-A SAFE SOLUTION TO A NATIONAL ENVIRONMENTAL PROBLEM

PUBLIC RADIATION CONCERNS: WIPP'S RATIONAL RESPONSE

George E. Dials
Manager, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM 88221

ABSTRACT

In 1978, a group of psychologists asked a representative sampling of the populace, and a panel of risk-assessment experts, to rank 30 activities and technologies by risk. The two groups had strong correlation in various areas. For example, the risk of motor vehicles placed number one by the experts and two by the public. Large discrepancies existed in other areas: the public ranked nuclear power number one, while the experts ranked it a relatively safe number 20. Experts assessed x-rays at seven, while the public graded it 22.1.

People have always been concerned with risk, defined as the probability that something harmful will occur. How we interpret and use this information influences how we live our lives, and how our society allocates limited resources to solve problems, real or perceived.

The Carlsbad Area Office (CAO) was formed in December 1993 with a mission to protect human health and the environment by opening and operating the Waste Isolation Pilot Plant (WIPP) for safe disposal of transuranic radioactive (TRU) waste and by establishing an effective system for management of TRU waste from generation to disposal. This paper discusses the CAO's rational response to the perceived risk of radioactive waste disposal while continuing on its path to opening.

The WIPP, a first-of-a-kind facility, will reduce radiation risks and increase the protection of human health and the environment by facilitating the removal of existing TRU waste from surface and near-surface storage areas near population centers to a repository located at a depth of approximately 650 meters (2,150 feet) in an uninhabited area. Over 20 years of site characterization efforts at WIPP have resulted in a solid understanding of its geology. A simple repository configuration was designed and constructed to achieve maximum benefit from geological processes like creep closure. The successful operation of the WIPP will enhance public confidence in deep geological disposal of radioactive waste both in the USA and abroad.

Safety is CAO s number one priority. In October 1994, WIPP was the first DOE site to receive "Star" status under the Voluntary Protection Program, an industrial safety program originally established to recognize exceptional safety performance in private industry. The WIPP site has also been recognized by the New Mexico Inspector of Mines as "Operator of the Year" for the last eight consecutive years.

The DOE is committed to interaction with all stakeholders regarding major decisions. Regulators must be confident that all stakeholder concerns are considered before compliance certification. Our aim is to identify and resolve concerns before they become more difficult and costly to resolve.

THE WIPP JOURNEY TO WASTE RECEIPT

G. J. Barnes, Westinghouse Electric Corporation, Waste Isolation Division
M. E. Whatley, Westinghouse Electric Corporation, Waste Isolation Division

ABSTRACT

In the early 1970s the federal government selected an area in southeastern New Mexico containing large underground salt beds as potentially suitable for radioactive waste disposal. An extensive site characterization program was initiated by the federal government. This site became the "Waste Isolation Pilot Plant," better known as WIPP.

It is now 1997, over two decades after the initial selection of the New Mexico site as a potential radioactive waste repository. Numerous scientific studies, construction activities, and environmental compliance documents have been completed. The United States Department of Energy (DOE) has addressed all relevant issues regarding the safety of WIPP and its ability to isolate radioactive waste from the accessible environment.

Throughout the last two decades up to the present time, DOE has negotiated through a political, regulatory, and legal maze with regard to WIPP. New regulations have been issued, litigation initiated, and public involvement brought to the forefront of the DOE decision-making process. All of these factors combined to bring WIPP to its present status - at the final stages of working through the licensing requirements for receipt of transuranic (TRU) waste for disposal.

Throughout its history, the DOE has stayed true to Congress' mandates regarding WIPP. Steps taken have been necessary to demonstrate to Congress, the State of New Mexico, and the public in general, that the nation's first radioactive waste repository will be safe and environmentally sound. DOE's compliance demonstrations are presently under consideration by the cognizant regulatory agencies and DOE is closer than ever to waste receipt.

This paper explores the DOE's journey towards implementing a permanent disposal solution for defense-related TRU waste, including major Congressional mandates and other factors that contributed to program changes regarding the WIPP project.

CRITICAL SCIENTIFIC ISSUES IN THE DEMONSTRATION OF WIPP COMPLIANCE WITH EPA REPOSITORY STANDARDS

Wendell D. Weart and Margaret S.Y. Chu
Sandia National Laboratories
P. O. Box 5800
Albuquerque, NM 87185-1337

ABSTRACT

The Department of Energy submitted a Compliance Certification Application for the Waste Isolation Pilot Plant to the Environmental Protection Agency (EPA) in October, 1996. A critical part of this application was a Performance Assessment which predicts the cumulative radioactive release to the accessible environment over a time period of 10,000 years. Comparison of this predicted release to the EPA standard shows a comfortable margin of compliance. The scientific understanding that was critical to developing this assessment spans a broad range of geotechnical disciplines, and required a thorough understanding of the site's geology and hydrology.

Evaluation of the geologic processes which are active in the site region establishes that there will be no natural breach of site integrity for millions of years, far longer than the 10,000 year regulatory period. Inadvertent human intrusion is, therefore, the only credible scenario to lead to potential radioactive release to the accessible environment. To substantiate this conclusion and to quantify these potential releases from human intrusion, it has been necessary to develop an understanding of the following processes:

- Salt creep and shaft seal efficacy;
- Gas generation from organic decomposition of waste materials and anoxic corrosion of metals in the waste and waste packages;
- Solubilities for actinides in brine;
- Fluid flow in Salado formation rocks, and
- Hydrologic transport of actinides in the overlying dolomite aquifers.

Other issues which had to be evaluated to allow definition of breach scenarios were brine reservoir occurrences and their associated reservoir parameters, consequences of mining over the repository, and drilling for natural resources in the vicinity of the repository. Results of all these studies will be briefly summarized in this paper.

AN OVERVIEW OF PERFORMANCE ASSESSMENT FOR THE WASTE ISOLATION PILOT PLANT

Hong-Nian Jow, D. R. Anderson, Mel Marietta
Sandia National Laboratories, Albuquerque, New Mexico, 87185-1328
Jon Helton
Department of Mathematics, Arizona State University, Tempe, Arizona, 85287-1804.
George Basabilvazo
Department of Energy, Carlsbad, New Mexico, 87220

ABSTRACT

This paper presents an overview of the methodology used in the recent performance assessment (PA) to support the U.S. Department of Energy (DOE) Carlsbad Area Office's (CAO's) Waste Isolation Pilot Plant (WIPP) Compliance Certification Application (CCA). The results of this recently completed WIPP PA will be presented. Major release modes contributing to the total radionuclide release to the accessible environment will be discussed. Comparison of the mean complementary cumulative distribution function (CCDF) curve against the Environmental Protection Agency (EPA) radionuclide release limits will be presented.

THE PATH TO WASTE RECEIPT AT THE WASTE ISOLATION PILOT PLANT AND STATUS OF MAJOR SITES

Amber Clay, DOE-Carlsbad Area Office, Carlsbad, NM
James L. Maupin, Advanced Sciences, Inc., Albuquerque, NM
Thomas E. Bearden, P.E., NFT, Inc., Lakewood, CO

ABSTRACT

The Waste Isolation Pilot Plant (WIPP), a deep geological repository located in southeast New Mexico, has been constructed by the U.S. Department of Energy (DOE) to permanently dispose of all defense-generated radioactive transuranic (TRU) waste. Much of this waste is retrievably stored at several DOE sites across the U.S.; some will be generated from ongoing weapons production and environmental restoration activities.

The DOE-Carlsbad Area Office (CAO) is responsible for granting waste certification and transportation authority to TRU waste sites. This authority allows waste sites to certify their TRU waste to meet the WIPP Waste Acceptance Criteria (WAC) and to transport their waste using the TRUPACT-II shipping container.

A rigorous site certification program has been developed for this purpose which includes extensive document preparation, program reviews, audits, and continuing coordination between CAO and thesites. Each of the major TRU waste sites is in the process of implementing the WAC and other CAO guidance required for waste certification. Some sites are also building or modifying the necessary facilities to characterize or treat TRU waste prior to shipment to and disposal at WIPP.

NATIONAL TRANSURANIC MOBILE SYSTEMS CAPABILITY PLAN AND TECHNOLOGY DEVELOPMENT

John F. Suermann, U.S. Department of Energy-Carlsbad Area Office, Carlsbad, NM
Michael R. Brown, U.S. Department of Energy-Carlsbad Area Office, Carlsbad, NM
Ann C. Kercher, NFT, Inc., Lakewood, CO
Mark Doherty, Advanced Sciences, Inc., Albuquerque, NM

ABSTRACT

The Mobile Systems Capability Plan (MSCP) has been prepared by the U.S. Department of Energy (DOE)-Carlsbad Area Office (CAO) to assess how mobile systems can be used to prepare, certify and package transuranic (TRU) waste for disposal in the Waste Isolation Pilot Plant (WIPP) in support of the DOE National Transuranic Waste Management Plan (NTWMP). The MSCP identifies TRU waste site needs and currently existing commercial capabilities and assesses the areas of capability that remain to be developed. Mobile technology development is briefly discussed. The MSCP concludes that a market exists in the form of the DOE's immediate needs for commercial mobile systems and that the DOE is aggressively pursuing contracts with commercial firms to privatize this market.

SUITABILITY OF THE WASTE ISOLATION PILOT PLANT (WIPP) AS A TRANSURANIC WASTE REPOSITORY

Review of the National Academy of Sciences report
Charles Fairhurst, Chairman
National Research Council WIPP Committee

ABSTRACT

The National Academy of Sciences/National Research Council (NAS/NRC) has prepared a report on the suitability of WIPP as a geological repository for transuranic (TRU) radioactive waste. TRU waste, although of low activity than high-level waste, contains long-lived emitters that require geological isolation. The NAS/NRC Committee was established in 1978, and last issued a comprehensive report in 1984. The U.S. Department of Energy (DOE) has prepared, for submission in October 1996, an application to the U.S. Environmental Protection Agency (EPA) for permission to begin disposal of TRU waste in November 1997. It was thus considered timely for the NAS/NRC to publish its views, based on a continuing review of DOE investigations at WIPP over the 12 years since the previous NAS/NRC report.

The talk will discuss the use of total system performance assessment at WIPP and the status of the principal issues and concerns which appear to influence the overall isolation capability of the repository. These issues include the significance of human intrusion in assessing repository performance; hydrology and radionuclide transport at WIPP; actinide solubility in WIPP brine; engineered barriers, and the mechanical characteristics of salt that affect its suitability for geological isolation of waste. General insights gained with respect to geological assessment of waste repositories will be reviewed.

- Though the recovery of each batch for ash varies slightly, the total amount of recovered ash is approximately equivalent to the calculated value.
- According to qualitative analysis of the incineration ash, more than 95% of it was calcium phosphate.
- The addition of 10 % n-dodecane improve incineration efficiency.
- Washing treatment and incineration treatment are safe and efficient.

TECHNOLOGY TRANSFER AS A BASIS FOR ENVIRONMENTAL INTEGRITY: WASTE MANAGEMENT SUCCESSES

Thomas A. Wilczek, M.S., CEM
IT Corporation, 4330 S. Valley View, Ste. 114
Las Vegas, NV 89103-4047
Dawn M. Starrett, Ph.D., PMP, CEM
Bechtel Nevada, P.O. Box 98521
Las Vegas, NV 89193-8521
Dennis L. Armstrong, B.S.
U. S. Department of Energy, 501 Atlas Drive, C-1
N. Las Vegas, NV 89030-4134

ABSTRACT

Through the application of proven measurement and evaluation techniques to environmental concerns, organizations are more apt to recognize Environmental Integrity as a skill which promotes cost-savings processes while minimizing environmental degradation. The economics of pollution, that is, the methodologies employed by organizations which quantify the positive and negative aspects of an action or activity, have historically been the means to economically justify an action which has the potential to negatively impact the environment. In many cases, a benefit/cost analysis, unless performed to an extremely high level of diligence, cannot adequately quantify the value of an unpolluted waterway or the scenic value of an unspoiled mountain peak. The impacts to the environment caused by this lack of qualification best illustrate the inherent problems in attempting to quantify a subjective value such as what constitutes an acceptable level of environmental protection. Most importantly, the lack of well-defined property rights within the sphere of the organization's influence, and an anthropocentric environmental ethic practiced by the decision makers within such an organization, are leading contributors to continued misuse of the natural environment.

In order to affect change within the corporate culture beyond the utilization of a benefit/cost analysis as the primary methodology for measurement of corporate well-being, the introduction of corporate Environmental Integrity is required. For this paper, Environmental Integrity is defined as the practice of applying quantitative tools toward the measurement of sound environmental principles and activities in such a way that the protection of the environment is demonstrated as a positive benefit for the organization.

In order to effectively implement such principles in the corporate sector, it is important that federal, state, and local government agencies, with their access to unique technologies and processes, engage in a concerted technology transfer effort. This effort will stimulate the advancement of not only scientific, but administrative/systems technologies and processes which are environmentally sensitive and/or minimize environmental degradation. The U.S. Bureau of Mines' charter for technology transfer and U.S. Department of Energy's Pollution Prevention Opportunity Assessment Program are examples of two federal programs which positively promote the use of environmentally beneficial technologies which also provide positive cost benefits. By recognizing and utilizing successful environmental technologies, organizations are more apt to recognize Environmental Integrity as a practice which promotes cost-saving processes while minimizing environmental degradation.

DETERMINATION OF SITE STATUS IN AN EVOLVING REGULATORY ENVIRONMENT

Martin J. Willett
Senior Project Manager
New York State Energy Research and Development Authority
Larry W. Luckett, CHP
Dames & Moore

ABSTRACT

In 1968, a filter failure at a nuclear fuel reprocessing facility operated by Nuclear Fuel Services at the Western New York Nuclear Services Center (WNYNSC) in West Valley, New York resulted in an airborne release of fission products with deposition of radioactivity on nearby private properties. Ground and aerial surveys performed over the area between 1969 and 1984 identified detectable concentrations of Cesium-137 (Cs-137) at levels below the existing U.S. Nuclear Regulatory Commission (NRC) guidelines necessitating corrective actions.

In 1993, New York State regulatory guidelines and proposed federal cleanup standards for site decommissioning were revised. This prompted The New York State Energy Research and Development Authority (NYSERDA) to evaluate whether the contaminated area would meet the newly revised standards. An investigation of the off-site properties was initiated using an innovative and cost-effective method to quantify radioactivity in soils within the area. This methodology, which met the intent of NRC guidance in NUREG/CR 5849 without the expense of extensive sampling and analysis, was used to evaluate an affected area of more than 404.7 hectares (1,000 acres) encompassing 56 private parcels. Throughout the investigation NYSERDA adopted a proactive public involvement process, keeping property owners and the local community informed of findings.

The WNYNSC Off-Site Radiation Investigation was performed in phases of field sampling, measurement, and analysis. The observations and survey results indicated that the area of deposited Cesium 137 (Cs-137) was adequately bounded and quantified by the survey procedures used. Within a 18.8 hectare (46.5 acre) focus area, test plots were used to calibrate field instrumentation and determine the vertical and spatial distribution of contamination. As a result, eight instrument readings in each 10m x 10m grid provided rapid quantification and location of Cs-137 and an indication of the average and 95th percentile Cs-137 activity which was required to meet regulatory requirements.

An assessment of potential doses to individuals in the off-site area indicates that, under current and postulated future land uses, conservative assumptions on personal exposure result in a projected annual dose to the maximally exposed individual below .08 mSv. The calculated upper bound doses are in the range of doses suggested by proposed federal criteria (.15 mSv per year) and New York State guidance (.10 mSv per year). Regulatory agency review of the study concluded that the characterization was thorough and that no additional action was required.

FERNALD'S APPROVED TEN YEAR PLAN LESSONS LEARNED AND FUTURE CHALLENGES

Dennis Carr, Terry Hagen, Fluor Daniel Fernald
Johnny Reising, DOE-FEMP
FDF with the U.S. Department of Energy
under Contract No. DE-AC24-920R21972

ABSTRACT

The Fernald Environmental Management Project (FEMP) is unique among DOE sites by virtue of successful efforts by Fluor Daniel Fernald and DOE-Fernald in developing and implementing the first approved, stakeholder-assisted final site closure vision, and initiating field activities supporting the EPA-approved Record of Decisions for final site remediation. DOE and Fluor Daniel Fernald have agreed in principle on a Ten Year Plan which accelerates all activities to remediate the site in approximately half of the target schedule, saving taxpayers more than $3 billion in the process. Key elements of the current Ten Year Plan are discussed; lessons learned from the development and initial implementation of the plan are presented, and expectations about future challenges DOE and Fluor Daniel Fernald face are detailed. This information is directly applicable to other DOE sites and can be used to better achieve DOE's complex-wide vision for accelerated environmental restoration.

REAL-TIME ALPHA EMITTER ASSAY OF LARGE VOLUMES

P. L. Kerr, J. E. Koster, Kevin Macy, Jay Cook
Los Alamos National Laboratory
Los Alamos, NM 87545

ABSTRACT

Detection of contamination within large volumes or pipes is important for the processes of decontamination and decommissioning and for the transportation and disposal of hazardous waste. Alpha-emitter contamination (actinides) has been particularly difficult to assay because of the short range of alpha particles in air — about 5 cm. In addition, real-time sensitive monitoring of long or small enclosures, or of large volumes with complicated internal geometries, is very difficult or impossible with traditional alpha detectors.

However, the ionization detection method (long-range alpha detection, or LRAD) in development at Los Alamos National Laboratory detects the air molecules ionized by alpha particles (rather than the alpha particles themselves), and these ions can travel long distances through enclosed volumes (several meters). In addition, a single 5-MeV alpha particle produces approximately 140,000 ions, and so even an incomplete collection of the ions will produce a significant signal as opposed to a traditional alpha detector which either detects or fails to detect a single alpha event. The LRAD method therefore offers significant advantages over other detector schemes.

Ionized air molecules are produced in an enclosed volume by alpha-emitting contamination. The LRAD detector collects these ions on a grid or on parallel plates held at 100-300 V. Ions of a given charge move onto the detector plates via the electric field. A fan is often used to help move the ions if they originate far from the electric field. The current produced is then measured by a very sensitive electrometer. For larger volumes, higher airflows and detector voltages are required to maintain the same sensitivity to alpha contamination. In addition, the parallel plates are the preferred method for high airflows because of reduced turbulence. However, the technique can be complicated by other sources of ions in the volume such as ventilation systems or background ion concentrations from the atmosphere and cosmic rays.

We will present the results of tests of a High Airflow Monitor alpha detector and draw conclusions about the optimum configuration for specific assay applications. Detector parameters examined include varying voltages, grid and plate geometries, airflow rates, and whether the signal originates from the neutral plates or the plates at high voltage.

DEVELOPMENT OF INTERNATIONAL CRITERIA FOR THE CLEANUP OF CONTAMINATED AREAS

G. Gnugnoli, G. Linsley, and P. Stegnar
International Atomic Energy Agency (IAEA)
Vienna, Austria

ABSTRACT

In the past, radiation protection has been concerned primarily with establishing the conditions that should be applied to the introduction of new practices and the management of continuing practices. Another category of situations which may need to be considered includes, for example, when a practice is discontinued at a particular site, when contamination from a previously discontinued practice is discovered, or when an accident occurs that leads to chronic exposures due to contamination. Different scales of the operation, source terms, radionuclides and environmental media lead to different contamination situations. They may be confined to the site of the operation or extended to the off-site area. In the latter case, the contamination situation may be caused for instance by inadequately controlled discharges, transportation accidents (including satellites and weapons) and major accidents with nuclear installations, causing large scale off-site contamination. Apart from the terrestrial contamination, such releases may also contaminate off-site groundwater, aquifers and river, lake and estuarine sediments. In order to bring

such environmental contamination situations to a state in which they can be safely reoccupied and utilised, some remedial actions may be necessary, such as removal, cover and/or mixing of radioactive materials in soil, treatment of ground and surface waters, and the decontamination of structures.

Over the last three years, an IAEA working group has been developing radiological principles for use in decisions related to the clean-up of contaminated areas. More specifically, it has been attempting to establish an approach to developing radiological criteria for clean-up and to recommend ranges of generically applicable numerical values. The draft guidance produced by this working group is about to be circulated within the international community of experts in this field for comment.

A POPULATION RISK VULNERABILITY EVALUATION METHOD FOR COMPARISON OF DOE PROGRAMMATIC WASTE DISPOSAL ALTERNATIVES

Philip Sczerzenie
META, Inc.
Lou Borghi
USDOE
Peter Siebach
SAIC

ABSTRACT

Statistical analyses of site environmental variables were conducted to enable the Department of Energy to compare alternative management strategies for low-level mixed waste and low-level waste disposal in terms of their relative potential for offsite population risk. Factor analysis of 16 candidate disposal sites used data on six site characteristics likely to be associated with future offsite population risk from waste disposal--annual rainfall, annual groundwater recharge, aquifer depth, travel time of water from the time it infiltrates the ground surface to the time it reaches the aquifer and appears in a well 300m downgradient, current human populations within 50 miles of the site center, and site acreage. Sites were depicted graphically according to their scores on two factors that explained 79 percent of the variability in the site data-- a site groundwater hydrology factor and a population/acreage factor. Cluster analysis of the site data and overlay of the clusters on the factor diagram enabled DOE to assign each of the 16 sites to one of three groups with relatively higher, intermediate, or lower potential for offsite population risk from disposal. The population risk vulnerability (PRV) groups developed in these analyses are used in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) for comparison of decentralized, regionalized, and centralized alternative disposal strategies. Alternatives are displayed in WM PEIS tables that identify for each site that would dispose under an alternative, the waste volume and curie load projected to be disposed and the site's PRV group. Summary tables display for each alternative the total waste volume and curie load for sites within each PRV group.

PROBLEMS OF REHABILITATION OF RADIOACTIVE CONTAMINATION AGRICULTURAL LANDS AND INFLUENCE PESTICIDES ON TRANSFER RADIONUCLIDES INTO THE YIELD

Oulianenko L.N., Ratnikov A.N., Jigareva T.L
Russian Institute of Agricultural Radiology and Agroecology

ABSTRACT

Contamination of agricultural lands by radioactive substances reduces their inflow in agroindustrial production. The food yields, containing radionuclides, form an additional interior radiation of persons. To reduce negative consequences of action of radiation it is possible at the expense of regulating inflow of radionuclides in an organism with yields of a feed. It is the most accessible path of reduction of doze loads per persons. Its effectiveness largely depends on a complex spent in plant breeding of measures. With production of plant breeding in organisms of persons inflow 20-40 % from the common daily of ralionuclides. At the same time just the plants are the most critical link in a carrier ralionuclides on a line-up soil - plant - animal production - person. The problems, connected to organization of plant management in zone of radioactive contamination have a defining value at rehabilitation of these territories and security of safe residing of the population. For obtaining "clean" plant production on radioactive polluted territories use a complex agrotechnical and agromeliorative receptions (modes of handling of soil, modification of norms of a mineral feed, importation of agromeliorants). At the same time, these receptions are capable to affect development of community of harmful organisms in crops of agricultural cultures, that requires struggle with dangerous pest species and fungous diseases and, therefore, application of pesticides. As a rule, pesticides are substances with biological activity and it is possible to expect their influence to passage radionuclides from soil in a crop. The probability of such influence is increased in that case, when a doze of importation of pesticides, used in protective process engineerings can be broken. Conducted in a zone of radioactive pollution researchers (Bryansk region, Russia) confirm a opportunity rehabilitation of agricultural lands and obtaining of "clean" production on them. At the expense of application the complex of measures it is possible to lower radionuclide concentration in a barley crop in 2-3 times. The application of herbicides in technologies of barley growing did not cause an additional significant increase of radionuclide transfer in a crop. Nevertheless, therevealed tendencies should be taken into account at development and introduction of the optimum circuits of plant protection on technogenous polluted territories.

QUALITY OF POTATO YIELD GROWN ON RADIOACTIVE CONTAMINATED TERRITORIES WITH USE OF PESTICIDES AND BIOLOGYCALLY ACTIVE SUBSTANSES

A.S.Filipas, E.P.Pimenov
Russian Institute of Agricultural Radiology and Agroecology

ABSTRACT

Necessary condition of plant breeding on radioactive polluted territories is reception of production with minimum of radionuclides and other toxicants. In modern conditions at cultivation of agricultural plant obtaning of high crops is impossible without application pesticides, growth regulator- inductor of immunity and other means chemical plant protection. However use of chemical preparations for struggle with harmful organizms can influence on radionuclides accumulation in plant production and its additional pollution. Researches in a zone of intensive radioactive pollution agricultural lands are shown, that pesticides and other chemical connections, used for protection to grew plants, in addition to action on harmful components of agrocenoces can influence to receipt radiocesium in a crop. And effect of various preparations, used in complex system of protection of potatoes, on accumulation of radioactive substances in tubers was unequal. In works, executed in a zone of intensive radioactive pollution, the influence of pesticides and plant growth regulator on crops of potatoes and their quality are investigated. It is shown, that use of a preparation Crezazin (plant growth regulator) for pre-sowing treatment potato tubers not increases radiocesium accumulation in a crop, however the efficiency of plantings rises on 14-34 %. A sprinkling with Crezazin on growing potato plants lead to the increase of crops (3-5 %) at steady tendency to reduction of ^{137}Cs accumulation in them. Different methods of herbicides treatment on potato plantings increased crop of tubers on 23-27 % but did not influence on ^{137}Cs accumulation. Except of this was double herbicides doze, when concentration ratio rised in 1.8 - 2.3 times.

PLOUCNICE RIVER ENVIRONMENTAL CONTAMINATION - RADIATION IMPACTS

Soòa Konopásková
Nuclear Research Institute plc
Czech Republic

ABSTRACT

The contamination of the Ploucnice river environment occurred in 1960 as a consequence of long-term leaching process in the site of chemical uranium mining facility. There were accepted no remediation activities until 1990. The river sediments and the riverside have been contaminated to the level of 200 nSv/h to 600 nSv/h, but in some parts of the riverside the dose rate increases even above the value of 2,5 mSv/h.. The site is contaminated mainly by Ra-226 and U(nat) isotopes. In 1995 the Ecology Division of DIAMO company has started the activities dealing with the radiological impact evaluation of the river contamination. The discussion about the final site remediation was opened. It was proved that the radiological impact is not negligible with respect to long-term safety requirements and all the region is followed at present to review the input data and to chose the alternative final solution of the site remediation.

THE SAFETY OF VARIOUS WASTE DISPOSAL OPTIONS FOR SOIL FROM THE CLEAN-UP OF FEDERAL FACILITIES

Steven A. Schafer, Thomas McLaughlin, Neil Numark
SC&A, Inc.
Michael Boyd
U.S. EPA

ABSTRACT

Contaminated soil from the clean-up of U.S. federal facilities represents a unique waste disposal problem because of its very large volume and relatively low concentrations of hazardous contaminants when compared to other waste streams. Disposal of this soil in a typical low-level waste facility could be extremely expensive and wasteful because of the large volume and low contamination characteristics of the soil. In addition, low-level waste disposal may not protect against the hazards of the non-radioactive hazardous substances.

A study was conducted to determine the safety of disposing contaminated soil in the following four different types of land disposal systems:

- Municipal Landfill (RCRA Subtitle D).
- Hazardous Waste Landfill (RCRA Subtitle C).
- Uranium Mill Tailings Facility.
- Low-level Waste Facility.

The radionuclide and non-radioactive hazardous components of typical contaminated soil waste from federal facilities were characterized. By assuming that this waste was the source of contamination, the risks from each waste disposal option was quantified using appropriate exposure pathway and risk models. The risks from each disposal facility was then compared.

The results of the soil characterization showed that typical soil waste from federal facilities would contain several fission and activation products, tritium, isotopes of thorium, several toxic elements, two polycyclic aromatic hydrocarbons, PCBs and chlorinated solvents. The results of the risk assessment showed that the more water soluble radionuclides (I-129 and Tc-99) represented the far greater risk. The overall risk from each disposal option was below 3E-04 suggesting that any of the four land disposal systems could provide an acceptable level of protection.

ENGINEERED BARRIER FOR THE STATIONARY LOW-POWER REACTOR NO. 1 BURIAL GROUND

Chris M. Hiaring, Douglas K. Jorgensen
Lockheed Martin Idaho Technologies
Joseph S. Rothermel, Gregory B. Collen, P.E
Parsons Infrastructure & Technologies Group Inc.

ABSTRACT

The SL-1 burial ground at the Department of Energy (DOE) Idaho National Engineering Laboratory was constructed in 1961 to dispose of radioactively-contaminated debris, soils, and gravel generated by the destruction of a small nuclear reactor. The INEL was officially placed on the National Priorities List in November 1989. Consequently, remediation of the SL-1 burial ground falls under the purview of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The SL-1 burial ground consists of three excavations, in which a total volume of 99,000 cubic feet of contaminated material was deposited. The excavations ranged from 8 to 14 feet in depth, and at least 2 feet of clean backfill was placed over each excavation. Shallow mounds of soil over the excavations were added at the completion of cleanup activities in September 1962.

Results of the baseline risk assessment indicate that the direct human exposure pathway dominates the overall risk for the burial grounds. The primary contributor to this risk is cesium-137 and its progeny. Based upon consideration of the requirements of CERCLA, on detailed analysis, and on public comments, the DOE, the Environmental Protection Agency (EPA), and the State of Idaho have selected containment by capping with an engineered long-term barrier comprised primarily of natural materials as the preferred alternative. The cover will be designed to maintain effective long-term isolation of contaminants. The number and thickness of layers designed in the cover were dependent on local climatic and geographic conditions, including precipitation rate, freeze depth, indigenous plant and animal species, and local topography. The engineered lifetime of the cap is a minimum of 400 years. Surface water diversion measures, including contouring and grading, will be used as necessary to direct runoff away from the burial ground and into nearby naturally-occurring drainage formations.

The cover system design provides:

- Shielding from penetrating radiation
- A barrier to inhibit biotic and inadvertent human intrusion
- Longevity through the predominant use of naturally-occurring materials
- Resistance to erosion that could expose buried waste and contribute to contaminant migration
- Low maintenance requirements

The capping system will be combined with institutional controls consisting of access and land use restrictions to discourage intrusion into the SL-1 burial ground. The DOE would be responsible for establishing and maintaining land use and access restrictions for at least 100 years. Access restrictions in the form of fences, warning signs, and permanent markers would be used to deter unauthorized entry into the burial grounds.

INFLUENCE OF WATER HARDNESS ON ACCUMULATION AND ELIMINATION OF CADMIUM IN TWO AQUATIC MOSSES UNDER LABORATORY CONDITIONS

C. Gagnon, G. Vaillancourt, L. Pazdernik
Laboratoire de Recherche sur les Communautés Aquatiques, Université du Québec à Trois-Rivières, Département de Chimie-Biologie, C.P. 500, Trois-Rivières, Québec, G9A 5H7, Canada

ABSTRACT

This study investigated the effect of water hardness on the accumulation and elimination pattern of Cd by two aquatic mosses, Fontinalis dalecarlica and Platyhypnidium riparioides, under laboratory conditions. The two mosses were exposed to nominal Cd concentrations of 0, 0.8, 2 and 10 µg•L-1, which are comparable to concentrations found in nature. The influence of three water hardness (very soft ≈ 15 mg•L^{-1}, soft ≈ 45 mg•L^{-1} and hard water ≈ 90 mg•L^{-1} as $CaCO_3$) was measured while maintaining the alkalinity and pH constant during the provide duration here. The Cd accumulation by the aquatic mosses was rapid, showing the potential of accumulation and sensitivity of this biomonitor. Even when the actual Cd concentration in the water was low (concentrations <0.15 to 6.82 µg•L^{-1}, the uptake of Cd was very fast and mostly linear. Accumulation rates of Cd were significantly different when the mosses were in very soft (≈ 15 mg•L^{-1}) as compared to hard water (≈ 90 mg•L^{-1} as $CaCO_3$). The elimination of Cd followed a very slow process for the two species studied. The elimination rates of Cd from the mosses were not influenced by water hardness.

HANDLING AND DISPOSAL OF RADIOACTIVE WASTE GENERATED DURING PARTIAL DECOMMISSIONING OF PAKISTAN RESEARCH REACTOR-1

S.D. Orfi, M. Aslam, M. Hussain, M. Israr, Showket Pervez and K.M. Akhtar*
Pakistan Institute of Nuclear Science & Technology
P.O. Nilore
Islamabad Pakistan
* Institute for Nuclear Power, P.O. Box 3140, Islamabad, Pakistan

ABSTRACT

The Pakistan Research Reactor-I (PARR-I) is a swimming pool type research reactor originally designed and built for a thermal power of 5MW using High Enriched Uranium(HEU) fuel. In 1990-91 the reactor was redesigned, partially decommissioned and recommissioned to operate with Low Enriched Uranium (LEU) fuel at a thermal power level of 9 MW.

During the partial decommissioning operations, radioactive wastes generated included 600m^3 low level liquid radioactive waste and 14m^3 solid radioactive waste with average specific activity of 2.22 KBq/g. The solid radioactive waste consisted mainly of the debris of ceramic tiles which was cementized and retained in an interim storage for five years, whereas the very low level solid radioactive waste was buried in the shallow ground disposal pits. Low level liquid radioactive waste, after decay in storage tanks, was disposed off in shallow ground seepage pits. Adherence to ALARA principle and sound decommissioning procedures helped to protect the working personnel from excessive radiation exposure. The radiological monitoring around the waste disposal pits has been conducted and no leakage or seepage of radioactivity to the surrounding environment has been detected.

TRANSPORTATION, TREATMENT, AND DISPOSITION OF A FORTY-YEAR-OLD REACTIVE MIXED WASTE

Charles G. Dietz
Lockheed Martin Idaho Technologies

ABSTRACT

Radioactively contaminated coolant (sodium and potassium) was removed from the Experimental Breeder Reactor (EBR-I)--the world's first nuclear reactor to produce usable amounts of electricity--in 1955. Transportation of this waste twenty years later to Argonne National Laboratories West (ANL-West) for treatment presented significant risks. The unknown nature of the waste and the unknown condition of waste containers (last inspected in 1979) presented significant challenges. The inability to conduct weekly inspections of individual waste containers resulted in a Resource Conservation Recovery Act draft consent order stating that the waste must be at ANL-West on or before October 1, 1995. Finally, the waste had the potential, when moved, to create a NaK ejecta event or low-order volumetric explosion. Safe transportation of the waste to ANL-West was accomplished by innovative inspection, extraction, repackaging, and temporary closure of approximately 21 miles of a State Highway to minimize risk to the public. Open communications and cooperation between crafts, professionals, management, organizations, departments, and State Agencies resulted in the successful completion of this high-risk, highly visible project.

RCRA CLOSURE OF A PERMITTED MIXED WASTE UNIT AND CONTAMINATED SOIL: A COOPERATIVE EFFORT BETWEEN THE U.S. DEPARTMENT OF ENERGY, THE ENVIRONMENTAL RESTORATION CONTRACTORS, AND THE STATE OF WASHINGTON

Janet W. Badden and Rex Miller
CH2M HILL Hanford, Inc., Richland, WA
Michael A. Mihalic
Bechtel Hanford, Inc., Richland, WA

ABSTRACT

Cooperative teaming between the State of Washington Department of Ecology (Ecology), the U.S. Department of Energy, Richland Operations Office (RL), and its Environmental Restoration Contractor (ERC) resulted in the successful closure of a mixed waste unit and associated contaminated soil at the Hanford Site. Success was measured by the achievement of large cost savings, waste minimization, and timely closure of the unit. Regulatory obstacles were significant. The 183-H Solar Evaporation Basins (183-H) were used for storage and evaporation of large volumes of radiological process wastewaters. The basins also received small quantities of RCRA listed wastes which defined the entire volume of process wastewaters as listed waste. Leakage from 183-H caused large areas of underlying soils and groundwater to be contaminated by these listed chemical and radiological constituents.

After removal and storage of the remaining mixed waste liquid and sludge from 183-H , decisions were needed on the disposition of the large volumes of listed soil and structural concrete. To avoid high disposal costs associated with permitted mixed waste landfills, a regulatory strategy was developed to remove the listed waste designation from the concrete and soil. Disposal costs were further reduced by regulatory approval of concrete and soil disposal in a landfill permitted to accept only CERCLA waste. During soil removal it was discovered that contamination went deeper than earlier characterization information indicated. A decision was made between RL, the ERC, and Ecology to integrate remaining RCRA postclosure actions on deep soil and groundwater contamination to remedial actions associated with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) operable unit. This decision avoided unnecessary and costly landfill closure options. This project provided evidence that the RCRA regulations can allow closure of a complex unit in a protective manner while avoiding unnecessary and costly actions.

DEVELOPMENT OF REMOTE CONTROLLED PLANT DATA ACQUISITION SYSTEM (REDAS) FOR DECOMMISSIONING OF NUCLEAR FACILITIES

Takeo Mimori, Yukio Iwasaki and Kazuo Tanaka
Japan Atomic Energy Research Institute (JAERI)
2-4, Aza-Shirane, Shiraoka, Tokai-mura, Naka-gun, Ibaragi-ken 319-11, Japan
Mitsubishi Heavy Industries, Ltd. (MHI)
3-1, Minatomirai 3-chome, Nishi-ku,Yokohama 220, Japan

ABSTRACT

JAERI has been developing the remote controlled plant data acquisition system as a part of the technology improvement program for decommissioning of nuclear facilities sponsored by the Science and Technology Agency.

Decommissioning procedure planning of nuclear facilities has to be based on the latest and exact plant data. But sometimes the latest data could not be constructed from the design drawings if long years had been passed after the construction and some modifications have been done after the start of operation. So the work of the data acquisition for the configuration and dimensions of facilities. Especially the development of remote con-

trolled plant data acquisition system is necessary for the decommissioning procedure planning of the high radiation area because of the difficulty of the accessibility to the area.

JAERI has developed the remote controlled plant data acquisition system which use the small mobile robot equipped with ITV and laser range finder from 1992. This system has been planned to apply to the JAERI's reprocessing test facility (JRTF).

Remote plant data acquisition system consists of three sections, mobile section, vision section and control section. Vision section is composed of the TV cameras and the laser range finder, and be able to collect the pictures of the object and the data of its location and distance.

In the decommission engineering, remote controlled plant data acquisition system is used to check the differences between actual plant image and 3D-CAD plant data based on the old drawings by comparing the ITV image of the actual plant and the plant view based on the 3D plant data. If some difference is found, the additional plant data is collected by the system and update to the latest data. After the update of 3D plant data, these data is used to the decommission engineering.

JAERI has performed the data acquisition function tests combined with the 3D-CAD system in 1995. In the tests, we have collected the fundamental data of the synchronous comparison between the ITV view from the robot and the 3D view.

From the test results, it seems that the precision of the view comparison is enough to distinguish the differences between the actual plant and the 3D plant data. Also, the precision of the measuring function is enough for the adjustment of the large equipment data. But the improvement of the precision is necessary for the adjustment of the small piping route.

We will test this system in the plant model of the JRTF and evaluate the performance, the efficiency and the restriction of system. This system will be developed to apply the actual decommissioning works of the JRTF.

DECONTAMINATION AND SIZE REDUCTION OF PLUTONIUM-CONTAMINATED PROCESS EXHAUST DUCTWORK AND GLOVE BOXES

Patrick LaFrate, John Elliott, David Siddway and Miguel Velasquez;
Los Alamos National Laboratory

ABSTRACT

The Los Alamos National Laboratory (LANL) Decommissioning Program has decontaminated and demolished two filter plenum buildings at technical area 21 (TA-21). During the project, a former hot cell was retrofitted for decontamination and size reduction of 1100 linear ft. of process exhaust and glove boxes highly contaminated with plutonium. Plutonium-238 and Pu-239 concentrations were as high as 1 Ci per linear foot and averaged approximately 1 mCi per linear ft.

The project's objective was to reduce plutonium contamination on surfaces to below transuranic levels. If possible, metal surfaces were further decontaminated to meet Science and Ecology Group (SEG) waste classification guidelines so that the metal could be recycled at the SEG facility in Oak Ridge, Tennessee. Ninety percent of all radioactive waste for the project was eventually characterized as LLRW. Twenty percent of this material was shipped to SEG.

This paper focuses on process exhaust and glove box decontamination methodology, size reduction techniques, waste characterization, engineering controls, worker protection, lessons learned, and waste minimization. Decontamination objectives are discussed in detail. The paper also presents the project's surface contamination acceptance criteria for low-level radioactive waste, transuranic waste, and SEG waste.

EXPERIENCE WITH END POINTS SPECIFICATION FOR SURPLUS FACILITY DEACTIVATION

C. Negin
Oak Technologies
A. Szilagyi
EM-62
J. Hayfield, L. Stefanski, L. Zinsli
B&WHC
R. Schmidt
SSOC

ABSTRACT

Deactivation is the conduct of a surplus facility's termination of operations within the scope of DOE's Office of Nuclear Material and Facility Stabilization (EM-60). This occurs prior to making a facility available for decommissioning and environmental restoration. EM-60 has stipulated that an end points approach be used for deactivation projects.

End point specifications define the facility conditions to be achieved prior to transferring a facility to those responsible for post-deactivation management, whether it be for surveillance, decommissioning, or conversion to non-defense use. Thus, all individuals and contractor organizations involved in either deactivation or decommissioning of surplus facilities necessarily have a need to understand the use of end points specifications. This paper is one vehicle to further such understanding.

DEMOLITION OF COOLING TOWERS AT THE OAK RIDGE K-25 SITE, OAK RIDGE, TENNESSEE

E. P. Larson and A. C. Lay, Lockheed Martin Energy Systems, Inc.
T. L. Hatmaker, Oak Ridge National Laboratory
R. DiDonato, Foster Wheeler Environmental Corp.
R. L. Yust, Science Applications International Corp.

ABSTRACT

The Cooling Towers Demolition Project consisted of the demolition and disposition of 6 out-of-service cooling towers, removal and disposal of radioactively contaminated sediment from the cooling tower basins, and demolition of 28 other auxiliary services facilities. This project was located at the Oak Ridge K-25 Site, a government-owned, contractor-operated facility managed by Lockheed Martin Energy Systems, Inc., for the U. S. Department of Energy (DOE) in Oak Ridge, Tennessee. These structures were associated with the deactivated gaseous diffusion process for uranium enrichment. The basins varied in dimensions but averaged approximately 8 m deep, 18 m wide, and 107 m long, creating four reservoirs of approximately 18 million liters each, which were essentially full during operations. During operations, the cooling towers provided approximately 1.4×10^6 L/m (204×10^6 L/d) of process cooling water.

The project was conducted using a partnering agreement between three prime contractors, where the partners shared liabilities for fines and penalties and shared in profits and loses. The scope was broken into the following three distinct phases:

1. Cooling tower superstructure demolition.
2. Removal of sediment from the cooling tower basins.
3. Demolition of above-grade basins and auxiliary facilities.

The first demolition phase of the project was preceded by the de-energizing of site facilities and construction of approximately 2 miles of security fencing to isolate the area from the rest of the K-25 Site. The superstructure demolition phase included the demolition of the wooden superstructures; removal of the fan assemblies and shrouds; removal of the fire protection sprinkler system; and removal of asbestos-containing materials (i.e., transite siding and Munters fill). The sediment removal phase consisted of the removal, dewatering, transportation, and disposal of over 2,600 m3 of radiologically contaminated sediment from the basins. The third and final phase was the demolition of above-grade concrete cooling tower basins and 28auxiliary facilities. The auxiliary facilities consisted of fire sprinkler valve houses, clarifiers, liquid storage tanks, and pumphouses.

Each phase of demolition was preceded by site characterization and integrated waste management planning. Chemical and radiological analyses of the superstructure wood and sediments were conducted. The final phase of the demolition required the characterization of the auxiliary facilities for lead (in paint), asbestos, mercury, and polychlorinated biphenyls. The basins and auxiliary facilities were also characterized for radiological contamination by following a project-developed radiological release protocol that was pre-approved by DOE and the State of Tennessee. The major waste streams identified were wood, asbestos, sediment, and concrete. Metal generated by the demolition of theses facilities was commercially recycled.

POST OPERATIONAL CLEAN OUT SUCCESS AT BNFL, SELLAFIELD, UNITED KINGDOM

EJ Williamson, Head of Retrievals, D H Norton, Group Project Manager Retrievals, A F Hurley, Plant Manager, N P Houghton Project Manager, BNFL Waste Management and Decommissioning

ABSTRACT

British Nuclear Fuels plc (BNFL) owns and operates the United Kingdom's nuclear fuel reprocessing facility at Sellafield on the West Coast of England. Several generations of plants have been operated to reprocess irradiated nuclear fuel over a period of time in excess of 40 years. Many of these early plants have now been taken out of service, but retain nuclear fuel and material inventory.

This paper describes how BNFL developed and implemented strategies to clean out residual radioactive wastes from these obsolete plants in preparation for final decommissioning. The Magnox Fuel Storage and Decanning Plant is used as an example of how BNFL has applied an integrated strategy to clean-up business. The objective is to carry out this work in a safe and economic manner within the overall site waste management programme.

IMPLEMENTING AN ISO-9002/14001-COMPLIANT QUALITY AND ENVIRONMENTAL MANAGEMENT SYSTEM IN AECL'S WASTE MANAGEMENT AND DECOMMISSIONING OPERATIONS BUSINESS UNIT

H.A. McArthur and J.R. Walker
Atomic Energy of Canada LimitedChalk River Laboratories
Chalk River, Ontario
Canada, K0J 1J0

ABSTRACT

Atomic Energy of Canada Limited (AECL) is a corporation wholly owned by the Canadian Federal Government. AECL's Waste Management and Decommissioning Operations (WM&DO) Business Unit is responsible for the decommissioning of nuclear facilities at all of AECL's Canadian sites and the management of radioactive wastes at the Chalk River and Whiteshell Laboratories.

The quality of our service and the challenge of protecting the environment, while decommissioning our sites and managing our nuclear waste, are two of the most important issues facing our organization in the next decade.

Plant operators, financial institutions, legislators, and regulatory agencies are recognizing that the prescriptive approach is not, by itself, sufficient to gain quality of service and improvement in protection of the environment. In a highly regulated industry such as the nuclear industry, in order to make gains in both quality and environmental performance an emphasis must be placed on improvement through the use of effective management systems.

As the regulatory environment changes, so do the rules of business. This creates opportunities for a progressive organization that accepts the regulatory environment as a competitive challenge rather than an opponent. A progressive organization will ultimately fare better than compliance-adverse organizations that resent and attempt to ignore changes in the rules of business. Organizations that grasp these competitive challenges as opportunities and progressively adapt through a systematic approach to the management of compliance, quality, and environmental protection activities will successfully meet the challenges of the next decade.

WM&DO is grasping this challenge and taking the steps necessary to integrate the division's compliance, quality assurance, and environmental protection programs into a single quality and environmental management system (Q/EMS). The WM&DO Q/EMS is designed to be fully compliant with corporate requirements, applicable regulations, and appropriate national (CAN/CSA N286) and international (ISO-14001, ISO-9002) standards.

This paper describes the content of a compliant quality and environmental management system,discusses its development, and outlines the steps being taken within WM&DO to implement the compliant Q/EMS.

DOE FACILITIES ON THE HAZARDOUS WASTE COMPLIANCE DOCKET

Kate Landkrohn, Environmental Scientist,
Environmental Programs Center, Brown & Root Environmental
Robert C. Fleming, Oakland Operations Team Leader,
Office of Environmental Restoration, U.S. Department of Energy
Juliet M. Berling, DOE Docket Coordinator
Office of Environmental Compliance, U.S. Department of Energy

ABSTRACT

The purpose of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is to encourage the identification and remediation of sites contaminated with hazardous substances. Federal facilities managing hazardous waste must comply with CERCLA and are listed on the Federal Agency Hazardous Waste Compliance Docket (the docket) maintained by the U.S. Environmental Protection Agency (EPA). The docket, among other things, provides a mechanism to identify those facilities which should be evaluated for placement on the National Priorities List (NPL).

Once listed on the docket, facilities must perform a preliminary assessment of the environmental conditions at the site within 18 months of the listing. If necessary, a site investigation may also be performed. EPA uses this information to make a determination regarding the status of a site, such as no further remedial action is planned, or further investigation is required to determine if inclusion on the NPL is warranted. If a facility becomes listed on the NPL, then it must perform a remedial investigation and feasibility study within six months and submit it for review by the EPA. The facility must enter into an interagency agreement within 180 days after EPA's review of the study.

However, there have been problems associated with docket listings, ranging from a facility's being listed twice to an inappropriate listing. For fiscal year 1996, the U.S. Department of Energy (DOE) has 90 facilities listed on the docket and 21 facilities on the NPL. DOE is required by CERCLA 120(e) to inform Congress and the public of its progress in cleaning up contaminated facilities. At the present time, DOE provides this

information in an Annual Report to Congress and Governors of affected states. Several other reports present similar information, however, and the information provided by the CERCLA Annual Report to Congress does not quantify the cleanup activities at the reporting sites. This paper suggests it is time to consider whether the intent of the original reporting requirements is appropriate for the current level of environmental knowledge held today by Congress and the public.

OBTAINING DEPARTMENT OF ENERGY APPROVAL FOR A RADIATION PROTECTION PROGRAM FOR DECONTAMINATION AND DECOMMISSIONING ACTIVITIES

Arthur G. Samiljan
Radiation Safety Officer, Manufacturing Sciences Corporation
Rocky Flats Environmental Technology Site
PO Box 4085, Building 883, Golden, Colorado 80402-4085

ABSTRACT

The National Conversion Pilot Project (NCPP) is the first of its kind to convert a former Department of Energy (DOE) weapons production facility into a private commercial enterprise. The NCPP aims to demonstrate that contaminated DOE facilities and equipment can be cleaned up and reused for commercial purposes. Significant cost savings can be realized through the refurbishment of surplus facilities and capital equipment valued at $92M. Additional benefits include re-employment of former production workers, recycling of scrap metal which would have otherwise been disposed of as contaminated waste, the declassification of 272,000 pounds of classified parts and tooling, and profitable commercial use of otherwise idle facilities and equipment. The success of the NCPP to transition from DOE Order regulatory control to a Nuclear Regulatory Commission (NRC) license will determine the viability of private commercialization at other DOE facilities.

BASIS OF ESTIMATE SOFTWARE TOOL (BEST) A PRACTICAL SOLUTION TO PART OF THE COST AND SCHEDULE INTEGRATION PUZZLE

Larry Murphy, Kaiser-Hill, L.L.C.
Pete Bain, Tenera Federal Projects

ABSTRACT

The Basis of Estimate Software Tool (BEST) was developed at the Rocky Flats Environmental Technology Site (Rocky Flats) to bridge the gap that exists in conventional project control systems between scheduled activities, their allocated or assigned resources, and the set of assumptions (basis of estimate) that correlate resources and activities. Having a documented and auditable basis of estimate (BOE) is necessary for budget validation, work scope analysis, change control, and a number of related management control functions. The uniqueness of BEST is demonstrated by the manner in which it responds to the diverse needs of the heavily regulated environmental workplace containing many features not found in conventional off-the-shelf software products. However, even companies dealing in relatively unregulated work places will find many attractive features in BEST. This product will be of particular interest to current Government contractors and contractors preparing proposals that may require subsequent validation.

REPLACEMENT OF UNDERGROUND STORAGE TANKS ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Robert P. Campbell
Rocky Mountain Remediation Services, LLC
Michael R. Ferrari
Kaiser-Hill Company, LLC

ABSTRACT

Twenty-two underground petroleum storage tanks (USTs) at the Rocky Flats Environmental Technology Site (RFETS) were replaced with eighteen aboveground storage tanks (ASTs) and five USTs. The old USTs were closed-in-place by filling with an inert polyurethane closed-cell foam. ASTs were selected in most cases to avoid interferences with existing structures and utilities, and minimize excavation in areas with potential hazardous and radioactive contamination. The tanks were closed-in-place with significant cost savings due to avoidance of excavation and generation of soils requiring management. Geoprobe sampling was used to verify subsurface soils were not contaminated from tank leakage. The closed-in-place tanks were filled with foam rather than concrete to facilitate future removal if required.

DEVELOPMENT OF DESIGN CRITERIA FOR THE INTERIM SAFE STORAGE OF THE 105-C REACTOR PROJECT AT THE U.S. DEPARTMENT OF ENERGY HANFORD SITE

Thomas Josef Rodovsky
Bechtel

ABSTRACT

The 105-C production reactor at the Hanford Site in Washington State will be placed into interim safe storage for up to 75 years. The 105-C reactor will be one of the first plutonium producing reactors, used in the cold war, to be decommissioned in the entire (DOE) Department of Energy complex. Extraneous structures outside the reactor shield walls will be decontaminated; waste will be removed; and the external structures will be demolished, leaving the shield walls as final containment for the reactor block for the safe storage period. After all contamination is removed or stabilized in underlying areas, a new stainless steel roof will be built. The design criteria reflects the construction, demolition, and decontamination and decommissioning (D&D) effort overall. The existing reactor shield walls will act as containment and will provide structural stability during the D&D and safe storage period.

The 105-C Reactor project will also include a large scale decommissioning technology demonstration for the U.S. Department of Energy (EM-50) and will demonstrate a variety of new, innovative, and previously overlooked technologies. The incorporation of innovative technologies into safety assessments, scheduling and work procedures has also created new challenges from the standpoint of design criteria.

The original design and construction of 105-C was undertaken on a "no-delay" basis in response to the international tension of the Cold War. Design started in March 1951 and construction began on June 6, 1951. Initial startup of 105-C was achieved on November 18, 1952, only 17 months after groundbreaking activities. The overall building requirements, for the most part, are more stringent now for the interim safe storage than during the time of actual operations, which poses several challenges in developing the design criteria for the interim safe storage. The facility will undergo continuous configuration changes during both the D&D operations and technology demonstrations and the sequence of these activities will need to ensure that the integrity of the structure will be maintained at all times in accordance with the design criteria.

The paper will provide insight into the process and the decisions needed to generate the new design criteria for the interim safe storage to comply with all requirements.

PILOT TREATMENT PROJECT FOR THE REMEDIATION OF URANIUM-CONTAMINATED SOIL AT A FORMER NUCLEAR WEAPONS DEVELOPMENT SITE AT THE LOS ALAMOS NATIONAL LABORATORY

W. R. J. R. Turney, N. P. Lu, C. F. V. Mason, M. C. Dulf, and D. E. Dry

ABSTRACT

An environmental pilot treatment study for the remediation of uranium-contaminated soil by use of a two-step, zero-discharge, 100% recycle system was conducted at a former weapons research site. In the first step, following excavation, the soil was sorted by use of the ThemoNuclean Services segmented gate system (SGS) into two different streams: One stream with radioactivily greater than 30 pCi/g, the other steam with radioactivity less than 30 pCi/g. Following the sorting, the soilwith radioactivities less than 30 pCi/g was returned to the excavation site as it met regulatory soil release guidelines. The portion of soil with radioactivities greater than 30 pCi/g was chemically treated in a second step containerized vat leach process by use of sodium-bicarbonate leach solution. The results of the second step are reported here.

ASSESSMENT AND INTERPRETATION OF ENVIRONMENTAL DATA FROM DU TEST ACTIVITIES CONDUCTED AT THE TRANSONIC RANGE AT ABERDEEN PROVING GROUND

Bruce R. Parrish and Donald Urbani, General Physics Corporation and Ralph Cardenuto, Raphel Corpuz and Matthew G. Wiherle, Aberdeen Proving Ground

ABSTRACT

An assessment of radioactive contamination and unexploded ordnance (UXO) at the Depleted Uranium (DU) testing area of the Transonic Range at the Aberdeen Proving Ground (APG) was conducted in the spring of 1996. DU penetrators were tested at the Transonic Range from 1973 through 1979. Since DU penetrator testing ceased at the site in 1979, the need to release the site for nonradioactive use has become the goal of the U.S. Army Research Laboratory (ARL), and the APG Health Physics Office.

APG is a Test and Evaluation Command installation within the United States Army Materiel Command. The mission of the installation is to develop and test military materials and to train officers and enlisted personnel in the use and maintenance of munitions. The installation wasestablished in 1917 as two separate military reservations, APG and Edgewood Arsenal. Both were consolidated into APG in 1971. APG is located in northeast Maryland, has approximately 73,000 acres of land and water and has approximately 55 tenant organizations, many of whom are engaged in munitions development and testing.

This paper discusses implementation of the work plan, radiation survey, and soil data, and the electromagnetic survey results. It discusses comparison of radiation survey data from site structures to guideline values for depleted uranium. It also discusses correlation of gross beta and gamma count rate data from site walkover radiation surveys to soil samples analyzed for depleted uranium content. This correlation allowed delineation of areas greater than the guideline value. This delineation was necessary in order to scope remediation efforts for soil contaminated with DU. In addition to the radiological data, other site data such as UXO density will be presented.

DEVELOPMENT OF A PROCESS FOR THE DISPOSITION OF BUILDINGS WITH ACTUAL OR POTENTIAL RADIOLOGICAL CONTAMINATION

Alan Spesard, US Department of Energy
Geneva Jensen, Project Performance Corporation
Laura Crane, Project Performance Corporation

ABSTRACT

The Cleanup Standards Committee, which consists of participants from the Department of Energy (DOE-Mound and DOE-Fernald), Wright Patterson Air Force Base, the Ohio Environmental Protection Agency (OEPA), the United States Environmental Protection Agency (USEPA), and the Ohio Department of Health's Bureau of Radiological Protection, has been working to develop a process for the disposition of buildings which have actual or potential radiological contamination. The purpose of developing this process is to provide a consistent approach in Ohio, that meets all Federal and State requirements, for the unconditional release of buildings for public occupancy, as well as to facilitate all end-disposition decisions for buildings that may or do contain radiological contamination. The Federal Facility Forum committee decided to develop the process for two reasons: (1) an increasing number of buildings on federal properties require disposition, due to changing missions, and (2) current federal initiatives encourage the transfer of buildings and land for reuse and economic redevelopment.

The objective of the Federal Facility Forum committee was to develop a process that establishes when a building is radiologically clean, determines disposition alternatives when a buildings is known to have radiological contamination, and addresses determination of disposition for potentially contaminated buildings. This paper describes four key elements of the disposition process: (1) the approach for development of the process, (2) a summary of how the process works, (3) a description of how the process can facilitate all end-use disposition decisions, and (4) the flexibility of the process that allows for modification to address site-specific issues.

The process provides numerous benefits to federal facilities that are dispositioning buildings which have actual or potential radiological contamination. The process draws off of the broad range of experience and expertise of committee members and offers an approach to address identified regulatory concerns. In addition to allowing radiologically clean buildings to be transferred to the public for reuse, unconditional release may decrease disposal costs and conserve low-level waste disposal capacity by potentially allowing radiologically clean material to be disposed of in a landfill.

HEALTH AND SAFETY: WORKING SMARTER, FASTER, AND CHEAPER IN ENVIRONMENTAL RESTORATION ACTIVITIES

Samuel E. Burns, Jacobs Engineering Group
Jennifer L. Brown, Environmental & Infrastructure Technologies, Inc.

ABSTRACT

Tightening budgets in the DOE complex are requiring contractors to accomplish more productive work at less cost, in every functional area. The health and safety function in environmental restoration work is not immune to this pressure: contractor health and safety groups need to work smarter, faster, and cheaper than they have in the past, showing good cost-effectiveness for their efforts. One way to succeed in this is by applying the "necessary and sufficient" or "work smart" process to the health and safety functions. This can have the benefit of focusing health and safety efforts clearly on those areas of concern to a particular program or project, thereby maximizing the use of personnel, materials, and funds. However, proper use of this process requires careful analysis and sound technical judgement to avoid errors in identifying the applicable health and safety concerns and regulations for a particular project or effort. The best results can be seen in an integrated team approach, where health and safety staff interact with the other functional groups on each project from initial planning to completion. The Jacobs Environmental Management Team in Oak Ridge uses just such an approach in its work. Experience over the past two years has developed a "lesson learned" list of things to do and things to avoid to achieve a successful integrated approach to "work smarter" in health and safety.

REMOVAL OF RADIOACTIVE AND HEAVY IONS METAL FROM WASTE WATER USING METAPURE

E. Tel Or and N. Cohen, The Hebrew University Jerusalem, Facully of Agriculture
D. Ilzyer, I. Gilath, A. Mei-Marom and H. Zafrir, Soreq Nuclear Research Center, Yavne, (ISRAEL)

ABSTRACT

Metapure is a patented material based on a dried plant (biomass). It has remarkable properties of selective binding and concentration for radioactive and heavy metal ions removal from waste water over a wide range of pH: 2-11. It has an indefinite shelf life in the dry form. It is a green product and is easily incinerated at low temperature to heavy metal enriched ashes, reducing the waste volume for disposal up to 1/10.

Solutions containing metal ions with radioactive tracers such as Zr, Hf, Cs, Ru, Ce, Co were tested in the laboratory. The metal ions concentrations were in the ppm, ppb and ppt range. The removal of most of the above ions was close to 100%.

The experimental set-up consisted of a container for the feed solution, a peristaltic pump, a packed column with Metapure, a NaI nuclear detector for continuous real time measurement of radionuclides uptake in the column, and a container for the effluent. The metal ion concentration was determined by activity measurements on feed and effluent solution as well as the metal ion uptake on the Metapure column.

Filtering system utilizing Metapure biomass is suitable for remediation of nuclear industry waste water from radioactive and toxic metal ions.

SESSION 22-ON-SITE DISPOSAL OF REMEDIATION WASTES

INNOVATIVE REGULATORY AND CONTRACTING STRATEGIES FOR HANFORD'S ENVIRONMENTAL RESTORATION DISPOSAL FACILITY (ERDF)

Mark T. Janaskie
USDOE

ABSTRACT

The Environmental Restoration (ER) Program at the Richland Operations Office and the Office of Northwestern Area Programs at Headquarters, EM-44, have worked together with the site regulators and stakeholders during the past several years to establish the Environmental Restoration Disposal Facility (ERDF) at the Hanford site. The purpose of the ERDF project was to plan and design a disposal facility that was capable of managing all of Hanford's current and future environmental restoration waste, yet protected the environment and was still cost efficient.

In pursuing the goal for a "better, faster, cheaper" disposal facility, the ER program turned to innovative regulatory and contracting strategies to complete the project. For the regulatory strategy, the Environmental Restoration (ER) program worked with regulators and stakeholders to secure a CERCLA ROD for the ERDF by integrating RCRA and NEPA requirements into the CERCLA process. This enabled ER to address the regulatory/compliance concerns normally associated with land disposal facilities, without having to enter into the lengthy and detailed RCRA permitting process. The strategy to obtain a CERCLA ROD, rather than a traditional RCRA permit, allowed the Department greater flexibility in determining what type of disposal facility would best fit the needs of the ER program.

When it was time to construct the facility and consider how best to operate it, ER employed a unique contracting strategy which subcontracted out the construction, operations and waste transportation functions of the project to private sector firms. Three different subcontracts were awarded through the Environmental Restoration Contract (ERC) at the site, via a competitive bid process. This practice enhanced the project's success because it has fostered an almosphere of cooperation amongst the subcontractors. Because each company is responsible for a major part of the ERDF's operational success, they are compelled to work together to ensure that the project remains successful.

The regulatory and contracting strategies used to establish the ERDF serve to demonstrate that the ER program does not have to follow conventional project management guidelines in order to be successful. In fact, the practices employed for the ERDF project actually improved it, reducing planning, design and construction time from about four years to 14 months, while still producing a cost-effective and "environmentally-friendly" disposal facility. More importantly, the commitment by the ER program to employ innovative regulatory and contracting strategies provides a working example that others in the complex can follow.

IMPACTED MATERIAL PLACEMENT PLANS

Michael J. Hickey
Fluor Daniel Fernald, Inc.
Fernald Environmental Management Project
P.O. Box 538704
Cincinnati, Ohio 45253-8704

ABSTRACT

Impacted Material Placement Plans (IMPP) are documents identifying the essential elements in placing remediation wastes into disposal facilities. Remediation wastes or impacted material(s) are those components used in the construction of the disposal facility exclusively the liners and caps. The components might include soils, concrete, rubble, debris, and other regulatory approved materials. The IMPP provides the details necessary for interested parties to understand the management and construction practices at the disposal facility. The IMPP should identify the regulatory requirements from applicable DOE Orders, the ROD(s) (where a part of a CERCLA remedy), closure plans, or any other

relevant agreements or regulations. Also, how the impacted material will be tracked should be described. Finally, detailed descriptions of what will be placed and how it will be placed should be included.

As the U. S. Department of Energy (DOE) moves through the remediation process, safe economical means to contain remediation waste must be developed. Several options exist for the safe disposal of this material. These options include off-site shipment to an approved DOE facility, a permitted commercial facility, or on-site disposal. Currently, there is only one DOE facility authorized to accept remediation waste. Furthermore, limited options exist at commercial sites. With so few options available, the use of engineered on-site disposal facilities should be evaluated.

An integral part of the off-site option is strict adherence to established waste acceptance criteria (WAC). If on-site disposal is an option, WAC are equally important. The criteria were developed to ensure that the remedy are protective of human health and the environment. As such, any on-site disposal facility should also establish site specific WACs. The records of decision (ROD) should identify the site specific WACs.

The placement of impacted material (material that complies with the WAC) into approved on-site disposal facilities (OSDF) is an integral part of gaining regulatory approval. To obtain this approval, a detailed plan (Impacted Material Placement Plan [IMPP]) was developed for the Fernald OSDF. The IMPP provides detailed information for the DOE, site generators, the stakeholders, regulatory community, and the construction subcontractor placing various types of impacted material within the disposal facility.

IMPROVED COST EFFECTIVENESS OF REMEDIAL ACTION PLANS AT HISTORIC WASTE SITES IN CANADA THROUGH THE USE OF WASTE SEGREGATION APPROACHES

R.W. Pollock and C.H. Clement
Low-Level Radioactive Waste Management Office
Atomic Energy of Canada Limited
1595 Telesat Court, Suite 700
Gloucester, Ontario K1B 5R3 CANADA

ABSTRACT

This paper discusses the application of waste segregation approaches at historic waste sites in Canada. At many sites, the original waste volume has been substantially increased due to contamination of soil by natural transport processes or by physical mixing from activities such as property development. This results in a heterogenous distribution of the contaminants between the original wastes and the native soils contaminated by the wastes. Segregation of a large fraction of the contaminant inventory, but in a small fraction of the volume, may thus lead to significantly reduced interim storage and final disposal costs since each fraction of the waste can be treated in a manner appropriate to its potential hazard. More expensive treatments can be reserved for a relatively small volume of material with the highest contaminant concentrations, while less expensive methods can be applied to the remainder.

Policy and regulatory considerations are discussed, and the cost-effectiveness of this approach is examined using five case histories. These demonstrate reduced costs at the two sites where remedial action plans based on waste segregation have been implemented, and the potential for cost reductions for future work at the other sites.

ON-SITE DISPOSAL: THE OAK RIDGE INITIATIVE TO DISPOSITION CLEANUP WASTE

Bill Cahill, U.S. Department of Energy
Rick Ferguson, Jacobs Environmental Management (EM) Team
United Science Industries
Marshall Davenport, Jacobs EM Team
Jacobs Engineering Group Inc.

ABSTRACT

Alternatives for disposal of wastes generated by remediation of the Oak Ridge Reservation (ORR) are being evaluated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). One alternative being considered in the feasibility study (FS) is the construction and operation of a waste management facility (the Environmental Management Waste Management Facility, or EMWMF) on ORR. The EMWMF would include a disposal cell, engineered and authorized to accept low-level radioactive waste, Resource Conservation and Recovery Act (RCRA) hazardous waste, Toxic Substance Control Act (TSCA) waste, and mixed waste (consisting of combinationsof the previously mentioned categories).

The proposed EMWMF will cover approximately 40-49 hectares (100-120 acres) and consist of an earthen disposal cell with necessary support facilities and additional area for potential future location of treatment, storage, and disposal facilities. The disposal cell is envisioned as a 1.1-million-cubic meter (1.4-million-cubic yard) capacity, above-grade, RCRA-compliant earthen structure with a robust, multicomponent cap.

The U.S. Department of Energy is developing a comprehensive strategy for remediation of ORR. Effort is being made to ensure this evaluation is integrated into this strategy. Should the evaluation determine that on-site disposal is preferred, several issues regarding on-site disposal must be resolved before regulatory approval is received and construction could begin.

This paper presents an overview of the CERCLA evaluation and its incorporation into the remediation strategy for ORR as well as discussion of the key issues associated with on-site disposal. It also briefly describes the conceptual EMWMF design and operations and concludes with several expected benefits of consolidated disposal of waste at ORR.

RADIOACTIVE SOIL CONSOLIDATION AT THE SAVANNAH RIVER SITE

Dr. W. Dean Hoffman, J. Mike Griffith
WSRC

ABSTRACT

This paper for Radioactive Soils Consolidation was prepared in order to share evaluation of on-site disposal alternatives for low-level radioactive soils and debris from various Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste units within the Savannah River Site (SRS).

Twenty RCRA/CERCLA waste units have been identified at SRS that contain low-level radioactive soils and debris and will be used as the baseline for disposal capacity evaluation. One remedial management option is to consolidate this material into one disposal facility constructed within the boundaries of SRS. The overall objectives of this paper were to provide decision makers adequate information to compare Soils/Debris Consolidation Facility (SDCF) alternatives, select the preferred SDCF option(s) to other remedial actions, including those involving treatment, that have been preliminarily identified for the individual SRS low-level radioactive RCRA/CERCLA waste units.

The SDCF could provide for a reduction of receptor exposure to the contaminant source by decreasing the total radioactively contaminated area (footprint) at SRS requiring institutional controls, minimizing the number of radioactive waste sites requiring long-term monitoring and maintenance, and streamlining by using generic remedies for the number of candidate units.

SESSION 23-INNOVATIONS IN WASTE TRANSPORTATION & PACKAGING CONTROL ISSUES

THE PEACE PIPE - RECYCLING NUCLEAR WEAPONS INTO A TRU STORAGE/SHIPPING CONTAINER

Dennis Floyd (MSC), Keith Biddle (BNFL Inc.), Carl Edstrom (MSC),
Rick Geinitz (Safe Sites of Colorado), Kevin Keenan (DOE-RFFO),
Ray Orlowski (BNFL Inc.), Mike Rivera (SAIC/LATA)

ABSTRACT

This paper describes results of a contract undertaken by the National Conversion Pilot Project (NCPP) at the Rocky Flats Environmental Technology Site (RFETS) to fabricate stainless steel "pipe" containers for use in certification testing at Sandia National Lab, Albuquerque to qualify the container for both storage of transuranic (TRU) waste at RFETS and other DOE sites and shipping of the waste to the Waste Isolation Pilot Project (WIPP). The paper includes a description of the nearly ten-fold increase in the amount of contained plutonium enabled by the product design, the preparation and use of former nuclear weapons facilities to fabricate the components, and the rigorous quality assurance and test procedures that were employed. It also describes how stainless steel nuclear weapons components can be converted into these pipe containers, a true "swords into plowshares" success story.

INCREASING TRUPACT-II WATTAGE LIMITS: TWO TECHNICAL APPROACHES

Eugene J. Mroz*, Chris Leibman and Stanley T. Kosiewicz
Chemical Science and Technology Division
Los Alamos National Laboratory
Los Alamos, NM 87545
*Corresponding Author
Mail Stop J514
Environmental Science and Waste Technology Group (CST-7)
Los Alamos National Laboratory
Los Alamos, NM 87545

ABSTRACT

More than one-third of the drums in DOE's TRU waste inventory cannot be presently shipped to WIPP in the TRUPACT-II because they exceed the allowed limit of heat generation by virtue of radioactive decay. This limit was imposed to ensure that the amount of hydrogen generated by radiolysis does not achieve the lower explosive limit of hydrogen in air (5% v/v). Los Alamos is working to justify increasing these wattage limits: 1) by demonstrating that the phenomenon of matrix depletion greatly reduces the potential for hydrogen generation and (2) by investigating the use hydrogen getters to actively remove hydrogen from the headspace of the waste drums and/or the TRUPACT-II.

DESIGNS AND METHODS FOR THE MANUFACTURING OF PERFORMANCE ORIENTED PACKAGING FROM VOLUMETRICALLY CONTAMINATED SCRAP STEEL AND CONCRETE

Joey F. McCarter, Senior Engineer
Scientific Ecology Group, Inc.
Oak Ridge, Tennessee

ABSTRACT

This paper presents the techniques, methods and design technology which led to the successful incorporation of volumetrically contaminated, recycled scrap steel and concrete into the design and manufacturing of performance oriented packaging for radioactive materials. The Scientific Ecology Group, Inc., SEG has successfully completed the design, fabrication and testing of concrete packaging. This packaging is designed to utilize over 41 percent recycled materials. This achievement was realized during work performed as part of a Program Research and Development Announcement (PRDA) Between the US DOE and SEG. This unique concrete packaging met all design criteria

and performance testing requirements for Type A packaging as stipulated by the US Department of Transportation (DOT) for performance oriented packaging.

Vast amounts of scrap steel and concrete are and will continue to become available for beneficial reuse as a result of efforts initiated by The US Department of Energy (DOE) through it's Environmental Management Program. This program will result in the decommission and industrialization of DOE sites. In addition, materials suitable for recycling are available in the commercial sector. If not recycled, these materials will require costly processing and disposal and will require the unnecessary use of vital disposal site resources that could otherwise be utilized for materials not suitable for recycling. On the other hand, recycling of these materials utilizing the design accomplishments in the generation of resource conscious packaging can provide an effective solution for the conservation of disposal resources while at the same time as provide performance oriented packaging which will be vital in the disposal and remediation of other non-recyclable waste streams that will be generated.

Although, this project consisted of the development of metal packaging in addition to the unique concrete packaging, the focus of this paper is to present specific aspects of the work which resulted in the research and development, engineering, design, manufacturing and testing of US DOT 7A, Type A packaging comprised of high compressive strength, high impact resistant concrete. The uniqueness of this type of packaging with regard to the application of recycled constituents, necessitates a concentration on the efforts specifically supporting it's development. These development activities targeted a material that was formulated specifically for the utilization of scrap steel as structural reinforcement and recycled concrete as a portion of the aggregate for the cement matrix. Design data, manufacturing specifications, testing criteria and test results are considered and discussed. In addition, the applicability of the data and the results achieved are presented with respect to both short term and long term goals for scrap materials currently slated for remediation disposal.

A UNIVERSAL CASK CONCEPT FOR TRANSPORT, INTERMEDIATE STORAGE AND FINAL DISPOSAL OF SPENT FUEL

U. Knopp
Gesellschaft für Nuklearbehälter mbH
Hollestr. 7a, 45127 Essen, Germany
H. Spilker
Gesellschaft für Nuklearbehälter mbH
Hollestr. 7a, 45127 Essen, Germany

ABSTRACT

In Germany some progress has been made to develop a system for final disposal of spent fuel. Apart from the exploration of a suitable storage site, transport and storage cask systems for consolidated and non-consolidated spent fuel assemblies have been designed. These packages meet the requirements for a safe handling during transport and final disposal as well as the requirements resulting from the site characteristics of a final repository.

DEMONSTRATION OF A PROTOTYPE DUAL PURPOSE CASK SYSTEM FOR RUSSIAN SUBMARINE SPENT NUCLEAR FUEL

N. Mote - NAC International, Atlanta, Georgia, USA
V. Guskov - Special Mechanical Engineering Design Office (KBSM), St. Petersburg, Russia
R. Dyer - U.S. Environmental Protection Agency, Washington, DC, USA
P. Moscowitz - Brookhaven National Laboratory, Upton, New York, USA

ABSTRACT

NAC International (NAC), a leading U.S. company in the nuclear spent fuel industry, and the Special Mechanical Engineering Design Office, known as KBSM, of St. Petersburg, Russia, have combined their technical expertise to develop a dual purpose cask system for submarine and ice breaker ship spent fuel. The project is being supported by the USEPA, the USDOD, the USDOE, the government of Norway and, of course, the Russian government. The cask system is to be qualified for both storage and transport. The basis of the system design is a KBSM cask technology for RBMK-1000 fuel now in the final stages of review by the Russian regulatory agency GAN. The RBMK technology was qualified by a 4:10 scale model series of drop tests and will have a full scale prototype thermally tested prior to development of the submarine/ice breaker version. NAC is designing the support equipment and interface equipment that will make the system functional at a plant or storage site. The design features of the system are presented and the schedule for the completion of the project.

TRANSPORTATION OF PYROCHEMICAL SALTS FROM ROCKY FLATS TO LOS ALAMOS

Stephen B. Schreiber
Actinide Process Chemistry
Nuclear Materials Technology
Los Alamos National Laboratory
Los Alamos, NM 87545

ABSTRACT

Radioactive legacy wastes or residues are currently being stored on numerous Sites around the former Department of Energy's (DOE) Nuclear Weapons Complex. Since most of the operating facilities were shut down and have not operated since before the declared end to the Cold War in 1993, the historical method for treating these residues no longer exists. The risk associated with continued storage of these residues will dramatically increase with time. Thus, the DOE was directed by the Defense Nuclear Facility Safety Board in its Recommendation 94-1 to address and stabilize these residues and established an eight year time frame for doing so. There are only two options available to respond to this requirement: 1) restart existing facilities to treat and package the residues for disposal or 2) transport the residues to another operating facility within the Complex where they can be treated and packaged for disposal.

This paper focuses on one such residue type, pyrochemical salts, produced at one Complex site, the Rocky Flats Plant located northwest of Denver, Colorado. One option for treating the salts is their shipment to Los Alamos, New Mexico, for handling at the Plutonium Facility. The safe transportation of these salts can be accomplished at present, with several shipping containers including a DOT 6M, a DOE 9968, Type A or Type B quantity 55-gallon drum overpacks, or even the TRUPACT II. The tradeoffs between each container is examined with the conclusion that none of the available shipping containers is fully satisfactory. Thus, the advantageous aspects of each container must be utilized in an integrated and efficient way to effectively manage the risk involved.

BEHAVIOUR OF LLW UNDER FIRE CONDITIONS

Stephen Barlow United Kingdom Nirex Ltd
Gordon Turner United Kingdom Nirex Ltd
John Palmer United Kingdom Nirex Ltd
Richard Bush AEA Technology Plc

ABSTRACT

High-force, whole drum compaction (supercompaction) is being adopted in the UK as a means of treating Low Level Waste (LLW) to reduce its volume prior to disposal. Fire tests on active and inactive supercompacted simulant wastes have provided data on thermal properties and behaviour under fire conditions and have permitted measurement of release fractions. Computer modelling techniques have been used to predict release fractions for packaged LLW in potential fire accident scenarios for the operational safety assessment for the UK deep repository.

CONTROLLING MOISTURE CONTENT IN FUSRAP RADIOACTIVE WASTE SHIPMENTS

Ben Rogers, CHMM, Bechtel National, Inc.
Co authors: Preston McDaniel and Eric Strassburger
Bechtel National, Inc.

ABSTRACT

The Department of Energy's Formerly Utilized Sites Remedial Action Program has developed a moisture control plan to prevent free-standing liquid from collecting in waste shipments. Site waste conditions are assessed, waste moisture content is measured before loading, waste containers are examined for integrity, and moisture reduction methods are applied as required. To determine the potential for excessive moisture in waste shipments, several laboratory tests were evaluated to find a suitable method of identifying the moisture-holding capability of soil at the anticipated shipping density. As a result of this evaluation, the vibratory free liquid test was devised and validated through field testing.

SESSION 24-REGULATORY COMPLIANCE FOR LOW-LEVEL AND LOW-LEVEL MIXED WASTES

GAPS AND INCONSISTENCIES IN THE U.S. EPA'S REGULATORY PROGRAM FOR RADIOACTIVE MATERIALS: WHAT IMPLICATIONS WOULD THEY HAVE FOR EXTERNAL REGULATION OF THE DEPARTMENT OF ENERGY?

Carl S. Pavetto
Attorney
Silver Spring, MD

ABSTRACT

Pursuant to the Atomic Energy Act of 1954 and its amendments and the federal government's Reorganization Plan of 1970, the U.S. Environmental Protection Agency ("EPA" or "U.S. EPA") obtained authority to "...establish generally applicable environmental standards for the protection of the general environment from radioactive material." This authority is not plenary, however, and what has resulted from this incomplete authority and from deliberate approaches taken by the U.S. EPA in the regulation of radioactive materials, is that EPA's program for radioactive materials is a patchwork of requirements. Sometimes the requirements are inconsistent from rule to rule; sometimes they are contradictory; and sometimes there are gaps in the regulatory program.

A key issue, and the focus of this paper, is: how transportable is EPA's program forthe external regulation of the U.S. Department of Energy ("DOE"). External regulation of DOE is Recommendation 94-2 of the Defense Nuclear Facilities Safety Board ("DNFSB") based upon the Board's analysis and Secretary O'Leary's agreement, shortly after the Board's recommendation was issued, to implement it.

Accordingly, this paper explores:

(1) The statutory basis for EPA's authority to regulate radioactive materials and radiation with a focus on identifying gaps in authority that would tend to place constraints on the direct transferability of programs to the DOE environment.

(2) The approaches that EPA has taken in rules it has both completed and is contemplating regarding radiation and radioactive materials such as the proposed low-level radioactive waste rule and the pre-proposed contaminated site cleanup rule.

(3) What aspects, if any, of EPA's program are transportable to the DOE environment, and, alternatively, what alterations would have to be made prior to such an action.

Thus, the analysis in this paper is oriented toward determining whether or how much of EPA's regulatory program could be applicable to the external regulation of DOE as recommended by the DNFSB and agreed to by Secretary O'Leary.

THE INCREASING ROLE OF STATE-DEVELOPED, CONTAMINANT-SPECIFIC STANDARDS IN REMEDIATION OF NUCLEAR WASTE SITES

Dr. Edward J. Bentz, Jr., C.B. Bentz, and T.D. O'Hora
E. J. Bentz & Associates, Inc.
Alexandria, Virginia

ABSTRACT

This paper reviews the increasing role of state-established, contaminant-specific remediation standards in environmental cleanup of nuclear waste sites, and discusses how the development of such standards has varied from U.S. Environmental Protection Agency (EPA) standards and guidelines. The paper describes the overall regulatory processes applicable to environmental cleanup at U.S. Department of Energy (DOE) Weapons Complex sites; describes the regulatory criteria which provide the framework for the development of preliminary remediation goals and final remediation levels under the Comprehensive Environmental Response, Compensation, and Liability Act, and for the development of action levels and media cleanup standards under the Resource Conservation and Recovery Act; and describes the role of states and state-derived standards in these processes. States which have, to date, established their own numeric standards and/or guidance regarding contaminant-specific exposures by media and their human use are identified, and a description is provided regarding how the various state-developed standards and/or guidance differ from and/or supplement EPA standards. The paper then provides examples of methodological approaches that have been used by states to develop general and DOE site-specific cleanup standards, and describes how such approaches are similar to and/or different from established methodologies recommended by EPA.

THE NEVADA TEST SITE ENVIRONMENTAL IMPACT STATEMENT LESSONS LEARNED

Angela Colarusso, DOE/NV EM, WMD EIS Coordinator
MaryEllen Giampaoli, DOE/NV EPD, EIS Document Manager
Jim Henderson, BN, EIS Contractor Project Manager
Joe Johnston, BN, EIS Contractor Deputy Project Manager
Carrie Stewart, PAI, EIS Contractor Project Manager

ABSTRACT

The Department of Energy (DOE) Nevada Operations Office recently completed a site-wide Environmental Impact Statement (EIS) for the Nevada Test Site (NTS) and off-site locations within the state of Nevada. This EIS was two years in the development and cost about 10 million dollars to produce.

The NTS EIS is a program level EIS, rather than a project-specific EIS. The NTS EIS identifies the potential environmental impacts to 13 natural resources (biology, hydrology, air quality, etc.) associated with 4 alternatives (No Action plus 3 alternatives) for implementing 5 DOE programs at 7 sites in the state of Nevada (the NTS plus 6 others). Such complexity created a need for author diversity, and ultimately nearly 300 contractor personnel (representing 10 organizations) and 100 federal staff (representing over a dozen DOE program offices, several DOE field organizations, the National Laboratories, as well as other federal agencies including the U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Air Force, and Defense Special Weapons Agency.) The lessons learned while developing this 2,000-page EIS are relevant to other complex environmental projects that produce large documents with input from many authors.

Four important lessons learned during the NTS EIS development are highlighted. They are in the areas of management, planning, the expanding scope, and the approval process. Although the development of the NTS EIS was success, there is always room for improvement and many lessons to learn.

A COMMON-SENSE PROBABILISTIC APPROACH TO ASSESSING INADVERTENT HUMAN INTRUSION INTO LOW-LEVEL RADIOACTIVE WASTE AT THE NEVADA TEST SITE

Paul Black, Mark Hooten, Kelly Black
Neptune and Company, Inc., Los Alamos, New Mexico
Beth Moore
U.S. Department of Energy, Nevada Operations Office, Las Vegas, Nevada
Bruce Crowe
Los Alamos National Laboratory, Las Vegas, Nevada
Stuart Rawlinson, Lawrence Barker
Bechtel Nevada Corporation, Las Vegas, Nevada

ABSTRACT

The United States Department of Energy (DOE) Order 5820.2A requires each site disposing of low-level radioactive waste to prepare and maintain a site-specific performance assessment (1) to determine potential risks posed by waste management systems to the public, and the environment, and (2) to compare these risks to established performance objectives. An inadvertent human intruder is a person who, without knowledge or intent, disturbs the waste after the period of institutional control ceases (assumed to be 100 years) and is exposed to radioactivity. The DOE Nevada Operations Office, Waste Management Program recently completed a one-year study of site-specific scenarios for inadvertent human intrusion by drilling into buried low-level radioactive waste sites, as part of ongoing performance assessment studies. A process involving participation of stakeholders, public, and scientists was used to develop likely homestead and community scenarios for inadvertent human intrusion at the Nevada Test Site (NTS) Area 3 and Area 5 Radioactive Waste Management Sites. Intrusion scenarios focus on possible penetration of buried waste through drilling for sources of groundwater. Past performance assessments of low-level radioactive waste sites at the NTS were deterministically based, assuming that inadvertent human intrusion will occur at a probability of 100 percent during the 10,000-year evaluation period. This expert elicitation was conducted as a first step towards bringing a probabilistic perspective to this aspect of a performance assessment. The Nevada Test Site approach to site-specific inadvertent human intrusion determination is not dependent on the waste form, and may be applicable to other DOE or commercial facilities.

A Subject Matter Expert panel, comprised of ten disciplines ranging from the social sciences to engineering and drilling, was convened to assess the site-specific probability of inadvertent human intrusion through a formal process of expert elicitation. The probability of drilling penetration into waste was judged to be driven primarily by two settlement scenarios: (1) scattered individual homesteaders, and (2) a community scenario consisting of a cluster of settlers that share drilling and distribution systems for groundwater.

Management control factors that may affect inadvertent human intrusion were developed in the stakeholder workshop and defined during the Subject Matter Expert elicitation sessions. Management control factors include institutional control, site knowledge, placards and markers, surface barriers, and subsurface barriers. The Subject Matter Experts concluded that institutional control and site knowledge may be important factors for the first few centuries, but are not significant over the evaluation period of 10,000 years. Surface barriers can be designed that would deter the siting of a drill rig over the waste site to an effectiveness of 95 percent. Subsurface barriers and placards and markers will not as effectively prevent inadvertent human intrusion.

The important factors affecting probabilistic assessment of the settlement and community scenarios are the remoteness of the alluvial valleys of the Nevada Test Site, and the presence of playas and surface-subsidence craters, which are unlikely to be settlement sites. The highest probability of intrusion was driven by a secondary community scenario. This scenario was described as a community settlement that develops from location of an industrial-technological complex in Jackass Flats (located in the southwest portion of the Nevada Test Site). Homestead and community scenarios were considered by the panel to render a site-specific probability of around 10 percent for inadvertent human intrusion. If management controls are designed and implemented effectively, then the probability of inadvertent human intrusion can be reduced to less than one percent.

GETTING IT RIGHT - ENSURING COMPLIANT WASTE GENERATION THROUGH THE USE OF ONSITE WASTE ACCEPTANCE CRITERIA

Pamela W. Edrich, Rocky Mountain Remediation Services

ABSTRACT

Rocky Mountain Remediation Services (RMRS) is the waste management subcontractor at Rocky Flats Environmental Technology Site (RFETS), accepting waste generated by all site subcontractors. RMRS is responsible for storing, treating, and disposing of all waste generated at RFETS. Over the past several decades of Site operations, a confusing assortment of waste management program plans, permits, plantwide and floor-level procedures, and operations orders have been published which control the generation and management of waste. One result of this confusion has been a high percentage of waste containers not generated in compliance with the applicable procedures, and therefore cannot be certified for offsite disposal. As more subcontractors perform work and generate waste at RFETS, the need for a formal set of Waste Acceptance Criteria (WAC) which summarize all waste generation requirements has become evident.

RMRS has developed a WAC document which concisely summarizes the documentation, content, packaging, training, and characterization requirements for the 14 primary waste types generated at RFETS. Waste generators are required to complete the new WAC Form for every containerized or uncontainerized waste that is offered to RMRS for acceptance. The WAC Form identifies general information about the waste and requests the generator to affirm that the waste complies with the requirements listed in the RMRS WAC. Once the waste is ready for transfer to RMRS, an RMRS employee reviews the WAC Form, all documentation provided, and visually evaluates the waste. RMRS then accepts the waste into RMRS custodianship.

The RMRS WAC document has only been in place for a short time, however, there have already been several positive outcomes since its implementation.

THE PROPOSED COMBUSTION STANDARDS AND DOE THERMAL TREATMENT SYSTEMS

Work supported by the U.S. Department of Energy, Assistant Secretary for Environmental Management, Idaho Operations Office, Contract DE-AC07-941D13223

John McFee
IT Corporation
Margaret B. Hinman
Carter & Hinman, P.A.
David Eaton, Kliss McNeel
Lockheed Martin Idaho Technologies, Inc.

ABSTRACT

Under the provisions of the Clean Air Act (CAA) concerning emission of hazardous air pollutants (HAPs), the Environmental Protection Agency (EPA) published the proposed Revised Standards for Hazardous Waste Combustors on April 19, 1996 (EPA, 1996). These standards would apply to the existing Department of Energy (DOE) radioactive and mixed waste incinerators, and may be applied to several developing alternatives to incineration. The DOE has reviewed the basis for these regulations and prepared extensive comments to present concerns about the bases and implications of the standards. DOE is now discussing compliance options with the EPA for regulation of radioactive and mixed waste thermal treatment systems.

DOE REGULATORY REFORM INITIATIVE VITRIFIED MIXED WASTE

Earl W. Holtzscheiler, Sandra J. Carroll
Westinghouse Savannah River Co.
James E. Flaherty
SAIC

ABSTRACT

The U. S. Department of Energy (DOE) is charged with responsibly managing the largest volume of mixed waste in the United States. This responsibility includes managing waste in compliance with all applicable Federal and State laws and regulations, and in a cost-effective, environmentally responsible manner. Managing certain treated mixed wastes in Resource Conservation and Recovery Act (RCRA) permitted storage and disposal units (specifically those mixed wastes that pose low risks from the hazardous component) is unlikely to provide additional protection to human health and the environment beyond that afforded by managing these wastes in storage and disposal units subject to requirements for radiological control.

In October, 1995, the DOE submitted a regulatory reform proposal to the Environmental Protection Agency (EPA) relating to vitrified mixed waste forms. The technical proposal supports a regulatory strategy that would allow vitrified mixed waste forms treated through a permit or other environmental compliance mechanism to be granted an exemption from RCRA hazardous waste regulation, after treatment, based upon the inherent destruction and immobilization capabilities of vitrification technology. The vitrified waste form will meet, or exceed the performance criteria of the Environmental Assessment (EA) glass that has been accepted as an international standard for immobilizing radioactive waste components and the LDR treatment standards for inorganics and metals for controlling hazardous constituents. The proposal further provides that vitrified mixed waste would be responsibly managed under the Atomic Energy Act (AEA) while reducing overall costs. Full regulatory authority by the EPA or a State would be maintained until an acceptable vitrified mixed waste form, protective of human health and the environment, is produced.

SESSION 25-REACTOR DECONTAMINATION AND DECOMMISSIONING

PHASE ONE DECOMMISSIONING OF THE WINDSCALE PILES

K. F. Collett, B. Hickey, S. J. Parkinson
WasteChem Ltd, UK

ABSTRACT

The two Windscale Pile Reactors constructed between 1946 and 1950 operated as military and civil research reactors. Both operated until October 1957 when Pile One was shut down following a Core fire. These reactors are now being decommissioned by UKAEA with DTI/MOD (Department of Trade and Industry/Ministry of Defence) funding. The current work plan encompasses the Phase One Decommissioning of both Piles One and Two. This is to enable a programme of Phase Two dismantling of the Pile One reactor core and a fifty year care and maintenance regime for the Pile Two reactor to be put in place. This paper addresses Phase One decommissioning.

THE JAPAN POWER DEMONSTRATION REACTOR DECOMMISSIONING PROGRAM — OVERVIEW AND LESSONS LEARNED

Mitsugu Tanaka, Satoshi Yanagihara and Yoshihiro Seiki
Japan Atomic Energy Research Institute
2-4, Shirakata-shirane, Tokai-mura, Ibaraki-ken, 319-11, Japan

ABSTRACT

The Japan Power Demonstration Reactor (JPDR) decommissioning program was successfully completed by March 1996. This was the first trial to dismantle a nuclear power plant in Japan. The program consisted of two phases: Phase I was the R&D on decommissioning technologies, and Phase II was the actual dismantling of JPDR facility. Especially efforts were made to develop various kinds of dismantling techniques. The developed techniques in the Phase I program were practically applied to actual dismantling activities. The usefulness of the developed techniques was verified through the dismantling activities. Various know-how and data was collected in the dismantling activities and these were accumulated in the decommissioning database. The data and lessons learned in the JPDR decommissioning program will be useful for future decommissioning of commercial nuclear power plants in Japan.

LESSONS LEARNED BY DISMANTLING TWO GERMAN BWR'S IN GUNDREMMINGEN, UNIT A (KRB), AND KAHL (VAK)

Dietrich Mertin, RWE Energie AG
Norbert Eickelpasch, Versuchsatomkraftwerk Kahl
Helmut Steiner, Kernkraftwerke Gundremmingen
Detlef Schmidt, NUKEM Nuclear Technologies
Germany/USA

ABSTRACT

The decommissioning of the first generation of nuclear reactors in Germany is underway since 1983 in the Gundremmingen Unit A plant (KRB A) and since 1988 in the pilot nuclear power plant in Kahl (VAK). Although they are both of the boiling water type, they are rather different to each other with reference to their size and construction. As the first German nuclear power plant at all, VAK had to serve mainly scientific purposes. KRB A was the first commercial reactor in Germany.

The actual work is the dismantling of high contaminated components inside the reactor building and the underwater cutting of activated internals of the RPV's. The decommissioning of KRB is foreseen to be finished before the year 2000, the work in VAK will end about three years later.

The experience made in both projects are not limited on dismantling work only, but also include know-how on costs, effective decontamination techniques and scrap recycling.

D&D TECHNIQUES APPLIED DURING DECOMMISSIONING OF WASTE STORES AT NPP RHEINSBERG

B. Christ
DETEC GmbH
D. Schmidt
NUKEM Nuclear Technologies

ABSTRACT

NPP Rheinsberg (KKR) was the first nuclear power plant of the former German Democratic Republic and started operation in 1966 after nine years of construction. Based on the former safety philosophy, it was expected that the final storage of low and medium active waste would take place on the KKR site. A special purpose storage facility for solid and liquid radioactive wastes (ALfR, "Lager für radioaktive Abfälle") was used. The so-called ALfR consists of:

- ALfR-solid", caverns for storage of solid dry active wastes.
- ALfR-liquid", stainless steel tanks for intermediate storage of liquid radioactive wastes including slurries.
- Beton-Monolith", concrete building for the storage of solidified evaporator concentrates.
- A stationary process installation for the solidification of liquid radioactive wastes using cement as binding agent.
- The overall decommissioning concept of KKR includes: Total dismantling of facilities and demolition of buildings.
- Release from the atomic act.
- Recultivation to "green-field" by the year 2009.
- Due to the potential risk to the environment of the wastes stored, the ALfR-part of KKR is to be decommissioned first. Wastes shall be removed as soon as possible. The facilities and buildings of the ALfR are scheduled to be treated subsequently.

The removal of solidified radioactive evaporator concentrates from the Beton-Monolith is now complete. The decontamination of the building is to a point where only some contamination remains in the deeper layers of concrete floor. Wastes have been sent for final storage at the Morsleben repository (ERAM).

The removal of ALfR-solid is currently completed and the wastes generated are placed in Morsleben.

Liquid radioactive wastes of ALfR-liquid are separated into solid and liquid parts. The solid wastes will also be sent to Morsleben. The liquids will be stored in other KKR tanks for further treatment with NPP standard equipment.

DECOMMISSIONING PLAN OF A NUCLEAR RESEARCH CENTER: LESSONS LEARNED BY SCK•CEN

L. Noynaert, V. Van Alsenoy, R. Cornelissen
SCK•CEN, Boeretang 200, B-2400 Mol, Belgium

ABSTRACT

During the last decade it became obvious that the management of nuclear installations does not stop at the end of its operational lifetime, but only when its decommissioning is completed. To optimize the decommissioning, measures have to be taken as early as the design phase of those installations. These measures include:

- Drawing up the physical and radiological inventory of the nuclear installation;
- Updating the inventory.
- Following up the available decommissioning techniques and their costs.
- Following up the rules for radioactive and exempted material and their associated costs.
- Optimizing the decommissioning strategies.
- Drawing up the schedule of financing.

The detailed description of all these measures must be collected in a decommissioning plan which has to be submitted for approval to the authorities.

In the case of a nuclear research center, the management of a decommissioning program is complex due to the diversity of the nuclear installations and the radioactive material generated by the research programs. In the case of SCK•CEN, the Belgian Nuclear Research Center, the nuclear installations include the air/graphite reactor BR1, the material testing reactor BR2, the first European PWR BR3, nuclear laboratory buildings, and a farm with pastures. The radioactive materials present on the site vary from ordinary materials like steel, aluminum and concrete to less common ones like beryllium, sodium and a large variety of fissile materials and spent fuel.

To develop its decommissioning plan, SCK•CEN set up a nuclear information system which is principally a database. This database records the physical and radiological inventory of the site infrastructure and its installations. It also contains waste and dismantling information necessary for the cost evaluation of decommissioning strategies. This system resulted in a tool which can be used by various facilities such as power reactor plants, reprocessing plants...

The decommissioning techniques and associated costs used in the decommissioning plan were based on experience accumulated by SCK•CEN since 1988. Since then, SCK•CEN has already carried out the complete decommissioning of 3 nuclear laboratories and is the dismantling operator of the BR3 plant. The draw up of the nuclear information system and the execution of the different cost evaluations finally resulted in SCK•CEN's decommissioning plan. This plan is in conformity with the IAEA recommendations and was approved by the Belgian authorities.

THE MANAGEMENT OF DECOMMISSIONING IN BELGIUM: NIRAS/ONDRAF'S RESPONSIBILITIES, DECOMMISSIONING WASTE STREAMS AND COST BREAKDOWNS

Schrauben, Manfred, Head of the Decommissioning Division
Verstraeten, Ingrid, BRAECKEVELDT Marnix, Decommissioning Program Officers

ABSTRACT

Since 1988, major nuclear facilities are being decommissioned on three sites in the Mol and Dessel area. Some other facilities were decommissioned and the remaining buildings were demolished or are being re-used e.g. for conventional research by a new owner.

NIRAS/ONDRAF is directly involved in these operations. Indeed, the Agency is legally bound to collect and assess information about the decommissioning of nuclear facilities in Belgium, to approve the decommissioning plans and, in some cases, to execute the decommissioning programs.

As costs for radioactive waste management are rather high and the recycling of materials was decided to be a major objective to preserve precious raw materials, efforts have been made since 1992 to minimize final amounts of radwaste arising from decommissioning. In this manner, encouraging results have been gained in building surface decontamination, where the removal of a 1.5-3 mm layer allows in most cases the remaining structure to be released. In the same way, the development and the implementation of an industrial decontamination unit for ferrous components by a dry abrasive technique allows free release of up to 90% of the arising steel components in the near future.

BIODECONTAMINATION OF CONCRETE SURFACES: OCCUPATIONAL & ENVIRONMENTAL BENEFITS

LaMar Johnson, R. Rogers, M. Hamilton, L. Nelson
Lockheed Martin Idaho Technologies, Idaho National Engineering Laboratory (INEL)
Idaho Falls, Idaho, USA
J. Benson, and M. Green
British Nuclear Fuels plc (BNFL), Preston, England

ABSTRACT

Managers and engineers around the globe are presently challenged by high estimated costs for the decontamination and decommissioning of nuclear facilities which are no longer needed or are abandoned. It has been estimated that more than 73 Km^2 of contaminated concrete currently exists in the USDOE complex and is increased many fold when similar facilities are accounted for in other countries. Needs for the decontamination of concrete have been identified as: more cost effective decontamination methods, reduction of secondary wastes, minimized worker radiation exposures and, contaminant containment.

Recently environmental microbes have been harnessed to remove the surface of concrete as a technique for decontamination and decommissioning (D&D). This BIODECONTAMINATION technology has been tested by INEL and BNFL scientists and engineers in both United States and United Kingdom nuclear facilities. Biodecontamination field tests at a shutdown nuclear reactor facility (EBR-I) have shown radioactively contaminated surface removed at rates of 4-8 mm/yr, thus validating the feasibility of this technology. Engineering economic analyses indicate two attractive benefits embedded in this approach to concrete D&D: (1) due to the passive nature of the technique, a cost savings of more than an order of magnitude is projected compared to the current labor intensive physical decontamination techniques; and (2) the exposure to humans and the natural environment is greatly reduced due to the unattended, highly contained biodecontamination process.

SESSION 26-LANL PREPAREDNESS TO SHIP TRU WASTE TO WIPP

PUBLIC INVOLVEMENT IN A MULTI-CULTURAL COMMUNITY

Catherine Coghill, Parsons Brinckerhoff Energy Services
Corey Cruz, United States Department of Energy - Albuquerque Operations Office
Maggie Wood, Parsons Brinckerhoff Energy Services

ABSTRACT

"Public Involvement in a Multi-Cultural Community" is a component of work being performed for the U.S. DOE Albuquerque Operations Office on the Los Alamos National Laboratory (LANL) Site Wide Environmental Impact Statement. The public participation program for the Los Alamos National Laboratory Site-Wide Environmental Impact Statement was designed to actively involve the many and diverse communities that surround LANL who historically have not participated in DOE public involvement programs.

LOS ALAMOS NATIONAL LABORATORY ACCELERATED TRANSURANIC WASTE WORKOFF STRATEGIES

Stanley T. Kosiewicz, Ines R. Triay, Pamela S. Z. Rogers, and Davis V. Christensen
Chemical Science and Technology Division, Los Alamos National Laboratory,
Los Alamos, New Mexico, 87545

ABSTRACT

During 1996, the Los Alamos National Laboratory (LANL) developed two transuranic (TRU) waste workoff strategies that were estimated to be capable of saving $270–340M through accelerated waste workoff and the elimination of a $70M facility. The planning effort included a strategy to assure that LANL would have a significant quantity of TRU waste certified for shipment to the Waste Isolation Pilot Plant (WIPP) beginning in April of 1998, when WIPP was projected to open.

One of the accelerated strategies can be completed in less than ten years through a Total Optimization of Parameters Scenario ("TOPS"). "TOPS" fully utilizes existing LANL facilities and capabilities. For this scenario, funding was estimated to be unconstrained at $23M annually to certify and ship the legacy inventory of TRU waste at LANL. With "TOPS", the inventory is worked off in about 8.5 years while shipping 5,000 drums per year at a total cost of $196M. This workoff includes retrieval from earthen cover and interim storage costs. The other scenario envisioned funding at the current level with some increase for TRUPACT II loading costs, which total $16M annually. At this funding level, LANL estimates it will require about 17 years to work off the LANL TRU legacy waste while shipping 2,500 drums per year to WIPP. The total cost will be $277M. This latter scenario decreases the time for workoff by about 19 years from previous estimates and saves an estimated $190M. In addition, the planning showed that a $70M facility for TRU waste characterization was not needed because mobile systems would be used.

After the first draft of the LANL strategies was written, Congress amended the WIPP Land Withdrawal Act (LWA) to accelerate the opening of WIPP from April 1998 to November 1997. Further, the No Migration Variance requirement for WIPP was removed. The impacts of this legislation on TRU waste management are being evaluated at present by all affected entities. This paper discusses the LANL strategies as they were originally developed.

KEY REGULATORY DRIVERS AFFECTING SHIPMENTS OF MIXED TRANSURANIC WASTE FROM LOS ALAMOS NATIONAL LABORATORY TO THE WASTE ISOLATION PILOT PLANT

Paul B. Schumann, Gian Bacigalupa, Barbara J. Sinkule, and Stanley T. Kosiewicz
Los Alamos National Laboratory
Deirdre M. Boak
Sandia National Laboratories

ABSTRACT

A number of key regulatory drivers affect the nature, scope, and timing of Los Alamos National Laboratory's (LANL's) plans for mixed transuranic (MTRU) waste shipments to the Waste Isolation Pilot Plant (WIPP), which are planned to commence as soon as possible following WIPP's currently anticipated November, 1997 opening date. This paper provides an overview of some of the key drivers at LANL, particularly emphasizing those associated with the hazardous and radioactive waste components of LANL's MTRU waste. The key drivers discussed here derive from the federal Resource, Conservation, and Recovery Act (RCRA) and its amendments, including the Federal Facility Compliance Act (FFCAct); the New Mexico Hazardous Waste Act (NMHWA), and the Atomic Energy Act (AEA).

These statutory provisions are enforced through several general mechanisms: RCRA permits; the New Mexico Hazardous Waste Management Regulations, set forth in the New Mexico Administrative Code, Title 20, Chapter 4, Part 1; compliance orders issued to enforce these requirements; and U.S. Department of Energy (DOE) Orders or policy directives. Requirements in these categories will apply to MTRU waste management and characterization activities at both WIPP and LANL. In addition, LANL is subject to facility-specific requirements in its RCRA hazardous waste facility permit, potential permit conditions as proposed in RCRA Part B permit applications presently being reviewed by the New Mexico Environment Department (NMED), and facility-specific compliance orders related to MTRU waste management. Likewise, permitting- and compliance-related requirements specific to WIPP indirectly affect LANL's characterization, packaging, record-keeping, and transportation requirements for MTRU waste.

LANL must comply with this evolving set of regulatory requirements to begin shipments of MTRU waste to WIPP in a timely fashion. Additionally, LANL and the Department of Energy must work on an ongoing basis with the regulatory agencies and the public in order to manage their compliance responsibilities as proactively as possible.

LOS ALAMOS NATIONAL LABORATORY TRANSURANIC WASTE DATABASE EVALUATION

Davis V. Christensen , Pamela S. Z. Rogers, Stanley T. Kosiewicz
Chemical Sciences and Technology Division, Los Alamos National Laboratory
Donald B. LeBrun, Department of Energy
Los Alamos Area Office, Los Alamos, New Mexico, 87544

ABSTRACT

This paper represents an overview of evaluations conducted on the Transuranic (TRU) waste database maintained by the Los Alamos National Laboratory (LANL). This evaluation was conducted to support the "TRU Waste Workoff Strategies" document and provides an estimate of the waste volume that potentially could be certified and ready for shipment to Waste Isolation Pilot Plant (WIPP) in April 1998. Criteria defined in the WIPP Waste Acceptance Criteria (WAC), including container type, weight limits, plutonium fissile gram equivalents, and decay heat were used to evaluate the waste for compliance. LANL evaluated the containers by facility and by waste stream to determining the most efficient plan for characterization and certification of the waste. Evaluation of the waste presently in storage suggested that 40%-60% potentially meets the WIPP WAC, Rev. 5 criteria based on potential changes to the wattage limits.

LOS ALAMOS NATIONAL LABORATORY TRANSURANIC WASTE SAMPLING PROJECTS

David R. Yeamans, Pamela S. Z. Rogers, Eugene J. Mroz
Chemical Sciences and Technology Division, Los Alamos National Laboratory,
Los Alamos, New Mexico, 87545

ABSTRACT

The Los Alamos National Laboratory (LANL) has begun characterizing transuranic (TRU) waste in order to comply with New Mexico regulations, and to prepare the waste

for shipment and disposal at the Waste Isolation Pilot Plant (WIPP), near Carlsbad, New Mexico. Sampling consists of removing some headspace gas from each drum, removing a core from a few drums of each homogeneous waste stream, and visually characterizing a few drums from each heterogeneous waste stream. The gases are analyzed by Gas Chromatograph/Mass Spectrometry (GC/MS), and the cores are analyzed for volatile and semi volatile organic compounds (VOCs and SVOC's) by a combination of spectroscopic techniques. The sampling and examination projects are conducted in accordance with the "DOE TRU Waste Quality Assurance Program Plan" (QAPP) and the "LANL TRU Waste Quality Assurance Project Plan," (QAPjP), guaranteeing that the data meet the needs of both the Carlsbad Area Office (CAO) of DOE and the "WIPP Waste Acceptance Criteria, Rev. 5," (WIPP WAC). No discrepancies have been observed between interpretation of radiography and visual characterization of the waste, and most of the TRU waste inspected so far contains both Resource Conservation and Recovery Act (RCRA) hazardous and radioactive materials.

MOBILE / PORTABLE TRANSURANIC WASTE CHARACTERIZATION SYSTEMS AT LOS ALAMOS NATIONAL LABORATORY AND A MODEL FOR THEIR USE COMPLEX-WIDE

Edward D. Derr, Johnny R. Harper, Stanley J. Zygmunt,
Daniel P. Taggart, and Stephen E. Belts
Chemical Sciences and Technology Division, Los Alamos National Laboratory
Los Alamos, New Mexico 87545

ABSTRACT

Los Alamos National Laboratory has implemented mobile and portable characterization and repackaging systems to characterize TRU waste in storage for ultimate shipment and disposal at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, NM. These mobile systems are being used to characterize and repackage waste to meet the full requirements of the WIPP Waste Acceptance Criteria (WAC) and the WIPP Characterization Quality Assurance Program Plan (QAPP).

Mobile and portable characterization and repackaging systems are being used to supplement the capabilities and through puts of existing facilities. Utilization of mobile systems is a key factor that is enabling LANL to: 1) reduce its TRU waste work-off schedule from 36 years to 8.5 years; 2) eliminate the need to construct a $70M+ TRU waste characterization facility; 3) have waste certified for shipment to WIPP when WIPP opens; 4) continue to ship TRU waste to WIPP at the rate of 5000 drums per year; and, 5) reduce overall costs by more than $200M.

Aggressive implementation of mobile and portable systems throughout the DOE complex through a centralized-distributed services model will result in similar advantages complex-wide.

LANL TRU WASTE CHARACTERIZATION AND CERTIFICATION PROGRAM - AN OVERVIEW OF CAPABILITIES AND CAPACITY

Pamela S.Z. Rogers, Barbara Sinkule, David R. Janecky, Marji Gavett,
Saundra Wander, Jane Enter, Stan Bodenstein, Dave Yeamans, Dan Taggart,
Gene Mroz, Ines Triay, Johnny Harper,
Chemical Sciences and Technology Division, Los Alamos National Laboratory,
John T. Zoltai,
Computer, Information and Communications Division, Los Alamos National Laboratory,
Bruce Le Brun,
DOE Los Alamos Operations Office,
Los Alamos, New Mexico, 87545

ABSTRACT

The Los Alamos National Laboratory (LANL) has full capability to characterize transuranic (TRU) waste for shipment to and disposal at the Waste Isolation Pilot Plant (WIPP) for its projected opening. LANL TRU waste management operations also include facilities to repackage both drums of waste found not to be certifiable for WIPP and oversized boxes of waste that must be size reduced for shipment to WIPP. All characterization activities and repackaging are carried out under a quality assurance program designed to meet Carlsbad Area Office (CAO) requirements. The flow of waste containers through characterization operations, the facilities used for characterization, and the electronic data management system used for data package preparation and certification of TRU waste at LANL are described.

SESSION 27-HYDROGEOLOGIC AND GEOCHEMICAL ASPECTS OF WASTE DISPOSAL

RATE LIMITED ISOTOPIC EXCHANGE INVOLVING NATURAL URANIUM IN THE APACHE LEAP TUFF

Ernest Hardin, Randy Bassett
The University of Arizona
Michael Murrell
Los Alamos National Laboratory

ABSTRACT

Water-rock interaction involving uranium was investigated by isotopic analysis of ^{238}U-series nuclides in pore water and secondary minerals. Samples of secondary U were obtained by selectively leaching intact rock samples, and by digestion of fracture lining minerals, from the Apache Leap Tuff. Leaching was used in order to preserve the structure of the water-rock interface. Leachates analyzed by mass spectrometry with isotope dilution, were found to contain much more U than present in pore water, yet with similar $^{234}U/^{238}U$ activity ratios. In principle these observations could have resulted solely from U coprecipitation with secondary minerals such as manganese oxides, but a model incorporating isotopic exchange provides a plausible alternative. Both coprecipitation and isotopic exchange hypotheses lead to predictions of U retardation in situ, but isotopic exchange can operate continuously without requiring transport and precipitation of a carrier species.

Isotopic exchange between groundwater and a high affinity sorbent layer was treated analytically as retarded diffusive transport within the layer, and equated with a classical first-order kinetic model to derive a rate constant representing layer diffusion behavior. First-order sorption rate parameters could then be calculated directly from laboratory selective leaching data, indicating that water-rock interaction is rate limited on the time scale of ^{234}U decay ($t_{1/2}$ = 245,000 yr). Similar results were obtained for intact core samples spanning the vadose zone at Apache Leap, representing a range of hydrologic conditions. These parameters can be used to compute rate dependent solute retardation in the rock matrix in situ.

The layer diffusion model was also applied to U-Th analysis of fracture-lining manganese oxide minerals from the Apache Leap Tuff. The $^{234}U/^{230}Th$ systematics indicated open-system behavior, and the shift was consistent with isotopic exchange involving ^{234}U. The fracture-lining mineral samples were relatively thick, and the calculated rate constant values were small. This outcome was predicted qualitatively by the layer diffusion model, and shows that retardation involving high affinity sorbents encountered as fracture-lining minerals at Yucca Mountain and elsewhere is strongly rate limited.

REPRESENTATIVE RECHARGE RATES IN A COMPLEX UNSATURATED HYDROGEOLOGY

E. Vold, B. Newman, K. Birdsell, B. Gallaher,
D. Krier, P. Longmire, D. Rogers, E. Springer
Los Alamos National Laboratory, Los Alamos, NM

ABSTRACT

This study summarizes analyses used for the determination of representative recharge rates in a semi-arid terrain of complex topography for the purpose of modeling the performance assessment of a mesa top low-level radioactive waste disposal facility. Four recharge rates are identified based on different terrains. The terrain is first broadly grouped into canyon bottoms and mesa tops, with each covering about half the topography. The canyon bottoms are considered wet or dry depending on the local infiltration conditions and the influence of mans' activities. The mesa-tops are separated into locations which are undisturbed and disturbed by laboratory operations. Disturbed locations at the disposal facility include the disposal pits utilized for shallow land burial of low-level radioactive waste, covering approximately half the mesa top area.

Several sources of data and analyses have been synthesized to estimate the resulting recharge rates. Data and analyses include:

- Detailed surface water balance calculations with site-specific parameter values provided as input.
- Chloride profiles and analysis of implied flux at several borehole locations.
- Analyses of liquid and vapor phase vertical flux from moisture profiles with stratigraphic unit averaged unsaturated hydrologic properties.
- Comparison of moisture content field data with values implied from Darcy flux calculations for assumed unit gradient conditions and for stratigraphic unit. averaged unsaturated hydrologic properties.
- Liquid flux calculated under self-consistent gradients from field observed moisture profiles and analytic determinations of in-situ moisture potential and conductivity at limited locations.
- Distributions in near surface soil moisture contents expressed as an equivalent vertical flux under unit gradient assumptions.
- Limited comparisons to tracers available from past disposal operations.

The results indicate subsurface recharge rates of 5 cm/yr or more under wet canyons and 5 mm/yr or less under dry canyons. A complex flow is indicated under the mesa surface, with negligible liquid phase movement and a vapor dominated flux within much of the mesa volume under undisturbed conditions. However, the mesa recharge rate may be dominated by the disturbances from disposal operations. Data cannot yet be used to distinquish a difference in mean recharge rate through the disturbed and the undisturbed locations on the mesa top. The best estimate for recharge on the mesa is 5 mm/yr, although a range above and below this value are being considered in the site performance assessment.

DESIGN OF CONCRETE VAULTS FOR LOWER COST AND IMPROVED LONG TERM PERFORMANCE

John C. Walton, Ahmad Arif Shahjahan, David LeMone,
Saifuddin Ahmed, and Aida Velasquez
University of Texas at El Paso El Paso, Texas 79968-0516

ABSTRACT

Hydraulic performance of below ground concrete vaults located in the unsaturated zone was examined in relation to design. Design parameters considered were soil layers placed around the vault, size or scale of vault, roof slope, and degree of degradation of the concrete. Performance was estimated as the rate of water flow predicted to pass through the vault using a numerical model. Clay layers placed adjacent to the concrete were found to lower water flow through the vault in most simulations. Smaller vault sizes result in lower flow rates giving a demonstrable scale effect. Roof slope, within the range considered, has a relatively small influence on hydraulic performance. A revised design strategy for below ground vaults provides improved performance at lower cost.

HYDROCHEMICAL EVIDENCE FOR THE EVOLUTION OF VARIABLE DENSITY GROUNDWATER AT A POTENTIAL DEEP REPOSITORY SITE

Adrian Bath
Golder Associates (UK) Ltd, Nottingham, NG12 4DG, UK
Anna Littleboy
Nirex, Harwell, OX11 0RH, UK

ABSTRACT

Nirex is investigating the suitability of a site in West Cumbria as a location for the deep geological disposal of solid intermediate and certain low level radioactive wastes. The host rock is low permeability metamorphosed volcanic rock overlain by Permo-Triassic sedimentary rocks. Three distinct groundwater régimes have been identified at the site.

Geochemical investigations at the Sellafield site have been carried out with the objectives of: (i) Supporting the development of conceptual and numerical models of the hydrogeology of the area; (ii) Constraining models of the fluid evolution history of the area; and (iii) Characterising the key chemical characteristics of the groundwater that will eventually resaturate the repository after closure.

This paper focuses on the first two of these objectives by discussing the key hydrochemical features of the Sellafield site and the inferences which can be drawn from this evidence.

Determination of the spatial distribution of groundwater salinity (and hence density) is particularly important to ensure correct interpretation of measured groundwater pressures in terms of present potential for flow. Variable density groundwater flow models are required for this system. Modelled output is evaluated by comparison with observations of both groundwater head and salinities. The hydrochemistry and mineralogy of the three régimes have been used to understand the past history of groundwater movement. The distribution of salinity, stable isotopes and halide ratios have been used to understand past and present groundwater processes. Comparisons of hydrochemical data with groundwater flow modelling have elucidated the driving forces and boundary conditions prevailing at the site, and their past evolution. These interpretations can be used to refine groundwater flow models which are used in repository performance assessment.

SESSION 28-RADIOACTIVE WASTE MANAGEMENT POLICY

RCR AND SUSTAINABLE DEVELOPMENT

J-P LAURENT
Vice-President
Quality, Safety and Environmental Protection
COGEMA 2 et 4, rue Paul Dautier 78140- Velisy- Villacoublay

ABSTRACT

A generally accepted definition of sustainable development is that it is "development which meets the needs of present generations without compromising the ability of future generations to meet their own needs". This principle was strongly supported by the participants to Rio Conference in 1992. In particular, it was recommended to make the most efficient use of natural resources and to minimize the production of waste.

In the field of nuclear energy, the reprocessing-conditioning recycling (RCR) policy clearly responds to such requirements, from several perspectives:

The primary purpose of RCR policy is to save natural resources of uranium and to avoid the dumping of the valuable materials contained in spent-fuel assemblies; 96% of the material included can be recycled, producing the energy equivalent of 20,000 toe per ton of heavy metal reprocessed.

The long term radiotoxicity of ultimate waste is reduced as low as reasonably achievable by the same process, since beyond 100 years it is predominantly related to the residual plutonium content; in La Hague, reprocessing extracts and recovers 99.98% of the plutonium contained in spent-fuel.

Another positive effect of reprocessing is to reduce the volume of high level waste and long-lived waste, as low as 0.5 m^3 per ton of uranium in spent-fuel, to be compared with 2 m^3/t from direct disposal according to published designs.

The benefits from RCR policy implementation will mainly come in the long run, for the future generations, since they will consist of preserved energy resources and smaller quantities of long4ived waste in repositories; that means the burden of environmental impacts is more fairly born by today electricity consumers;

Moreover, the current performances of La Hague reprocessing plants demonstrates that the actual present burden of such a RCR policy can be minimized, down to negligible levels. Radioactive releases to the sea and to the atmosphere have been constrained to very small amounts and the resulting radiological exposure of the neighboring population remains lower than one hundredth of the exposure to natural radioactivity. The site routine programme of sampling and mesurements both in the sea and on the land encompasses more than 20,000 samples and 80,000 analytical results each year; it ensures permanent monitoring of the local radiological state. A monthly report is published by La Hague plant to divulgate the released quantities and the results of environmental monitoring. Direct access to the data is also possible by televideo means.

The excellent environmental performances achieved by the RCR industry confirm the edge of nuclear energy over other energy sources as concerns environmental protection and long term sustainability. It also sets an example of present industrial, efficient material recycling to the benefit of future generations.

UTILITY NUCLEAR WASTE MANAGEMENT STRATEGY

F. Glodeanu, V. Andrei, D. Popescu, G. Barariu, C. Mingiuc
Romanian Electricity Authority, Nuclear Power Group
Magheru Blvd. 33, Sector 1
Bucharest, Romania

ABSTRACT

The Romanian Electricity Authority operates a CANDU-6 reactor at the Cernavoda site, a Fuel Manufacturing Plant and a Nuclear Research Centre at Pitesti and a Heavy Water Plant at Drobeta Turnu Severin. All our branches involved in the nuclear sector are generating nuclear and toxic wastes which require treatment, packing and disposal.

For the Cernavoda NPP, the waste management system, now in place, is based on the Canadian technology and consists of:

- Low and intermediate wastes are collected, packed and temporarily stored on site.
- Spent fuel is temporarily stored in the reactor bay for 10 years.

The waste management strategy for the Cernavoda NPP, now under consideration, aims at the following objectives:

- To have, in 2005, a near surface repository operational for low and intermediate wastes on the Cernavoda site.
- To have, in 2007, an interim dry storage facility operational for spent fuel at the Cernavoda NPP.
- To define and promote a solution for final disposal of spent fuel.

The Fuel Manufacturing Plant and the Nuclear Research Centre at Pitesti have a common facility for treatment and stabilisation of low and intermediate wastes, including wastes containing natural uranium. The spent fuel from TRIGA research reactor will be returned to US for disposal, within the framework of the project supported by the American Government.

Additionally to the nuclear waste , the utility waste management strategy includes provisions for toxic waste generated at Heavy Water Plant, the main goals being the following; to operate a facility for sludge treatment and disposal; to upgrade the facility for treatment of liquid effluents from heavy water technology.

Starting with 1992, the company is firmly commited in a waste management program, providing large resources and R&D facilities. On this basis the approached topics are in connection with the feasibility study for the near surface L/ILW repository and the conceptual design for the spent fuel interim dry storage facility on the Cernavoda site.

Our strategy for radioactive and hazardous waste management is open for co-operation and its successful implementation will be an important argument for the promotion of nuclear power in our country.

NUCLEAR MATERIALS TRANSPORTATION: A KEY COMPONENT IN THE NUCLEAR FUEL CYCLE

B. Lenail
Assistant of the Chairman
TRANSNUCLEAIRE
J C. Guais Vice-President
COGEMA Inc.

ABSTRACT

Our world is an increasingly free-trader world, in which the transportation of goods is absolutely essential. While multimedia allows information to circulate without moving, food and commodities go from one place to another one by road, sea, air or rail. Because each activity generates traffic, a city like Tucson couldn't live without contacts with the outside. Acting as a link between the different plants (conversion, power generation, reprocessing plants and recycling facilities), transport is a key component of the nuclear fuel cycle industry.

A close examination at the transport breakdown shows that those concerning nuclear fuel cycle materials aren't of numerous importance. Whereas some million radioactive material casks are transported all around the world each year, only 5% of these contain nuclear fuel cycle materials. The remainder is related to radio-isotope transports, generally used for medical purpose.

As an example: each year in France out of 15 million dangerous goods containers transported, only 0.1% (15 000 containers) convey fuel cycle materials casks. Out of these 15 000, only 5% are Type B packaging for high activity materials.

Like any other transportation activity, the transportation of radioactive materials takes place in the public domain; but in view of the materials transported, it may appear to have a special relationship with both the population and the environment.

In this framework, some limited but strong protests have been voiced by environmentalists, and reports have drawn the media's attention to this topic. Most of the arguments used to challenge these operations focus on the safety aspects of these transports, leading to a vociferous debate.

These systematic criticisms have to be appreciated in the context of the reality of the transportation activity:

- First of all, the nuclear industry managers have to be conscious that, beyond some media highlights, there are various situations: they must distinguish carefully between on one hand the legitimate expectations of the population, which is understandable and have to be taken into account, and on the other hand the attempt of some international pressure groups, which aim to destabilize by this way the whole nuclear industry.
- More deeply, whatever the particular circumstances of one transport operation or another (various geographical, political or economical aspects), any response or initiative has to be closely evaluated in a global context. It is especially important to keep in mind that the current nuclear materials trans-

portation system is an international one. Its efficiency is mainly based on an international body of rules and recommendations, which consistency has to be protected. For many years, international agencies such as IAEA or IMO, in charge of these matters have efficiently dealt with regulatoru issues. The result is a world-wide implemented safety-oriented regulatory framework fitted to all types of transport conditions, whether normal or accidental.

All the partners of the nuclear industry and not only the limited number of direct actors of the technical transport operations themselves have to be conscious of the importance of any evolution and change in the field of transportation.

COGEMA and TRANSNUCLEAIRE -like other companies involved in the radioactive materials transportation- have developed a comprehensive transport organization system dealing with all fields of the industrial fuel cycle and relying on a well-mastered industry. The COGEMA Group has also implemented a transparency policy on these matters and, with its international partners (Japanese, German, Belgium, British...), plays a leading role in contributing to inform the general public and various decision-makers.

STATUS OF THE UNITED STATES FOREIGN RESEARCH REACTOR SPENT NUCLEAR FUEL PROGRAM

Kenneth A. Chacey
Office of Spent Nuclear Fuel Management
United States Department of Energy
Ibrahim H. Zeitoun and Elizabeth C. Saris
Science Applications International Corporation

ABSTRACT

A significant step was made in 1996 with the establishment of a new nuclear weapons nonproliferation policy concerning foreign research reactor spent nuclear fuel. Specifically, the United States will accept, over a 13-year period, up to 20 metric tons of spent nuclear fuel from 41 countries. Only spent fuel containing uranium enriched in the United States is covered under this policy. Since the acceptance policy took effect on May 13, 1996, the Department of Energy has undertaken a number of steps to effectively implement the policy. An Implementation Strategy Plan, Mitigation Action Plan, and detailed Transportation Plans have been developed. Other activities include: foreign research reactor assessments; the establishment of contracts with reactor operators and shipping agents; and the determination of shipment priorities and schedules. The first shipment under the acceptance policy was received into the United States in September 1996. A second shipment was received from Canada in December 1996. The next shipment of foreign research reactor spent nuclear fuel is expected from Europe in early March 1997. The primary challenge for the Department of Energy is to continue to transport this material in a consistent, cost-effective manner over the 13-year duration of the program.

THE RUSSIAN FEDERATION'S NUCLEAR WASTE PROGRAM AND EXAMPLES OF WESTERN COOPERATION FOR ITS IMPROVEMENT

M Jensen, R Avila
Swedish Radiation Protection Institute
171 16 Stockholm, Sweden

ABSTRACT

Sweden and the other Nordic countries have taken an active part in the description of nuclear waste management in the Russian federation. A seminar 15 - 17 May, 1995, in Vienna, has been a starting point for a coordination effort in the form of a Expert Contact Group, collecting information about international cooperation in the field of Russian nuclear waste management. The Russian participants also presented a high-priority project list at the seminar, covering a large range of activities. The list contains legal and regulatory projects, but production-type or hardware projects dominate. A high concentration of projects is found in the north-western region.

The creation of waste is a living process and it is often difficult to judge the consequences of one particular project in nuclear waste management, as plans still are in the process of being formed. For this reason, it is valuable to cooperate with the regulating bodies such as Gosatomnadzor who, at least in principle, can require that such plans are presented as part of the licensing dialogue. For the same reason, it is valuable to include the regulatory body also in production program.

The Swedish Radiation Protection Institute and the Norwegian Radiation Protection Authority have jointly started a cooperation project with Gosatomnadzor to establish, through seminars and courses, a common view of environmental impact assessment of nuclear installations.

SESSION 29-POSTER-MIXED WASTE

THE MIXED WASTE FOCUS AREA MERCURY WORKING GROUP: AN INTEGRATED APPROACH FOR MERCURY TREATMENT AND DISPOSAL

Thomas B. Conley
Michael I. Morris
Chemical Technology Division
Oak Ridge National Laboratory
P. O. Box 2008
Oak Ridge, Tennessee 37831-6202
Heather Holmes-Burns
Savannah River Technology Center
Westinghouse Savannah River Company
P. O. Box 616
Aiken, South Carolina 29802
Jeff Petersell
AIMS, Inc.
Rocky Flats Plant
P.O. Box 464, Bldg. 881
Golden, Colorado 80402-0464
Lynn Schwendiman
Lockheed Martin Idaho Technologies Company
P. O. Box 1625, MS-8102
Idaho Falls, Idaho 83415

ABSTRACT

In May 1996, the U.S. Department of Energy (DOE) Mixed Waste Focus Area (MWFA) initiated the Mercury Working Group (HgWG), which was established to address and resolve the issues associated with mercury-contaminated mixed wastes. Three of the first four technology deficiencies identified during the MWFA technical baseline development process were related to mercury amalgamation, stabilization, and separation/removal. The HgWG will assist the MWFA in soliciting, identifying, initiating, and managing all the efforts required to address these deficiencies.

The focus of the HgWG is to better establish the mercury-related treatment needs at the DOE sites, refine the MWFA technical baseline as it relates to mercury treatment, and make recommendations to the MWFA on how to most effectively address these needs. The team will initially focus on the sites with the most mercury-contaminated mixed wastes, whose representatives comprise the HgWG. However, the group will also work with the sites with less inventory to maximize the effectiveness of these efforts in addressing the mercury-related needs throughout the entire complex.

ENGINEERING DEVELOPMENT AND DEMONSTRATION OF DETOXSM WET OXIDATION FOR MIXED WASTE TREATMENT

Patrick M. Dhooge, Scott D. Goldblatt, James E. Moslander, Donald T. Robertson, Terry W. Rogers, and Joseph A. Zigmond
Delphi Research, Inc., Albuquerque, NM

ABSTRACT

DETOXSM, a catalyzed chemical oxidation process, is under development for treatment of hazardous and mixed wastes at Department of Energy sites. To support this effort, developmental engineering studies have been performed for aspects of the process to help ensure safe and effective operation. Subscale agitation studies have been performed to identify a suitable mixing head and speed for the primary reaction vessel agitator. Mechanisms for feeding solid waste materials to the primary reaction vessel have been investigated. Filtration to remove solidified process residue, and the use of various filtration aids, has been studied. Extended compatibility studies on the materials of construction have been performed. Due to a change to Rocky Flats Environmental Technology Site (RFETS) for the mixed waste portion of the demonstration, types of wastes suitable and appropriate for treatment at RFETS had to be chosen. A prototype unit has been fabricated and will be demonstrated on hazardous and mixed wastes at Savannah River Site (SRS) and RFETS during 1997 and 1998. The unit is in shakedown testing at present. Data validation and an engineering evaluation will be performed during the demonstration.

STABILIZATION OF CONTAMINATED SOIL AND WASTEWATER WITH CHEMICALLY BONDED PHOSPHATE CERAMICS

A. S. Wagh, S. Y. Jeong, D. Singh, H. No, and J. Wescott
Argonne National Laboratory
Argonne, IL 60439

ABSTRACT

At Argonne National Laboratory, we have developed chemically Bonded phosphate ceramic (CBPC) technology to stabilize the U.S. Department of Energy's problem mixed waste streams, for which no other stabilization technology is suitable. In this technology, solid waste is mixed with MgO and reacted with aqueous solutions of phosphoric acid or acid phosphates at room temperature to form a slurry that sets in ≈2 h into a hard and dense ceramic waste form. Initial studies involved stabilizing the surrogate waste streams and then testing the waste forms for leaching of contaminants. After achieving satisfactory performance of the waste forms, we next incorporated actual waste streams at bench scale and produced waste forms that were then tested with the Toxicity Characteristic Leaching Procedure (TCLP). This presentation deals with stabilization of soil contaminated with Cd, Cr, Pb, Ag, Ba, and Hg, and of low-level radioactive wastewater. To enhance the contaminant levels in the soil, we further spiked the soil with additional amounts of Cd, Cr, Pb, and Hg. Both the soil and the wastewater were incorporated in the same waste

form by stabilizing them with the CBPC process. The waste forms had a total waste loading of ≈77 wt.% and were dense with an open porosity of 2.7 vol.% and a density of 2.17 g/cm³. Compression strength was 4910 psi. The TCLP results showed excellent immobilization of all the RCRA metals, and radioactive contaminant levels were below the detection limit of 0.2 pCi/mL. Long-term leaching studies using the ANS 16.1 procedure showed that the retention of contaminants is excellent and comparable to or better than most of other stabilization processes. These results demonstrate that the CBPC process is a very superior process for treatment of low level mixed wastes; we therefore conclude that the CBPC process is well suited to the treatment of low-level mixed waste streams with high waste loading.

Work supported by the U.S. Department of Energy, Office of Technology Development, as part of the Mixed Waste Integrated Program, under Contract W-31-109-Eng-38.

IRON-PHOSPHATE-BASED CHEMICALLY BONDED PHOSPHATE CERAMICS FOR MIXED WASTE STABILIZATION*

A. S. Wagh, S. Y. Jeong, D. Singh
Argonne National Laboratory
Argonne, IL 60439,
A. S. Aloy, T. I. Kolytcheva, E.N. Kovarskaya
V. G. Khlopin Radium Institute
St. Petersburg, Russia
Yevgeny (Jenya) Macheret
U. S. Department of Energy,
Idaho Operations Office
Idaho Falls, ID 83401-1563

ABSTRACT

In an effort to develop chemically bonded phosphate ceramics for mixed waste stabilization, a collaborative project to develop iron-phosphate based ceramics has been initiated between Argonne National Laboratory and the V. G. Khlopin Radium Institute in St. Petersburg, Russia. The starter powders are oxides of iron that are generated as inexpensive byproduct materials in the iron and steel industry. They contain iron oxides as a mixture of magnetite (Fe_3O_4) and haematite (Fe_2O_3). In this initial phase of this project, both of these compounds were investigated independently. Each was reacted with phosphoric acid solution to form iron phosphate ceramics. In the case of magnetite, the reaction was rapid. Adding ash as the waste component containing hazardous contaminants resulted in a dense and hard ceramic rich in glassy phase. On the other hand, the reaction of phosphoric acid solution with a mixture of haematite and ash waste contaminated with cesium and americium was too slow. Samples had to be molded under pressure. They were cured for 2-3 weeks and then hardened by heating at 35°C for 3 h. The resulting ceramics in both cases were subjected to physical tests for measurement of density, open porosity, compression strength, phase analyses using X-ray diffraction and differential thermal analysis, and leaching tests using toxicity characteristic leaching procedure (TCLP) and ANS 16.1 with 7 days of leaching. Using the preliminary information obtained from these tests, we evaluated these materials for stabilization of Department of Energy's mixed waste streams.

Work supported by the U.S. Department of Energy, Office of Technology Development, as part of the Mixed Waste Integrated Program, under Contract W-31-109-Eng-38.

OFF-GAS MONITORING OF THE PLASMA HEARTH PROCESS

Michael A. Power
Engineering Division
Argonne National Laboratory
P.O. Box 2528
Idaho Falls, ID 83403-2528
Oleg O. Tolstikhine
College of Engineering
Idaho State University
P.O. Box 8895
Pocatello, ID 83209
Kevin P. Carney
Engineering Division
Argonne National Laboratory
P.O. Box 2528
Idaho Falls, ID 83403-2528

ABSTRACT

Argonne National Laboratory, Science Applications International Corporation and Lockheed Martin Idaho Technologies are developing a Plasma Hearth Process (PHP) which will process mixed hazardous and radioactive waste. The goal of this work is to convert the Infra-Red (IR) spectrum of the PHP off-gases into CO concentration data using neural network and Partial Least Squares (PLS) techniques, and to determine which technique produces a more accurate estimate of the CO concentration. The neural network technique produces a more accurate estimate of the CO concentration in that the sum-squared relative error and the worst-case relative error are smaller. The research is obtained using non hazardous, non radioactive waste since the PHP is not yet used to process hazardous, radioactive waste.

PLASMA HEARTH PROCESS BENCH-SCALE DEMONSTRATION PROJECT

Robert L. Gillins and Steven D. Poling
Science Applications International Corporation
545 Shoup Ave.
Idaho Falls, ID 83402-3575
Kevin P. Carney, Carla C. Dwight, and Frank S. Felicione
Argonne National Laboratory-West
P.O. Box 2528
Idaho Falls, ID 83403

ABSTRACT

The Plasma Hearth Process (PHP) is a high-temperature, thermal process designed to treat a wide variety of DOE mixed waste to produce a reduced-volume, highly stable product for disposal in a waste repository. The PHP Bench-Scale demonstration project is being conducted under the sponsorship of the U.S. Department of Energy (DOE) Mixed Waste Focus Area (MWFA). The demonstration is a joint project by Science Applications International Corporation (SAIC) and Argonne National Laboratory-West (ANL-W).

The Bench-Scale Project features a reduced-scale PHP system, configured for testing radioactive materials. This new system has been constructed at the ANL-W site at the Idaho National Engineering Laboratory. The Bench-Scale demonstration program will evaluate the behavior and fate of radionuclides and assess the performance of the PHP for treating DOE-complex mixed waste.

Analytic results and observations from the first five full operations conducted in this facility are presented. These operations included two integrated system tests and the first two full experiments using an inorganic-sludge feed, and one experiment that processed a debris recipe. Two of these experiments included hazardous heavy metals, but no radio-active materials. Radioactive testing is planned for the third quarter, FY97. Elemental distributions for the numerous treatment-residue samples that were collected are reported.

PROCESSING OF DUKE POWER'S MIXED WASTE VIA QUANTUM-CATALYTIC EXTRACTION PROCESSING (Q-CEP®), A CASE STUDY

Larry Evans
Duke Power Company
Tina Richards, Cheryl Baker, Eli Eilbolt
M4 Environmental L.P.
Esther Wong, Ron Sills
Molten Metal Technology, Inc.

ABSTRACT

Mixed wastes have posed significant problems for utilities. Processing / disposal options have been limited by physical form, chemical composition and radionuclides. Lack of processing / disposal capacity for more difficult mixed wastes (MW) such as Freon™ filters, sludges, greases, paint sludges and solids, and batteries have required some utilities to store their MW while waiting for commercial processing capacity to come on-line. Duke Power recently initiated an Electric Power Research Institute (EPRI) Tailored Collaboration (TC) with M4 Environmental L.P. (a joint venture between Lockheed Martin Corporation and Molten Metal Technology) to process their stored MW and demonstrate a commercial recycling alternative for MW.

The Duke MW will be processed at M4's Technology Center in Oak Ridge, Tennessee. This 100,000 ft² facility houses four Q-CEP® units. Quantum-CEP® is a proprietary recycling technology developed by Molten Metal Technology, Inc. The technology utilizes a metal bath that acts as a catalyst and solvation medium, dissociating and dissolving hazardous and radioactive compounds into their elemental constituents. This ensures complete destruction of the hazardous components, demonstrated by destruction removal efficiencies (DREs) ≥ 99.9999%. By careful selection of co-feeds including other wastes such as waste oil, the elements can be recombined to form commercial products such as synthesis gas, and ceramics and metal alloys with condensed radionuclides.

The Duke Power MW slate was broken down into three categories with chemically and physically similar forms to support operational and regulatory strategies. The categories were organic liquids and sludges, organic solids, and inorganic solids. Treatability studies were designed to the following objectives: demonstration of targeted product formation, partitioning of Resource Conservation and Recovery Act (RCRA) metals and radionuclides, and DREs in support of broad recycling applications for each waste category.

M4 has completed the treatability study on Duke Power's mixed waste organic liquids and sludges (MWOLS) and is currently performing treatability studies on Duke's organic solids and inorganic solids. The Tennessee Department of Environment and Conservation (TDEC) issued a use/reuse recycling determination on December 24, 1996, for the broad category of MWOLS based on the treatability study results from Duke's MWOLS and previous data from processing various organic liquids at Molten Metal Technology's Recycling Research and Development (R&D) Facility in Fall River, Massachusetts. Having received the use/reuse recycling designation, M4 will receive and process the remainder of Duke's MWOLS in 1997 without being subject to RCRA permitting requirements. M4 also expects to obtain a recycling determination for organic and inorganic solids in 1997. This paper focuses on the objectives for the treatability studies and the results of the studies to date.

DEVELOPING MASS BALANCE NOMOGRAPHS TO ASSESS SOLVENT EXTRACTION PERFORMANCE

S. Amrit, P.E.; L. Baldy; E. Newberry, P.E.B. Kapoor, CHMM
Bechtel National, Inc., Oak Ridge, TN

ABSTRACT

Approximately 1,485kg of mixed waste (uranium oxides mixed with oil) at a Department of Energy site in Colonie, New York, contained elevated levels of extractable organic halides (EOX). The initial EOX concentration of the waste feed was 16,900 ppm. This waste was regulated under the Resource Conservation and Recovery Act (RCRA), and the land disposal restrictions criterion for EOX is 1,000 ppm.

To reduce the EOX concentration to an acceptable level, a solvent extraction process was deemed feasible because organic halides are in general miscible with organic solvents, while uranium oxides are not. The performance of three readily available and inexpensive organic solvents (isopropanol, diesel oil, and kerosene) in extracting the EOX compounds was evaluated. Bench-scale studies were conducted to assess the ability of each solvent (in the following order of priority): (1) to extract the EOX compounds, (2) to obtain a distinct phase separation, and (3) to obtain a clear extract phase. Bench-scale study evaluation and analytical results led to the selection of kerosene as the organic solvent.

The full-scale extraction system was a single-stage multiple contact scheme. The process generated two phases: the extract and the raffinate (product). The extract, consisting primarily of kerosene and oil, was the EOX-rich phase; it was shipped for offsite incineration. The raffinate consisted primarily of the uranium oxides and the residual oil. The efficiency of the solvent extraction process in removing EOX from the matrix was approximately 80-90 percent (by weight).

Using the mass balance principle, the weight of EOX in the extract and the raffinate was calculated. For a feed-batch size range of 135.5kg to 315.5kg, the theoretical EOX concentration in the raffinate relative to its weight was plotted, and nomographs were generated. The theoretical EOX concentration was multiplied by a solvent-specific, empirically derived correlation factor, a, to estimate the actual EOX concentration in the raffinate.

These nomographs were used as guidelines to determine the performance of the solvent extraction process and eliminate the need for intermediate sampling of the product stream. Use of these guidelines reduced analytical costs by approximately $15,000.

PROCESS AND EQUIPMENT DESIGN FOR POLYMER STABILIZATION OF MIXED LOW-LEVEL WASTES WITH NO SECONDARY CONTAINMENT REQUIRED

Martin J. Mechsner
Schober's Machine and Engineering

ABSTRACT

Schober's Machine and Engineering has designed and constructed a mobile treatment apparatus capable of stabilizing mixed low-level waste. This high performance waste stabilization process secures low-level, mixed, and organic wastes in a composite polymer module that is readily fabricated with commercially available materials and simple processing equipment.

The equipment is capable of producing full sized (1,000 pound) modules that stabilize the mixed waste in a polybutadiene matrix which is mechanically stabilized by a seamless thermoplastic wall. This process has a working temperature of less than 350 degrees Fahrenheit.

Neither the process or the composite waste form requires auxiliary containers which are subject to damage, corrosion, and costly storage. The composite module shape approximates that of a 55 gallon drum, thus making the modules manageable by conventional drum handling equipment.

The full sized modules are produced by a patented staged mold. Schober's has designed and constructed a transportable stabilization unit. The modules are produced systematically in agglomeration and encapsulation molds whereby the mold base indexes the module between molds by a remotely controlled indexing motor. Schober's is currently developing designs for effective machinery to support fixed operations. These designs include multiple agglomeration molds that are indirectly heated and encapsulation molds that are directly heated.

This equipment was designed and constructed to demonstrate full scale capabilities of a polymer stabilization process developed by Environmental Protection Polymers. The process has shown excellent performance in preventing leaching and superior mechanical stability under stresses that would be encountered in disposal activities

The benefits of the process include conservation of space in landfills as the polymer composite allows for a very high waste loading. Wastes that cannot be managed by by aqueous cement such as salts and petroleum products can be treated. Lastly, the final cost of disposal is comparable to cementatious fixation.

DEVELOPMENT OF A PRE-TREATMENT SYSTEM FOR POLYETHYLENE ENCAPSULATION OF MIXED WASTES

P.D. Kalb, P.R. Lageraaen, and B.R. Patel
Environmental & Waste Technology Center
Brookhaven National Laboratory
D. C. Sangster
EcoLEX, Inc.
A. Poste
GenTech Engineering, Inc.

ABSTRACT

The presence of moisture and/or volatile organics (VOCs) contained in low-level radioactive or mixed waste can adversely affect polyethylene microencapsulation processing. Extrusion processing can also be limited by the range of particle sizes that can be successfully processed. This paper describes the development of a kinetic mixing process to remove moisture and volatile contaminants and broaden the range of particles amenable to polyethylene microencapsulation. Kinetic processing uses high shear and rapid rotational mixing to create frictional heat sufficient to drive off volatile constituents and/or melt thermoplastic materials. A pilot-scale processor (rated at approximately 450 kg/hr) provided by EcoLEX, Inc., was installed at BNL's Polyethylene Encapsulation Test Facility. Preliminary testing with waste surrogates indicated that up to 23 wt% moisture can be successfully removed but the maximum limits for moisture content and optimization of processing parameters are currently being evaluated. Because of its robust agitation and mixing action, kinetic processors are less sensitive to particle size limitations for waste additives than conventional extrusion systems. The ability of kinetic processing to expand the range of acceptable particles sizes beyond current limitations is currently being investigated. The work is supported by the U.S. DOE Mixed Waste Focus Area and is being conducted under a Cooperative Research and Development Agreement (CRADA) between Brookhaven National Laboratory and EcoLEX, Inc.

RESULTS FROM FIVE YEARS OF TREATABILITY STUDIES USING HYDRAULIC BINDERS TO STABILIZE LOW-LEVEL MIXED WASTE AT THE INEL

Kevin L. Gering, G. Lynn Schwendiman
Lockheed Martin Idaho Technologies

ABSTRACT

This paper is a summary of five years of work involving bench-scale solidification of nonincinerable, land disposal restricted low-level mixed waste at the Idaho National Engineering Laboratory. The solidification studies performed for this work were done under Resource Conservation and Recovery Act treatability studies. Waste forms included liquids, sludges, and solids, and treatment techniques included the use of conventional hydraulic systems (Portland cement with and without additives), proprietary commercial formulations, and sulphur polymer cement. Solidification was performed to immobilize hazardous heavy metal constituents of concern (most notably mercury, lead, chromium, and cadmium), as well as small amounts of volatile and semivolatile organic compounds. Pretreatment options for mixed wastes are also discussed, utilizing a decision tree based on the form of mixed waste and the type of hazardous constituents.

Over the past five years, hundreds of small concrete monoliths were formed for a variety of waste types. The experimental parameters used for the hydraulic concrete systems include the ratio of waste to dry binder (Portland cement, proprietary materials, etc.), the total percentage of water in concrete, and the amount of concrete additives. The only parameter that was used for the sulfur polymer-based monoliths is ratio of waste to binder. Optimum concrete formulations or "recipes" for a given type of waste were derived through this study, as based on results from the Toxicity Characteristic Leaching Procedure analyses and a free liquids test. Overall results indicate that high waste loadings in the concrete can be achieved while the monolithic mass maintains excellent resistance to leaching of heavy metals. In our study the waste loadings in the concrete generally fell within the range of 0.5 to 2.0 kg mixed waste per kg dry binder. Likewise, the most favorable amount of water in concrete, which is highly dependent upon the concrete constituents, was determined to be generally within the range of 300 to 330 g/kg (30-33% by weight). The results of this bench-scale study will find applicability at facilities where mixed or hazardous waste solidification is a planned or ongoing activity.

PROOF OF PROCESS DEMONSTRATION FOR VITRIFICATION OF LOW LEVEL MIXED WASTE SLUDGE

Matt Cage
Scientific Ecology Group

ABSTRACT

Between 1994 and 1996, the Scientific Ecology Group, Inc. (SEG), supported by Envitco, Inc., performed a proof-of-process demonstration test for vitrification of West End Treatment Facility (WETF) mixed waste sludge generated at Oak Ridge's Y-12 Plant. The test was the largest mixed waste vitrification demonstration to date; 7011 lb. of surrogate and 6815 lb. of dried WETF feed were successfully vitrified, producing respectively 5008 and 4362 lb. of stable glass product with a projected full scale volume reduction (VR) ranging from 2.8:1 to 13.8:1, depending on the percent solids in the sludge. The vitrification unit used in the demonstration test was the Envitco Waste-Vit® EV-101, a two ton/day joule-heated melter which operates at temperatures up to 2700°F. As the WETF sludge is a mixed waste, the objective for the treatment process was for the glass waste form to meet both the RCRA Land Disposal Restrictions (LDR) and the disposal site waste acceptance criteria (WAC).

Bench tests were conducted to select glass forming ingredients that produced a processable glass that maximized waste loading without negatively impacting life-cycle costs through either increased wear on melter refractory or increased energy requirements. In the proof of process demonstration, three melter volumes of surrogate were processed to achieve steady state vitrification conditions. The wastesurrogate was chemically similar to the actual WETF waste and included a lead and cadmium spike to demonstrate the robustness of the treatment process. Actual mixed waste glass produced met the proof-of-process objectives by meeting the disposal site WAC and RCRA LDR with 95% confidence.

The system proved highly reliable with a 95% availability during the two week test. The melter was operated at 40% of the design capacity, which is based on the melting rate for dry batch soda-lime-silica (SLS) glass. From the demonstration, several process improvements have been identified to increase the throughput to near SLS capacity, including:

- Reducing moisture content in the feed from 20% to less than 5% to reduce evaporative load on melter.

- Improving batching and blending to provide homogeneity for increased flux wetting of silica particles and to improve particle size distribution.
- Installing a bubbler in the glass melt to increase activity at the glass/batch interface.
- Modifying the batch delivery system with screw feeders to minimize particulate carryover into the off-gas system, and provide better batch coverage to minimize system heat losses.

PILOT TESTING OF A VITRIFICATION SYSTEM FOR LOW-LEVEL RADIOACTIVE WASTES

Prent C. Houck, ATG Inc., Allied Technology Group (ATG)

ABSTRACT

ATG Inc., Allied Technology Group (ATG) is a technology development company committed to recognizing complex waste problems and providing technology for their solutions. The low-level dry active waste stream from nuclear power, R & D, and industry is amenable to thermal destruction. ATG is developing a commercial, multi-zone joule heated vitrification process system for thermal destruction of carbonaceous materials and radionuclide incorporation into glass prior to disposal. ATG conducted a series of pilot tests with a proto-type joule heated vitrification system. The results of DAW surrogate testing using wood, paper, cardboard, plastic, cloth, and rubber showed rapid depletion of oxygen with plastics and much lower oxygen consumption rates and processing rates for cellulosic materials and rubber as compared to plastic. These results provided the qualitative and quantitative data for the design basis of a full-scale multi-zone vitrification system. A full-scale system for thermally treating low-level radioactive wastes has been permitted and designed, and is in the final stages of construction and shake-down.

RISK REDUCTION: PROCESSING OF ACID CONTAMINATED LEADED RUBBER GLOVES TO ELIMINATE HYDROGEN GAS ACCUMULATION AND REACTIVE COMPOUNDS

G.A. O'Leary, P.M. Arnold, E.L. D'Amico
Rocky Mountain Remediation Services, L.L.C.

ABSTRACT

In the late 1960's problems were observed at Rocky Flats and Mound with nitrated leaded rubber gloves. Various reports documented the formation of a yellow crystalline compound of lead nitrate in a matrix of organic material (carboxylic acid). Recent studies conducted at the Rocky Flats Environmental Technology Site (RFETS) and the Colorado School of Mines also confirmed these earlier findings. In addition to the lead nitrates, these controlled analytical experiments looked for the presence of fulminates that were also thought to form. No fulminates were found in the reaction of the lead oxide inner glove layer with nitric acid. A yellow crystalline product was observed (consistent with the earlier studies) that, when separated, had a flammability temperature between 175 and 200 degrees centigrade. Infrared (IR) analysis of this material indicated the presence of short-chained carboxylic acids with randomly substituted nitro-groups, which was also consistent with the earlier studies.

The Rocky Mountain Remediation Services (RMRS) L.L.C developed a project to inspect and process containers of transuranic-mixed waste acid-contaminated leaded rubber gloves to eliminate any potential risk associated with the formation of the lead nitrate. This process utilized xisting facilities to process the gloves and the byproduct rinse water. RMRS is the waste management subcontractor at RFETS, managing waste generated by all site subcontractors. In this capacity RMRS is responsible for storing, treating and disposing of all waste generated at the site.

MIXED WASTE TREATMENT AT DIABLO CANYON POWER PLANT

Philip Steiner and Clint Miller
Pacific Gas and Electric
Waste Management 97

ABSTRACT

This paper will discuss the on site treatment of two mixed waste streams at Diablo Canyon Power Plant. Twenty five drums of freon dry cleaner still bottoms were treated by distillation. This resulted in seven drums of non-radioactive freon which were sold for reuse and eighteen drums of radioactive still bottoms. The still bottom drums were sent off site for incineration. Due to the reduced content of freon in the still bottoms the cost of the incineration service was reduced. On site treatment of this material enabled freon to be recycled, decreased the volume of mixed waste to be shipped for off site treatment and reduced the cost of this treatment.

Micro encapsulation of radioactive resin contaminated with chromates using a polymer binder will also be discussed. Treatability studies indicated that cement encapsulated resin would not pass a TCLP test. Vinyl Ester Styrene micro encapsulation of the resin did pass the TCLP test, rendering the material non hazardous for heavy metals. This product has been approved for disposal at the Barnwell, SC burial site as a radioactive waste. This on-site treatment enabled the disposal of this resin while other treatment methods are still awaiting approval.

A STUDY OF REMOVAL OF HAZARDOUS METALS AND RADIONUCLIDES IN GROUND WATER

K. Suzuki, M. Hirano
Oarai Nuclear Research Center
JGC Corporation
2205 Naritacho Oaraimachi
Ibaraki 311-13 Japan
T.Nakashima, Richard L Baker,
Phil N Baldwin
ADTECHS
2411 Dulles Corner Park Suite 520
Herndon VA 22071

ABSTRACT

This study investigated the performance of coagulation for treatment of ground water containing Cd, Cr, Ni, Pb, U and radionuclides. Additive reagents of TMT, Na_2HPO_4, and an emulsion breaker were satisfactorily used to remove heavy metals and Am radionuclide. It was shown that the selective adsorbent, zeolite, has an effective ability to completely eliminate radioactivity of Cs and Sr, and that Dowex anion resin adsorbs Tc-99 selectively. A basic process consisting of coagulation and selective adsorption was discussed.

VORTEC CMS™ VITRIFICATION DEMONSTRATION AT DOE'S PADUCAH GASEOUS DIFFUSION PLANT

James G. Hnat, John S. Patten
Vortec Corporation

Construction of the Vortec Cyclone Melting System (CMS™) Demonstration Plant at DOE's Paducah Gaseous Dilusion Plant has been under way since August 1996 with start-up scheduled for July 1997. The Vortec Vitrification Facility has the capacity to process 36 tons/day of as received mixed waste that is presently being stored at DOE's Paducah.

The principal objective of the program is to demonstrate the ability of the Vortec CMS™ to remediate DOE contaminated soils, mixed wastes, and other waste forms containing RCRA hazardous materials, low levels of radionuclides, and TSCA (PCB containing) substances. The demonstration program will verify the capability of this vitrification process to produce a chamically stable glass which passes both TCLP and PCT requirements, while meeting all federal and state emission control regulations.

This paper presents a description of the Demonstration Plant design, and will include a report on the construction activities completed to date. In addition, the paper will present a summary of the lesson learned during the design, permitting, and construction activitiese. At present, approximately 75% of the construction activities have been complete.

MIXED WASTE PROCESSING OPERATIONS IN THE RADIOACTIVE PROCESSING UNIT-3 AT THE M4 ENVIRONMENTAL® TECHNOLOGY CENTER

Kenneth P. Guay, Frederick Evans, Tom Price, Bobby Cross, Duane Smith,
Tom Bratton, Ed Triplett, Craig Simon
M4 Environmental L.P.
1000 Clearview Court
Oak Ridge, TN 37830

ABSTRACT

M4 Environmental L.P. (M4) has been processing radioactively contaminated mixed waste in 1995 and 1996 in its Radioactive Processing Unit number 3 (RPU-3). The process utilizes the waste minimization and recycling technology called Quantum-Catalytic Extraction Processing (Q-CEP®) developed by Molten Metal Technology. Q-CEP® uses molten metal as a catalytic solvent to reduce hazardous and mixed waste compounds to their basic elements and isolating the radionuclides in a stable form. The technology has been designated by the U.S. Environmental Protection Agency as a Best Demonstrated Available Technology for all wastes for which incineration had been the only approved processing method.

RPU-3 conducted its first run in December 1995 and has since completed ten processing runs in 1996 for the purpose of conducting treatability studies, process optimization tests, and evaluation of commercial recycling campaigns on mixed wastes. The unit contains a molten metal bath operating at temperatures between 1,400-1,650°C. The waste material processed has included surrogate sludge materials, virgin solvents, fuel oil, mixed waste solvents and sludges, and contaminated scrap metal. To date, about 1,800 kilograms of waste and surrogate material have been successfully treated and processed. Each run campaign is characterized by system assembly and preheat, melting the metal bath, injection of the waste material, removal of the metal inventory, disassembly of the reactor vessel, and reporting of the data. Major parameters measured during system operations include throughputs and injection rates, equipment performance, partitioning of radionuclides and heavy metals to the desired phase, and quality of synthesis gas generated such as carbon monoxide and hydrogen.

This paper will present the results obtained from the processing of the different waste forms and discuss the major parameters measured from the completed campaigns. The first campaign processed sludge from the West End Treatment Facility at the U.S. Department of Energy's (DOE) Oak Ridge Y-12 Plant which led the State of Tennessee to grant a "use/reuse" designation for the technology. The second campaign processed mixed hazardous and radioactive waste generated by the commercial utility, Duke Power Company. The third campaign was treatment of DOE organic liquid waste contaminated with radionuclides. The various projects have demonstrated safe operations with full compliance of regulatory and permit requirements, significantly reduced the volume of pri-

mary, secendary, and tertiary waste streams, properly containerize, track and manage all residues, and demonstrated the ability of nonproduct residues to meet disposal requirements.

LANL MIXED WASTE TREATMENT FACILITY TREATABILITY STUDY

Ernest F. Stine, IT Corporation

ABSTRACT

A bench-scale treatability study was conducted to provide data to the Los Alamos National Laboratory (LANL) Mixed Waste Disposal Facility (MWTF) on stabilization of mixed waste soils at the site. The site soil may potentially be contaminated with RCRA metal and organic compounds and Nuclear Regulatory Commission (NRC) materials. In the treatment process the soil was to be mixed with reagents to form a soil-like or easily friable material which would pass the Toxicity Characteristic (TC) regulatory criteria and minimize the leachability of the NRC materials. This product must easily release from the holding container after 2 to 48 hours of curing. After this initial cure period, the treated material was to be placed in a landfill and recompacted, with water addition - if necessary. The recompacted material must obtain an unconfined compressive strength of greater than 60 psi, pass the TC regulatory criteria, and have low effective diffusion coefficients (Lx ~ 6) for the NCR materials as measured by the 5-day ANS/ANSI-16.1 procedure.

In this project, tests were conducted on surrogate material spiked with the worst case concentrations of materials that would be sent to the MWTF. A Plackett-Burman design with sixteen formulations that varied the loadings of Portland cement, flyash, blast furnace slag, carbon, clinoptilolite, and 85% phosphoric acid were investigated. Effective formulations that met all the short term and long term physical and leaching requirement were identified.

THE TECHNOLOGY INVESTMENT DECISION MODEL DOES IT WORK:TESTING THE VALIDITY OF A MARKET BASED INVESTMENT METHODOLOGY FOR MANAGING TECHNOLOGY DEVELOPMENT IN THE UNITED STATES DEPARTMENT OF ENERGY

Katherine J. Owens
Paragon Professional Associates Idaho Falls, Idaho

ABSTRACT

The word "model," when used in context of a system or theory, is defined as: 1) a tentative description accounting for all known properties, or 2) a preliminary pattern serving as the plan from which an item not yet constructed will be produced (American Heritage Dictionary, 2nd College Edition). Given these definitions, one could conclude that any unknown variable could negatively influence the overall effectiveness, accuracy, or usefulness of the model. Therefore, prior to accepting a model as a standard worthy of imitation, sufficient data must support the models validity in the application for which it is intended (i.e., the model must be validated against test data). This paper presents a case study of one such test. A test was conducted to determine if a market based decision methodology known as the Technology Investment Decision Model is a valid tool for managing technology development in the U.S. Department of Energy Mixed Waste Focus Area. This paper summarizes the origins of the model and the methodology for validating it's application in the Mixed Waste Focus Area.

MIXED WASTE MANAGEMENT BY FORCED PERMITTING

Mr. Thomas Hillmer, CHMM Hillmer Enterprises
Dr. Nicholas Hild
Arizona State University

ABSTRACT

This paper reviews the regulatory history of Mixed Waste and discusses the dilemma that face facilities that store mixed waste. Every nuclear power facility that relies on the Environmental Protection Agency's notice of non-enforcement now finds itself in violation of storage restrictions for mixed waste because there are no approved disposal facilities that are licensed to take all the various types and forms of mixed waste that are being generated. The only choice for facilities that have generated mixed waste in a form that cannot be disposed of is to obtain a Part B Permit for storage of mixed waste. In effect they are forced to obtain a permit, "forced Permitting", or run the risk of having legal action taken against them by environmental activist groups. A guide to writing a Part B Permit for mixed waste is included in this paper.

PRESIDENTIAL RAPID COMMERCIALIZATION INITIATIVE FOR MIXED WASTE SOLVENT EXTRACTION

Larry Honigford, Fluor Daniel Fernald
Dan Dilday, Fluor Daniel Fernald
Dennis Cook, Fluor Daniel Fernald
John Sattler, DOE-FEMP

ABSTRACT

The challenge of treating mixed waste at the Fernald Environmental Management Project (FEMP) is being answered through the implementation of numerous Federal programs and initiatives. The Department of Energy (DOE) complex has long been challenged by the difficult prospect of treating mixed waste generated through the production of nuclear materials for the United States defense programs. Until recently, the only answer to mixed waste treatment was storage and await the solution. But recently, the FEMP has made some major steps in mixed waste treatment which have taken it closer to meeting final remediation goals. The steps include the use of vendor provided transportable treatment services in coordination with available treatment and disposal outlets.

However, one major hurdle remains for the FEMP mixed waste treatment program, and that hurdle is tri-mixed waste. "Tri-mixed" is a term coined to describe low level waste containing RCRA hazardous constituents along with polychlorinated biphenyls (PCB). The prescribed method for disposal of PCBs is incineration. In mixed waste treatment plans developed by the FEMP with public input, the FEMP committed to pursue non-thermal treatment methods and avoid the use of incineration. The FEMP then began the task of identifying non-thermal treatment processes, which are rarely preferred by industry to incineration, to treat organic and PCB waste.

To locate potential treatment technologies, the FEMP searched numerous informational sources including the Environmental Protection Agency (EPA) Superfund Innovative Technology Evaluation (SITE) Program. Through the SITE Program, the FEMP identified a non-thermal treatment technology which uses solvents to extract PCBs. The technology belongs to a small company called Terra-Kleen Response Group, Inc. A question arose as to how can this new and innovative technology be implemented by a small company at a Department of Energy (DOE) facility. The answer came in the form of the Rapid Commercialization Initiative (RCI) and the Mixed Waste Focus Area (MWFA). RCI is a program sponsored by the Department of Commerce (DOC), DOE, Department of Defense (DOD), U.S. EPA and various state agencies to aid companies to market new and innovative technologies. The MWFA was looking for new innovative treatment technologies for mixed waste treatment. The goal of implementing the technology at the FEMP also met the objectives of both programs and a team was born. Now the FEMP is in the midst of implementing the technology in the field and is doing this through the cooperative efforts of RCI, MWFA, DOE-FEMP, Terra-Kleen Response Group Inc., and Fluor Daniel Fernald.

SESSION 30-CONCEPTS UNDER INVESTIGATION (INCLUDING ENVIRONMENTAL STUDIES)

THE SHAPE OF THINGS TO COME

Ann McCall, Nirex Engineering Design Manager

ABSTRACT

This paper describes the design development of the UK's potential national deep disposal facility for radioactive waste. Nirex is developing the design and specification of this potential facility alongside the results of a site investigation programme at the preferred site. This paper describes the three design concepts which Nirex is currently considering for a potential repository at the Longlands Site in Cumbria in the North West of England. It also describes the evolution of the design alongside the public consultation process and environmental, economic and regulatory aspects of such a project.

HOW PERFORMANCE ASSESSMENT OF A GEOLOGICAL WASTE DISPOSAL IN CLAY HAS CONTRIBUTED TO FOCUS THE RADIONUCLIDE MIGRATION RESEARCH

M. J. Put, J. Marivoet, G. Volckaert and B. Neerdael
SCK•CEN, Boeretang 200, B-2400 Mol, Belgium

ABSTRACT

Because of limited resources available for the research on geological waste disposal we needed an effective research strategy. Therefore we used performance assessment to determine the most critical components of the system. The results of a preliminary performance assessment study indicated that the Boom Clay formation was the main barrier and deserved the most attention. From the interaction with this study we derived a list of radionuclides to consider in the migration R&D programme. We identified the sensitive phenomena and parameters for the conceptual model, and focused the research on the study of these phenomena and the measurement of the parameters. To study the migration of radionuclides in the Boom Clay we used laboratory diffusion and percolation experiments on small clay cores. To test the soundness of the approach and to gain confidence in the obtained model and parameters we started large scale in situ radionuclides migration experiments. After eight years these large scale experiments still show good agreement with the predictive calculations.

FIELD-SCALE PERMEATION TESTING OF JET-GROUTED BURIED WASTE SITES

Guy G. Loomis
Idaho National Engineering Laboratory
Andrew P. Zdinak
MSE Technology Applications Inc.

ABSTRACT

The Idaho National Engineering Laboratory (INEL) conducted field-scale hydraulic conductivity testing of simulated buried waste sites with improved confinement. The improved confinement was achieved by jet grouting the buried waste, thus creating solid monoliths. The hydraulic conductivity of the monoliths was determined using both the packer technique and the falling head method. The testing was performed on simulated buried waste sites utilizing a variety of encapsulating grouts, including high-sulfate-resistant Portland cement, TECT, (a proprietary iron oxide cement), and molten paraffin. By creating monoliths using in situ jet grouting of encapsulating materials, the waste is simultaneously protected from subsidence and contained against further migration of contaminants. At the INEL alone there is 56,000 m^3 of buried transuranic waste commingled with170,000-224,000 m^3 of soil in shallow land burial. One of the options for this buried waste is to improve the confinement and leave it in place for final disposal. Knowledge of the hydraulic conductivity for these monoliths is important for decision-makers. The packer tests involved coring the monolith, sealing off positions within the core with inflatable packers, applying pressurized water to the matrix behind the seal, and observing the water flow rate. The falling head tests were performed in full-scale 3-m-diameter, 3-m-high field-scale permeameters. In these permeameters, both water inflow and outflow were measured and equated to a hydraulic conductivity.

LONG-TERM BEHAVIOR OF CEMENT PASTES UNDER WATER ATTACK

P. Faucon [a,b], F. Adenot[c], J.F Jacquinot[a], R. Cabrillac [b], F. Pineau[d], M. Jorda[d]
[a]Service de Physique de l'Etat Condensé, C.E.A Saclay, 91191 Gif sur Yvette, France
[b]Université Cergy-Pontoise, Laboratoire Matériaux et Sciences des Constructions
I.U.P Génie Civil et Infrastructures, Rue d'Eragny, Neuville sur Oise,
95031 Cergy Pontoise Cedex, France
[c]Service d'Entreposage et de Stockage des Déchets, C.E.A Saclay,
91191 Gif sur Yvette, France
[d]Agence Nationale pour la Gestion des Déchets Radioactifs,
92298 Châtenay-Malabry, France

ABSTRACT

During development studies of a site for the storage of highly radioactive waste, we examined the degradation of several cement pastes by completely demineralized water. In the short term, degradation results from transport of matter between the sound zone and the aggressive solution by diffusion of ionic species from the interstitial solution of the cement paste.

After a critical time, which depends on the type of paste, the dissolution of the surface layer in contact with the aggressive solution will determine the kinetics of degradation. Unlike diffusion, surface dissolution accelerates and then becomes constant, and must therefore be limited.

Dissolution of the surface layer is principally controlled by its solubility. The presence of trivalent iron in the paste considerably reduces this solubility and slows dissolution. In deep storage sites, where the water is not continually renewed, the critical time will never be reached if calcium solubility is low enough.

RISK, PUTTING THE NUMBERS IN PERSPECTIVE!

Mahmoud H. Haghighi, Ph.D.
Bechtel National, Inc.
151 Lafayette Drive
P.O. Box 350
Oak Ridge, TN 37831-0350

ABSTRACT

Under Environmental Protection Agency (EPA) regulations and the Comprehensive Environmental Response, Compensation, and Liability Act, the risk attributable to releases from a contaminated site (due to waste management practices) to a hypothetical resident receptor should be evaluated. Also results of risk assessments are used to prioritize waste management and site remediation activities.

Estimates of exposure and risk are usually calculated for a hypothetical resident receptor at this site, using Risk Assessment Guidance for Superfound, Volumel, Human Health Evaluation Manual (Part A). The scope and objectives of such evaluation are to estimate risk to an individual (human health) due to the contaminants of potential concern produced by a site operation or waste management practices. Most often these values overestimate the risk levels (very conservative) to human health especially in the case of radiological contaminants. This results in stringent cleanup criteria that may not be achievable with current technology or budget. One of such situation is the proposed federal regulations by the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA) for cleanup criteria to be applied to radiological remediation activities, have been set at 15 mrem/y above background. But to verify that the criteria have been met (upon the completion of the cleanup) depends on two major factors: (1) the determination of the natural background against which the criteria is applied, and (2) the sensitivity of the measurement protocols for evaluating the residual activity to the criteria.

This presentation will describe a proposed new methods in selecting the radiological contaminants of potential concern at a site and calculates exposure/risk using exposure parameters range and distribution along with statistical range analysis methodology. EPA RAGS methodology for exposure assessment, toxicity assessment , and risk characterization are briefly explained and compared to the new proposed method. In addition other types of risks existing in the today's society due to other human behavior along with the risks associated with some of the established regulatory limits will be discussed and compared to EPA action levels. This presentation also discusses the issues that impacts the determination of site specific background conditions and how variations can affect assessments against the cleanup criteria and cleanup management and prioritization.

SESSION 31-INNOVATIVE TECHNIQUES IN PUBLIC PARTICIPATION AND INFORMATION

WHERE HAS THE PUBLIC GONE AND WILL COMMUNICATIONS TECHNOLOGY BRING THEM BACK?

L. Hutterman and R. Smith
Idaho National Engineering and Environmental Laboratory
Lockheed Martin Idaho Technologies Company
P.O. Box 1625, Idaho Falls, Idaho 83415

ABSTRACT

This paper addresses the decreasing number of persons interested and participating in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or "Superfund" process. It also looks at communications technology to bring people back into participation in the Superfund process. The material studied and the technologies evaluated involve the Environmental Restoration Program at the Idaho National Engineering and Environmental Laboratory. The conclusions are probably valid for most DOE Superfund activities.

Where has the public gone? The public has taken an interest in issues that they perceive have greater impact on their quality of life and that have an adverse impact on the environment, such as the shipment and storage of spent nuclear fuel. Will communications technology bring them back? Technology can do many things: it can reduce cost; it can allow quicker access to and from the public; it can offer more information; and it can increase interest because of its novelty for short periods of time, but it will not, in and of its own, create public involvement.

KNOCK, KNOCK! WHO'S THERE? THE GOVERNMENT. A CASE STUDY IN PROACTIVE PUBLIC INVOLVEMENT AND RISK COMMUNICATION

Tom Attridge
Community Relations Manager
New York State Energy Research and Development Authority

ABSTRACT

On the Saturday after Thanksgiving in 1993, staff of the New York State Energy Research and Development Authority (NYSERDA) divided into teams of two, knocked on the doors of 57 property owners, and asked permission to take soil samples to test for Cesium-137 (Cs-137) contamination. Within a week, 53 property owners had agreed to allow access to their land for testing. Two years later, NYSERDA delivered the final project report to each property owner amid little reaction.

The project had the potential for NYSERDA to lose credibility and, at the same time, for public fear to increase. But neither happened. Why? Because NYSERDA employed a proactive public involvement and risk communication strategy to successfully complete the project.

The Western New York Nuclear Service Center (Center) is located 30 miles south of Buffalo, New York and occupies 3,340 acres of land. Nuclear Fuel Services, Inc. (NFS) operated a fuel reprocessing plant at the Center from 1966 to 1972. In 1968, NFS reported an airborne release of Cs-137 due to a filter failure in the process building's main stack. The winds carried the material to the west and northwest where some of it was deposited in areas outside the boundaries of the Center. To ensure people living in the area were safe, several testing campaigns were conducted in portions of the off-site area over the next 20 years. During each survey, the results indicated that the soil contained slightly elevated Cs-137 levels, but the levels were below the existing regulatory limits.

Over time, however, the regulatory limits became more restrictive, thus prompting NYSERDA to undertake a more detailed study of the area in 1993. The project carried with it many challenges. For example, since 1968, many individuals had purchased property and moved into the affected area. So, to even begin the investigation, NYSERDA needed permission to gain access to private land from 57 property owners. Also, there was a concern to move as quickly as possible to determine whether the radiation doses to people living in the area were above current regulatory guidance.

To meet the challenges, NYSERDA implemented a proactive public involvement and risk communication strategy for the project. At project completion, NYSERDA had learnec a lot about communication. Among the many lessons learned, the following seemed most important to project success:

- Understand the different "publics" affected - be sensitive to different informational needs of the people affected by the project.
- Be prepared for interactions - use preproject risk communication training and "practice, practice, practice" before each interaction.
- Be proactive with information - saturate the various "publics" with project information as soon as it becomes available.
- Develop clear and open relationships - facilitate as much in-person, one-on-one contact as possible with the people affected by the project.
- Listen, then always respond - make sure you understand the concerns of the public first, then make sure you respond; and
- Compare results with known standards - provide the appropriate safety standards along with the project results for comparative purposes.

The full paper will elaborate on the above elements in greater detail.

A STAKEHOLDER-BASED RISK ASSESSMENT OF THE NEVADA TEST SITE

W.B. Andrews, Senior Program Manager, Pacific Northwest National Laboratory
E. J. Bentz, President, EJ Bentz & Associates (EJB&A)
C. B. Bentz, EJB&A
D. H. Baepler A. Hechanova, P. A. Jonker, T. Johnson, M. D. Pandian, D. D. Weber,
Harry Reid Center for Environmental Studies (HRC),
University of Nevada Las Vegas UNLV

ABSTRACT

The team of the Harry Reid Center for Environmental Studies (HRC) at the University of Nevada Las Vegas and the firm of E. J. Bentz & Associates (EJB&A) of Springfield, VA was awarded in April 1995 a cooperative agreement by the US Department of Energy Environmental Management Program Office of Science and Risk Policy (EM-52) to conduct an independent stakeholder-based risk assessment and risk management evaluation of environmental management activities in Nevada and to transfer this experience to other sites. The NRAMP is demonstrating the application of risk assessment and risk management techniques with direct stakeholder involvement.

No significant radiological hazards to the public were identified at the present time due to institutional control of the current combined DOE and U.S. Air Force exclusion area. However, hazards would be severe if public access occurs to underground contaminants from underground nuclear tests. Access to these contaminants would require drilling and removal of the contaminants to the site surface. Hazards from ground disturbing human uses of areas with surface contaminants at the Nevada Test Site are significant on at least 10 percent of the Nevada Test Site at the present time and significant

hazards exist at portions of the current NTS border from surface contaminants.

The PRA does not answer all technical concerns. Complete information on NTS contaminants is not publicly available because information on nuclear weapons source terms remains classified. Long time-frames (more than 100 years) have yet to be addressed. Radiological contaminants will exist at hazardous levels for thousands of years at DOE sites in Nevada. Future waste storage volumes and forms at the NTS are not known and are the subject of current policy discussions.

The PRA does not answer all stakeholder concerns. Comprehension of risk assessment information is difficult because of its voluminous and technical nature. A technical risk assessment cannot address all stakeholder concerns. This limitation is because of weaknesses in current risk assessment techniques as well as the vast range of stakeholder interests. The goal of developing a broad participation and a public consensus is also elusive. Diverse opinions have been expressed and recorded, but consensus has not been achieved.

RADIOACTIVE WASTE: A COMMUNITY VOLUNTEERS – THE SUCCESS STORY

D.A. Walker, J.P. Murphy, C. Carroll, and J. Dickens
Corporation of the Town of Deep River
Deep River, Ontario
Canada, R0E 1L0

ABSTRACT

In September of 1995, the residents of the town of Deep River, Ontario, Canada participated in a unique referendum. The question: Are you in favour of a low-level radioactive waste disposal facility under the terms and conditions defined in the Community Agreement-in-Principle dated July 14, 1995? Of those who voted, 72% voted YES.

This paper is authored by the negotiating team for the Town of Deep River. On behalf of the municipal council, this team negotiated with a federally-appointed Siting Task Force. The outcome of these negotiations was the Community Agreement-in-Principle (CAP).

This paper details the background to the problem – 1 million m^3 of historic low-level radioactive waste – and describes the efforts to find a permanent solution to the problem. This paper examines the voluntary siting process experience as an alternative to decide-announce-defend (DAD) and discusses the factors that can turn NIMBY into YIMBY.

This paper provides a detailed examination of:

- The community profile and its influence.
- The drivers for a successful siting experience.
- The form of compensation.
- The role of safety and environmental factors.
- The reassurance model.
- The liability trail.

In detailing the Deep River experience, this paper presents a template for a successful siting process.

THE ACCEPTABILITY DIAMOND: ESSENTIAL ELEMENTS OF LEGITIMACY AND SOCIAL TRUST

Judith A. Bradbury
Pacific Northwest National Laboratory, Washington D.C.
Kristi M. Branch
Pacific Northwest National Laboratory, Seattle, WA

ABSTRACT

This paper draws on the social science literature on social trust and on research conducted by the authors to answer the following questions:

- What is trust?
- Why is trust important in society, in general?
- Why is trust important to agencies such as the Department of Energy (DOE) or the Department of Defense (DOD) who are responsible for development and implementation of policies involving technological risk?
- What is the relationship between trust and public participation?
- What does the literature on trust tell us about the challenges facing organizations and publics attempting to use public participation to leverage transformation of distrusting relationships?

SESSION 32-HANFORD HIGH-LEVEL WASTE SAFETY ISSUE RESOLUTION

RESOLUTION OF THE NUCLEAR CRITICALITY SAFETY ISSUE FOR THE HANFORD SITE HIGH-LEVEL WASTE TANKS

D. R. Bratzel, Duke Engineering and Services Hanford, Inc.
C. L. Sohn, U.S. Department of Energy
R. J. Serne, Pacific Northwest National Laboratory
W. W. Schulz, W2S Company
R. Vornehm, Consultant
H. Babad, Babad Technical Services

ABSTRACT

This paper describes the approach used to resolve the Nuclear Criticality Safety Issue for the Hanford Site high-level waste tanks. Although operational controls have been in place at the Hanford Site throughout its operating life to minimize the amount of fissile material discarded as waste, estimates of the total amount of plutonium that entered the waste tanks range from 500 to 1,000 kg. Nuclear criticality safety concerns were heightened in 1991 based on a review of waste analysis results and a subsequent U.S. Department of Energy (DOE) review of the nuclear criticality program. Although the DOE review team concluded that there was no imminent risk of a criticality at the Hanford Site tank farms, the team also stated its concern regarding the lack of definitive knowledge of the fissile material inventory and distribution within the waste tanks and the lack of sufficient management support for the overall criticality safety program.

An in-depth technical review of the nuclear criticality safety of the waste tanks was conducted to develop a defensible technical basis to ensure that waste tanks are subcritical. The review covered all relevant aspects of nuclear criticality safety including neutronics and chemical and physical phenomena of the waste form under aging waste conditions as well as during routine waste management operations. This paper provides a review of the technical basis to support the conclusion that given current plutonium inventories and operating conditions, a nuclear criticality is incredible. The DOE has been requested to close the Nuclear Criticality Safety Issue. The Defense Nuclear Facilities Safety Board is currently reviewing the technical basis.

RESOLUTION OF TANK C-106 ORGANIC FUEL-RELATED CONCERNS IN SUPPORT OF RETRIEVAL AND RESOLUTION OF THE HIGH-HEAT SAFETY ISSUE AT THE HANFORD SITE

R. D. Schreiber
Lockheed Martin Hanford Corporation
H. Babad
Lockheed Martin Hanford Corporation
R. J. Cash, presenter
Duke E&S Hanford Company

ABSTRACT

Single-shell tank C-106 is on an accelerated schedule for partial retrieval of its softer, high-heat sludge. The sludge is being transferred to a double-shell tank because they have the capacity to handle more heat-bearing materials than do single-shell tanks. Also, unlike single-shell tanks, they have not shown any tendency to leak. This transfer will eliminate the need to add water to tank C-106, thus lowering the risk of waste leaking to the environment. The transfer also will allow obligations to the Washington State Department of Ecology regarding removal of drainable liquid from all single-shell tanks to be met. Current schedules show the soft-sludge retrieval starting in September 1997. To prepare for retrieval, issues related to the risk from potential propagating reactions caused by the organic chemistry of tank C-106 were evaluated.

SESSION 33-LOW-LEVEL WASTE - NEW STABILIZATION AND DISPOSAL CONCEPTS

LARGE-SCALE TREATABILITY TESTING OF IN SITU VITRIFICATION TECHNOLOGY AT ORNL WAG 7 PIT 1 SITE: CHALLENGES, RESULTS, STATUS

Craig L. Timmerman, Geosafe Corporation
Brian P. Spalding, ORNL
John S. Tixier, PNNL

ABSTRACT

Large-scale treatability testing of the DOE-developed In Situ Vitrification (ISV) technology was performed at Oak Ridge National Laboratory's (ORNL) Waste Area Group (WAG) 7 Pit 1 site to generate data needed for completion of the RI/FS activity for the 6 remaining pits and trenches located at WAG 7. This paper discusses the unique challenges posed by the site, problems encountered, project results, and significance of test findings relative to future applications of ISV at WAG 7 and similar DOE sites.

The ISV technology has been developed for DOE by the Pacific Northwest National Laboratory (PNNL) since its inception in 1980. Collaboration on technology development and application began with ORNL in 1985. Geosafe Corporation, the commercial licensee of the technology, has also contributed heavily to the development of the technology since 1988 by transitioning it to acommercially viable production technology for a broad range of contaminated soil and waste/debris applications. Over 200 laboratory tests and experiments plus almost 100 large-scale field tests, demonstrations, and commercial melts have demonstrated the broad applicability of the technology for the destruction/removal of organic contaminants and permanent immobilization of inorganic and radionuclide contaminants within a high integrity vitrified product. Geosafe has successfully applied the technology since 1993 on a broad range of contaminated soil and buried waste and debris applications at U.S. Superfund sites and overseas sites.

PHASE TWO OF THE SOURCE RELEASE MODELING FOR THE LOS ALAMOS AREA G DISPOSAL FACILITY PERFORMANCE ASSESSMENT

Erik Vold
Los Alamos National Laboratory
Rob Shuman
Rogers and Associates Engineering Corporation

ABSTRACT

Analytic and numerical modeling of the aqueous phase release to the unsaturated zone of low level radioactive waste from a shallow burial disposal facility was initiated last year (Phase One) for the Los Alamos Area G Performance Assessment. This year (Phase Two) the effort is continuing to refine the results in the previous analyses. The previous results showed that the 'rapid release' waste category (with solid-liquid phase partition coefficient, $K_d = 0$) dominates the peak release concentrations and therefore controls the offsite dose. The model for the dissolution transition from the waste package solid phase to liquid phase for the rapid release inventory is improved to reflect a transition limited by the local percolation rate. The analytic solution to the previous model was singular for this case, and so a new solution is derived and applied to the site assessment. A detailed numerical analysis is completed of transient percolation and its effect on the source

release model output as a function of time. Transients can be significant locally but attain average values rapidly over local variations in time and space. The site inventory is sorted into groups by time period of interest, allowing analysis of nuclide solubility limits by individual disposal unit. A detailed implementation of the source release model has been incorporated directly into the source term module of the 3-D unsaturated zone computational model used in the site performance assessement.

THE IMMOBILISATION AND PACKAGING OF RADIOACTIVE WASTES FOR DEEP GEOLOGICAL DISPOSAL IN THE UK - AN INTEGRATED APPROACH

Graham A Fairhall, BNFL, Sellafield, UK
John D Palmer, UK Nirex Ltd

ABSTRACT

The UK Government Policy for the management of Intermediate Level Wastes (ILW) has been established for over a decade. It involves the packaging and ultimate disposal of the wastes in a deep geological repository.

Radioactive wastes have been generated in the UK for over four decades. The largest volume and most diverse range has been generated by British Nuclear Fuels plc (BNFL) at its Sellafield plant. In the early 1980s BNFL developed a strategy which involved the treatment and immobilisation of ILW to produce packages that would be acceptable for storage and transport and would meet anticipated requirements for disposal. This strategy involved a systematic evaluation of options for the treatment of wastes and included a detailed decision analysis process to produce the best packaging options for each ILW. Each waste treatment option was evaluated against criteria relating to processing, storage, transport and disposal. The strategy has been successfully implemented by BNFL with a number of fully active plants in operation.

A key issue facing BNFL and other waste producers in the UK was how to ensure that packages produced would meet anticipated disposal requirements in advance of an available repository. UK Nirex Ltd (Nirex) were formed in the early 1980s as the disposal agency for developing and eventually operating future repositories for radioactive wastes. To ensure that waste producers plans for treating waste would be compatible with deep disposal NIREX have developed a number of specifications for waste packages over the past decade. These specifications relate to a generic repository concept and have been generated in collaboration with Nirex's customers. The specifications cover a range of requirements including quality assurance, wasteform, containers and data recording.

BNFL has worked closely with NIREX to agree packaging plans. BNFL and other waste producers gain advice from NIREX regarding the suitability of packaging plans, at different stages from concepts to the active operation of plants. Advice is based upon assessment covering fifteen technical areas for each packaging proposal and include the nature of the waste, wasteform, container design, accident behaviour, transport and operational and post closure safety.

The approach adopted in the UK by BNFL and NIREX has been very successful. BNFL has been encapsulating ILW for over six years with an assurance from NIREX that the packages will meet anticipated disposal requirement when the deep repository becomes operational in the next century.

CONTROL OF WATER INFILTRATION INTO NEAR SURFACE LLW DISPOSAL UNITS—FINAL REPORT ON FIELD EXPERIMENTS AT A HUMID REGION SITE, BELTSVILLE, MARYLAND

Edward O'Donnell, U.S. Nuclear Regulatory Commission, Washington, DC 20555
Robert W. Ridky, University of Maryland, College Park, Maryland 20742
Robert K. Schulz, University of California, Berkeley, California 94720

ABSTRACT

This study's objective was to assess means for controlling water infiltration through waste disposal unit covers in humid regions. Experimental work was carried out in large-scale lysimeters 21.34 m x 13.72 m x 3.05 m (70 ft ¥ 45 ft ¥ 10 ft) at Beltsville, Maryland. Results of the assessment are applicable to disposal of low-level radioactive waste (LLW), uranium mill tailings, hazardous waste, and sanitary landfills.

Three kinds of waste disposal unit covers or barriers to water infiltration were investigated: (1) resistive layer barrier, (2) conductive layer barrier, and (3) bioengineering management. The resistive layer barrier consisted of compacted earthen material (e.g., clay). The conductive layer barrier consisted of a conductive layer in conjunction with a capillary break. As long as unsaturated flow conditions are maintained, the conductive layer will wick water around the capillary break. Below-grade layered covers such as (1) and (2) will fail if there is appreciable subsidence of the cover, and remedial action for this kind of failure will be difficult. A surface cover, called bioengineering management, is meant to overcome this problem. The bioengineering management surface barrier is easily repairable if damaged by subsidence; therefore, it could be the system of choice under active subsidence conditions. The bioengineering management procedure also has been shown to be effective in dewatering saturated trenches and could be used for remedial action efforts. After cessation of subsidence, that procedure could be replaced by a resistive layer barrier or, perhaps even better, by a resistive layer barrier/conductive layer barrier system. The latter system would then give long-term effective protection against water entry into waste without institutional care.

As mentioned in the preceding paragraph, a bioengineering management cover might well be the cover of choice during the active subsidence phase of a waste disposal unit. Some maintenance is required during that period. Final closure, using geological materials, could follow cessation of subsidence. No further significant maintenance would then be required. If the geological material used is solely a clay barrier to water infiltration, the cover will be "sensitive" to imperfect construction or degradation by penetrating roots. The roots will die and decay, causing markedly increased permeability of the clay with the passage of time. A system using a conductive layer under the clay layer as a water-scavenging system will, in comparison, be "robust." Roots will still degrade the clay layer but will not degrade the scavenging layer. A root hole through the conductive layer will be analogous to a hole through a wick. It will do no significant damage. The combination of a resistive layer with a conductive (scavenging) layer underneath is thus less dependent on perfect construction techniques and will be resistant to damage by root invasion. In the absence of subsidence such a system should function effectively for millennia.

Another very useful application of the resistive layer barrier/conductive layer barrier system would be to protect an earth-mounded concrete bunker disposal unit. In that case, the barrier system would shield the concrete from exposure to flowing water. The resulting stagnant alkaline film of water would tend to protect the concrete from degradation over a long time period. Similarly, a resistive layer barrier/conductive layer barrier system could be used to protect high-level waste. If high-level waste were disposed of in fractured rock, this system could be used to divert possible fracture flow water around the waste.

A BIOENGINEERING MANAGEMENT TECHNOLOGY DEMONSTRATION ON A SHALLOW-LAND DISPOSAL TRENCH IN A HUMID ENVIRONMENT

Martin J. Willett
New York State Energy Research and Development Authority

ABSTRACT

In response to rising leachate levels in waste disposal trenches at the State-Licensed, Low-Level Radioactive Waste Disposal Area (SDA), the New York State Energy Research and Development Authority (NYSERDA) has installed infiltration control technologies to remedy the water management problems caused by the wet climate and silty-clay soils found at the SDA.

In 1993, NYSERDA began the Bioengineering Management Pilot Project on a waste disposal trench at the SDA near West Valley, New York. The Pilot Project was initiated to evaluate the effectiveness of this technology for minimizing or eliminating water infiltration into the shallow, land burial disposal trenches and to assess the feasibility of a bioengineering management program as a longer-term alternative to geomembrane covers, which were placed over the remaining trenches. Installation of a bioengineered cover at the SDA marked the first demonstration of this technology on an actual disposal trench.

The bioengineering management system eliminates infiltration of water by placing fiberglass panels, mounted on wooden frames, perpendicular to the length of the trench. This design provides a hard cover to increase runoff to approximately 80 to 90 percent of precipitation. Shallow-rooted Hetzi junipers planted between the panels provide evapotranspiration (ET) of the remaining precipitation to prevent deep percolation of water through the trench cap soil.

Environmental data, which includes trench leachate elevations, radioactivity levels in vegetation, and soil moisture, along with observed maintenance requirements, are being used to determine the viability of this technology at the SDA. To date, the bioengineered cover has required minimal maintenance while maintaining the trench water level in a steady-state condition.

COMPARISON OF LIFE CYCLE COSTS FOR DISPOSAL AND ASSURED STORAGE OF LOW-LEVEL RADIOACTIVE WASTE

Arthur A. Sutherland; Nam Chau, Robert D. Baird
Rogers & Associates Engineering Corporation

ABSTRACT

Recently, a novel approach to long term management of low-level radioactive waste (LLW) called assured storage has been proposed. It has been suggested that this concept offers several major advantages over the usual LLW disposal methods, including reduced siting costs. By reducing early expenditures, the present value of life cycle costs could also be reduced. This paper presents the results of present value analyses of costs associated with assured storage and disposal facilities for the management of LLW that are based on similar designs.

CHARACTERIZATION AND REMEDIATION OF SOIL PRIOR TO CONSTRUCTION OF AN ON-SITE DISPOSAL FACILITY AT FERNALD

Arlen Hunt, Fluor Daniel Fernald
Robert Janke, USDOE
Keith Nelson, Jacobs Engineering
Greg Jones, Fluor Daniel Fernald

ABSTRACT

During the production years at the Feed Materials Production Center (FMPC), the soil of the site and the surrounding areas was surficially impacted by airborne contamination. The volume of impacted soil is estimated at 2.2 million cubic yards. During site remediation, this contamination will be excavated, characterized, and disposed of.

In 1986 the U.S. Environmental Protection Agency (EPA) and the Department of Energy (DOE) entered into a Federal Facility Compliance Agreement (FFCA) covering environmental impacts associated with the FMPC. A site wide Remedial Investigation/Feasibility Study (RI/FS) was initiated pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act (CERCLA). The DOE has completed the sitewide RI/FS process and has received approval of the final Records of Decision (RODs). The name of the facility was changed to the Fernald Environmental Management Project (FEMP) to emphasize the change in mission to environmental restoration.

Remedial actions which address similar scopes of work or types of contaminated media have been grouped into remedial projects for the purpose of managing the remediation of the FEMP. The Soil Characterization and Excavation Project (SCEP) will address the remediation of FEMP soils, certain waste units, at- and below-grade material, and will certify attainment of the final remedial limits (FRLs) for the FEMP. The final remedial limit

is the concentration of a given contaminant which would be allowed to remain in soil, sediment, and groundwater following the implementation of remedial actions.

The FEMP will be using an on-site facility for low level radioactive waste disposal. The facility will be an above-ground engineered structure constructed of geological material. The area designated for construction of the base of the on-site disposal facility (OSDF) is referred to as the "footprint". Prior to construction, the footprint must be free of contamination. Contaminated soil within the footprint must be identified and remediated. The success of characterization and remediation will be verified through a certification process required and approved by the regulatory agencies.

Material exceeding the OSDF waste acceptance criteria (WAC) will be disposed of at an appropriate commercial or federal disposal facility.

Characterization, remediation, and certification activities are guided by the Remedial Action Work Plans (RAWPs) developed by the SCEP. Excavation of Phase I of the first of seven remediation areas is complete. Certification and reseeding will be completed in the spring of 1997.

DRIFT MINE DISPOSAL OF LOW-LEVEL AND GREATER-THAN-CLASS C RADIOACTIVE WASTE*

P.J. Mayo, P.J. Mayo & Associates
C. D. Breeds, SubTerra, Inc.
B. G. Goodale, former Project Director, New York State LLRW Siting Commission

ABSTRACT

Drift mine disposal technology is recommended for disposal of most low-level radioactive waste, but is considered especially appropriate for greater-than Class C waste and reactor decommissioning waste. Drift mine disposal is believed to possess many inherent advantages over near-surface disposal methods being considered in the U.S. Some of these include: superior long-term containment of radioactive waste, an economically competitive technology, superior stability, water intrusion resistance, less land use impacts, and siting flexibility. A drift mine represents a superior solution in terms of sociopolitical issues and acceptability; and a timely and technically superior solution for the disposal of decommissioning wastes, GTCC waste, and other problematic LLW.

SESSION 34-D&D PLANNING & ACCOMPLISHMENTS AT ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE (RFETS)

ROCKY FLATS 10 YEAR PLAN — OVER 500 STRUCTURES TO BE DEMOLISHED

Ben Evans
Kaiser-Hill L.L.C., Rocky Flats, Colorado
Paul Bengel
Rocky Mountain Remediation Services, L.L.C., Rocky Flats, Colorado

ABSTRACT

Rocky Flats Environmental Technology Site has prepared a Ten Year Plan (Plan) that demonstrates how the Site would achieve accelerated cleanup and rapidly reduce the risks the Site currently poses in its workers, the public, and the environment. A major element of the Plan is the decontamination and demolition of over 500 Site facilities, including all of the former nuclear production facilities, by the end of 2006. Facilities used for the storage of plutonium, treatment of low-level mixed waste, and several office building would remain until the plutonium is removed or there is no longer a need for the facility, in which case it would be demolished. While the Plan considers all aspects of the cleanup and closure, this paper focuses on the challenges posed by the removal of highly contaminated equipment and the demolition of structures.

This paper describes near-term decommissioning projects as well as the long range plans and budgets. Cash flow ultimately controls schedule, and sharing of budget priorities among processing of special nuclear material, disposing of waste, and cleaning up the environment has to be juggled carefully to attain the goals of the Plan. The total cost of the Plan exceeds $5 billion, and over $1 billion will be spent on decommissioning activities. Following removal of the plutonium and the demolition of the plutonium storage and remaining Site facilities by the end of 2015, the cost to perform the long-term environmental monitoring at the Site is estimated to be $10 million per year.

PLANNING FOR THE ROCKY FLATS CLOSURE: TRI-PARTY, CERCLA, AND DECOMMISSIONING

John Whiting (KH), John Chapin (RMRS) and Gary Guinn (RMRS)

ABSTRACT

The Department of Energy (DOE) at Rocky Flats has commenced the actions to close the Site in accordance with the scenario outlined in an aggressive 10-year plan. This action will include the regulatory framework provided by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This paper documents the regulatory documents and process that have been adopted at the Rocky Flats Environmental Technology Site (RFETS) to implement its decommissioning program. Each document is discussed in regards to its contents and its regulatory elements. The Rocky Flats Cleanup Agreement (RFCA), the tri-party agreement, implements the DOE/Environmental Protection Agency (EPA) guidance on decommissioning with the State of Colorado involvement. The Facility Disposition Process chronicle the cleanup process of the RFETS from operations to final disposition. The Decommissioning Program Plan (DPP) documents how decommissioning is conducted at RFETS. Decommissioning will utilize a Decommissioning Operations Plan (DOP) for high risk projects or the RFCA Standard Operating Protocol (RSOP) for all other buildings. Applicable or Relevant and Appropriate Requirements (ARARs) and administrative records will be included in each project. ARARs are discussed for general knowledge.

PRICE ANDERSON AMENDMENT ACT ISSUE TRACKING SYSTEM

John Ross
Compliance and Liability Manager
Los Alamos Technical Associates
Rocky Flats Environmental Technology Site
Mail Stop T886A, P.O. Box 464
Golden, CO 80402-0464

ABSTRACT

The Price-Anderson-Amendment-Act (PAAA) Issue Tracking System (PITS) was developed to support the effective management of the contractor's PAAA requirements at Department of Energy (DOE) Defense Program (DP) and Environmental Management (EM) sites to track and analyze potential and/or confirmed PAAA events. This system is a valuable tool that walks the user through the screening process, decision making process, and provides user friendly data input screens, along with tracking and trending, report writing, and performance indicator capabilities. The system is used to enhance Nuclear Safety Compliance, limit contractor liability, and to comply with DOE-Anderson enforcement guidance.

PITS is a relational database that retrieves historical information from several existing occurrence tracking systems in order to more efficiently provide accurate information in managing facilities and projects. This information is maintained on a file server, for access levels by those in the field with a need to update, track, and trend Price-Anderson information. The tool is extremely user friendly. The system architecture is designed to promote ease of use through pull down menus and navigational buttons. The main menu allows the user to enter the data entry, reports menu, or performance indicator development sections to easily update, view, or print information to fit their needs. The attached flow chart shows the components of each of these sections.

System security has been built into the system. The level of system access is determined by the program manager and appropriate access is provided by the system administrator. This system is easily customized to site needs. It can be customized and operational normally in five days. Training and complete familiarization of the system can take place in four hours. Included with the system is a desk instruction and help screens. The system is operational in both Apple and DOS operating environments.

This system can be set up for demonstration on a screen for conference participants to see for themselves what a complete and user-friendly tool we have developed.

WORKFORCE MOBILIZATION FOR D&D AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE (RFETS)

Gary W. Coles, Robert C. Easdon
Kaiser-Hill, L. L. C., RFETS, Colorado
Thomas G. Bourgeois
Rocky Mountain Remediation Services, RFETS, Colorado

ABSTRACT

Construction of the Site began in the early 1950's. Labor policies and precedence began to evolve from the time of initial construction. The Site was an active production facility through the Cold War. Labor agreements with the Colorado Building and Construction Trades Council, which represents the construction craft in local trade unions that support construction activities at the Site, and with the United Steelworkers of America, Local 8031, which represents production and maintenance workers at the Site, evolved in a production atmosphere.

With the end of the Cold War and the resulting change in mission for the nuclear weapons complex, labor agreements, work assignment practices and the jurisdictional precedence set in the production environment did not address the needs of the D&D mission. Organizational boundaries that served the Site for nearly fifty years became barriers. The organizational evolution of management and labor relations functions began with a consolidation of responsibilities. With labor relations responsibilities consolidated into one directorate, the task of forging the required work assignment guidelines and D&D agreements commenced.

Applicable federal requirements, such as the Davis-Bacon Act, practices that already were being used in the government arena, DOE and DOD demolition activities for example, as well as published DOL guidance was gathered, reviewed and compared with mission requirements and existing labor agreements. Two significant documents, the Site Work Assignment Guidelines and the D&D Agreement, were produced. The documents were presented to the Unions, and after negotiations, were accepted as the Sites labor guidance documents. The implementation of the provisions of these documents has allowed the start of cost efficient D&D of the Site.

DECONTAMINATION AND DECOMMISSIONING OF BUILDING 889 AT ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

K. A. Dorr, Kaiser Hill, R. J. Sexton
Scientific Ecology Group
M. E. Hickman, B. J. Henderson
Rocky Mountain Remediation Services

ABSTRACT

With the end of the Cold War the decontamination and decommissioning of surplus facilities at the Rocky Flats Environmental Site (RFETS) has begun. There are approximately 450 individual buildings to be dispositioned as part of the proposed 10-year plan. Only 35 of these facilities have significant levels of radiological and chemical contamination. The decommissioning of Building 889 was a major accomplishment for the Rocky Flats Environmental Technology Site and provided valuable lessons learned which are being incorporated in preparing for future decommissioning projects.

This paper discuses the Building 889 Decommissioning Project which was the first large scale decommissioning project of a radiologically contaminated facility at Rocky

Flats. The scope of the project consisted of the removal of all equipment and utility systems from the interior of the building, decontamination of interior building surfaces, and the demolition of the facility to ground level. The project was performed using proven decontamination and demolition techniques, incorporating lessons learned from previous DOE and commercial decommissioning projects.

Details of the Project Management Plan, which include; schedule, engineering, cost, characterization methodologies, decontamination techniques, radiological control requirements, and demolition methods are provided.

THE IMPACTS OF DECONTAMINATION AND DECOMMISSIONING ACTIVITIES ON WASTE MANAGEMENT PRACTICES AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Mary T. Aycock
Scientific Ecology Group, Rocky Flats, Colorado
Kent Dorr
Kaiser-Hill, L.L.C. Rocky Flats, Colorado

ABSTRACT

This presentation describes the lessons-learned, planning practices, and impacts on current waste management practices resulting from decontamination and decommissioning (D&D) activities at the Rocky Flats Environmental Technology Site (RFETS). The successful D&D of the RFETS site is dependent upon having waste management programs in place which address the eventual treatment, storage and disposal of D&D wastes generated as a result of the D&D process. This presentation discusses the impacts of the D&D process on waste management activities and the lessons learned in dealing with special waste considerations, including waste minimization for selected D&D projects at RFETS. The RFETS site has completed a series of D&D projects within the last year which have generated what are considered to be non-routine wastes which are not normally generated in day-to-day operations. The management of these wastes required technical as well as administrative modifications to the routine waste management practices at the site. The impacts discussed in this presentation include methods of performing waste characterization prior to and during D&D, waste packaging for unusual materials being generated (i.e. glove boxes, large tanks, etc.), waste storage considerations, waste recycling, and waste minimization techniques for decontamination of lead and other materials. The guidance for waste management planning is based on technical information presented in DOE/EM-0142P Decommissioning Handbook. The information presented implements the DOE program and would be of interest to others within the DOE complex who are performing D&D. RFETS has implemented a coordinated planning process between the D&D and Waste Management Divisions which incorporates the technical guidance provided in the DOE Decommissioning Handbook and the Rocky Flats Clean-up Agreement (RFCA).

FUTURE PLANS AND TECHNICAL NEEDS FOR RFETS

John Chapin (RMRS) and Terry Healy (KH)

ABSTRACT

The Department of Energy/Rocky Flats Field Office (DOE/RFFO) is faced with the challenge of decommissioning its weapons production facilities within the next ten years (i.e., 2006). Rocky Flats Environmental Technology Site (RFETS) has developed a comprehensive Decommissioning Program Plan and a 10-Year Site Plan to accomplish this monumental task.

The decommissioning projects at RFETS vary in complexity from simple, non-contaminated structures such as trailers, to large complex plutonium (Pu) contaminated buildings. The majority of these facilities will either be moved off-site for reuse or demolished. Of the over 500 facilities identified at RFETS, 8 are contaminated with Pu, 12 are contaminated with both uranium (U) and Pu, 34 have minor radioactive contamination, and the reminder have no known history of radioactive contamination.

The technical challenges reside within the small number of Pu and U contaminated facilities and are associated with gloveboxes, ductwork, and building surfaces.

SESSION 35-DATA MANAGEMENT

UNITED STATES OF AMERICA ACTIVITIES RELATIVE TO THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) INITIATIVE: RECORDS MANAGEMENT FOR DEEP GEOLOGIC REPOSITORIES

Peggy J. Warner
Records Manager
Nuclear Waste Management Programs Center
Sandia National Laboratories

ABSTRACT

The International Atomic Energy Agency (IAEA) has conducted consultant and advisory meetings to prepare a Technical Document which is intended to provide guidance to all IAEA Member States (otherwise known as countries) that are currently planning, designing, constructing or operating a deep or near surface geological repository for the storage and protection of vitrified high-level radioactive waste, spent fuel waste and TRU-waste (transuranic). Eleven countries of the international community are presently in various stages of siting, designing, or constructing deep geologic repositories. Member States of the IAEA have determined that the principle safety of such completed and operation sites must not rely solely on long term institutional arrangements for the retention of information. It is believed that repository siting, design, operation and postoperation information should be gathered, managed and retained in a manner that will provide information to future societies over a very long period of time. The radionuclide life is 10,000 years thus the retention of information must outlive current societies, languages, and be continually migrated to new technology to assure retrieval.

This presentation will provide an overview of the status of consideration and implementation of these issues within the United States efforts relative to deep geologic repository projects.

DATA MANAGEMENT FOR THE DISTANT FUTURE

M. Jensen
Swedish Radiation Protection Institute

ABSTRACT

Spent nuclear fuel from nuclear power generation will remain radioactive for millennia even though 99% of the radioactivity will have decayed within the first millennium. Certain information about the waste may be of value to keep for long time periods for future generations which may - intentionally or inadvertently - come into contact with the radioactive waste.

The function of a nuclear waste archive must be related to its purpose, that is the safety issues of the repository. There are several ways to interpret the notion of safety, and the unusual long time periods involved, require a thorough analysis of what the archive should achieve.

We find that analogies exist, but they are not immediately relevant as input to a discussion of an analysis which must embrace both the archive safety and the timely retrieval and use of the information to achieve the ultimate goal - safety. Work to describe this whole chain has barely begun.

Present day waste management should identify records to be part of a future post-closure archive for radioactive waste repositories.

AN EFFECTIVE WASTE TRACKING AND INVENTORY DATABASE - THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE WASTE AND ENVIRONMENTAL MANAGEMENT SYSTEM (WEMS)

Pamela W. Edrich, Dwan A. Franks, M. Kay Prideaux, and Veronica Santistevan,
Rocky Mountain Remediation Services

ABSTRACT

The Rocky Flats Environmental Technology Site (RFETS) currently has over 70,000 containers of waste in storage, and approximately 225 new containers of waste are generated each month. A waste tracking and inventory database known as the Waste and Environmental Management System (WEMS) has been in use at RFETS since the early 1990's. The system is used daily by approximately 100 users to track waste, access a variety of information concerning individual waste containers, and acquire useful inventory data for waste planning and strategy determinations.

The WEMS database can accept up to 1200 pieces of information on each waste container, including container number, waste type, characterization and content information, weight and volume, radioassay results and radiation readings, generation and storage locations, generation start and fill dates, and information concerning waste non-conformances. In addition to accepting information concerning the generation and movement of waste, WEMS has several modules which allow the WEMS user to record waste management operations such as:

- Repackaging a container.
- Correcting non-conformances.
- Venting and aspirating a container.
- Monitoring organic air emissions.
- Transferring liquid waste in tanks.
- Selecting drums for supercompaction.
- Shipping waste to offsite facilities.

History files are maintained on every container of waste so that a user can quickly access information regarding every movement and operation that has occurred for that container.

The data contained in WEMS is considered a part of the RCRA Operating Record for the RCRA regulated waste generated and stored onsite. WEMS also provides information required by offsite waste disposers and treaters.

WEMS features a variety of standard reports, easily accessible by the WEMS user to query the database and print out a predetermined set of data for selected storage units and containers. Additionally, computer analysts supporting the WEMS users can create specialized reports to meet the requestor's data needs.

LOS ALAMOS PLUTONIUM FACILITY WASTE MANAGEMENT SYSTEM

Kathryn Smith, Andrew Montoya, Ronald Wieneke, Dennis Wulff, Chester Smith, and
Kathleen Gruetzmacher
Nuclear Materials Technology Division, LANL
Los Alamos, New Mexico, 87545

ABSTRACT

This paper describes the new computer-based transuranic (TRU) Waste Management System (WMS) being implemented at the Plutonium Facility at Los Alamos National Laboratory (LANL). The Waste Management System is a distributed computer processing system stored in a Sybase database and accessed by a graphical user interface (GUI) written in Omnis7. It resides on the local area network at the Plutonium Facility and is accessible by authorized TRU waste originators, Non-Destructive Assay (NDA) Laboratory personnel, radiation protection technicians (RPTs), quality assurance personnel, and waste management personnel for data input and verification. Future goals include bringing outside groups like the LANL Waste Management Facility on-line to participate in this streamlined system. The WMS is changing the TRU paper trail into a computer trail, saving time and eliminating errors and inconsistencies in the process.

MATERIAL FLOW MONITORING SYSTEM FOR HOTCELL SAFEGUARDS USING NEURAL NETWORK

Ho Dong Kim , Young Soo Park, Jong Sook Hong
Korea Atomic Energy Research Institute

ABSTRACT

As the concept of DUPIC (Direct Use of spent PWR Fuel in CANDU) has emerged as a new technological option for the nuclear fuel cycle in Korea, it became necessary to develop a viable safeguards system. To this end, this paper presents a neural network based diagnostic system for safeguarding radioactive material flow into and out of hot cell environments. While the surveillance system consisting of a CCD camera and NDA equipment continuously monitors the material flow, the sensory data are integrated to a neural network to automatically diagnose the normal and off normal conditions of material flow. Unlike other existing safeguards systems, the presented system facilitates detailed identification on the validity of material flow path, type of container and radiation source in real-time. The integral part of the multisensory system and analytical paradigm may provide an effective technological alternative for safeguarding of new conceptual hotcell facilities such as the DUPIC facility.

SESSION 36-POSTER-HLW/TRU & D&D

DEVELOPMENT AND APPLICATION OF SEPARATION TECHNOLOGIES FOR THE TREATMENT OF RADIOACTIVE WASTES

T. A. Todd, K. N. Brewer, J. D. Law, D. J. Wood, T. G. Garn, R. D. Tillotson, P. A. Tullock, and E. L. Wade
Lockheed Martin Idaho Technologies Co.

ABSTRACT

Separation technologies for the treatment of radioactive wastes, including highly radioactive liquid wastes, solid calcined wastes, mixed wastes and contaminated groundwater are under development at the INEL. An overview of the technologies under development, specific applications of the technologies, and the benefits derived from use of the technologies are discussed. The INEL has recommended radionuclide partitioning technologies for the treatment of high activity wastes. This alternative involves the separation of radionuclides and possibly RCRA metals from the existing liquid tank waste and HLW calcine. The results of recent tests, including countercurrent pilot plant demonstrations of solvent extraction processes with actual tank waste, are presented. Removal of radionuclides to levels below the NRC Class A LLW criteria has been demonstrated. Results of tests to remove cesium and strontium from contaminated groundwater using highly-selective ion-exchange sorbents are also presented. Removal of cesium and strontium to below drinking water standards (119 pCi/L and 8 pCi/L) has been demonstrated.

IMMOBILIZATION OF FISSION PRODUCTS IN LOW-TEMPERATURE CERAMIC WASTE FORMS

D. Singh, A. S. Wagh, M. Tlustochowicz, and V. Mandalika
Energy Technology Division
Argonne National Laboratory
Argonne, IL 60439

ABSTRACT

Over the last few years, Argonne National Laboratory has been developing room-temperature-setting chemically bonded phosphate ceramics (CBPCs) for use insolidifying and stabilizing low-level mixed wastes. The focus of this work is development of CBPCs for use with fission-product wastes generated from high-level waste (HLW) tank cleaning or other decontamination and decommissioning activities. The volatile fission products such as Tc, Cs, and Sr removed from HLW need to be disposed of in a low-temperature immobilization system. Specifically, this paper reports on the solidification and stabilization of separated ^{99}Tc from Los Alamos National Laboratory's complexation-elution process. Using rhenium as a surrogate form technetium, we fabricated CBPC waste forms by acid-base reactions. Dense and hard ceramic waste forms are produced in this process. The principal advantage of this technology is that the contaminants are immobilized by both chemical stabilization and subsequent microencapsulation of the reaction products. This paper reports the results of durability studies conducted on waste forms made with 35 wt.% waste loading. Standard leaching tests such as ANS 16.1 and PCT were conducted on the final waste forms. In addition, stability of the waste forms in aqueous environments was evaluated by long-term water-immersion tests.

PROGRESS ACHIEVED IN SILICA GEL SOLIDIFICATION TECHNOLOGY

Anna Nardova, Evgeny Filippov
Russian Research Institute for Chemical Technology, Moscow
Evgeny Dzekun, Konstantin Korchenkin, Alexander Mashkin
"Mayak" Production Association, Ozersk

ABSTRACT

In Russia in the late 1980's, Russian Research Institute for Chemical Technology in cooperation with "Mayak" Production Association developed technology for solidification of liquid radioactive wastes by the method of high temperature adsorption of radionuclides on porous inorganic matrices. The goal of the investigation is to develop a procedure for liquid HLW, transuranic- and long-lived waste solidification meeting the requirements of the environmental safety and generating the ultimate waste form suitable for long-term safe storage 1).

The process is based on adsorption of radionuclides and stable metals at boiling point of solution by inorganic sorbents, for example, silica gel, followed by baring saturated granules. Waste solution and silica gel pellets are mixed and thermally treated (100 - 130°C). When the solution had completely evaporated the silica gel was dried until granulation occurred. The drying and calcination procedures were carried out at temperatures of 220 - 1,000°C 2&3).

The process was developed initially for the processing of high level waste and was demonstrated small scale on real HLW solutions. The results achieved recently indicate that this method could be used for the immobilization of plutonium, neptunium, americium, technetium on inorganic matrices.

This report presents the results of investigation of actinides (Np, Pu, Am) and Tc immobilizationfrom solutions on silica gel with the purpose to producing a solid waste form.

THE HIGH TEMPERATURE ADSORPTION METHOD FOR SOLIDIFICATION OF NEPTUNIUM

K.K.Korchenkin, A.N.Mashkin, E.G.Dzekun
"Mayak" Production Association, Ozyorsk, Russia
A.K.Nardova
Russian Research Institute for Chemical Technology, Moscow, Russia

ABSTRACT

The problem of neptunium converting into solid form has been considered. Aspects of behaviour of neptunium have been investigated if handling of radionuclide solutions by the Method of high temperature adsorption using porous inorganic matrices (if using silica gel, it has been named as Silisorb Method). Particular emphasis has been placed on the production of solid form for the controlled temporary storage (with possible return of neptunium in solution).

The samples of solidified neptunium were prepared by the following procedure. The silica gel charge was placed in the reaction vessel into which the initial solution was than dosed. The initial solution consist of nitric acid one of neptunium with some additives in specific cases. The initial solution was boiled off to dryness. The loading of silica gel by neptunium was up to 600 mg/g in some tests. Thereafter the calcination of saturated sorbent was carried out at different temperature. Neptunium may be desorbed, if need be, by nitric acid. It has been found experimentally that the loading and strength of fixation depends on the conditions of sorption process, composition of initial solution and valence form of neptunium. The distribution of neptunium, daughters, residual attendant and fission products of it was examined between the solid and vapour-gas phases. The purification coefficient has reached several thousands for neptunium and several tens of thousands for other radionuclides. The possibility for reuse of regenerated neptunium was determined. All results are consistent with the specifications that can be placed upon the reprocessing of neptunium solutions by solvent extraction method. The recovery of neptunium was carried out for samples of saturated silica gel which had been kept on deposit for 1.5 year. Mechanical degradation of silica gel wasn't detected. The yield of the element reaches up to 99.9 %.

The production of solidified form for neptunium, which is suitable for temporary storage and transport, is a result of our testing. Conversion to form, which is suitable for long-term storage, may be easily realized. The reprocessing process and final product satisfy the ecological requirements and radiation safety standards.

SEPARATION AND FIXATION OF FISSION PRODUCTS FROM LIQUID WASTE SOLUTION USING INORGANIC ION EXCHANGERS

I.M. El-Naggar, E.S. Zakaria, M.M. Abu-Mesalam and H.F.Aly
Hot Labs. Centre, Atomic Energy Authority,
P.O.Code 13759, Cairo, Egypt

ABSTRACT

Tin(IV) antimonate (SnSb), cerium(IV) antimonate (CeSb), silicon(IV) antimonate (SiSb) and titanium(IV) antimonate (TiSb) were prepared under various conditions. The ion-exchange properties and the thermal stability of these materials were examined in order to elucidate their applicability to the processing of radioactive liquid wastes. Capacity, equilibrium measurements,adsorption isotherms and the selectivity patterns for Cs^+, Sr^{2+}, Co^{2+} and Eu^{3+} ions on these sorbents at different conditions were determined.

The effect of high concentrations of salts and complexing agent as interferring ions in the feed solutions on the distribution coefficient of the metal mentioned above was tested as a function of $[HNO_3]$.

Based on the obtained results, practical separation experiments on column were performed.

IMMOBILISATION OF HLW FRACTIONS FROM HANFORD IN SYNROC

A. Jostsons, E. R. Vance, K. P. Hart, R. A. Day, B. D. Begg, M. L. Carter
Australian Nuclear Science and Technology Organisation (ANSTO)
PMB 1, Menai, N.S.W. 2234, Australia

ABSTRACT

The behaviour of 3 wt.% each of Cs_2O and Tc in Synroc has been studied as part of a strategy to develop improved methods of immobilisation of some of the HLW streams envisaged to be separated during Hanford Tank Waste remediation. Low losses of Tc (10^{-1}-10^{-3}%) and Cs (~ 0.1%) were measured during calcination at 750°C in argon and 3.5% H_2N_2 atmospheres, with and without formic acid pre-treatment. The Tc loss by volatilisation under typical Synroc process conditions was in the range of 1-30 x 10^{-3}%. X-ray absorption spectroscopy measurements showed that the Tc valence in the calcine varied with the calcination atmosphere. The normalised Tc differential leach rate in deionised water at 70°C, from hot-pressed specimens in which the Tc was immobilised in the metallic state, was 2.5 x 10^{-6} g/m²/d after 56 days. The general viability of Synroc/glass composite for immobilising the Hanford HLW sludges is further demonstrated using an "All-blend" waste formulation containing uranium.

CHARACTERIZATION OF HANFORD K BASIN FUEL AND SLUDGE: A SECOND LOOK

B. J. Makenas, R. B. Baker, A. L. Pitner, D. J. Trimble and R. P. Omberg
Duke Engineering & Services Hanford, Inc.
Post Office Box 350
Richland, Washington 99352-0350

ABSTRACT

Characterization of N Reactor metal spent fuel and associated sludge stored in the two Hanford K Basins has entered a more mature stage. Previous campaigns had consisted of top-view visual surveys of open fuel canisters, limited collection of gas and liquid from sealed canisters, detailed examinations of only a few fuel elements and collection of sludge from the floor of only one basin. More recent work has included lifting fuel elements from both Basins to ascertain bottom end and circumferential cracks. Sludge collection has now been performed for material residing inside of spent fuel canisters in both Basins. Finally the number of gas and liquid samples from sealed canisters has been greatly expanded leading to a maximum observed cesium-137 content ten times higher than previous reports. Characterization has been a challenge because of the age of the fuel materials, the water environment, and the radiation field.

ACCIDENT AT SIBERIAN CHEMICAL COMPLEX IN TOMSK-7 ON APRIL 6, 1993

V.N. Mineev, A.V. Mineev
High Energy Density Research Center of the Institute for High Temperatures (IVTAN)
Russian Academy of Science. Izhorskaya, 13/19, Moscow, 127412, Russia

ABSTRACT

Considering a data about an accidental explosion of a chemical extraction reactor (description event, radioactive situation). Analysis of an explosion ruin show a realized explosive energy is equivalent to 100 kg TNT explosion.

Nature of an explosion is demonstrated to connect with formation of an auto-ignition explosive substance when mixing a contents reactor is absence. Mechanism formation of a gas and liquid systems fuel-oxidizer is discussed.

This off-process has much in common with a gas release event in high-level waste tanks (Norton G. McDuffie, Westinghouse Hanford Company) and a light water nuclear reactor, in particular reactors of a nuclear submarines.

IMPROVED NEW SHIELDING MATERIALS FOR SPENT FUEL AND HIGH LEVEL WASTE STORAGE, TRANSPORTATION, AND DISPOSAL CASK DESIGN

Steven M. Mirsky, Alexander P. Murray, and Stephen J. Krill, Jr.,
Science Applications International Corporation (SAIC)
20201 Century Boulevard,
Germantown, Maryland 20874

ABSTRACT

Adequate shielding of highly radioactive materials remains a concern for both the nuclear industry and the public, particularly for spent nuclear fuel (SNF) and high-level waste (HLW). Current shielding relies upon heterogeneous combinations of metal and hydrogenous materials or mammoth concrete structures. This paper discusses new shielding materials and concepts based upon dense uranium dioxide that provide optimal neutron and gamma shielding for SNF and HLW applications. The materials include "DUCRETE" - a combination of uranium dioxide and concrete - and other improved materials. The new materials possess superior heat transfer and shielding characteristics in a single material, without the processing difficulties of uranium metal. One shield material is composed of waste products from the nuclear and petrochemical industries which, when combined and treated, becomes suitable for direct emplacement in a future geologic repository. These new shield materials are ideal for use in SNF and HLW storage, transport, and disposal casks resulting in smaller, lighter, and less expensive casks than comparable current designs. Using the standard regulatory analysis approach, a typical 24 PWR SNF assembly storage cask would use a shield wall which could be as much as 50%-70% thinner than current concrete cask designs and would eliminate the need for internal heat removal air passages. Typical, loaded cask weights are in the 80-90 tonne range and reduce operator exposure as compared to existing designs. Key shielding, thermal, and chemical properties are presented to demonstrate the capabilities, including its suitability for direct disposal of the dense uranium dioxide material. Cost estimates are also provided for typical cask designs, and indicate competitive life cycle costs are achievable. The paper concludes that this nonmetallic, dense uranium dioxide shielding allows the advantages of metal casks to be achieved with lower life cycle costs than either metal or concrete casks, in an environmentally compatible package.

USE OF THERMALLY BONDED PRESSURE EQUALIZATION CAPS FOR INTERIM STORAGE OF SOLUBILIZED PLUTONIUM AND URANIUM AQUEOUS SOLUTIONS

Terry J. Wickland, Nuclear Filter Technology, Inc.
William V. Conner, Los Alamos Area Office, Rocky Flats Plant

ABSTRACT

At the Rocky Flats Plant draining process pipes and tanks that contain as much as 140 grams per liter of plutonium in aqueous hydrochloric acid and nitric acid solutions pose a challenge for interim storage. Solubilized plutonium solutions stored for up to six years in pipes and tanks are drained into one-gallon polyethylene bottles for interim storage until permanent solidification or immobilization may be conducted. Until the solutions are treated, they are stored in one-gallon, low density or high density polyethylene bottles capped with threaded polypropylene tops. At the Rocky Flats Plant, experience has shown that radiolytic effects, specifically, hydrogen gas generation, pressurizes the bottles which accelerates embrittlement of the polyethylene bottle.

Nuclear Filter Technology has developed a low cost method of safely venting the hydrogen gas from the poly-bottles through a Gore-Tex® membrane, which is permeable to vapors yet impermeable to liquids. Pressure equalization caps (PEC's) allows hydrogen gas diffusion, yet retention of liquids in the event that the bottle is capsized. The membrane is thermally fused to the interior surface of the polypropylene cap. With the thermally bonded membrane, the pressure equalization cap is physically durable, and chemically resistant to the severe acid conditions of the liquid waste. The PEC's have undergone extensive testing including acid compatibility tests to verify vent integrity after exposure to hydrochloric acid (HCL), nitric acid HNO_3 and mixtures of both acids for periods of 40 days and longer. The PEC's allow the safe release of gas that may be generated in the storage of solubilized uranium or plutonium, yet will retain liquid contents in the event that the bottle is capsized. The membrane also filters out greater than 99.97% of submicron particulates which is verified by challenging the membrane with a stream of DOP aerosol and measuring filtration efficiency with an optical photometer.

The established performance criteria for the PEC's are that each vent, after 40 days of exposure to 6.0 Normal nitric, hydrochloric or 50/50 mixture of each acid, must prove to be leak tight (no liquid release) for a period of 8 hours, given a liquid head pressure of 0.92 psi.

Test results demonstrate that the membrane and the sealing mechanism of thermally fusing the membrane to the polypropylene cap is durable and tolerant of the acidic vapors. It has been demonstrated that the PEC's will withstand liquid head pressure of 0.92 psi, for periods of 8 hours and longer, even after 40 days of exposure to the acids. Further, each cap was tested for liquid release at a pressure of 7 PSI after six months of exposure to the acids. None leaked during the pressure test which lasted for 6 hours.

SUCCESSFULLY IMPLEMENTING A GRADED APPROACH TO SMALLER WASTE MANAGEMENT PROJECTS THROUGH CLARITY AND SIMPLICITY

Subhash C. Sethi
BSRI
Mary L. Windmiller
DOE-SR
Bansi K. Patel, Peter L. Nowacki
WSRC

ABSTRACT

A graded approach to problems in waste management is a powerful and flexible tool that can provide the environmental engineer with innovative and cost-effective solutions a better way to do more with less. Throughout the Savannah River Site (SRS) and the Department of Energy complex, requirements and Orders are being revised or eliminated as part of a new initiative, the "necessary and sufficient" process. The results achieved by using a simple and clear graded approach are twofold. Projects cursed from the beginning with high costs and tight completion dates can be brought in under budget and ahead of schedule. The graded approach used on the New Solvent Storage Tanks (NSST) project at SRS is applicable complex-wide and for private industry too. Using a graded approach process resulted in cost savings for the NSST project (a $6M project) of $2.5M (Reference cost data).

A NEW GENERATION MONITOR FOR RADON IN STACK EMISSIONS

C. R. Whitley, P. A. Steadman, D. W. MacArthur, J. G. Conaway
LANL

ABSTRACT

This paper describes a radon monitor developed at the Los Alamos National Laboratory for analyzing stack emissions from the Fernald Vitrification Facility pilot plant now under construction. During the vitrification process, radon offgas is expected to be released into the atmosphere even though radon scrubbing systems will be used. To operate the plant in the most economical way, it is desirable to have a reliable radon monitor that would prevent the occurrence of unnecessary and costly shutdowns. The monitor described here incorporates long-range alpha detection (LRAD) technology. Its intended purposes are to supplement other radon monitoring systems at Fernald and to demonstrate the sensitivity and reliability of this new type of monitor.

The monitor is to receive a continuous, HEPA-filtered, isokinetic sample of stack emissions. With LRAD technology, ions created in the detector volume by energy loss mechanisms of decay alphas are collected on a charged plate, and the current generated by this is measured with a sensitive electrometer. In electrostatic LRAD designs, the linearity of the measured current with gross alpha activity is well-established. To address the potential presence of thoron (^{220}Rn) in the emissions, a double-chambered monitor was designed to discriminate between thoron and the radon isotope of interest (^{222}Rn). This method relies on a continuous flow of the sample through the detector, with a length of pipe between the two detection chambers providing a time delay that allows substantial decay of the relatively short-lived thoron. A computer code then unfolds the amount of ^{222}Rn present in the stack. In addition, the code accounts for plating of the charged daughter products from both isotopes on the interior surfaces of the detector, which themselves can contribute greatly to the gross alpha activities. The algorithm has been shown to be stable and self-correcting in laboratory studies.

Calculations and the results of tests and preliminary calibrations show this monitor can detect the presence of ^{222}Rn in concentrations from 20 pCi/l to nearly 100,000 pCi/l. The tests indicate the monitor can achieve the design goal of detecting concentrations as great as 200,00 pCi/l, and have a minimum sensitivity of 10% throughout its range using a five minute integration time. The monitor should provide a rugged, reliable, and sensitive radon detection system requiring little maintenance.

DEVELOPMENT AND IMPLEMENTATION OF A MIXING OF SHIPPING CATEGORIES METHODOLOGY FOR CERTIFYING TRUPACT-II PAYLOADS

Sinisa M. Djordjevic and L. Richard Spangler
Benchmark Environmental Corporation
Michael J. Connolly
Lockheed Martin Idaho Technologies Company

ABSTRACT

Each CH-TRU waste container destined for the Waste Isolation Pilot Plant (WIPP) is designated by a Transuranic Package Transporter-II (TRUPACT-II) shipping package shipping category based on the type of container (i.e., drum, standard waste box, or ten-drum over pack), the type of waste material, and the packaging configuration (i.e., number and type of plastic confinement layers). Each waste container is assigned a unique wattage (decay heat) limit based on the shipping category. Currently, all containers forming a payload in a single TRUPACT-II are required to belong to the same shipping category. As a consequence, many shipments may be made with dunnage (empty) drums as part of the payload because of the difficulty in assembling enough containers of the same shipping category.

A methodology was developed to allow any combination of shipping categories with either drum or SWB payload containers to be mixed within the TRUPACT-II. The methodology takes credit for shipping less than the maximum allowable number of containers and the additional void volume of dunnage containers. A computer program was developed in the Java programming language to implement this methodology. The computer program incorporates a graphical user interface (GUI) that facilitates data input, performs a series of checks to eliminate invalid input, provides for software revision control, and facilitates the certification process. Upon acceptance of the methodology and computer program by the U.S. Nuclear Regulatory Commission (NRC), a trained operator can use the computer program to configure individual TRUPACT-II shipments from the available inventory at a site, minimizing the need to utilize dunnage containers or repackage higher wattage containers for shipment.

USE OF MGO TO MITIGATE THE EFFECT OF MICROBIAL CO_2 PRODUCTION IN THE WASTE ISOLATION PILOT PLANT

Yifeng Wang
Sandia National Laboratories
WIPP Chemical & Disposal Room Department, MS 1341,
P. O. Box 5800, Albuquerque, NM
Laurence H. Brush
Sandia National Laboratories
WIPP Chemical & Disposal Room Department, MS 1341,
P. O. Box 5800, Albuquerque, NM 87185-1341
Richard Vann Bynum
SAIC, Inc.
Albuquerque, NM 87106

ABSTRACT

A large quantity of organic materials will be emplaced in the waste isolation pilot plant (WIPP). Those material will potentially be biodegraded in the presence of liquid water in the repository, producing a large amount of CO_2. The accumulation of CO_2 in the repository will (1) acidify the brine, through the dissolution of carbon dioxide and the dissociation of carbonic acid in the brine, and (2) increase the concentrations of carbonate species capable of forming stable complexes with actinides in the solution. Those detrimental effects, however, can be effectively mitigated by adding MgO backfill. The MgO reactions will practically remove all CO_2 from both gaseous and liquid phases and buffer the brine pmH within a desired range, thus significantly improving the WIPP long-term performance.

THE IMPACT OF HETEROGENEITY OF FRACTURED MEDIA IN MONTE CARLO ASSESSMENTS OF HIGH-LEVEL NUCLEAR WASTE.

M. Andersson, B. Mendes and A. Pereira
Dep. of Physics, Stockholm University
Box 6730, S-113 85 Stockholm, Sweden.

ABSTRACT

The impact of the heterogeneity of fractured media on the risk estimations obtained from a radionuclide transport model is studied. The model used is the CRYSTAL3D model, which has been developed for use in probabilistic assessments. CRYSTAL3D is used as a submodel of a parallel Monte Carlo driver now under development for the GESAMAC project. Case calculations have been done for ^{243}Am. They confirm previous results concerning the effect of heterogeneity along the nuclide transport pathway. Peak releases tend to decrease, as does the variance of the output distribution of the consequences, i.e., the uncertainty results are narrowed for the peak distribution due to the averaging of properties along the pathway.

The downside for increasing the realism of the model is two-fold: first, one needs high-performance computing resources, and second, extra complexity is introduced in the sensitivity analysis of the results. In our sensitivity analysis the parameter distributions have been reduced to single numbers, in this paper, to median values which make it possible to apply the usual sensitivity analyses methods to rank the importance of the geosphere parameters.

A preliminary evaluation of the performance of the parallel Monte Carlo driver shows very satisfactory results.

LOS ALAMOS PLUTONIUM FACILITY NEWLY GENERATED TRU WASTE CERTIFICATION

Kathleen Gruetzmacher and Andrew Montoya
Nuclear Materials Technology Division, LANL
Barbara Sinkule
Chemical Sciences and Technology Division, LANL
Marshall Maez
Environmental Safety and Health Division, LANL
Los Alamos, New Mexico, 87545

ABSTRACT

This paper presents an overview of the activities being planned and implemented to certify newly generated contact handled transuranic (TRU) waste produced by Los Alamos National Laboratory's (LANL's) Plutonium Facility. Certifying waste at the point of generation is the most important cost and labor saving step in the WIPP certification process. The pedigree of a waste item is best known by the originator of the waste and frees a site from many of the expensive characterization activities associated with legacy waste. Through a cooperative agreement with LANLs Waste Management Facility and under the umbrella of LANLs WIPP-related certification and quality assurance documents, the Plutonium Facility will be certifying most of its own newly generated waste.

Some of the challenges faced by the Plutonium Facility in preparing to certify TRU waste include the modification and addition of procedures to meet WIPP requirements, standardizing packaging for TRU waste, collecting processing documentation from operations which produce TRU waste, and developing ways to modify waste streams which are not certifiable in their present form.

HYDROGEN DIFFUSIVITY THROUGH THREE TYPES OF TAPE SEAL ON A VOLLRATH® 88020 STAINLESS STEEL SLIP-LID DRESSING CONTAINER

Terry J. Wickland, Nuclear Filter Technology, Inc.
Marty Mataya, Safe Sites of Colorado, Rocky Flats Plant

ABSTRACT

The hydrogen diffusion rate through three different types of tape seal on a 2 quart Vollrath® slip lid dressing container have been measured. The three different types of tape --either yellow Slipknot® #44 Vinyl, Slipknot white polyethylene, or 3M brand # 850 aluminized polyester tape, are presently used throughout the DOE complex for securing the lid to the body of the Vollrath 88020 slip lid dressing container. In addition to measuring the diffusion of hydrogen through a single layer of tape, the effect of a second layer of tape on hydrogen diffusivity has been measured. The measurements are the first of their kind and are required to assure that potentially explosive concentrations of hydrogen gas do not accumulate within the containers that are used to store plutonium residues.

THE SEPARATION AND DETERMINATION OF PLUTONIUM IN TWO LOW LEVEL RADIOACTIVE WASTE STREAMS

K.I. Burns and D.W. Everall
AECL
Chemistry and Chemical Engineering Division
Chalk River Laboratories
Chalk River, Ontario, Canada K0J 1J0

ABSTRACT

A program was initiated at Chalk River Laboratories (CRL) to determine the physical, chemical and radiological properties of wastes intended for disposal in IRUS (Intrusion Resistant Underground Structure), a belowground vault to be constructed at CRL. The isotopes of plutonium are among the most restrictive radionuclides for IRUS due to their high radiotoxicity and long half lives. A radiochemical method has been developed to determine ^{238}Pu, $^{239+240}Pu$ and ^{242}Pu in two waste streams, incinerator ash and liquid feed to a bitumenizer. Samples are spiked with ^{236}Pu tracer, dried and fused at 960°C with $Li_2B_4O_7/LiBO_2$ (2:1) in a platinum boat. The plutonium is then separated by solvent extraction, electrodeposited onto stainless steel counting planchettes and measured by α-spectrometry. Limits of detection for plutonium in solids are typically 0.01 Bq/g based on a 1-gram sample, a 4-hour counting period, and a 5% counting efficiency. This paper presents a summary of the method and the results from analysis of the two waste streams.

DECONTAMINATION AND DISMANTLEMENT OF GLOVEBOXES IN BUILDING 371 AT ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

R. J. Sexton
Scientific Ecology Group
M. E. Hickman, B. J. Henderson
Rocky Flats Environmental Remediation Services
Golden, CO 80402

ABSTRACT

With the redirection and discontinuation of plutonium processing at Rocky Flats, development and installation of plutonium residue processing systems has begun. To accommodate these new systems, many of the existing process equipment must be decontaminated, dismantled, and removed.

This paper discuses the removal of gloveboxes in Building 371 to accommodate the installation of new plutonium waste processing equipment. The scope of this project consists of removal of process equipment from the glovebox, decontamination of the internal surfaces of the glovebox, removal of all processes piping, ventilation, and drain systems from the glovebox, and in-place size reduction of the glovebox.

DECOMMISSIONING OF GLOVEBOXES FROM BUILDING 707 AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Timothy J. Humiston
Rocky Mountain Remediation Services, L.L.C.
P.O. Box 464, Golden, CO 80402-0464,
a member of the Kaiser-Hill, L.L.C. Team at the U.S. Department of Energy's
Rocky Flats Environmental Technology Site, Golden, Colorado

ABSTRACT

Five glovebox systems were decommissioned from Building 707 at the Rocky Flats Environmental Technology Site (the Site) to make room for a new packaging and stabilization process line. Methodology, equipment developments, and lessons learned are presented. The greatest challenge for the project was to decommission the gloveboxes and simultaneously keep the area fully functional, (e.g., off respiratory protection) so the building operations personnel could perform plutonium thermal stabilization. The decommissioned gloveboxes were attached to the same glovebox system as the one used for stabilization. One of the resulting project constraints was that no in-situ glovebox size reduction was allowed. The gloveboxes were therefore, removed whole and transported to a remote size reduction facility. This was due to the requirement to keep the stabilization process operational. Several innovative pieces of equipment resulted from this constraint, including: specialized window and bracket assembly for breach-less window changes, internal glovebox isolation devices, and a glovebox flange attachment that allows a breach-less new glovebox installation after attachment. To keep radiation exposure and radiological contamination to As Low As Reasonably Achievable, strippable coatings were used. A valuable secondary benefit was that the coated gloveboxes were reduced from transuranic to low level waste with the application and removal of two coats. Direct radiological measurements were taken inside the gloveboxes with a Ludlum® 12A combined with a 10% efficiency probe before and after application. The result was a decontamination factor of greater than 10, enough to bring the gloveboxes into the low level waste category.

WIP-III: THE WASTE OPERATIONS DATA MANAGEMENT SYSTEM AT AECL'S CHALK RIVER LABORATORIES

M.A. ter Huurne, G.W. Csullog, S.M. Dunford, V.R. Hulley, J.D.M. Martin, M.T. Miller
Atomic Energy of Canada Limited, Chalk River Laboratories
Chalk River, Ontario, Canada, K0J 1J0

ABSTRACT

The Waste Inventory Programs (WIP) application was developed by Atomic Energy of Canada Limited (AECL) in the mid 1980's as a typical, inventory database to record and report on wastes in AECL's storage facilities. The latest version, WIP-III, was developed to integrate waste inventory management with a variety of day-to-day waste management operations, by incorporating functions such as:

- Invoicing for waste management services provided to customers.
- Tracking of preshipment (waste data sheet) non-conformances.
- Integration of inspection and compliance monitoring data.
- Integration of hazardous waste classification.
- Recording/reporting inspection and compliance monitoring non-conformances/corrective actions.
- Recording and reporting of authorized changes to data.
- Automatic categorization for disposal by comparing quantities of contaminants reported with contaminant limits established by performance assessments.
- Linking of waste characteristics reported to supporting documentation.

Routine waste acceptance is supported by the Waste Identification (WI) Program, which requires generators to (1) develop waste management plans, (2) provide facility maps and process/waste flow sheets and (3) assess the characteristics of their processes and each routine "waste block" generated. The information about process and waste block characteristics is entered into WIP-III, which assigns a unique identifier to each process and waste block.

WIP-III prints hard copy, template data sheets that are pre-populated with the information entered from the WI Program. In addition, by entering a waste block number, the WIP-III electronic data sheet is also pre-populated with the same information. Template data sheets (1) simplify generator training, (2) minimize generator effort for "paperwork", (3) make data entry faster and less prone to errors and (4) directly link the information on waste data sheets (used for day-to-day shipments) to the information assembled in the WI Program.

WIP-III is a client/server application. The user interface is a Windows front-end developed usingPowerSoft's PowerBuilder development tools. A VAX server runs the ORACLE7 relational database where the data reside. Data access points are PCs (at least 486) running Microsoft Windows v.3.11 or Windows 95.

The application was developed in phases, with pre-defined documentation and deliverables reviewed and approved at each phase. Extensive manual and automated testing of each phase rounded out the QA development process.

Design issues for each phase focused on integrating the application's functions with work processes. Data integrity is also a major feature of the application - validation rules and limits are verified for each field and many enterable fields only allow selection from an authorized 'lookup list'.

MANAGEMENT OF LOW-LEVEL AND INTERMEDIATE WASTES IN ALBANIA

Luan Qafmolla
Chemist Engineer,
Institute of Nuclear Physics
Tirana, Albania

ABSTRACT

This paper presents the main activities in Albania for the treatment of radioactive wastes generated during the last years due to the nuclear physics research and application in different fields including nuclear medicine, industry, agriculture, etc.

BENCHMARK ENVIRONMENTAL RADIOACTIVITY AT A RESEARCH REACTOR SITE

S.R. Bose, R. U. Mulder
Department of Mechanical, Aerospace and Nuclear Engineering,
University of Virginia, Charlottesville, VA 22903
C.A. Sondhaus, D. Silvain
Department of Aerpspace and Mechanical Engineering,
University of Arizona, Tucson, AZ 85721.
M. E. Wacks
Radiation Control Office, University of Arizona, Tucson, AZ 85724

ABSTRACT

The assessment of pre-operational benchmark radioactivity in and around a nuclear facility is necessary to determine whether an observed change in the radioactivity levels is due to the operation of the facility. A detailed investigation of radioactivity levels in soil samples obtained from sites at the University of Arizona (UA) campus and at the off-campus Page Ranch Radioactive Waste Repository (now closed) was carried out during 1994-95. The on-campus soils were analyzed to evaluate a potential influence on the radioactivity in the local environment due to research application of isotopes at various laboratories at the University and operation of the UA TRIGA reactor. Unfortunately, no background measurements were made prior to operation of either facility. In the absence of baseline data, off-campus soils at and near the repository were analyzed to compare radioactivity in these samples as well as with the University samples in reference to soil samples collected on the UA campus.

The variation in natural radioactivity found was attributed to normal ranges due to soil and rock type affected by natural erosion, weathering and rock ageing processes. The results indicate that reactor fission or activation products are not present in the soils obtained from the UA either on- or off-campus. However, measurable levels of 137 Cs fallout were observed in both on- and off-campus samples. These variations are not related to the research reactor activities but to natural processes such as rainfall variations, wind patterns and surface water flow.

SESSION 37-ENVIRONMENTAL RESTORATION - POLICIES AND PROGRAMS

"LESSONS LEARNED" - A COMPARISON OF THE PROPOSED ON-SITE WASTE MANAGEMENT FACILITIES AT THE VARIOUS DEPARTMENT OF ENERGY SITES

Dipti Singh
Booz Allen and Hamilton
8283 Greensboro Drive
McLean, VA, 22102
Hector Rodriguez
U.S. Department of Energy
P.O. Box 212
Richland, WA 99352

ABSTRACT

The Department of Energy Sites (DOE) are faced with the challenge of managing several categories of waste generated from past or future cleanup activities, such as 11(e)2 by-product material, low-level radioactive (LL), low-level radioactive mixed (LLM), transuranic (TRU), high level radioactive (HL), and hazardous waste (HW). DOE must ensure safe and efficient management of these wastes while complying with all applicable federal and state laws. Proposed waste management strategies for the EM-40 Environmental Restoration (ER) program at these sites indicate that on-site disposal is becoming a viable option. For purposes of this paper, on-site disposal facilities managed by the EM-40 program at Hanford, Weldon Spring, Fernald Environmental Management Project (FEMP) and Rocky Flats were compared. Programmatic aspects and design features were evaluated to determine what comparisons can be made, and to identify lessons learned that may be applicable to other sites.

Based on comparative analysis, it can be concluded that the DOE EM-40 on-site disposal facilities are very unique. Stakeholders played a major role in the decision to locate the various DOE on-site disposal facilities. The disposal facilities will be used to manage 11(e)2 by-product materials, LL, LLM, and/or HLW. The analysis further suggests that the design criteria are comparable. Lessons learned relative to the public involvement activities at Weldon Spring, and the design approach at Hanford should be considered when planning future on-site disposal facilities at DOE sites. Further, a detailed analysis of progress made at Hanford should be evaluated for application at sites that are currently planning on-site disposal facilities.

A STRATEGY FOR MAINTAINING CERCLA CLEANUP MOMENTUM IN AN UNCERTAIN FEDERAL FUNDING CLIMATE

Gregory B. Colten, P.E.
Jake D. Dustin, Ph.D., P.E. (COL, USAF (RET))

ABSTRACT

Every Department of Energy (DOE) site has some form of Environmental Restoration (ER) in progress - be it remedial investigations or remedial action. A great challenge to successful-and timely-execution of projects within a federal ER program is preparing for and coping with the financing of those projects. There are two aspects of the budget "process" that make execution challenging, 1) living with the annual allocation-which is sometimes delayed until after the fiscal year has begun, and has a high likelihood of being less than optimally required, and 2) the inevitable release of additional "year end" money late in the fiscal year which requires the site to be able to solicit, award, mobilize, perform the cleanup, and demobilize in a few short months while coordinating these actions and obtaining the necessary approvals as required in the multi-party agreements that the various agencies are signatory to.

To cope with these uncertainties effectively and efficiently, one must stay ahead of the curve by completing conceptual designs for a cross section of project types and complexity. These would be taken to an early stage, such as 30 percent design, which will give a technical scope and a budget and schedule estimate to a degree much better than a rough order of magnitude. These conceptual designs could then be "put on the shelf" and brought forward in short order when funds become available.

While there is yet a long way to go, the Idaho National Engineering Laboratory (INEL) has made some progress toward implementing such a program with fairly impressive results in FY 96.

Refinements are being made and there is fairly good promise that FY 97 will be a watershed year.

ENVIRONMENTAL RESTORATION PROJECT RISK MANAGEMENT

Todd A. Walsh, Roberta E. Day
Project Performance Corporation

ABSTRACT

This paper will present the approach that the Department of Energy (DOE) at Mound adopted to manage the programmatic risks that will impact their ability to complete their environmental restoration projects as planned. DOE Mound's goal is to complete all of their environmental restoration projects and reach final site disposition by the year 2005. Several changes will occur over this time period that will influence DOE Mounds ability to accomplish the 2005 goal. To manage these changes, DOE Mound conducted an uncertainty analysis to:

1) Provide a format for communicating the impacts of risks to DOE, regulators, and the public.
2) Identify schedule impacts across several projects from multiple risks.
3) Decide where to focus risk management efforts on minimizing impacts of risks.

A method that could analyze risks with impacts across several projects and could meet all of DOE Mound's objectives was not readily available. Therefore, DOE Mound developed a qualitative analysis process as the basis for determining relationships between risks and quantifying potential cost impacts. This process captured impacts of the risks across the multiple projects and assessed their impact on the final site disposition schedule. DOE Mound used information from this analysis to create a schedule uncertainty model using a software program called Decision Programming Language. The model provided a method for measuring the impacts of the risks on the entire environmental restoration program rather than individual consequences within a specific project. DOE Mound used this information to focus their efforts on developing alternative plans and contingencies ensuring their environmental restoration schedule could be realistically met.

AN ANALYTICAL FRAMEWORK FOR ASSESSING ENVIRONMENTAL TECHNOLOGY APPLICATIONS AT U.S. DEPARTMENT OF ENERGY SITES

J.L. Regens, D.G. Hodges
Tulane University Medical Center
P. Wilkey, E. Zimmerman
Argonne National Laboratory
E. A. Hughes, A. Unione
Erin Engineering

ABSTRACT

An integrated framework was developed by the Consortium for Environmental Risk Evaluation for planning, making, and communicating decisions regarding the selection of technologies to remediate subsurface contamination. The framework is designed to be used by U.S. Department of Energy managers to help them determine what innovative environmental technologies to deploy as part of remediation actions for cleanup following full field demonstrations.

MULTIMEDIA RISK MODEL COMPARISON FOR ENVIRONMENTAL RESTORATION

J.L. Regensl, K. Watanabe, Tulane University Medical Center
C Whipple, ICF Kaiser
C. Travis, Informatics International
D. Hoel, Medical University of South Carolina
G. Chieruzzi, ManTech Environmental

ABSTRACT

Multimedia risk assessment models are key tools for organizing and summarizing knowledge about environmental settings, contaminant sources, pollutant transport, and exposures. The model comparison effort conducted by the Consortium for Environmental Risk Evaluation is designed to compare model attributes and determine situations for which the models are best suited for applications to subsurface contamination.

DEVELOPMENT AND BENCHMARKING OF PRESTO-EPA-CLNCPG AND PRESTO-EPA-CLNPOP TO ASSESS SITES WITH RADIOACTIVELY CONTAMINATED SOIL

Vern Rogers and Gary B. Merrell
Rogers & Associates Engineering Corporation
P.O. Box 330
Salt Lake City, UT 84110-0330
Cheng Y. Hung
U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Judiary Square, Room 3202A
501 Third Street, N.W., Third Floor
Washington, D.C. 20005

ABSTRACT

State and federal regulatory agencies have promulgated and continue to promulgate numerous sites with regulations regarding radioactively contaminated soil. The primary health risk posed by exposure to radiation levels associated with radioactively contaminated soils is that of contracting cancer. Two new additions to the U.S. Environmental Protection Agency's PRESTO family of computer codes, PRESTO-EPA-CLNCPG and PRESTO-EPA-CLNPOP, have been developed to estimate the impacts of radioactively contaminated soils on humans and the environment. PRESTO-EPA- CLNCPG and PRESTO-EPA-CLNPOP evaluate the health impacts to individuals and populations using potentially contaminated ground water, surface water, produce vegetables, milk, meat, and fish are evaluated. They also estimate additional exposures from inhaling contaminated dust and radon gas, inadvertently ingesting soil, and from being exposed to direct gamma radiation. The methodologies and uses of the two codes have been discussed. The codes also have been compared to RESRAD which is often applied to conservatively assess radioactively contaminated soil sites. Finally, it was concluded that the methodology used in PRESTO-EPA-CLNCPG and PRESTO-EPA-CLNPOP is less conservative and more realistic than that used in RESRAD.

SESSION 38-LOW LEVEL WASTE DISPOSAL OPERATION STATUS

LOW-LEVEL WASTE DISPOSAL OPERATIONS STATUS

Tony Stanford
Environmental Management Division, Solid Waste Operations Group
Los Alamos National Laboratory, Los Alamos, New Mexico 87545

ABSTRACT

Los Alamos National Laboratory (LANL) generates low-level radioactive waste (LLW) from various activities: research and development, medical radioisotope production, decommissioning and decontamination of facilities, and nuclear-weapons stockpile stewardship. The Laboratory has an on-site LLW disposal facility located at Technical Area 54, Area G. Because it supports the fundamental mandates of the Laboratory, Area G is considered a mission-critical facility. Nonetheless, it must be used in a safe, compliant, and cost-effective manner. The natural characteristics of the site and conscientious operation and management of the facility allow these objectives to be met. Those features and uses of the LANL Area G LLW disposal facility are described in this paper.

LLW/ILW DISPOSAL IN THE MORSLEBEN REPOSITORY

Peter W. Brennecke
Bundesamt für Strahlenschutz, Salzgitter, Germany

ABSTRACT

In the former German Democratic Republic short-lived low and intermediate level radioactive waste with rather low concentrations of alpha emitters originating from the production and application of radioisotopes in research, medicine and industry was disposed of in the Morsleben repository, an abandoned salt mine. Until 1991, a total volume of solid and solidified radioactive waste of about 14,500 m^3 ($5.1 \cdot 10^5$ ft^3) and about 6,200 spent sealed radiation sources were disposed of. In total, an activity of $1.8 \cdot 10^{14}$ Bq was emplaced (as of 1991). Subsequent to German unity in October 1990, the Morsleben facility has the status of a federal repository in the sense of section 9a (3) of the German Atomic Energy Law. The operational license is limited by law until June 30, 2000. Resumption of emplacement operations took place in January 1994. Until June 30, 2000, according to present plannings, a waste volume of about 40,000 m^3 ($1.4 \cdot 10^6$ ft^3) is envisaged to be disposed of. According to the waste acceptance requirements, a maximum activity of alpha emitters was estimated to be about 10^{13}Bq, that of beta/gamma emitters to be about 10^{16}Bq; the activities actually to be expected until June 30, 2000, are lower in the order of up to two magnitudes. The operation of the Morsleben repository is an important step in the final realisation of a proper radioactive waste management system in the Federal Republic of Germany.

A COMBINED PERFORMANCE ASSESSMENT AND COMPOSITE ANALYSIS FOR THE NTS AREA 3 RADIOACTIVE WASTE MANAGEMENT SITE

by Lawrence Barker, Vefa Yucel, and Greg Shott
Bechtel Nevada

ABSTRACT

The Area 3 Radioactive Waste Management Site (RWMS) is operated by the U. S. Department of Energy (DOE) on the Nevada Test Site (NTS) for the disposal of low-level

bulk radioactive waste. A combined performance assessment (PA) and composite analysis (CA) for the Area 3 RWMS is in preparation. While a PA consists of analyses to determine the likelihood of meeting performance objectives for the disposal of low-level radioactive waste (LLW), a composite analysis of interacting source terms requires a more comprehensive approach. A CA provides an assessment of the cumulative impacts from active and planned LLW disposal facilities, as well as impacts from all other sources of radioactive contamination that could interact with the LLW disposal facility to affect the dose to members of the public. Potential sources for the Area 3 RWMS in addition to LLW disposal which must be considered include: groundwater contamination from underground nuclear weapons testing; soils contaminated with radioactive isotopes from various nuclear tests; and industrial sites. Methodologies developed to provide the assessment required for the PA/CA will be presented. Additionally, preliminary analysis results will be given.

SESSION 39-COST ISSUES IN WASTE MANAGEMENT AND DISPOSAL

COST ISSUES IN WASTE MANAGEMENT AND DISPOSAL

Kenneth S. Redus
MACTEC
189 Lafayette Drive, Suite C
Oak Ridge, TN 37830
Scott E. State
MACTEC
1419 Denver West Drive, Suite 400
Golden, CO 80401

ABSTRACT

Results in optimal project selection are demonstrated using U. S. Department of Energy 1996 Baseline Environmental Management Report strategic requirements. This paper describes how to select an optimal portfolio of multiple Waste Management, Environmental Restoration, Nuclear Material and Facility Stabilization, and landlord activity projects. An optimal portfolio of projects minimizes total Life Cycle Cost while meeting constraints in the areas of annual funding levels and risk management. Although this approach presented in this paper is not currently used by DOE, optimal project portfolios are proven in the commercial and financial sectors, and the portfolios provide rigorous and efficient allocation of fiscal resources.

DISPOSAL SYSTEM SPECIFICATION AND OPTIMISATION

H Beale, B J McKirdy, M Sweatman
UK Nirex Limited, Curie Avenue, Harwell, Didcot, Oxon OX11 0RH, UK

ABSTRACT

The Nirex mission is to provide a safe environmentally sound and efficient service to dispose of the United Kingdom's intermediate and some low-level radioactive wastes. The disposal system being developed is based on isolating conditioned and packaged waste deep underground in a stable geological environment. Nirex is concentrating its investigations on Sellafield, in Cumbria - England, as a potential location for a deep repository.

The complexity and magnitude of the task facing Nirex demands the adoption of a rational and systematic approach to achieving its mission in an optimal manner. The specification and design of the disposal system are therefore being developed iteratively and assessed in terms of performance requirements at each stage.

The disposal system specification covers a large number of interacting variables relating to the waste, its packaging, transport and disposal. Further, it integrates results from the Company's scientific and technical programmes, to provide a unified and justified system specification for design work and the preparation of operational and post-closure safely assessments.

The overall system has been structured into a hierarchy of subsystems to facilitate its analysis and optimisation. As an aid to improving or optimising the system a computer model, designed to run on a fast PC, has been developed based on a number of interdependent modules representing the subsystems. The model includes variable parameters (e.g. depth, waste package throughput etc.), and fixed parameters (e.g. regulatory requirements). It relates these parameters to the objective function - the total detriment. Optimisation of the model is achieved automatically by use of a numerical method that iteratively adjusts the variable parameters. The model can readily deal with new information and data, that will inevitably arise through time, and can be used to assess the implications of changes ahead of each revision to the specification.

The paper describes the approach adopted by Nirex to ensure that it delivers a disposal system capable of meeting all that is required of it in terms of performance, cost and programme.

ADVANCED COST-BENEFIT ANALYSIS FOR INFRASTRUCTURE INVESTMENT UNDER UNCERTAINTY. THE CASE OF A STATE-OWNED AGENCY

P.L. Kunsch, and D. Emmery
ONDRAF/NIRAS
Place Madou 1 POB 25
B-1210 Brussels, BELGIUM

ABSTRACT

The paper gives a qualitative overview of the advanced cost-benefit analysis based on the option value methodology. This methodology, first developed in finance and applied to profit-oriented firms, is equally valuable for a state-owned radwaste agency committed to non-profit aims. We first show why the traditional Net Present Value technique (NPV) fails to define adequate timing in the starting date and in the completion schedule of irreversible investment decisions to be made under uncertainty. The option approach, on the contrary, gives a tool for coping with the uncertainty in a flexible way. Two main sources of uncertainty are considered. The first, input cost uncertainty, affects the amount of resources necessary to complete a project. It can be resolved by observing the cost evolution. The second, technical uncertainty, relates to the imperfect knowledge of actual costs. It can be resolved by realizing the project. We illustrate the use of the methodology by a qualitative discussion of several decision processes related to radwaste management projects.

BENEFITS AND BARRIERS TO A WASTE CHARGEBACK SYSTEM IN THE U.S. DEPARTMENT OF ENERGY

Paul Higgins
Project Performance Corporation

ABSTRACT

The Department of Energy (DOE) is planning to implement an internal transfer pricing ("waste chargeback") system under which some waste generators would be charged for the cost of wastes that are treated, stored or disposed by its Office of Waste Management. This innovation has the potential to significantly reduce DOE's total waste management costs while improving the overall efficiency of its waste management operations. However, successful implementation is by no means certain, and depends on several factors, including how prices are set, how broadly DOE decides to apply the chargeback plan, and whether the necessary regulatory reforms are forthcoming. Using existing data sources, we describe the proposed chargeback system, discuss the role of waste management in the overall structure of DOE's costs, review the economic theory of costs, and provide rough estimates of the possible savings which could be realized.

COMPARISON OF COSTS FOR ALTERNATIVE MIXED LOW-LEVEL WASTE TREATMENT SYSTEMS

W. E. Schwinkendorf, Lockheed Martin Idaho Technologies Company, INEL
L.Harvego, Lockheed Martin Idaho Technologies Company, INEL
C.R. Cooley, U. S. Department of Energy
C. Biagi, Morrison Knudsen

ABSTRACT

Total life cycle costs (TLCCs), including disposal costs, of thermal, nonthermal and enhanced nonthermal systems were evaluated to guide future research and development programs for the treatment of mixed low-level waste (MLLW) consisting of RCRA hazardous and low-level radioactive wastes. In these studies, nonthermal systems are defined as those systems that process waste at temperatures less than 350°C. Preconceptual designs and costs were developed for thirty systems with a capacity (2927 lbs/hr) to treat the DOE MLLW stored inventory (approximately 236 million pounds) in 20 years in a single, centralized facility. The same waste throughput and profile were used for all systems to allow a comparison of the results of the system studies. A limited comparison of the studies' results is presented in this paper. Sensitivity of treatment costs with respect to treatment capacity, number of treatment facilities, and system availability were also determined.

The major cost element is operations and maintenance (O&M), which is 50 to 60% of the TLCC for both thermal and nonthermal systems. Energy costs constitute a small fraction (<1%) of the TLCCS. Equipment cost is only 3 to 5% of the treatment cost (i.e., TLCCs without disposal) indicating that process selection and R&D funding should promote improved performance, reliability, and technical risk to minimize operations and maintenance labor rather than be based on the capital cost of the technology. Evaluation of subsystem costs demonstrate that receiving and preparation is the highest cost subsystem at about 25 to 30% of the TLCC for both thermal and nonthermal systems.

These studies found no cost incentives to use nonthermal or hybrid (combined nonthermal treatment with stabilization by vitrification) systems in place of thermal systems. However, there may be other incentives including fewer air emissions and less local objection to a treatment facility. Building multiple treatment facilities to treat the same total mass of waste as a single facility would increase the total treatment cost significantly, and improved system availability decreases unit treatment costs by 17% to 30%.

A QUANTITATIVE ECONOMIC WORTH MODEL FOR HUMAN POPULATIONS

G. M. Sandquist and V. C. Rogers
Rogers and Associates Engineering Corporation

ABSTRACT

An analytical model for assessing the quantitative economic worth of a member of a given population is presented. The model employs the expected growth in population and GDP over the anticipated lifetime of an average population member. The growth projections may be based upon the past historical record for the population and its economy. US economic and population data for the 35 year period from 1960 to 1994 yield an economic worth of $3.5 million for a US population member using this model and appropriate mean values obtained from the data.

SESSION 40-INDIGENEOUS PEOPLES PERSPECTIVES CONCERNING RADIOACTIVE WASTE MANAGEMENT

HOW INCORPORATING TRIBAL INFORMATION WILL ENHANCE WASTE MANAGEMENT DECISIONS

Stuart G Harris
Confederated Tribes of the Umatilla Indian Reservation
Barbara L Harper
Pacific Northwest National Laboratory

ABSTRACT

U.S. Department of Energy (DOE) managers commonly perceive that engaging tribal nations and public stakeholders as partners in decision making results in unnecessary delays and a reduction in information quality. However, the old paradigm "stakeholders versus science" is wrong, and the correct paradigm is "stakeholders + science = better science." In particular, certain information is needed about long-term endstate risk commitments after the DOE cleanup mission is done. Decisions are being made now that create commitments affecting environmental quality, and interrelated eco-cultural integrity because residual contamination and eventual leaks from stored/disposed waste will be released into the environment. These decisions are embedded (sometimes hidden) in Site baselines and the Ten Year Plan. The right information is not being gathered in the current ten-year planning effort and is likely to result in its rejection by tribes and stakeholders. Tribal nations need information regarding community-level exposures and impacts over time, the anticipated endstate quality, quantity, and fragmentation of natural resources and cultural landscapes, and our ability to regain access to ceded lands in order to exercise treaty-reserved rights. The federal government is the trustee of the lands on which Hanford is located and is obligated to protect our treaty rights (this is not option- al any more than regulatory compliance is optional). The complexity of a traditional person's ties to the environment means that conventional suburban exposure scenarios are inadequate to evaluate human health impacts, so we have developed a Native American subsistence Scenario suitable for applications in the Columbia River Basin. We have also revised the Ten Year Plan's Management Evaluation Matrix used for qualitatively estimating project risks to also include socio-cultural impacts and to correct major deficiencies and internal inconsistencies in the public health and environmental impact categories.

NATIONAL TRIBAL PLUTONIUM FORUM: DEFINING THE TRIBAL POSITION IN THE WEAPONS-USABLE FISSILE MATERIALS DISPOSITION DIALOGUE

Donna L. Powaukee
Manager
Nez Perce Tribe Department of Environmental Restoration and Waste Management
David F. Conrad
Acting Director
Council of Energy Resource Tribes Environmental Program
Kristie L. Baptiste
Policy Analyst
Nez Perce Tribe Department of Environmental Restoration and Waste Management

ABSTRACT

The Nez Perce Tribe has been involved with the Department of Energy's environmental management efforts since as early as 1987, during a predecessor Office's tenure during the Basalt Waste Isolation Pilot Project. From that time until now, the Nez Perce Tribe has initiated a number of activities which serve to broaden the scope of what have been considered "tribal" issues. The latest demonstration of sustained effort by the Nez Perce Tribe has been in the area of weapons-usable fissile materials disposition decision making. The Nez Perce Tribe developed an idea of how it should proceed to involve itself in the decision making process, and when confronted with the prospect of missing this opportunity and having other Tribes potentially miss out on the opportunity and duty to be involved in decisions of such magnitude, the Nez Perce Tribe changed its plans and developed a mechanism for other Tribes to be involved as well. This effort demonstrated leadership in the arena of tribal involvement in nuclear waste decision making, and is setting the stage for future tribal involvement.

NATIONAL TRIBAL RISK ASSESSMENT FORUM: DEFINING TRIBAL APPROACHES IN ENVIRONMENTAL RISK ASSESSMENT

Rico O. Cruz, Ph.D.
Environmental Specialist
Nez Perce Tribe Department of Environmental Restoration and Waste Management
David F. Conrad, Acting Director
Environmental Programs, Council of Energy Resource Tribes
Donna L. Powaukee, Manager
Nez Perce Tribe Department of Environmental Restoration and Waste Management
Kristie L. Baptiste, Policy Analyst
Nez Perce Tribe Department of Environmental Restoration and Waste Management

ABSTRACT

Conventional risk assessments typically focus solely on reducing human exposure with minimal attention given to environmental and ecological goals and none given to values-based indigenous cultural goals. Thus, risk measurements for ecological and cultural impacts are almost totally ignored. The Nez Perce Tribe, and perhaps other tribes, identify at least three health impacts other than exposure. These include spiritual, emotional, and physical impacts. The tribal risk assessment approach usually incorporates indigenous cultural values and the holistic philosophy of the relationship between humans and the environment. The holistic approach defines human health in a broad way to mean health, environment, and culture. This holistic approach considers indirect health effects, the knowledge held by tribal elders about the significance of natural resources to the Nez Perce people, and tribal community-based knowledge on how contaminants impact cultural identity. Hence, a tribal risk model defines each living organism as connected to every other living organism. Harm caused to any living thing also harms the whole. Although the tribal risk assessment task if formidable, tribes must acknowledge and understand the concept of risk assessment in the broader context of policy and decision-making. Tribes must become technically and scientifically adept at using the risk assessment tool, and must be administratively proficient in managing risks for tribal communities.

SESSION 41-FEDERAL AND TRIBAL PERSPECTIVES ON IMPLEMENTING THE ENVIRONMENTAL JUSTICE STRATEGIES

IMPLEMENTATION OF THE U.S. DEPARTMENT OF ENERGY'S ENVIRONMENTAL JUSTICE STRATEGY EXECUTIVE ORDER 12898

Georgia R. Johnson and Melanie A. Pearson
U.S. Department of Energy

ABSTRACT

This paper presents an outline of ongoing program activities to implement the Department of Energy's (DOE) Environmental Justice Strategy. The relationship to existing legislation and regulations, as well as methods to institutionalize environmental justice into DOE's public participation activities, the recognition of appropriate government entities, human health research, safety and risk reduction and effective methods of communicating environmental issues and risk information to our stakeholders are described.

HOW TRIBAL PRINCIPLES OF ENVIRONMENTAL JUSTICE GUIDE TRIBAL GOVERNMENT DECISIONS ABOUT RADIOACTIVE WASTE MANAGEMENT

Kimberly TallBear
Council of Energy Resource Tribes
1999 Broadway, Suite 2600
Denver, CO 80202

ABSTRACT

The paper examines the differing participation of two tribal governments (the Chemehuevi Indian Tribe in California and the Skull Valley Goshute Tribe in Utah) in radioactive waste management. The paper shows that tribes act within tribal-specific notions of environmental justice when making decisions to participate in the development of radioactive waste policies and programs.

Whether a government or industry would coerce siting of a radioactive waste facility on tribal lands or whether a state or environmental interest group would paternalistically suggest that tribes be excluded from nuclear energy and radioactive waste management, both constitute attacks on tribal sovereignty and preclude environmental justice for tribes. The paper argues that the achievement of environmental justice on reservations depends upon the ability of tribes to make policy and upon non-tribal governments, citizens, companies, and organizations to respect the legitimacy of tribal governments that retain the right to make policy decisions, even if those decisions include participation in radioactive waste storage and disposal research, debates and activities.

TRIBAL AND STAKEHOLDER INVOLVEMENT IN TECHNOLOGY ASSESSMENT AND SELECTION: AN INNOVATIVE APPROACH TO PUBLIC ACCEPTANCE

Ginger Swartz, Swartz & Associates, Boulder City, Nevada

ABSTRACT

In 1989, the National Research Council recognized that, although the benefits of technology have increased, so too, have the public's fears related to the potential risks of those technologies. Technological decision making is no longer the sole function of technical and economic research and debate, but has far-reaching political and social implications. When technical decisions become political, the importance of vesting responsibility and power in the citizenry should not be ignored.

But, in the technical realm, what is it we get in the bargain when we ask for public participation in the decision-making of technology selection? Technical experts worry that a given technology will not be accepted simply because the public does not understand the technical details of how the system operates. The public worries that scientists and engineers will confuse the issue with language that is inaccessible to the non-technical public or will use the power of their expertise to manipulate the public for some hidden political purpose. Despite the difficulties apparent in such a dichotomy, tribal and public involvement is a democratic task that cannot be ignored in the process of assessing, selecting and implementing innovative technologies for use in the cleanup of contaminated sites in the United States,

DOE's Integrated Non-Thermal Treatment Systems (INTS) study moved outside the framework of existing public involvement programs by providing the opportunity for technical and non-technical make holders alike to work in a collaborative decision-making framework at the very early stages of criteria development and technology assessment and selection. In addition to addressing its responsibility to educate the public about available non-thermal treatment systems, the INTS study attempted to consider human values and perceptions as part of the technology equation.

SESSION 42-FACILITY DECONTAMINATION AND DECOMMISSIONING

REGULATION OF GROUND-WATER CONTAMINATION AT DECOMMISSIONING NRC-LICENSED FACILITIES

Jack D. Parrott
Project Scientist
Division of Waste Management
U.S. Nuclear Regulatory Commission

ABSTRACT

Radionuclides contaminate ground water at certain U.S. Nuclear Regulatory Commission-licensed facilities undergoing decommissioning. For these sites, NRC generally has only guidance (as opposed to regulations) for "decommissioning" contaminated ground water. Recently, it has proposed new dose-based release limits for decommissioning sites as part of a rulemaking regarding decommissioning criteria. Because the proposed rulemaking specifically identifies ground water as an exposure pathway of concern, ground-water contamination at NRC-licensed sites undergoing decommissioning will be specifically regulated once the rule becomes final. The specific regulation of contaminated ground water at decommissioning sites will help to clarify the requirements for decommissioning these sites.

ECONOMIC FEASIBILITY OF UNCONDITIONAL RELEASE OF A BUILDING WITH RADIOLOGICAL PROCESS HISTORY

R. L. Bauer, EG& G Mound Applied Technolgies
S. A. Spesard, USDOE
Laura S. Crane, J.D. Smyth
Project Performance Corporation

ABSTRACT

EG&G Mound Applied Technologies (MAT) and the Department of Energy (DOE)-Miamisburg Environmental Management Project Office (MEMP) conducted an evaluation to determine the viability of unconditional release of demolition debris from Building 21 at Mound. The primary advantage of pursuing unconditional release of debris is the economic benefit derived from disposal of debris as other than low-level waste. However, if extensive decontamination is required prior to release, the decontamination and verification costs can exceed the benefit of unconditional release. This paper describes the evaluation to determine the feasibility of decontamination of Building 21 in order to unconditionally release demolition debris.

The feasibility analysis for the unconditional release of Building 21 demolition debris was comprised of three sections: (1) an evaluation of criteria to unconditionally release the debris, (2) an evaluation of existing information to determine the extent of decontamination that would be required, and (3) an order of magnitude comparative cost evaluation to approximate the probable magnitude of economic benefit possible.

Based on existing information, the contaminants of concern in Building 21 are Th-232 and its decay products, and U-238 and its decay products. To date, a dose limit or generic criteria for unconditional release of D&D debris to a construction and debris (C&D) landfill have not been established. In order to proceed, a range of dose limit criteria (i.e., 15, 18, 25, 30, and 100 mrem) were used to develop recommended average volume concentrations (i.e., a range of criteria) for the unconditional release of Building 21 debris. EG&G MAT and DOE-MEMP developed specific guideline criteria, derived from basic dose limits, for the average volume residual radioactivity acceptable for release.

The analysis outlines the considerations for developing an unconditional release process related to the disposal of D&D debris, details an order of magnitude cost comparison, and provides a recommendation for the preferred disposition alternative, including next steps, for Building 21's demolition debris.

LARGE-SCALE DECONTAMINATION AND DECOMMISSIONING TECHNOLOGY DEMONSTRATION PROJECT AT A FORMER URANIUM METAL PRODUCTION FACILITY

R. A. Martineit, P. J. Pettit
FDF*/HNUS
T. D. Borgman, M. S. Peters, G. P. Ruesink, L. L. Stebbins
FDF
S. J. Bossart
DOE-FETC
D. M. Brown, D. R. Krause
B&W NESi
R. D. Warner DOE-FEMP

ABSTRACT

The Department of Energy's (DOE) Office of Science and Technology Decontamination and Decommissioning (D&D) Focus Area, led by the Federal Energy Technology Center, has been charged with improving upon baseline D&D technologies with the goal of demonstrating and validating more cost-effective and safer technologies to characterize, deactivate, survey, decontaminate, dismantle, and dispose of surplus structures, buildings, and their contents at DOE sites. The D&D Focus Area's approach to verifying the benefits of the improved D&D technologies is to use them in large-scale technology demonstration (LSTD) projects at several DOE sites.

The Fernald Environmental Management Project (FEMP) was selected to host one of the first three LSTD's awarded by the D&D Focus Area. The FEMP is a DOE facility near Cincinnati, Ohio, that was formerly engaged in the production of high quality uranium metal. The FEMP is a Superfund site which has completed its RI/FS process and is currently undergoing environmental restoration.

With the FEMP's selection to host an LSTD, the FEMP was immediately faced with some challenges. The primary challenge was that this LSTD was to be integrated into the FEMP's Plant 1 D&D Project which was an ongoing D&D Project for which a firm fixed price contract had been issued to the D&D Contractor. Thus, interferences with the baseline D&D project could have significant financial implications. Other challenges include defining and selecting meaningful technology demonstrations, finding/selecting technology providers, and integrating the technology into the baseline D&D project.

To date, twelve technologies have been selected, and six have been demonstrated. The technology demonstrations have yielded a high proportion of "winners." All demonstrated technologies will be evaluated for incorporation into the FEMP's baseline D&D strategy. Those technologies that are not added to the FEMP's baseline D&D strategy will be documented to aid other sites/companies engaged in D&D activities with their D&D technology selection process.

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DECONTAMINATION AND DECOMMISSIONING OF A NATURE METAL URANIUM NUCLEAR FUEL FABRICATION PLANT

Han Ruiping
Bureau of Nuclear Fuel, CNNC
Beijing, China

ABSTRACT

Many Chinese nuclear facilities are getting into their decommissioning stage currently. In the early 90's, the Chinese government approved that the nature metal uranium nuclear fuel fabrication plants were in decontamination and decommissioning (D&D). The D&D of one of these plants started in 1991 and was achieved by the end of 1995. This is the first nuclear fuel fabrication plant which was through with the D&D completely in China. After D&D, the final environment radiation monitoring results indicate the present status of the plant meet the related regulations. The buildings and facilities in the plant can be restored to unrestricted-use condition except for producing food and medicine. The site of the plant was covered with new soil after decontamination, so that it became green field. The effective decontamination for the plant has provided a fruitful experiences.

This paper will mainly describe the D&D of the nature metal uranium nuclear fuel fabrication plant, including the environment status of the plant before the D&D, the general plan of D&D, the decontamination techniques for the facilities and buildings, the waste treatment, the final environmental impact report of the plant, and the conclusions.

DECOMMISSIONING OF HOBEG FUEL ELEMENT FABRICATION PLANT GERMANY

Hartmut Runge, B. Sohnius, DETEC GmbH; P. Borner, NUKEM GmbH; D. Schmidt, NUKEM Nuclear Technologies Corp.

ABSTRACT

As the first of four German fuel element fabrication sites requiring decommissioning, the HOBEG facility in Hanau has completed the decommissioning process.

This project took six years due to complicated German licensing procedures. After removal of all nuclear material, the process equipment was dismantled and the buildings were cleared from all installations. This initial work was followed by remediation of outside areas and decontamination of the process buildings. Problems were encountered since the natural background of the site exceeded the regulatory clean-up guidelines.

After extensive radiological control measures and regulatory negotiations, the facility was released from the atomic law and is now used for civilian purposes.

OPERATIONAL EXPERIENCE OF DECOMMISSIONING THE FIRST PRIMARY SEPARATION PLANT AT SELLAFIELD, U.K.

S. F. Challinor
C.Eng., BNFL, Sellafield, U.K.

ABSTRACT

Decommissioning of the first primary separation plant at Sellafield, U.K., is one of a number of major projects within BNFL's overall decommissioning programme covering all aspects of the nuclear fuel cycle. The project demonstrates that large scale, highly contaminated, complex nuclear reprocessing installations can be safely and cost effectively decommissioned utilising today's technologies. In order to reduce costs an integrated dismantling strategy has been developed which utilises a mixture of manual and remote decommissioning techniques in a structured, phased approach. Experience from early phases is reviewed and fed into later stages to constantly improve safety and operating performance, reduce technical uncertainty and financial risk. Where remote systems are required the use of proprietary items for manipulators, deployment systems, tooling and computer modelling reduces development costs and time scales whilst providing robust, reliable and easily maintainable equipment.

This paper describes the operational experience of decommissioning the first primary separation plant at Sellafield. Construction of the 61m high facility commenced in 1947 and comprised two mirror image process lines to reprocess irradiated metal fuel from the

Windscale piles. The facility operated between 1952 and 1964 until it was subsequently superseded by the current Magnox reprocessing facility. One of the original process line was converted to reprocess oxide fuels, operating from 1969 until 1973. The stage 2 decommissioning project commenced in 1990 and has been subdivided into 9 distinct decommissioning phases. The project is due to be complete in 2010 at an estimated cost of $155 Million (low case). Three preparatory phases have been completed to date at a cost of 97% of original estimate. Decommissioning operations are underway in the first of 8 major cell areas, decommissioning of a second area is due to commence in early 1997.

SESSION 43-INNOVATIVE TECHNOLOGY FOR ENVIRONMENTAL REMEDIATION

BENCH- AND PILOT-SCALE TESTING OF ION-EXCHANGE MEDIA FOR REMOVAL OF RADIONUCLIDES FROM HANFORD 200 AREA GROUNDWATER

Abdul Dada, Bechtel Hanford Inc.
David Erb, IT Hanford Inc.
Stuart Shealy, IT Corporation

ABSTRACT

Bench-scale and large-scale pilot treatability testing was conducted in support of remedial design activities in the Hanford Site 200 Area. This testing provided data needed to develop pump and treat systems for the BP-5 Reverse Well groundwater plume in the 200 Area. The treatability testing included bench-scale batch equilibrium (isotherm) and mini-column tests on a number of ion exchange resins and other adsorption media and testing of selected media in the large-scale (100 liters/minute feed) pilot treatment facilities. The mini-column and pilot tests were conducted in the field with groundwater from the BP-5 Reverse well plume.

The B-5 Reverse Well plume contains plutonium, strontium and cesium and a series of batch equilibrium tests were conducted to evaluate several adsorbents and ion exchange materials for removal of these contaminants. Bone Char was effective on plutonium while clinoptilolite, a natural zeolite ion exchange material, was very effective on cesium and strontium. Based on the batch test results, the pilot system included adsorbers packed with bone char and clinoptilolite.

After the batch tests mini-column tests on clinoptilolite were conducted. These tests demonstrated that, while the clinoptilolite has a good loading capacity for both strontium and cesium, ^{90}Sr bleeds through the column fairly rapidly. In addition a second series of batch equilibrium tests were conducted to screen additional ion exchange media for strontium removal. The second round of batch equilibrium tests identified a synthetic zeolite that had better performance for strontium than did the clinoptilolite and also a synthetic resin that was effective on plutonium. The synthetic zeolite was also tested in a mini-column system and gave slightly lower effluent ^{90}Sr than the clinoptilolite. The mini-column and pilot-scale testing also showed that kinetics were limiting strontium removal and that contact times of 40 to 54 minutes will be required for achieving the 8 pCi/Liter criteria for ^{90}Sr. These tests were conducted concurrent with operation of the pilot system.

The pilot-scale testing demonstrated that plutonium and cesium treatment criteria were met for a run length of 3700 bed volumes. Strontium in the effluent rapidly broke through to 1200 pCi/liter, 32% of inlet concentration but did not increase for 3700 bed volumes. One of the mini-column systems, operating with longer contact time with the clinoptilolite, gave better performance, 86% strontium removal for 3500 bed volumes.

This paper summarizes the results of the bench-scale and pilot ion exchange testing for removal of contaminants from the extracted groundwater. A more detailed presentation of these results, as well as discussion of the effect of the pilot-scale pump and treat study on aquifer contaminant concentrations and other aspects of the pump and treat evaluation, can be found in the 200-BP-5 Operable Unit Treatability Study Report (DOE/RL-95-59, September 1995).

SOIL WASHING TECHNOLOGIES IN EUROPE

H. Runge, DETEC GmbH; D. Schmidt, NUKEM Nuclear Technologies

ABSTRACT

Cleaning of radioactive contaminated ground is a very recent development in Western Europe. Technology development and projects performed are mainly reported from Germany. Namely, soil washing was applied in several projects.

NUKEM has demonstrated that the volume of contaminated ground which otherwise must be disposed as radioactive waste can be reduced by about two orders of magnitude if treated in combined sieving and washing processes.

CHARACTERIZATION AND REMOVAL OF RADIONUCLIDES FROM THE DRAINAGE SEDIMENT

Tau-Being Hsu and Ben-Li Pen
Tamkang University
Department of Water Sources and
Environmental Engineering
Tamshui , Taiwan , R.O.C.
Lee-Chung Men and Ching-Ho Yang
INER
Chemical Analysis Division
Lung-Tan , Taiwan , R.O.C.

ABSTRACT

The purpose of this study were to determine the characteristics of the chemical extraction for ^{60}Co and ^{137}Cs radionuclides in the slightly contaminated drainage sediment by Tessier's sequential extraction and to compare the radionuclides removal using the same solution among three simple processes: shaking method, column washing and microwave treatment. The results obtained show that a significant part of the ^{137}Cs radionuclide was found in the residual fraction of sediment, while the ^{60}Co was mostly associated with Fe/Mn oxides fraction. The removing efficiencies in both microwave treatment and column washing are higher than that in sediment shaking treatment. However, the total removals for all three treatments have almost the same values(~70%). The microwave treatment has advantages of easy operation, time saving and less equipment required. These preliminary experimental results indicated that the microwave treatment might be considered as alterative method in the treatment of heavy-metal contaminated sediments.

TRENCHES T-3 AND T-4 SOURCE REMOVAL PROJECT AT ROCKY FLATS

Shaun L. Garner
Rocky Mountain Remediation Services, L.L.C., Rocky Flats, Colorado
Hopi Salomon
Morrison Knudsen Environmental Services, Denver, Colorado
Marcella C. Broussard
Rocky Mountain Remediation Services, L.L.C., Rocky Flats, Colorado
Ann M. Tyson
Rocky Mountain Remediation Services, L.L.C., Rocky Flats, Colorado

ABSTRACT

The Trenches T-3 and T-4 Source Removal Project performed by Rocky Mountain Remediation Services under subcontract to Kaiser-Hill at the Rocky Flats Environmental Technology Site involved the excavation and treatment by thermal desorption of approximately 2,902 cubic meters of soil and debris contaminated with volatile organic compounds (VOCs). The trenches contained soil, drum carcasses, and miscellaneous debris contaminated with VOCs which were contributing to groundwater contamination. Primary contaminants of concern were tetrachloroethene, trichloroethene, and carbon tetrachloride, as well as low level radiological contamination. The project was scoped, planned, and executed within a single fiscal year and saved $2 million and 33 months over the originally proposed remedy.

Several factors were instrumental in successful completion of the project. Integration of union labor forces and subcontracted personnel and services was the primary key to the project. The use of an on-site laboratory and a modified analytical method allowed for near real time analytical results to both guide the excavation and verify treatment effectiveness greatly reduced downtime during project execution. Also, negotiations with the Environmental Protection Agency and the Colorado Department of Public Health and Environment for establishing realistic cleanup criteria and accepting simplified field sampling techniques facilitated timely completion of the project.

SESSION 44-INFRASTRUCTURE IN WASTE MANAGEMENT

THE CHALLENGES AND ISSUES FACING THE RADIOACTIVE WASTE MANAGEMENT IN BELARUS

Vladimir I. Yatsevich, Larissa F. Rozdialovskaya, Andrei A. Tukhto
Committee for Supervision of Industrial and Nuclear Safety (Promatomnadzor),
Republic of Belarus

ABSTRACT

Since Belarus gained its independence a lot of problems have been arising with regard to institutional and capacity building of a newly independent state. The problems associated with establishing radiation safety and radioactive waste management infrastructure became especially acute after the Chernobyl catastrophe, when 70% of the radioactive by-products fell out on the Belarus territory.

The paper's intention is to show the present situation and outline the actions taken to enhance developments in the field of managing of different categories of radioactive waste generated in Belarus.

INTEGRATED ENVIRONMENTAL MONITORING PLAN FOR THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

G. M. Kelly, Rocky Flats Environmental Technology Site, 11/15/96

ABSTRACT

The Rocky Flats Environmental Technology Site (RFETS) has to conduct extensive monitoring to characterize emissions, assess emission impacts, and comply with numerous environmental laws and regulations associated with Site missions, including waste management, deactivation, decontamination and decommissioning, and environmental restoration. Historically, the Site has operated extensive monitoring programs, which grew over the years as new requirements were added, to cover surface water, ground water, air and various ecological systems. In the face of severe budget cuts in FY 95 and FY 96, Kaiser-Hill (K-H) undertook a structured, comprehensive, holistic reevaluation of all environmental monitoring programs. The objective of this effort was to identify monitoring needs, based on environmental management and compliance decisions that need to be made, and to develop specifications for monitoring utilizing the U.S. Environmental Protection Agency (EPA) data quality objectives (DQO) process. The effort involved EPA and the Colorado Department of Public Health and Environment (CDPHE) regulators, representatives from adjacent cities, and members of the K-H Team evaluating all monitoring being conducted by all parties. Using the consensus specifications (DQOs), optimal data collection schemes were determined and the media-specific programs of the parties were modified accordingly. Such an approach demonstrates compliance with the myriad of Federal and State regulations and Department of Energy (DOE) orders, and supports the decisions that must be made to protect human health and the environment with an acceptable degree of certainty. Additional effort is required to ensure that programs are integrated across media. The results will be a truly integrated, multi-party Site monitoring program.

U.K. PRIVATISATION OF DECOMMISSIONING AND RADIOACTIVE WASTE MANAGEMENT SERVICES

K. F. Collett, WasteChem Ltd.
S. Beackon, UKAEA, UK

ABSTRACT

The United Kingdom Atomic Energy Authority, UKAEA, was established to undertake nuclear research and development. Fusion R&D apart, the original mission has now been largely completed. Across its sites some 80% of UKAEA's facilities are redundant and in various stages of closure. UKAEA has now turned its attention to discharging its decommissioning liabilities.

Procurement of services through fixed-price competitive tendering dominates UKAEA's contract strategy. To help develop the supply base and thereby increase competition, UKAEA has undertaken a strategy of skill transfer through the divestment of operational teams and associated contracts. This is also seen as the way to secure the best possible long term futures for the staff involved.

BENCHMARKING AND PERFORMANCE IMPROVEMENT AT ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Craig Elliott, Kaiser-Hill Company, L.L.C., Glenn Doyle, DOE/RFFO, and
W. David Featherman, Project Performance Corporation

ABSTRACT

The Rocky Flats Environmental Technology Site (RFETS) has initiated a major work process improvement campaign using the tools of formalized benchmarking andstreamlining. This paper provides insights into some of the process improvement activities performed at Rocky Flats from November 1995 through December 1996. It reviews the background, motivation, methodology, results, and lessons learned from this ongoing effort. The paper also presents important gains realized through process analysis and improvement including significant cost savings, productivity improvements, and an enhanced understanding of site work processes.

SESSION 45-LOW/INTERMEDIATE LEVEL WASTE PROCESSING

ENGINEERING AND PROGRAMMATIC UPGRADES FOR THE COMISION FEDERAL DE ELECTRICIDAD LAGUNA VERDE NUCLEAR PLANT LIQUID RADWASTE TREATMENT PROCESS

Ing. Alejandro Garcia Martinez, Comision Federal de Electricidad
Larry Campo, Raytheon Nuclear Company
Donald Gardner, Raytheon Nuclear Company
Craig Knauss, Raytheon Nuclear Company
Edward Taylor, Raytheon Nuclear Company

ABSTRACT

The Comision Federal de Electricidad (CFE) performed a review of the existing Laguna Verde Nuclear Plant (LVNP) liquid radwaste system design and operational performance. Radwaste streams were identified and characterized. Processing protocols used by the operations staff were reviewed and compared against current industry protocols. The review determined that the amount of liquid radwaste generated was substantially above the Plant's designed basis.

It was determined that programmatic and engineering enhancements to the existing liquid radwaste generation, collection and treatment program process could be achieved, reducing the amount of waste generated and processed to acceptable levels.

Figure 1 depicts the Laguna Verde liquid radwaste process flow. Recommended new equipment, recommended upgraded equipment, existing equipment, and associated new and existing piping are featured.

PLASMA ARC MELTING TREATMENT PROCESS OF LOW LEVEL DRY ACTIVE WASTE

Katsuo Yamazaki, Satoshi Karigome, Yoshihiro Akagawa
The Japan Atomic Power Company
Yasuo Dougaki, Yoshihisa Nakayama, Keishi Obara, Akio Tsuchiya, Yukito Tsuji
Toyo Engineering Corporation

ABSTRACT

The Japan Atomic Power Company (JAPC) and Toyo Engineering Corporation (TEC) have developed an incinerating/melting process using the Plasma Arc Centrifugal Treatment process (PACT) for Low Level Dry Active (Miscellaneous Solid) Waste (DAW). We had supported tests of melting incombustible waste, tests treating organics which have high chlorine/sulfur content with controlling, together with incombustible waste, and tests of certifying the proper characteristics of solidified slag and metal.

JAPC placed an order with TEC for constructing an incinerating/melting facility using Plasma Arc Centrifugal Treatment process (PACT developed by Retech ,USA) in Tsuruga Nuclear Power Station because of it's advantage in progress of development and the highest treatment efficiency at the result of comparison with other plasma technologies in 1995. This paper shows the results of incineration/melting tests and explains the concept of our Plasma Arc Waste Volume Reduction Facility, for which engineering is on-going.

MANAGEMENT OF SPENT ION-EXCHANGE RESINS AT NARORA ATOMIC POWER STATION

S.D. Misra, P.M. Gandhi & S.B. Bodke
Bhabha Atomic Research Centre
Mumbai-400 085, India
S. Mittal
Narora Atomic Power Station
Narora-202 389, India

ABSTRACT

In nuclear power plants, primary heat transport (PHT), spent fuel storage bay (SFSB) and moderator circuits employ organic ion exchange resins in their purification systems for removal of impurities that accumulate in the streams during plant operation. These ion exchange resins, when exhausted, constitute a special category of radioactive waste owing to their organic nature and the high levels of radioactivity associated. Philosophy for their management has been evolved over a period of time. In the early stages, the resin management policy in India was storage in underground tanks or disposal of the IX column after dewatering. Near surface storage after cementation was also done occasionally. Studies on conditioning of the spent IX resin in a suitable matrix were also taken up alongside. After preliminary evaluation of different binding materials, a polyester styrene based organic matrix was selected for detailed investigation. Extensive laboratory studies resulted in development of a suitable waste form of acceptable characteristics. After full scale inactive demonstration trials carried out at BARC, spent resin fixation system as an industrial unit was considered for adoption at Waste Management Plant (WMP) at Narora Atomic Power Station (NAPS). The system has been fully established through inactive trials followed by hot commissioning of the facility. The scheme of treatment essentially involves hydraulic transfer of spent IX resin from the reactor hoppers into specially designed disposable drums, their vacuum dewatering in these drums and in-drum mixing with organic binders and additives followed by curing therein. Several full scale inactive and active blocks have been made and through these trials, all process parameters have been established. Two separate catalyst/accelerator systems suitable for polyester styrene resin have been finalised. While inactive waste form products were fully characterised for mechanical, chemical, thermal, radiation and bio-degradation properties, core drilled samples from active blocks were tested for compressive strength and leach resistance. The paper highlights the commissioning experiences of the spent IX resin fixation facility at NAPS. Waste form characteristics of products obtained during the above trials are also presented.

TRITIUM BEHAVIOUR DURING UNDERWATER CUTTING AND FURTHER PROCESSING OF HIGHLY IRRADIATED CONTROL RODS

Klaus Springer, Ministry of Environmental Affairs, Munich
Dietrich Mertin, RWE Energie AG, Essen
Christoph Lierse, Technical University, Munich

ABSTRACT

The control rods of BWRs consist of stainless steel tubes filled with vibrocompacted boron carbide (B4C). In order to dispose of irradiated control rods, it is necessary to cut them into small pieces. Of significant interest is the release of tritium during the shearing process in the fuel storage pool and during further processing.

An extensive measurement programme carried out during the treatment of 22 highly irradiated control rods of the Kahl nuclear power plant (VAK) proved that only a very small portion of the total tritium inventory (less than 0.1 %) was released during on-site shearing, packaging and drying. From the radiological and environmental point of view this procedure is feasible without reservation.

This experience is taken as a basis for the disposal of 100 control rods of the Gundremmingen nuclear power plant, unit A (KRB A).

SESSION 46-MIXED WASTE EXPERIENCE AND INITIATIVES

TRANSPORTABLE VITRIFICATION SYSTEM: OPERATIONAL EXPERIENCE GAINED DURING VITRIFICATION OF SIMULATED MIXED WASTE

J. C. Whitehouse, P. R. Burkel, D. A. Crowley, E. K. Hansen, C. M. Jantzen, R. P. Singer,
M. E. Smith, S. R. Young, J. R. Zamecnik
Westinghouse Savannah River Company
T. J. Overcamp, Clemson University
I. W. Pence Jr., Georgia Institute of Technology

ABSTRACT

The Transportable Vitrification System (TVS) is a large-scale, fully-integrated, transportable, vitrification system for the treatment of low-level nuclear and mixed wastes in the form of sludges, soils, incinerator ash, and similar waste streams. The TVS was built to demonstrate the vitrification of actual mixed waste at U. S. Department of Energy (DOE) sites. Currently, Westinghouse Savannah River Company (WSRC) is working with Lockheed Martin Energy Systems (LMES) to apply field scale vitrification to actual mixed waste at Oak Ridge Reservation's (ORR) K-25 Site. Prior to the application of the TVS to actual mixed waste it was tested on simulated K-25 B&C Pond waste at Clemson University. This paper describes the results of that testing and preparations for the demonstration on actual mixed waste.

During TVS acceptance testing, the TVS vendor, Envitco Inc., demonstrated the unit using a simple soda-lime-silica glass formulation. The TVS was then disassembled and moved from the vendor's facility to Clemson University. Clemson's Environmental Systems Engineering (CESE) Department was responsible for site selection, TVS setup and teardown, and simulated waste preparation. CESE selected a site just off campus on the grounds of The Institute for Wildlife Environmental Toxicology. A concrete pad and utility

services were installed. The TVS was assembled in four weeks. WSRC and CESE then began an extensive equipment verification and testing program. Prior to heatup of the melter, CESE manufactured simulated waste based on a surrogate of K-25 B&C Pond Waste developed at Oak Ridge National Laboratory (ORNL) and modified by WSRC. The major components of the simulated waste were Si, Ca, Al, Fe, and K. RCRA (Resource Conservation and Recovery Act) regulated metals and Ce (to simulate U) were added to the waste surrogate. A glass formulation was developed which used Si, Li, and Na glass formers. The glass formulation was extensively tested in a series of crucible tests at Clemson. After successfully completing these tests the glass formulation was tested in an existing pilot-scale, joule-heated melter at CESE's Vitrification Laboratory. The purpose of the pilot-scale tests was to confirm that the glass formulation could be successfully melted and poured in a joule-heated melter. Once this was accomplished the TVS was operated using the same glass formulation. Operational problems were identified and corrected. The glass product, containing the simulated waste, from the crucible, pilot-scale and TVS testing successfully passed the Toxicity Characteristics Leaching Procedure (TCLP).

At the conclusion of the checkout testing program at Clemson the TVS was disassembled and shipped to the Oak Ridge K-25 site for demonstration with actual mixed waste.

THE DESIGN AND CONDUCT OF MEANINGFUL SOIL CHARACTERIZATION AND TREATABILITY STUDIES BASED ON A KNOWLEDGE OF MINERAL PROCESSING TECHNOLOGY

William S. Richardson, III
Auburn University at Montgomery and S. Cohen & Associates, Inc.
Charles R. Phillips
S. Cohen & Associates, Inc.
Gerald H. Luttrell
Virginia Polytechnic Institute and S. Cohen & Associates, Inc
Clinton Cox
U.S. Environmental Protection Agency

ABSTRACT

Mineral processing technology has been in use for decades and can be applied to separation of radionuclide contaminants from their host soil matrix by exploiting differences in physical properties between them or these two constituents. A number of studies have been performed to assess the applicability and effectiveness of mineral processing technology for treatment of radionuclide-contaminated soils. Many of these studies have produced inconclusive results because of their incomplete scope and a lack of understanding of radionuclide contamination and its association with the host soil. Some of the past studies were limited by a lack of commitment of funds to develop the proper application of characterization and treatability studies to mineral processing and others by a lack of understanding of the necessary requisites for a definitive study. In order to select potential treatment process(es), a complete characterization study of both host soil and contaminant materials must be performed to determine their physical and chemical properties as well as their relative associations with each other. Full characterization must be followed by treatment studies to evaluate the performance of process units and to optimize separation by computer modeling. Process modeling can save time and is critical to the successful selection and design of a treatment process train. Most characterization and treatability studies performed to date on radionuclide-contaminated sites lack this completeness and applicability and, therefore, have not resulted in a successful process design.

This paper describes the approach to the design and conduct of characterization and treatment studies and their relation to the conceptual and engineering design phase of the treatment process. Four important themes run throughout the paper: (1) the tiered approach to process selection, (2) the application of proven physical processes for treatment, (3) the importance of economic and practical comparison to other potential approaches to remediation, and (4) the importance of performing a complete, integrated, iterative, and reliable study of the contaminant and soil and the separation processes that are suitable for treatment and remediation.

MIXED WASTE FOCUS AREA WASTE FORM INITIATIVE - TECHNICAL BASIS, STRATEGY AND PLANS

Jenya Macheret, DOE-ID;
Dieter A. Knecht and Dirk Gombert, LMITCO; Robert Waters, SNL; and
Ron Nakaoka, LANL

ABSTRACT

The U.S. Department of Energy (DOE) has responsibility for treating and disposing of its mixed hazardous and low-level radioactive Waste (MLLW). A total volume of 130,000 m^3 is expected to require treatment to produce final waste forms for disposal. Treatment and disposal requirements for MLLW have not been established by DOE on a national basis. The performance assessment of disposal facilities, technology development, and waste form testing efforts by DOE have been separate, disjointed activities which may not lead to producing disposable waste forms. A Waste Form Initiative (WFI) is established to ensure that treatment technologies produce waste forms for MLLW that meet the waste acceptance requirements of potential disposal facilities. The Waste Form Initiative integrates in one program results of previous performance evaluations and assessments of selected disposal facilities, performance characteristics of waste forms, and development of waste treatment technologies. This paper summarizes the technical basis, strategy, and plans of the Waste Form Initiative.

INCINERATION OF DOE OFFSITE MIXED WASTE AT THE IDAHO NATIONAL ENGNEERING LABORATORY

Keith Kristofferson
John D. Harris
(Lockheed Martin Idaho Technologies Company)
Donald N. Rasch
(U.S. Department of Energy Idaho Operations Office)

ABSTRACT

Contained within the Idaho National Engineering Laboratory (INEL) Site Treatment Plan (STP) is language addressing receipt, storage, and treatment of Department of Energy (DOE) mixed waste from offsite facilities. The Waste Experimental Reduction Facility (WERF) incinerator has been identified by several DOE sites as the preferred treatment facility for their mixed wastes. As a result, these sites have indicated in their STPs that WERF will be used to treat a portion of their waste streams. The WERF incinerator has an annual treatment capacity of 2000 m^3, A small portion of thiscapacity, 136 m^3 per year through 2002, will be used by the INEL, leaving 1,864 m^3 of available capacity for mixed waste treatment each year that WERF operates.

The process, put in place by the INEL STP, and agreed to by the State of Idaho, was used first in the DOE Complex to ship mixed waste from Naval shipyards facing imminent closure under the Base Realignment and Closure (BRAC) action which implements the Defense Base Closure and Realignment Act. The STP language was again used to receive and treat mixed waste from Los Alamos National Laboratory (LANL). The above-mentioned waste streams were part of the INEL STP at the time the document was signed. However, since signing the STP, several DOE sites have requested the addition of waste streams to the INEL STP because the WERF incinerator is operating and treating mixed waste. In addition, budget cuts have eliminated many planned treatment facilities, which now makes WERF a viable option for treating offsite mixed waste.

Pre- and post-treatment storage of offsite mixed waste and waste treatment residues at the INEL, other than the waste received from Naval shipyards facing closure, requires approval of DOE-ID and the State of Idaho. Offsite waste treated at the WERF incinerator, and waste treatment residues (characteristic or listed), will not be disposed at the INEL. Rather, treated waste and waste treatment residues from incineration will be temporarily stored at the INEL until a disposal facility can be identified and arrangements made to transport the waste to the disposal facility. If no disposal facility can be found, the treatment residue is returned to the generator.

RCRA PART B PERMIT MODIFICATIONS FOR COST SAVINGS AND INCREASED FLEXIBILITY AT ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Candice C. Jierree, Rocky Mountain Remediation Services
Kirk Ticknor, ICF Kaiser, Inc.

ABSTRACT

With shrinking budgets and downsizing, a need for streamlined compliance initiatives became evident at the Rocky Flats Environmental Technology Site (RFETS). Therefore, Rocky Mountain Remediation Services (RMRS), part of the Kaiser-Hill team at RFETS, successfully modified the Rocky Flats RCRA Part B Permit to obtain significant cost savings and increased flexibility. This was done by requesting operations personnel to suggest changes to the Part B Permit which would be cost beneficial. The team subsequently obtained approval for those changes from the Colorado Department of Public Health and the Environment (CDPHE).

SESSION 47-MANAGEMENT OF HIGH LEVEL AND TRU WASTE-CHARACTERIZATION AND WASTE FORM PERFORMANCE ASSESSMENT

INTERIM STORAGE OF HIGH-LEVEL WASTE IN BELGIUM

J.P. Boyazis and M. Demarche
ONDRAF, Belgium

ABSTRACT

A new facility for the receipt and storage of radioactive waste, known as Building 36, was built on the Belgoprocess site in Belgium. This facility is intended to receive and store intermediate and high radioactive waste originating from the reprocessing by COGEMA of spent fuel from Belgian nuclear power plants.

The facility consists of:

- A storage cell for packages with very highly radiating and heat producing vitrified waste. This cell consists of 2 x 30 stainless steel pits which can each receive 10 primary packages.
- A storage bunker with a capacity of 1.000 cubic meters for the medium and highly radiating primary packages.
- A common receiving station (receiving hall, lock, unloading cell), which serves the storage areas.

Storage modules can be added in the future, without interfering with the operational area of Building 36. The storage capacity can thus be extended eight to ten fold.

Building 36 is designed to withstand earthquakes, external explosions and airplane crashes.

The duration of storage depends on the development of final disposal facilities. The design life is planned for a period of 75 years, although 100 years or more are possible.

NONDESTRUCTIVE ASSAY AND NONDESTRUCTIVE EXAMINATION SYSTEMS AND ACTIVITIES AT THE INEL RADIOACTIVE WASTE MANAGEMENT COMPLEX

Clifford J. Stanley
Idaho National Engineering and Environmental Laboratory
Lockheed Martin Idaho Technologies Company
P. O. Box 1625 Idaho Falls, ID 83415-4201

ABSTRACT

The Radioactive Waste Management Complex (RWMC) located within the Idaho National Engineering and Environmental Laboratory (INEEL) contains facilities and equipment to manage low-level, mixed, and transuranic (TRU) solid radioactive waste generated by the INEEL and other Department of Energy (DOE) laboratories and operations. The primary mission of the RWMC is safe disposal of INEEL-generated low-level waste (LLW) and temporary storage of mixed and TRU waste. Much of this waste will be retrieved, nondestructively examined, and shipped to a centralized DOE disposal facility, such as the proposed Waste Isolation Pilot Plant (WIPP) facility in New Mexico.

The Transuranic Storage Area (TSA) within the RWMC is used for examination, segregation, certification, and interim storage of TRU waste. Within the TSA, a facility referred to as the Stored Waste Examination Pilot Plant (SWEPP) provides space for the nondestructive assay and examination systems that characterize and certify the various waste forms for shipping and disposal to WIPP. The process through SWEPP includes waste container warmup, radiological survey and weighing activity, radiographic examination, fissile material assay, container integrity visual inspection, container overpacking, and gamma-ray spectrometer evaluation. This paper will provide an overview of the current and planned NDA/NDE waste characterization activities associated with SWEPP. The SWEPP efforts are getting a lot of attention as the result of the Settlement Agreement between the governor of Idaho and the DOE requiring that we start shipping TRU waste to WIPP by 1998.

UPDATE ON INTRUSIVE CHARACTERIZATION OF MIXED CONTACT-HANDLED TRANSURANIC WASTE AT ARGONNE-WEST

Carla C. Dwight, Bruce A. Jensen, C. Dwayne Bryngelson, and David S. Duncan
Argonne National Laboratory-West

ABSTRACT

Argonne National Laboratory and Lockheed Martin Idaho Technologies Company have jointly participated in the Department of Energy's (DOE) Waste Isolation Pilot Plant (WIPP) Transuranic Waste Characterization Program since 1990. Intrusive examinations have been conducted in the Waste Characterization Area, located at Argonne-West in Idaho Falls, Idaho, on over 200 drums of mixed contact-handled transuranic waste. This is double the number of drums characterized since the last update at the 1995 Waste Management Conference. These examinations have provided waste characterization information that supports performance assessment of WIPP and that supports Lockheed's compliance with the Resource Conservation and Recovery Act. Operating philosophies and corresponding regulatory permits have been broadened to provide greater flexibility and capability for waste characterization, such as the provision for minor treatments like absorption, neutralization, stabilization, and amalgamation. This paper provides an update on Argonne's intrusive characterization permits, procedures, results, and lessons learned. Other DOE sites that must deal with mixed contact-handled transuranic waste have initiated detailed planning for characterization of their own waste. The information presented herein could aid these other storage and generator sites in further development of their characterization efforts.

HOW A SIMPLE EFFECTIVENESS COST ANALYSIS EXPEDITED A COMBINED DECONTAMINATION AND DECOMMISSIONING ACTION AND A REMEDIAL ACTION AT THE OLD HYDROFRACTURE FACILITY AT OAK RIDGE NATIONAL LABORATORY

Kenneth S. Redus
MACTEC
189 Lafayette Drive, Suite C
Oak Ridge, TN 37830
Clay Bednarz
Lockheed Martin Energy Systems
Bldg 7078, MS-6402, ORNL PO Box 2008
Oak Ridge, TN 37831

ABSTRACT

An effectiveness-cost (EC) analysis was performed on several strategies that combined tank, surface impoundment, or waste pit Comprehensive Environmental Restoration and Compensation Liability Act (CERCLA) remedial actions with a structural decontamination and decommissioning action at the Old Hydrofracture Facility (OHF) in Waste Area Group 4 at the Oak Ridge National Laboratory (ORNL). Results of were obtained and subsequently approved by Department of Energy Oak Ridge Office program manager in less than three weeks.

It is a fact that DOE is rapidly moving to a project-based approach of dealing with environmental challenges in the areas of waste management, environmental restoration, nuclear material and facility stabilization, science and technology development, landlord activities, and national program planning and management.

This means that Maintenance and Integration (M&I) contractors at DOE sites will be required to support and justify strategy planning and decisions in these project areas. This paper demonstrates that EC analysis can be accomplished in a timely manner to support such decisions.

CONVERSION OF HISTORIC WASTE TREATMENT PROCESS FOR PRODUCTION OF AN LDR AND WIPP/WAC COMPLIANT TRU WASTEFORM

Richard P. Dunn, Ricky A. Wagner
Rocky Mountain Remediation Services (RMRS)

ABSTRACT

In support of the historic weapons production mission at the Rocky Flats Environmental Technology Site (RFETS), several liquid waste treatment processes were designed, built and operated for treatment of plutonium-contaminated aqueous waste. Most of these processes ultimately resulted in the production of a cemented wasteform. One of these treatment processes was the Miscellaneous Aqueous Waste Handling and Solidification Process, commonly referred to as the Bottlebox process. Due to a lack of processing demand, Bottlebox operations were curtailed in late 1989. Starting in 1992, a treatment capability for stabilization of miscellaneous, Resource Conservation and Recovery Act (RCRA) hazardous, plutonium-nitrate solutions was identified. This treatment was required to address potentially unsafe storage conditions for these liquids. The treatment would produce a TRU wasteform. It thus became necessary to restart the Bottlebox process, but under vastly different conditions and constraints than existed prior to its curtailment.

This paper provides a description of the historical Bottlebox process and process controls; and then describes, in detail, all of the process and process control changes that were implemented to convert the treatment system such that a Waste Isolation Pilot Plant (WIPP) and a Land Disposal Requirements (LDR) compliant wasteform would be produced. The rationale for imposition of LDRs on a TRU wasteform is discussed. In addition, this paper discusses the program changes implemented to meet modern criticality safety, Conduct of Operations, and Department of Energy Nuclear Facility restart requirements.

REMOTE-HANDLED TRANSURANIC WASTE SYSTEM ASSESSMENT AT THE WASTE ISOLATION PILOT PLANT

Michael R. Brown, U.S. Department of Energy-Carlsbad Area Office, Carlsbad, NM
J. Carlos Lopez, P.E., Rogers & Associates Engineering Co., Salt Lake City, UT
Joe P. Harvill, Advanced Sciences Inc., Albuquerque, NM

ABSTRACT

The U.S. Department of Energy (DOE) plans to dispose of over 2,200 m^3 of remote-handled transuranic (RH-TRU) waste by the end of fiscal year 2006. In support of this goal, efforts are ongoing for the Waste Isolation Pilot Plant (WIPP) to begin receiving RH-TRU waste in October 2001 from Los Alamos National Laboratory (LANL) and Oak Ridge National Laboratory (ORNL). An RH-TRU System Assessment that identifies the technical and programmatic challenges associated with RH-TRU waste disposal at WIPP was issued in November 1995. This paper discusses preparation, transportation, and disposal of RH-TRU waste in light of recently published goals in the National Transuranic Waste Management Plan. The Waste Management Plan calls for the certification of RH-TRU waste at LANL and ORNL in 2001.

The RH-TRU System Assessment has identified necessary measures for characterizing and repackaging waste, certifying the RH-72B transportation cask, and preparing the WIPP facility to receive RH-TRU waste. This paper finds that although the current status of activities in these areas can support initial disposal in 2001, sustained, long-term throughput will require greater financial commitment at RH-TRU waste storage sites.

SCENARIO ASSESSMENT OF AUTOCATALYTIC CRITICALITY IN THE YUCCA MOUNTAIN GEOLOGIC REPOSITORY

W. E. Kastenberg, P. F. Peterson, J. Ahn, J. Burch, G. Casher, P. L. Chambré, E. Greenspan, D. R. Olander, J. Vujic
Department of Nuclear Engineering
University of California
Berkeley, CA 94720-1730
B. Bessinger, N. G. W. Cook, F. M. Doyle, B. Hilbert
Department of Materials Science and Mineral Engineering
University of California
Berkeley, CA 94720-1760

ABSTRACT

We systematically assess potential routes to autocatalytic criticality in geologic repositories. Our focus is on heterogeneous depositions of Pu and U away from emplacement having high concentration of fissile isotopes. If HEU or ^{239}Pu are transported and deposited in concentrations similar to natural uranium ore, criticality can, in principle, occur. Removal of a small fraction of pore water provides a positive reactivity feedback mechanism which can initiate a supercritical chain reaction. Rock heating and mixing of fissile material and rock can further increase reactivity significantly. However, at Yucca Mountain, it is highly unlikely that these configurations will occur; Pu transport would occur primarily as colloids and deposit over short distances. HEU solute can move large distances in the Yucca Mountain setting; its ability to precipitate into critical configurations is unlikely, due to a lack of active reducing agents. Uranium accumulation by ion-exchange with zeolite need be thoroughly considered. Appropriate engineering of the waste form and the repository can reduce criticality probability.

ANALYSIS OF UNDERGROUND AUTOCATALYTIC CRITICALITY BY VITRIFIED HLW IN WATER-SATURATED GEOLOGIC REPOSITORIES

Jeonhong Ahn*, Ehud Greenspan, and [illegible] L. Chambré
Department of Nuclear Engineering
University of California, Berkeley
Berkeley, California 94720-1730

ABSTRACT

An analysis of underground autocatalytic criticality has been performed for vitrified high-level radioactive wastes arising from reprocessing of spent nuclear fuel that are placed in a water-saturated fractured geologic formation. We estimate by mass transport analyses the mass and ^{235}U-enrichment of accumulated uranium in the host rock originated from multiple failed waste canisters, for which static neutronic analyses are performed. Uranium accumulation with 12% enrichment (denoted as U(12)) can be created. With 30% porosity of the host rock, the minimum critical mass of U(12) required for over-moderated criticality is 280 kg. Heterogeneous U(12) depositions can exhibit positive reactivity feedback due to medium temperature increase.

SESSION 48-ISO 14000 ENVIRONMENTAL MANAGEMENT SYSTEMS STANDARD

CHANGING THE WAY WE DO BUSINESS: DEPARTMENT OF ENERGY EXPERIENCE WITH ENVIRONMENTAL MANAGEMENT SYSTEMS

Larry Stirling
U.S. Department of Energy

ABSTRACT

The Department of Energy has been actively considering use of Environmental Management System (EMS). This approach represents a fundamental change in the way that the Department ensures environmental protection. This is not an add-on but a basic change in how business is done. This shift can be important because the Department cannot afford business as usual. Some of the reasons for adopting an EMS in DOE programs and sites are outlined as well as providing an update on EMS activities within the Department in this presentation.

ISO 14000: WHAT'S IN IT FOR THE ENERGY FACILITY CONTRACTOR?

George D. Greeny Jr., CCM, QEP
Battelle-Pantex
Amarillo, Texas

ABSTRACT

On September 2, 1996 the International Organization for Standardization (ISO) published the international standard for environmental management systems (EMS), ISO 14001 (Environmental Management Systems—Specification with Guidance for Use) and an accompanying document ISO 14004 (Environmental Management Systems—General Guidelines and Principles, Systems and Supporting Techniques), which is the conformity guideline document for ISO 14001. This was the culmination of about five years of effort which started in August 1991, when the International Organization for Standards and the International Electrotechnical Commission (IEC) established the Strategic Advisory Group on the Environment (SAGE). SAGE's charge was to make recommendations regarding international standards for the environment. The result of that work was a series of recommendations on environmental management including one that ISO create a new technical committee to develop standards in environmental management. In January of 1993, ISO created Technical Committee (TC) 207 and asked TC 207 to develop a uniform international EMS standard and other "guideline" documents for use as environmental management tools. The committee met for the first time in Toronto in June 1993. The resulting standards and guideline documents are a testimony to the dedication of thousands of environmental professionals in 50 countries, an example of unprecedented international cooperation, and testament to a rather widely accepted perception of the viability of an EMS as an effective set of environmental protection tools vice the standard command and control modus operandi. Shortly after the first meeting of TC 207, President Clinton signed Executive Order No. 12856 which pledges our Federal Government to implement pollution prevention measures, and publicly report and reduce the generation of toxic and hazardous chemicals and associated emissions. On September 12, 1995, senior Federal agency representatives signed the Charter for the Interagency Pollution Prevention Task Force (IPPTF). This committed the Federal Government, among other things, to participate in the establishment of an agency Code of Environmental Management Principles (CEMP). The U.S. Environmental Protection Agency (EPA) has been working to develop the CEMP through the IPPTF and published the final version of the CEMP in the Federal Register on Wednesday October 16, 1996. EPA is seeking the endorsement of the CEMP principles from all Federal Agencies; however, it is doing so with flexibility as to how agencies implement the principles at the facility level. It is allowing agencies the choice of directly implementing the CEMP at the facility level or the use of another alternative EMS like ISO 14001. This approach by EPA recognizes the fact that individual Federal facilities and installations may already have embarked on an EMS course via ISO 14001 or are considering adoption of the International Standard. These events, in the international and the U.S. national arenas, have presented Federal agencies with an unprecedented opportunity to improve their modus operandi, i.e., "to work smarter" and perhaps cheaper in the decades to come. The U.S. Department of Energy's (DOE) Energy Facility Contractors Group (EFCOG) has recognized this and has authorized the formation of an ISO 14000 Working Group. The primary purpose of this working group is to promote excellence in DOE EMSs by sharing information and lessons learned, and by facilitating the exchange of information and experiences, in implementing the ISO 14000 series of standards, and their implications for integrating strategic environment, safety, and health (ES&H) management programs into the daily operations at DOE sites. Working group participation will provide EFCOG member companies the opportunity to exchange information and to discuss the benefits of ISO 14000. There is, however, a very real question lurking somewhere in the shadows of the EMS standards. That question is "What's in it for the Energy Facility Contractor?" An ancilary question is, What's in it for the U.S. Taxpayer?

IMPLEMENTATION OF ISO 14001 AT THE SAVANNAH RIVER SITE

Ronald L. Peterson, Department of Energy, Savannah River
Operations Office (DOE-SR)
H. Steve Etheridge, Westinghouse Savannah River Company (WSRC)

ABSTRACT

DOE's Savannah River Site (SRS) covers 310 square miles and employs approximately 16,000 people. The primary mission for the site has undergone a significant change from the production of nuclear materials for the nation's strategic weapons program to the protection and restoration of the environment at SRS. Our goal is to become a leader in restoring, stabilizing, protecting, and enhancing the environment. To achieve this goal, SRS has begun implementation of an environmental management system complying with the ISO 14001 Standard. SRS will fully integrate the system into the management structure and obtain recognition that our EMS complies with the standard. It is SRS's intention to be in a position to obtain registration to the ISO 14001 standard should the DOE decide to do so. This paper describes SRS's decision to implement the environmental management system, the action plan for implementation, and challenges in their ongoing implementation process.

ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEMS: AN OPPORTUNITY FOR IMPROVING INTEGRATION OF ENVIRONMENT, SAFETY, AND HEALTH AT DOE SITES

Diane Meier
Lawrence Livermore National Laboratory
Fission Energy Safety and Systems Safety Program, Washington Operations Office
William Roy-Harrison
Department of Energy
Office of Defense Programs, Germantown, Maryland

ABSTRACT

ISO 14001, the new international standard, is a tool that public and private organizations can use to improve environment, safety, and health (ES&H) protection and pollution prevention. The standard's specifications for environmental management systems (EMS) are intended to assure integration of ES&H considerations into the mainstream of operations. There is no overall federal policy, nor is there any Department of Energy (DOE) policy, specifically on the use of ISO 14001 for federal facilities. However, DOE has clearly indicated its support for the use of standards developed by voluntary, private sector, consensus bodies, as is evident in numerous policies and requirements. In addition, DOE's quality assurance program requires implementation of management systems. What is new for DOE is the application of the management system approach to ES&H programs. The Department issued a new integrated safety management systems (SMS) policy in October 1996. While the SMS policy does not reference ISO 14000, there are many parallels between the SMS and the EMS. Both are based on the management system approach that is often referred to as "plan, do, check, act." The SMS and EMS have the same fundamental elements, although there are some differences in terminology and categorization of elements. Both involve work planning, analysis of hazards and impacts, operational controls, feedback, and improvement. DOE already has in place many of the elements of the EMS and the SMS. However, linkages between existing ES&H programs and integration with operations could be improved. Whether it is called an EMS or an SMS, the management system approach would enable DOE sites to improve ES&H integration. Work planning and execution would proceed with full consideration of ES&H objectives and targets. The adverse impacts and costs of violations, occurrences, and accidents would be avoided and/or mitigated more effectively, and continual improvement would be assured.

DEVELOPING AN INTEGRATED ECOLOGICAL RESOURCE MANAGEMENT AND MONITORING PLAN AS PART OF AN ENVIRONMENTAL MANAGEMENT SYSTEM

Daniel Michael and Mark Hooten, Neptune and Company, Inc.
Elizabeth Kelly, Los Alamos National Laboratory
William Roy-Harrison, US Department of Energy

ABSTRACT

Recent interest in defining the appropriate content of an Environmental Management System (EMS), as specified by ISO 14001, prompted this study to determine how ecological concerns should be incorporated into an EMS and subsequently implemented. In this paper, we present both a conceptual approach and an example based on an actual application.

The approach described in this paper involves developing management goals and measurement endpoints based on a facility-specific ecological resource policy statement, and a management and monitoring plan based on the specified goals and endpoints. We believe that this approach should be employed at Department of Energy (DOE) facilities where an ecological resource management approach that goes beyond simple regulatory compliance is warranted. This approach, based on EMS principles, is comprehensive and integrated. It culminates in an integrated data collection and management plan, which will be useful for ecological risk assessments, NEPA environmental assessments, NRDA damage assessments; and protection of threatened and endangered species, migratory birds, and wetlands.

We believe that there is a growing need at DOE facilities to move toward such a com-

prehensive, integrated systems approach so that these facilities can proactively address ecological concerns, rather than being forced to respond retroactively to damage claims, restoration requirements, and/or bad publicity. Data generated from a proactively conceived, integrated ecological monitoring plan will also greatly improve the ability of the DOE facility to evaluate the impact of proposed projects and assess the impacts of past environmental problems. In addition, integrated environmental monitoring, data management, data interpretation, and reporting that incorporate the needs of multiple environmental regulations, across media, could result in enormous savings and increase the defensibility of DOE environmental decision making.

STRATEGIC ENVIRONMENTAL COMPLIANCE PLANNING: A TOOL FOR ISO 14000 EMS DEVELOPMENT

Dennis Lew and Bruce Parrish
Environmental Engineering & Technology Division
General Physics Corporation
Columbia, MD
Tim McNamara
Directorate of Safety, Health and Environment
U.S. Army Garrison Aberdeen Proving Ground

ABSTRACT

The U.S. Army Garrison Aberdeen Proving Ground (APG) has developed a Strategic Environmental Compliance Plan (SECP) to manage its environmental regulatory requirements in a more "forward looking" manner. APG has also begun the task of developing an Environmental Management System (EMS) with the goal of eventual certification under ISO 14001. The SECP has provided APG with a solid base on which to build their EMS. This paper presents the major elements of the SECP, how they relate to the requirements for an EMS under ISO 14001, and a discussion of additional elements that must be developed to fulfill the requirements of ISO 14001.

SELF ASSESSMENT OF FACILITY ENVIRONMENTAL MANAGEMENT

Gary Kaszynski
CH2M-Hill

ABSTRACT

A new and innovative approach has been developed for conducting a management self-assessment of the functional components of facilities' environmental programs. The management self assessment approach is complementary to the analysis of root causes of environmental noncompliance. Although root cause analysis routinely is confused with management self assessments, it is quite different. Root-cause analysis focuses on why specific compliance deficiencies occur. Examples include equipment failure, poor maintenance, lack of training, lack of budgets, or a breakdown in an existing management system. Management self-assessments focus on systems and procedure that need to be in place to address root causes. Both assessment techniques share the goal of converging the management assessment with a root cause analysis, resulting in improved environmental performance.

In this context, management self assessment checklists have been developed to answer the following types of questions:

- Are all necessary systems/environmental management functions in place?
- Are they appropriate to the environmental management needs of the facility?
- Are they effective in achieving environmental goals?
- Do the systems assist in reducing compliance (or other) deficiencies?

Alternatively, root cause analysis involves answering different questions: Ehat is the compliance (or other performance) deficiency? What is the regulatory criterion? What is the sonsequence of doing nothing? What caused the defiency? Was the cause technical, managerial, or awareness related? What can be implemented to achieve a solution to the problem?

To address the need for a method to review environmental management systems, a series of Environmental Management Self-Assessment checklists have been developed for a major Air Force Command that will allow environmental managers to perform a self evaluation of their environmental management functions. The checklists were designed to allow the users to quantify their responses to a series of questions, identify areas of strength and weakness, and measure performance over time to document improvement. The checklists are included in a Microsoft ACCESS database that allows the users to complete the checklists electronically, customize the checklists, develop management action items to implement, conduct trend analysis and produce reports.

USING ISO 14001 TO SPEED DEPLOYMENT OF NEW ENVIRONMENTAL TECHNOLOGY

Dr. Jean E. Shorett
Battelle, Pacific Northwest National Laboratory

ABSTRACT

Environmental Management Systems (EMS) and the ISO 14001 EMS Standard have been widely discussed as ways to upgrade management of environmental activities at Federal facilities. Increasingly, there is recognition that the ISO Standard also serves as a general management tool. This broader view recognizes the value added in areas beyond what is usually seen as 'environmental.' This paper continues that expansion. It will outline ways in which an EMS can ease deployment of new environmental technologies. Although not currently recognized as such, an intelligently implemented EMS can become an important tool for reducing cycle time in technology deployment and enhancing ability to manage hurdles and impediments. In turn, streamlined deployment can support effective use of new technology in EM's Ten Year Plan and beyond.

SESSION 49-ENVIRONMENTAL RESTORATION-SITE PROJECTS

HANFORD 100-B/C DEMONSTRATION PROJECT

Nancy Werdel
U.S. Department of Energy, Richland Operations Office
Glenn Van Sickle
Bechtel Hanford, Inc.
John April
CH2M HILL Hanford, Inc.

ABSTRACT

This paper presents the findings of the 100-B/C Demonstration Project conducted at the U.S. Department of Energy's Hanford Site in southeastern Washington State. The purpose of the 100-B/C Demonstration Project was to initiate remedial action in the 100 Area source sites and to address uncertainties in the remedial design planning. A series of objectives, defined through the Data Quality Objectives (DQO) process, were addressed during the excavation of three waste features. In addition, the opportunity to implement two new technologies was taken. These technologies consisted of advanced characterization using both the sonic cone penetrometer and gamma logging to delineate contamination boundaries during remediation of the 116-B-4 site and using the SonSub™ soil excavator during the 116-C-1 site excavation.

This project initiated remediation for the source sites at the Hanford Site and paved the way for the larger remediations in the 100 and 300 Areas. The lessons learned during the implementation of this project benefited the remedial designs and procurements for these larger projects and will benefit professionals involved in remediation throughout the U.S. Department of Energy complex.

THE DECONTAMINATION OF A LARGE LUMINISING FACTORY SITE USING A NOVEL RADIUM IN SOIL ANALYTICAL METHOD

F J Coleman, K F Collett
WasteChem Ltd.

ABSTRACT

The factory site of one of the main UK suppliers of radium luminised dials to the public, aerospace and defence industries, covers an area of 6.7 hectares. It contained laboratory and factory buildings which had been in use since the factory site was first established for this purpose in 1937. Luminising of dials ceased in the early 1980s. Part of the site formed the company's sports field which had been built on infill waste materials.

The company owning the site had been given planning permission for development and a certain amount of decontamination work had been carried out in the 1980s. WasteChem contracted to remove, segregate, package and transport the remaining radium radioactivity, which was spread throughout the site on land to a depth of 3 metres, and in buildings to the foundations.

On-site analysis of soil and rubble samples was normally carried out by sodium iodide gamma spectrometry, an occasional sample being sent to a NAMAS Approved Laboratory for measurement on a GeLi gamma spectrometer for calibration quality assurance purposes.

To speed up the process, reduce waiting time and the high cost of off-site analysis, a novel instrument was developed by WasteChem. The original prototype instrument consisted of a large area plastic scintillator (LAPS) attached to a commercially available portable counter-timer-EHT unit. The combined LAPS and associated counter instrument formed a portable laboratory-type analytical system that could be used anywhere on site in four operational modes. The calibration and readout method has been designed so that immediate in-the-field specific activity levels in Bq.g-1 can be obtained to an acceptable accuracy by non technical staff. Experience with the prototype on this project has led to a robust improved design that incorporates within the body of the LAPS its own miniature counter-timer-EHT unit, Fig. 1.

ROCKY FLATS CLEANUP AGREEMENT-IMPLEMENTATION SUCCESSES AND CHALLENGES

David C. Shelton
Kaiser-Hill Company, L.L.C.
Rocky Flats Environmental Technology Site
Golden, Colorado

ABSTRACT

On July 19, 1996 the U. S. Department of Energy (DOE), State of Colorado (CDPHE), and U. S. Environmental Protection Agency (EPA) entered into an agreement called the Rocky Flats Cleanup Agreement (RFCA) for the cleanup and closure of the Rocky Flats Environmental Technology Site (RFETS or Rocky Flats). Major elements of the agreement include: an Integrated Site-Wide Baseline; up to twelve significant enforceable milestones per year; agreed upon soil and water action levels and standards for cleanup; open space as the likely foreseeable land use; the plutonium and TRU waste removed by 2015; streamlined regulatory process; agreement with the Defense Nuclear Facilities Safety Board (DNFSB) to coordinate activities; and a risk reduction focus.

Successful implementation of RFCA requires a substantial effort by the parties to change their way of thinking about RFETS and meet the deliverables and commitments. Substantial progress toward Site closure through the implementation of RFCA has been accomplished in the short time since the signing yet much remains to be done. Much can be learned from the Rocky Flats experience by other facilities in similar situations.

MODELING EXPOSURE TO DEPLETED URANIUM IN SUPPORT OF DECOMMISSIONING AT JEFFERSON PROVING GROUND, INDIANA

Michael H. Ebinger, Environmental Science Group,
Los Alamos National Laboratory, Los Alamos NM
Tanya P. Oxenberg, U. S. Army Test and Evaluation Command,
Aberdeen Proving Ground, MD

ABSTRACT

Jefferson Proving Ground was used by the U. S. Army Test and Evaluation Command for testing of depleted uranium munitions and closed in 1995 under the Base Realignment and Closure Act. As part of the closure of JPG, assessments of potential adverse health effects to humans and the ecosystem were conducted. This paper integrates recent information obtained from site characterization surveys at JPG with environmental monitoring data collected from 1983 through 1994 during DU testing. Three exposure scenarios were evaluated for potential adverse effects to human health: an occasional use scenario and two farming scenarios. Human exposure was minimal from occasional use, but significant risk were predicted from the farming scenarios when contaminated groundwater was used by site occupants. The human health risk assessments do not consider the significant risk posed by accidents with unexploded ordnance. Exposures of white-tailed deer to DU were also estimated in this study, and exposure rates result in no significant increase in either toxicological or radiological risks. The results of this study indicate that remediation of the DU impact area would not substantially reduce already low risks to humans and the ecosystem, and that managed access to JPG is a reasonable model for future land use options.

VALUE OF INFORMATION ANALYSIS - NEVADA TEST SITE

G. McNulty, B. Deshler, H. Dove
IT Corp.
K. Rehfeldt, W. Fryer
GeoTrans
D. Hippensteel
USDOE

ABSTRACT

This paper presents an innovative use of decision analysis to perform a Value of Information Analysis (VOIA) that compares the cost of acquiring information during a corrective action investigation with its benefits. The benefit has been defined as the percent reduction in the contaminant boundary. The decision analysis incorporates many of the detailed elements of flow and transport modeling with some simplification. The decision model actually uses the flow and transport model to calculate the contaminant boundary, defined as the 95 percent confidence level for a 4 mrem/year dose, to evaluate the benefit not only of various field data acquisition and analysis tasks, but also the importance of uncertainties in the conceptual flow model. The results indicate that vertical flow, not the currently assumed horizontal flow model, may actually control the site characterization effort for the corrective action unit. Furthermore, the results indicate that a sizeable investment on the orders of several millions of dollars is required to either resolve the likelihood of a fast path to the carbonates or improve the uncertainty in the contaminant boundary associated with horizontal flow by only a few percent. If the new information shows that a fast path to the carbonates actually does exist, the boundary location may change significantly and extend well into the carbonate aquifer. The likelihood of resolving the presence or absence of this important pathway can be increased with expenditures similar to those expected for the minor uncertainty reductions in the source term and horizontal flux.

SESSION 50-METAL RECYCLE, FACILITY REUSE, AND ASSET RECOVERY

RECYCLING OF DECOMMISSIONING WASTE - JAERI'S PERSPECTIVE AFTER JPDR DECOMMISSIONING -

Kazuo Fujiki & Hisashi Nakamura
Japan Atomic Energy Research Institute
Tokai-mura, Ibaraki-ken, 319-11 JAPAN

ABSTRACT

Dismantling of the Japan Power Demonstration Reactor (JPDR) generated about 3,770 tons of low level radioactive solid waste. After the completion of the JPDR decommissioning, future possibility of the recycling of a part of LLW generated is being discussed, in conjunction with JAERI's recent activities on melting tests, feasibility study of the recycling system, and the development of new volume reduction facilities in Tokai site. Controlled recycling within the nuclear facility will be favored as a first step of realization of slightly contaminated materials, for demonstration of waste volume minimization and safe management of the waste. Equipment for waste management such as containers will be primary candidates for recycling of radioactive metallic materials to be used in JAERI.

ASSET RECOVERY AS A WAY TO FUND D&D PROJECTS

John M. Tuohy, Nathan H. Hurt, Daniel Quinn, Jose Capote
IDM Environmental Corp.

ABSTRACT

There exists a world-wide market for the re-utilization of surplus plants, equipment and materials. The effective integration of asset recovery strategies in conjunction with facility D&D projects provides a number of very significant benefits: (1) the proceeds generated by the sale of surplus assets can be directly applied toward funding the D&D project, (2) the salvage of surplus equipment and materials significantly reduces the volume wastes requiring disposal, (3) the relocation of surplus plants can provide unique opportunities for site re-development and re-industrialization. This paper describes several recent examples of IDM's innovative approach to the decommissioning of industrial facilities, involving the integration of asset recovery and plant relocation strategies as essential elements of a comprehensive D&D strategy.

FEASIBILITY STUDY ON RECYCLING OF DISMANTLED METAL BY INDUCTION COLD CRUCIBLE MELTING METHOD

Masahiro Suzuki
Kunisuke Tsurumaki
Junji Komatsu
Research Association for Nuclear Facility Decommissioning (RANDEC),
821-100,Funaishikawa,Tokai, Ibaraki, Japan
Tsutomu Tanaka, Yoshiaki Ikenaga
Corporate Research Labs.,Sumitomo Metal Ind. Ltd.(SMI),
16,Sunayama,Hasaki,Kashima,Ibaraki,Japan
Hiroshi Nose
Sumitomo Metal Technology Ind. Ltd.(SMT),
1-1-3,Otemachi,Chiyodaku,Tokyo,Japan

ABSTRACT

An induction cold crucible melting is one of the most promising technologies for the reuse of radioactively contaminated metals because it ensures a long life operation without generating secondary wastes under the high temperatures of metal melting.

A feasibility study on MERC (Melting and Recycling of Metals by Cold Crucible) process has been recently finished in RANDEC. In MERC, an induction cold crucible, which mainly consists of a melter, decontaminator and continuous caster is used for the melting and recycling of metals contaminated by low level radiation with small section generated from the nuclear facilities.

A cylindrical ingot of 3kg and 45mm in diameter was continuously cast by the MERC process through melting and solidifying simulated radioactive metallic tubes with the addition of flux composed of lime, alumina and silica. Neither splash of the melt nor increase in the temperature of the hook supporting tubes took place during releasing the tube onto the melt dome. The ingot surface was smooth and crack free, promising removal of radioactive elements contained in a slag stuck to the ingot surface. There was no macro segregation inside. Tracer elements of Sr and Hf remained in the slag, Cs and Zn in the dust. Co and Mn mostly remained in the ingot. However, up to 10% of Co could be transmitted to the slag.

Necessary data in the scheduled scale-up of MERC process was obtained through experiment as well as theoretical study. These results are transferred to the design and manufacturing of testing apparatus.

THERMOCHEMICAL DECONTAMINATION OF METALLIC SURFACES

Igor A. Sobolev, Viktor M. Tivansky, Arcady G. Petrov, Olga K. Karlina, Michael I. Ojovan
Scientific and Industrial Association "Radon",
The 7-th Rostovsky Lane, 2/14, Moscow, 119121, Russia

ABSTRACT

Exothermic metallic compositions (EMC) were used in order to decontaminate radionuclide contaminated metal surfaces. Experiments were carried out with samples of carbon and stainless steel which were contaminated by ^{137}Cs. Radionuclide distribution and aerosol releases were measured during the process of decontamination. High efficiency of the applied technique was found as well as absence of environmental contamination.

URANIUM DEPOSIT REMOVAL AT THE OAK RIDGE GASEOUS DIFFUSION PLANT

M. J. Haire
Chemical Technology Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831-6495
T. L. Dahl, Sr.
Decontamination and Decommissioning Program
Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7328

ABSTRACT

A first step in the decontamination and decommissioning of the shutdown gaseous diffusion plant at the K-25 Site in Oak Ridge, Tennessee, is the removal of uranium deposits from unfavorable geometry cascade process equipment to improve nuclear criticality safety. The U.S. Department of Energy has initiated a Deposit Removal Program (DRP) to accomplish deposit removal. The organization of the DRP is described, deposit removal techniques are discussed, and photographs of facilities and support equipment with which deposits are removed are shown. The current accomplishments and status of the DRP described.

THE BIG "R-WEAPONS" AGAINST THE NEW THREAT TO ECONOMIC SECURITY: REINDUSTRIALIZATION, REMANUFACTURING, AND REUSE

Terry L. Payne, Jack L. Cook
Lockheed Martin Energy Systems, Inc.
Oak Ridge Y-12 Plant

ABSTRACT

Waste management is a topic that becomes increasingly more important as markets become global. Organizations that are able to merge waste management objectives with their competitive strategies should attain a competitive advantage by lowering their product costs. Three strategic weapons can be used in today's business environment to

obtain this desirable competitive advantage: reindustrialization, remanufacturing, and reuse. This paper discusses not only each of these weapons but also reasons for government assistance in private waste management.

For this paper, the authors consider "waste" to be any materials input to the process that would not be required if the process were 100% efficient. In manufacturing, for example, a process that is 100% efficient transforms raw materials and energy into finished products containing no defects and has no raw materials or energy to spare.

REINDUSTRIALIZATION, REUSE, AND RECYCLING ON FUSRAP ENVIRONMENTAL REMEDIATION PROJECTS

Ben Rogers, CHMM, Bechtel National, Inc.
Coauthors: Rick McNutt and Preston McDaniel (Bechtel); Jason Darby
Department of Energy Former Sites Restoration Division

ABSTRACT

The Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP) has remediated 23 sites contaminated with low levels of radioactive materials. While cleaning up these sites for commercial reuse, the FUSRAP team has developed and applied cost-effective methods for working in operating facilities, reducing waste volumes, using supplemental cleanup criteria, and recycling waste materials. For example, to verify that cleanup levels of underground piping met the specified criteria, an innovative in situ inspection instrument was used that minimized the impact of the inspection on an operating commercial production facility. At several sites, a rock crusher reduced rubble and building debris to soil-like material that can be beneficially reused, for a program savings of more than $4 million. Recycling efforts include the smelting and reuse of approximately 1million kg of radioactively contaminated scrap metal and an aggressive program for reclaiming and recycling materials from building demolition.

SESSION 51-PUBLIC COMMUNICATION AND TRAINING

CLARIFICATION OF THE COMMUNITY'S PERCEIVED RISK OF IONIZING RADIATION THROUGH EDUCATION AND TRAINING

Robert L. Jeffries
Radiological Training Officer
New Hampshire Office of Emergency Management
107 Pleasant Street
Concord, New Hampshire 03301

ABSTRACT

One of the greatest obstacles to educating the community in emergency response preparedness, is overcoming the excessive fear of nuclear power. Just over fifty years ago, this fear began when the world saw the awesome and fearsome power of the atomic bomb. The fear associated with nuclear weapons has improperly become associated with "anything nuclear". This has produced an unhealthy fear. Our citizens must have a healthy respect for the risk/reward ratio associated with nuclear power and ionizing radiation. This produces a base from which productive dialog can take place between the state and the community, enabling the community to eventually deal with a radiological incident in an informed and educated manner.

BREAKING DOWN REGULATORY BARRIERS TO THE USE OF INNOVATIVE TECHNOLOGIES THROUGH INTERSTATE COOPERATION

James Harrington, NY Dept. of Environmental Conservation
Chris Renda, Environmental Services Network for the
Interstate Technology and Regulatory Cooperation Work Group
Low Temperature Thermal Desorption Work Team

ABSTRACT

The Interstate Technology Regulatory Cooperation Work Group (ITRC) was formed in March 1995 by the Western Governors' Association, with funding provided by the United States Department of Energy (DOE) Office of Technology Development (EM-50), Department of Defense (DoD), and Environmental Protection Agency (EPA). Its mission is to facilitate interstate cooperation in the common effort to remove barriers to the development and use of innovative environmental technologies for the remediation and treatment of hazardous and radioactive wastes. The ITRC has evolved into a Performance Partnership between States, Federal Agencies and Stakeholders. As such, it is supported by 27 states, DOE, DoD, EPA and members of the stakeholder community. Ground breaking efforts in interstate cooperation were recently underscored when the ITRC received Vice President Al Gore's prestigious "Hammer Award," recognizing the group's significant contribution in support of President Clinton's National Performance Review (NPR) principles.

The ITRC continues to break down regulatory barriers and promote the advancement of environmentaltechnology through:

- Development of consistent technical requirements for technology permitting/approval.
- Development of technology demonstration verification protocols for use by stakeholders, states and federal agencies.
- Coordination of interstate participation in technology demonstrations and verifications.
- Improvement of interstate information and communications networks.

Organized into various work teams, the ITRC addresses different areas and projects in support of the overall mission. Each team is responsible for development of products that relate to a specific technology or subject area. FY 1997 work teams include: In situ Bioremediation, Accelerated Site Characterization, Permeable Treatment Walls, Metals in Soil, Plasma, Low Temperature Thermal Desorption (LTTD), Policy, Communication, and Implementation.

An example of ITRC efforts is the development of a multi state, consensus-based Technical Requirements Documents being finalized by the LTTD Work Team. LTTD was chosen as an example of an ex situ technology which is newly being used to partition hazardous and radioactive mixed waste. The LTTD documents lay out the technical regulatory requirements for deployment of the technology to treat hazardous and mixed waste contaminated with chlorinated constituents and/or mercury. Technical requirements covered by the LTTD documents range from sample parameters, methods, and quality assurance/quality control (QA/QC) to proof of performance test and operations requirements.

During the Spring of 1997, the ITRC will be finalizing several new work products to facilitate interstate cooperation in the efforts to test, demonstrate, evaluate, verify and deploy innovative environmental technologies and will be distributing those work products for multi state concurrence. Common issues addressed by the ITRC Work Teams include standardized cost and performance reporting requirements, provisions for flexibility and variances, and public involvement in ITRC efforts. The ITRC expects their work products will be used by states, agencies, industry and stakeholders.

INTERNATIONAL DEEP GEOLOGICAL R&D DISPOSAL ACTIVITIES WORKSHOP

NAGRA R&D ACTIVITIES SUPPORTING HLW/TRU DISPOSAL

C. McCombie, I. McKinley
Nagra, 5430 Wettingen, Switzerland

ABSTRACT

In Switzerland, the planned repository for co-disposal of HLW and long-lived ILW (loosely termed "TRU") is not needed before 2020, at the earliest, and a more realistic operational date would be ~2050. Despite this, an active R&D programme is ongoing with the next major milestone being demonstrating by around 2000 the feasibility of siting such a repository in Northern Switzerland.

The main components of the active R&D programme which has been running for ~15years can be grouped as follows:

- Geological studies to characterise the crystalline and sedimentary host rocks which are under consideration
- Investigation of the long-term behaviour of various types of waste in a deep repository in such rock and of the engineered barriers (container, backfill) around the waste form

Use of system studies and performance assessment to develop of a convincing case to demonstrate that safe disposal in one, or both, of these host rocks would be feasible in an identified potential siting region.

The main studies ongoing in each of these areas are now discussed in some further detail.

KEY ISSUES OF THE SWEDISH PROGRAMME FOR RESEARCH, DEVELOPMENT AND DEMONSTRATION OF DEEP GEOLOGICAL DISPOSAL OF SPENT NUCLEAR FUEL

Claes Thegerström
Director Deep Repository Division
Swedish Nuclear Fuel and Waste Management Co
P.O. Box 5864
S-102 40 STOCKHOLM
e-mail: skbcth@skb.se

ABSTRACT

The Swedish programme is aimed at final disposal of unreprocessed spent nuclear fuel into the crystalline bedrock. Copper canisters will be used for long term containment of the radionuclides. Extensive research and development work has been performed since the 1970ies. SKB is now shifting to practical demonstration and execution of encapsulation, repository design and site selection. Research is focusing on examining those processes that are most important for safely and gathering data as a basis for designing the barriers.

In the paper key issues for research and development are highlighted. One such area is design, fabrication and sealing of canisters. SKB is constructing a laboratory for encapsulation technology in Oskarshamn. Buffer and backfill materials as well as development of a geoscientific site investigation programme are other important areas in the programme.

The Äspö Hard Rock Laboratory is a key facility for further development of the scientific and technical basis of future implementation of deep geological disposal in Sweden. Planned activities at Äspö are briefly described. Studies underway are for example

- ZEDEX, a study of the disturbed zone for blasted and bored tunnel.
- Test and development of investigation methodology for detailed characterisation.
- Tracer Retention Understanding Experiment, TRUE.

Finally the plans for construction of a full scale inactive prototype of a deposition tunnel at Äspö are outlined.

THE WASTE ISOLATION PILOT PLANT PROJECT: BUILDING CONFIDENCE THROUGH INTERNATIONAL COOPERATION

Mark Matthews, U. S. Department of Energy, Carlsbad Area Office
Anita Reiser, Sandia Nantional Laboratories
Les E. Shephard, Sandia Nantional Laboratories

ABSTRACT

The U. S. Department of Energy (DOE) has conducted site characterization and laboratory tests related to the safe disposal of long-lived radioactive waste for the past 22 years at Waste Isolation Pilot Plant (WIPP). As a direct result, it has developed an operating, world-class underground facility that is scheduled to begin to receive waste in November, 1997. A disposal phase experimental program is being planned to enhance repository operations and reduce costs associated with waste disposal while continuing to increase confidence in long-term repository performance. An important element of this disposal phase program is active participation with the international radioactive waste management community through collaborative experimental programs conducted at facilities world-wide, including the WIPP. These programs are intended to enhance confidence in predicting long-term repository performance and in extending the state-of-the art capabilities for characterizing natural and engineered systems. These activities will have an immediate and direct impact on the WIPP by contributing to cost effective operational improvements and reducing uncertainty associated with key parameters that influence repository performance. Further, the continued development and enhancement of working relationships with international waste management programs ensures timely exchange of information and identification of emerging technical needs within the radioactive waste management community.

CANADIAN RESEARCH ON DISPOSAL OF NUCLEAR FUEL WASTE

K.W. Dormuth
Atomic Energy of Canada Limited

ABSTRACT

Canada's program of research into disposal of nuclear fuel waste in plutonic rock of the Canadian Shield has covered all components of the disposal system—waste form, container, repository seals, geosphere, and biosphere. The generic research, not aimed at disposal in a particular rock body, has provided information that affirms the appropriateness of disposal in plutonic rock as part of a long-term waste management strategy. Issues in each area remain to be resolved before disposal can take place, but they would be most efficiently and effectively addressed in the context of particular potential disposal sites.

ER WORKSHOPS

LESSONS LEARNED AND CURRENT STRATEGY FOR GROUND WATER CLEANUP AT LAWRENCE LIVERMORE NATIONAL LABORATORY

ABSTRACT

Lawrence Livermore National Laboratory (LLNL) has recently completed the cleanup and closure of a gasoline spill site. Innovative thermal methods were shown to quickly and effectively clean the contaminated site. At the LLNL Livermore Site a geographically widespread problem is the presence of solvent plumes. Pump and treat is effective in cleanup of solvent plume regions distant from the source, but a more aggressive approach is needed for the source region itself.

ACCELERATED AQUIFER REMEDIATION UTILIZING GROUNDWATER REINJECTION AT THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Marc Jewett, Jyh-Dong Chiou, Ron White, Ken Broberg
Fluor Daniel Fernald
Kathi Nickel, Robert Janke
DOE-Fernald

ABSTRACT

The Fernald Environmental Management Project (FEMP) facility formerly operated from 1952 to 1989 as a large-scale production facility of high-purity uranium metal products in support of U.S. defense initiatives. Environmental restoration at the site includes the active restoration of the contaminated portions of the Great Miami Aquifer. It has been determined through computer model simulations that the use of a promising innovative technology--groundwater reinjection--could help reduce the time required to restore the Great Miami Aquifer to approximately ten years. If successful, the long-term savings in operations and maintenance costs associated with the faster remediation time are estimated at over $50M.

LESSONS LEARNED AND CURRENT STRATEGY FOR GROUND WATER CLEANUP AT LAWRENCE LIVERMORE NATIONAL LABORATORY

Alan B. Copeland
Lawrence Livermore National Laboratory
P. O. Box 808, L-544
Livermore, CA 94551

ABSTRACT

Spills of volatile solvents or fuel hydrocarbons are often difficult to clean up, especially if the contaminants are present in the aquifer as a separate liquid phase. Excavating and treating the contaminated soil may not be practical or even possible if the affected zone is relatively deep. Pumping from the aquifer has proven to be very time consuming and this is because huge amounts of water must be flushed through the area to clean it. Due to the low solubility of most common contaminants and the difficulty of removing contaminants from fine grained low permeability sediments, such pump and treat systems can be expected to take decades to centuries to clean a site.

ACCELERATING THE USE OF INNOVATIVE REMEDIATION TECHNOLOGIES THROUGH COOPERATIVE PARTNERSHIPS

Mike Hightower
Sandia National Laboratories
Albuquerque, NM 87185

ABSTRACT

To accelerate the adoption and implementation of new and innovative remediation technologies, the Innovative Treatment Remediation Demonstration (ITRD) Program was created by the Department of Energy's (DOE) Environmental Restoration Program Office (EM40) as a public-private partnership in cooperation with the Environmental Protection Agency's (EPA) Technology Innovation Office (TIO). Coordinated for the DOE by Sandia National Laboratories, the ITRD Program directly involves government, industry, and regulatory agencies in the assessment, implementation, and validation of innovative technologies. DOE facilities participating in this program work with technical experts from DOE, EPA, industry, the national laboratories, and state and federal regulatory agencies to identify and evaluate innovative technologies applicable to the clean-up of their sites. This cooperative approach reduces many of the common barriers to the implementation of innovative remediation technologies, creating a nonadversarial relationship between participants where innovative technology issues can be openly discussed and addressed in a technical dialogue.

There are currently five projects underway within the DOE using this process. Though conducted at DOE sites, each of the projects that has been initiated is designed to address a major industrial contamination concern, such as organic or heavy metal contamination of either soil or ground water. At each of the facilities involved, the innovative technologies selected for implementation are to be used to fully remediate representative areas at each site. This generates the full-scale and real-world operating, treatment performance, and cost data needed to validate the technologies and gain wider acceptance by industry and regulatory agencies nationwide.

DEVELOPMENT OF A MODEL DECOMMISSIONING PROJECT USING AN INTEGRATED SAFETY AND STREAMLINED APPROACH

Norman C. Burdick
EG&G Mound Applied Technologies
Sam C. Cheng, P.E.
U. S. Department of Energy
Miamisburg Environmental Management Project Office

ABSTRACT

The Building 59 decommissioning project was selected as a pilot for a number of initiatives in June 1996. They are intended to streamline the process of building disposition and field activities to achieve time and cost savings while ensuring maximum protection of workers, public, and environment. These initiatives include: 1) process integration of Safe Shutdown and Decontamination and Decommissioning (D&D). This initiative is to minimize redundant acceptance requirements mandated by EM-60 and EM-40, respectively, by utilizing a single project team concept throughout the entire project. It will also streamline characterization surveys required by both programs; 2) application of Work Smart Standards. This process allows the project manager to apply only necessary and sufficient standards to the project activities. The effort would improve project performance and worker safety while maintaining the paper work required by a typical DOE project to a minimum; and 3) application of a "Free Release" process for debris, developed jointly by the DOE, U.S. EPA, Ohio EPA and the Ohio Department of Health. This initiative would allow debris generated from the project to be safely released to a local construction debris landfill, thereby avoiding lengthy process for packaging and shipping materials to an approved low level waste (LLW) disposal site. The lessons learned from this project will used to fine tune an integrated safety management system for the remaining D&D projects at the Mound Plant.

INNOVATIVE APPROACHES TO ENVIRONMENTAL RESTORATION AT FUSRAP OPPORTUNITY SITES

J.D. Kopotic, U.S. Department of Energy
D.E. Dunning, Argonne National Laboratory
D.S. Browning and G.M. Stephens, Science Applications International Corporation
M.A. Kucera and M.E. Redmon, Bechtel National, Inc.

ABSTRACT

The Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP) is responsible for evaluating and conducting remedial actions at 46 sites located in 14 states. Twenty-four of these sites have been cleaned up to date. In many cases, remediation strategies for these sites have benefitted from innovative use of technology, partnerships with stakeholders, and waste minimization practices to generate significant savings in remediation costs and accelerate remediation schedules. Case studies are presented in this paper which summarize innovative remediation strategies at several FUSRAP sites. While each of these sites presented unique challenges, several elements of the remediation strategy were common to each case. These include: 1) use of a multidisciplinary management team to develop and evaluate alternative remediation strategies; 2) proactive communications with site owners, regulators, and other stakeholders to identify site-specific concerns and determine realistic future use scenarios; 3) development of risk-based remediation criteria based on the site-specific conditions and realistic future land use assumptions; and, 4) innovative application of available technology.

RELEASE PROCESS FOR NON-REAL PROPERTY CONTAINING RESIDUAL RADIOACTIVE MATERIAL

R. Fleming, S. Warren, A. Wallo
U.S. Department of Energy, Washington, DC
N.L. Ranek, S.Y. Chen, S. Kamboj and J. Hensley
Argonne National Laboratory, Washington, DC
D. Burns
Trinity Environmental Systems, Inc., Cincinnati, OH

ABSTRACT

It is DOE's objective to operate its facilities and to conduct its activities so that radiation exposures to members of the public are acceptable and as low as reasonably achievable. To accomplish this, DOE has adopted Order DOE 5400.5, "Radiation Protection of the Public and the Environment," and will be promulgating 10 CFR Part 834 to codify and clarify the requirements of DOE 5400.5. Under both DOE 5400.5 and 10 CFR Part 834, radioactively contaminated DOE property is prohibited from release unless specific actions have been completed prior to the release. This paper outlines a ten-step process that, if followed, will assist DOE Operations Office and contractor personnel in ensuring that the required actions established by Order DOE5400.5 and 10 CFR Part 834 have been appropriately completed prior to the release for reuse or recycle of non-real property (e.g., office furniture, computers, hand tools, machinery, vehicles and scrap metal). Following this process will assist in ensuring that radiological doses to the public from the released materials will meet applicable regulatory standards and be as low as reasonably achievable (ALARA).