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INMM
INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT

Nuclear Materials Management Concerns the World

Nuclear materials management continues to be a topic of national and international concern. Almost every day, the news reports carry stories that are of interest to the nuclear materials management community and the public. Around the world, discussion and debate continues on topics such as nuclear waste management, reprocessing and plutonium use policies, disposition of excess weapons nuclear materials, costs of safeguards, strengthening international safeguards, extension of the Nonproliferation Treaty, improving physical protection systems, and packaging and transportation of nuclear materials.

The INMM provides an ideal forum in which to present and test new ideas for dealing with a wide range of nuclear materials management issues. The Institute is an international, professional and technical organization that attempts to be neutral on all issues except the responsible management of nuclear materials.

Our goal is to be an honest broker, providing the best professional advice and technical systems to facilitate nuclear materials management. Some of our members believe in the future of spent fuel reprocessing and plutonium recycling, others do not; some believe in the future of nuclear power, and others do not. But all are interested in and dedicated to nuclear materials management.

The March 7 meeting in Chicago of the INMM Annual Meeting Technical Program Committee, chaired by Charlie Pietri, provided graphic proof of the continued worldwide interest in nuclear materials management. This year's meeting is July 9-12 at the Marriott Desert Springs Resort Hotel in Palm Desert, Calif. The committee reviewed and organized into sessions a record number of abstracts for an INMM meeting. Fortunately, the Marriott has ample convention space. Come prepared to work hard throughout the meeting to get the most out of the wide spectrum of interesting papers. INMM Vice Chair Obie Amacker has the overall responsibility for the Annual Meeting and, on page 6, provides particulars about the technical program and the meeting site.

I am looking forward to the meeting and expect to be exhausted by the end of nearly a week of activity, beginning with the Executive Committee meeting on Saturday, July 9, and ending with special interest and Technical Committee meetings on Thursday and Friday.

The INMM Executive Committee held its meeting on March 8 following the Technical Program Committee meeting. In addition to reviewing the status of the Annual Meeting preparations, we covered a number of standard business items, such as reviewing our financial position (so far, so good this fiscal year) and Technical Division reports. (See page 5 for more information.)

The Technical Committees that sponsor the American National Standards Institute's N14 and N15 committees are being revitalized under the overall leadership of John Arendt, with Bruce Moran taking over N-15. Standards are important for the nuclear materials management profession and can play a particularly important role, for example, in our collaborative efforts with professionals from the former Soviet Union to improve safeguards, security and other aspects of nuclear materials management.

The Executive Committee continues to explore ways we can use new information storage, transmission and retrieval technologies to improve services to INMM members, including making the Annual Meeting Proceedings available in an electronic format. We solicit your ideas on this or other subjects that would facilitate the communication of technical information for our community. You can send e-mail to INMM Executive Director Barb Scott at INMM headquarters, bscott5465@aol.com, or to me at jtape@lanl.gov.

In January, Bill Teer stepped down as chair of the Packaging and Transportation Division to accommodate changing work assignments. I thank him for his service to the Institute in this capacity and for recommending an able replacement. At our March meeting, the Executive Committee voted to appoint Billy Cole as chair of the division. As is the case with all the division chairs, I know Cole could use the help of INMM members interested in packaging and transportation. Please contact him at (703) 359-9355 and volunteer some of your time.

The Packaging and Transportation Division is undertaking the organization of a major meeting, the Third International Uranium Hexafluoride Conference, "Processing, Handling, Packaging and Transportation," in Paducah, Ky., Nov. 28-Dec. 1, 1995, under the leadership of Francis Kovac. (See page 5.) Although this is not a new conference, this is the first time it is organized under INMM auspices. We expect this to be a large and successful meeting that will provide the INMM another opportunity to be of service to the nuclear materials management community.

I hope to see all of you at the Annual Meeting in in July.

James W. Tape
Los Alamos National Laboratory
Los Alamos, New Mexico, U.S.A.

The More Things Change, the More They Stay the Same

In the United States, the nuclear community is undergoing a period of perhaps unprecedented rapid change, precipitated by the end of the Cold War a few years ago. The Galvin Committee recently submitted its report and recommended radical, if somewhat unspecified, changes in the U.S. Department of Energy (DOE) — this is on the heels of a General Accounting Office report calling for similar changes. Secretary of Energy Hazel O'Leary is busy restructuring the DOE. Several of our nuclear facilities already made the transition from weapons-related missions to environmental management roles.

Russia, Ukraine and Kazakstan also are experiencing a period of rapid change, and many of us in the United State, and indeed throughout the world, are helping our colleagues in the former Soviet Union to deal with the many changes taking place in their nuclear communities.

And yet, amid all of these changes, some things have not changed — the need for effective nuclear materials management is an example important to many members of the INMM. Much to some people's disappointment, the world's nuclear materials won't just disappear, and they can't be wished away. To be sure, in the United States, at least, much of our emphasis is shifting from the relatively straightforward-to-measure feed and product materials that we have traditionally addressed to residues and waste materials, which are much more difficult to account for and manage.

The five papers in this issue all deal with such materials in one way or another. Four of them come to us from the INMM Spent Fuel Management Seminar XII, an annual project of the Waste Management Division. The first, by Daniel Dreyfus, director of the DOE's Office of Civilian Radioactive Waste Management, discusses the restructuring of the United States' waste management program and describes its two major "business centers": the Yucca Mountain Site Characterization Project and the Waste Acceptance, Storage and Transportation Project.

The second paper is a summary of U.S. Nuclear Waste Negotiator Richard Stallings' luncheon remarks at the seminar. It is a fascinating account of his first year as negotiator and seeking a home for the United States' nuclear wastes.

The paper by W.H. Lake describes the DOE's ongoing effort to demonstrate criticality safety for multipurpose canister systems, which use burnup credit in addition to more conventional criticality control techniques. The multipurpose canister is a sealed container that holds several spent fuel assemblies and is used for transport, storage and disposal. Because of its multipurpose use, the canister must simultaneously satisfy three sets of technical and regulatory design requirements.

Not all the world considers spent reactor fuel to be waste. A paper by F. Takáts from the International Atomic Energy Agency describes the various approaches to the back-end of the nuclear fuel cycles adopted in countries of the former Soviet Union and eastern Europe and discusses how spent-fuel management policies are being affected by changes in politics and trading relationships in those countries. The article also reports data on the amount of spent fuel discharged from their nuclear power reactors.

The final paper in this issue, by Mark Rudin and Michael O'Brien, describes technology logic diagrams, which are a planning and management tool that relates environmental restoration and waste management problems to technologies that can be used to remediate these problems. Technology logic diagrams are widely used within the DOE's Office of Environmental Restoration and Waste Management to ensure that the office can carry out its cleanup mission using the most technically sound and cost-effective means possible.

Darryl Smith
Los Alamos National Laboratory
Los Alamos, New Mexico, U.S.A.

Secretary's Corner: Executive Committee Meets, Sets UF_6 Sponsorship

In order to better communicate with the INMM membership, the Institute will recap INMM Executive Committee actions and annoucements in each issue of the *Journal of Nuclear Materials Management.*

The following action items and announcements resulted from the Executive Committee board meeting held in Chicago on March 8:

- The INMM balance sheet on Jan. 31 showed total assets of $257,167. The income and expense budgets for fiscal 1995 are $434,500 and $452,500, respectively.
- The committee appointed Billy Cole of E.R. Johnson Associates Inc. to chair the INMM Packaging and Transportation Division.
- An ad hoc committee was appointed to establish criteria for a memorial scholarship in honor of former *Journal of Nuclear Materials Management* Technical Editor Willy Higinbotham, who passed away Nov. 10, 1994.
- The INMM Russian Federation Chapter, which was approved at the Executive Committee's previous meeting in November 1994, will be formally recognized at the INMM 36th Annual Meeting, July 9-12, at the Marriott Desert Springs Resort Hotel in Palm Desert, Calif.
- The INMM Membership Directory mailed to all members in late April.
- The INMM is sponsoring the Third International Uranium Hexafluoride Conference, "Processing, Handling, Packaging and Transporting," November 28-Dec.1, 1995, in Paducah, Ky. (See below for more information and a registration form.)
- The INMM is again hosting U.S. Department of Energy Central Training Academy training courses at the Annual Meeting. The courses are: MCA 101, Introduction to Nuclear Material Control and Accountability; and MCA 130, Statistical Concepts in Nuclear Material Control and Accountability.
- As of March 8, the INMM has 687 members, composed as follows:

Regular members	326
Senior members	36
Emeritus members	18
Fellows	14
Foreign members	275
Sustaining members	18

A complete copy of the Executive Committee meeting minutes can be obtained from INMM headquarters, 60 Revere Dr., Suite 500, Northbrook, IL 60062; phone (708) 480-9573; fax (708) 480-9282.

Vince DeVito, secretary
INMM Executive Committee
Consultant
Waverly, Ohio, U.S.A.

Third International Uranium Hexafluoride Conference: Processing, Handling, Packaging and Transporting

The Third International Uranium Hexafluoride (UF_6) Conference is being organized to continue the dialogue and discussion of issues that were initiated at the two previous meetings and also to provide opportunities to discuss current issues of importance to the UF_6 industry.

The conference is Nov. 28-Dec. 1, 1995, at the J.R. Exeuctive Inn in Paducah, Ky., U.S.A.

This year's conference is being organized by the Institute of Nuclear Materials Management. Participating organizations are Martin Marietta Energy Systems Inc., Martin Marietta Utility Services Inc., U.S. Department of Energy, U.S. Nuclear Regulatory Commission and U.S. Enrichment Corp.

In order to assure that the most important topics are included, your response is requested. **Please complete the form on the right and return to INMM, Third International UF_6 Conference, 60 Revere Dr., Suite 500, Northbrook, IL 60062. Or fax to INMM at 708/480-9282.**

Name ____________________

Company ____________________

Address ____________________

City ____________ State ______ Zip ______

Phone ____________ Fax ____________

Country ____________________

I **plan / do not plan** (circle one) to attend the Third International UF_6 Conference

I **wish / do not wish** (circle one) to present a **paper / poster exhibit** (circle one). My presentation will be on:

____

Presenters will receive submission information at a later date.

I would like to see the following issues or topics discussed:

____

____

INMM Annual Meeting Provides an International Information Exchange

It is my pleasure to invite you to attend the INMM 36th Annual Meeting, July 9-12, at the Marriott Desert Springs Resort Hotel in Palm Desert, Calif. The Annual Meeting is the major INMM activity where members and other interested parties from around the world meet for the exchange of ideas on technological advances and policies related to nuclear materials management.

With the changing worldwide political climate and numerous technical issues facing nuclear materials management, this is a particularly important time for the exchange of technical information on an international basis. We are expecting a meeting that will be important for all members of the nuclear materials management profession, including technology developers, operational personnel, national policy makers, regulators and members of international organizations.

INMM is pleased to announce that Department of Energy Secretary Hazel O'Leary accepted the invitation to be the Annual Conference Plenary Speaker. As someone who is in the middle of many of the changes going in the industry, O'Leary can give a unique perspective.

The INMM Technical Program Committee, chaired by Charles Pietri, worked closely with the six INMM Technical Divisions — International Safeguards, Materials Control and Accountability, Nonproliferation and Arms Control, Packaging and Transportation, Physical Protection, and Waste Management — to select papers and arrange a program that will appeal to a broad range of nuclear materials management professionals. The technical program will comprise 273 papers presented during 25 sessions. These topics of immediate interest to the technical and policy communities will be discussed not only in formal presentations, but also in the informal discussions among the attendees.

In addition to the formal technical program, the INMM Annual Meeting also provides attendees the opportunity to conduct business with one another in an efficient, cost-effective manner. One trip to California will bring you in contact with people you need to see from all over the United States and the world. Each of the Technical Divisions will conduct meetings the afternoon of July 9. There will also be a number of special interest meetings conducted before and after the technical program that are open to all attendees.

The Marriott Desert Springs Resort Hotel is ideally suited for hosting the Annual Meeting. It has a conference center facility that is unsurpassed and has ample space to accomodate a centrally located exhibit area, and oral presentation and poster sessions. And there is hallway space for those all-important informal discussions.

In your free time during the week, you can swim in one of the resort's three pools, play tennis or golf, visit the 27,000-square-foot ultra spa, take in the acres of glistening fresh water lakes, or go shopping and sightseeing.

Mark your calendar and plan to attend the INMM 36th Annual Meeting. The unique informational and networking opportunities provided by this meeting should prove to be a valuable experience for all attendees.

Obie Amacker Jr., INMM vice chair
Pacific Northwest Laboratory
Richland, Washington, U.S.A.

Committees: Communications

The INMM Communications Committee met at the INMM Executive Committee meeting in Chicago on March 8. One item on the agenda was to look at ways to better serve the membership. Responses from members indicate a desire to retain the *Journal of Nuclear Materials Management* in its present format. With that in mind, the committee also discussed ways to increase the technical papers submitted for publication in the *JNMM*, as well as ways to make the *JNMM* more interesting and useful to the members.

There were a lot of good ideas tossed around, but all those good ideas need good people to make them happen. As one example, the committee would like to include a member news column in the *JNMM* to report news and interesting items about INMM members. If you have an item of interest or would like to submit a short article, please contact *JNMM* Technical Editor Darryl Smith or me. (See numbers at end of column.) If you are interested in assisting with the *JNMM* by taking charge of this column or in other ways, please let either of us know.

We would also like to increase the number of technical articles in each issue of the *JNMM*. The *JNMM* is particularly geared to publication of longer articles that do not lend themselves to presentation at the INMM Annual Meeting. Directions for submittal are included on the last page of every issue of the *JNMM*.

There was also considerable discussion about creating an INMM newsletter. Due to the expense involved, the idea was tabled. Instead, the *JNMM* will be targeted for inclusion of more personal interest items to supplement the technical articles.

The committee is completing an Operations Handbook for INMM Executive Committee members, Technical Divisions chairs and committee chairs. The handbook is designed to provide overall operational information about the INMM and serve as a basic guide for members serving in INMM leadership capacities. To date, two drafts were completed and reviewed by the Executive Committee. The final draft is scheduled for publication prior to the INMM 36th Annual Meeting, July 9-12.

Please give some thought to ways you could help the Communications Committee improve the *JNMM* or increase its member outreach activities. Darryl Smith can be reached at: phone 505/667-6394; fax 505/665-0492; and e-mail dbsmith@lanl.gov. I can be reached at: phone 509/376-3658; fax 509/372-3046; and e-mail da_dickman@pnl.gov.

Debbie Dickman, chair
INMM Communications Committee
Battelle Pacific Northwest Laboratory
Richland, Washington, U.S.A.

Government Liaision

For the fourth consecutive year, the INMM Government Liaison Committee is organizing a special session at the INMM Annual Meeting. The session will focus on national and international initiatives in nuclear materials management, and specific information will be in a special mailing to members and in the Annual Meeting Final Program. For additional information, contact John Matter at: phone (505) 845-8103; fax (505) 844-5321; or e-mail jcmatte@sandia.gov.

John Matter, chair
INMM Government Liaison Committee
Sandia National Laboratories
Albuquerque, New Mexico, U.S.A.

N14 Standards

The INMM N14 Standards Committee met Nov. 3, 1994, at the U.S. Department of Transportation in Washington, D.C. The committee is composed of 85 members, including nine alternates and 33 people designated "for information only." Recommendations have not been received to fill the vacancies for the American Institute of Chemical Engineers, American Industrial Hygiene Association and Conference of Radiation Control Program Directors Inc.

The PATRAM '95 Conference will be held in Las Vegas, Dec. 3-8. N14 will hold its annual meeting at this event and will sponsor a poster session.

John Arendt, chair
INMM N14 Standards Committee
John Arendt Associates Inc.
Oak Ridge, Tennessee, U.S.A.

Committees: N15 Standards

Work continues on trying to determine an appropriate level of effort and direction for the N15 standards effort. Discussions with management personnel in material control and accountability from several sites, the Department of Energy and the Nuclear Regulatory Commission (NRC) were discouraging. The majority of the comments were that people had never heard of the N15 standards or did not use them.

A poll of the facility licensees by the NRC revealed that they felt the standards were out of date and no longer referred to them. A review of the DOE orders indicated that only the uranium and plutonium scrap classification standards were referenced in the orders. Both NRC and DOE have guidance documents covering many of the same issues covered by the N15 standards. The licensees and contractors refer to the guidance documents of their regulators rather than the N15 standards.

On the positive side, the N15 standards were utilized in developing some of the DOE and NRC guidance documents and are referenced in the documents. In addition, the N15 standards were requested by regulatory development personnel from the countries of the former Soviet Union.

If the N15 standards have been generally overcome by DOE and NRC guidance documents, and nuclear facilities are no longer referring to the standards, is further work on the N15 standards justified or is it just a technical exercise for those people on the committee?

The standards *are* necessary, perhaps more on the international level than on the domestic. Reduced funding and changing missions are requiring safeguards organizations to do more with fewer people. This will result in changes in the ways in which the facilities do business and will result in substantial revisions to their safeguards procedures and documentation. The standards need to be revised to address these changing missions and provide expert guidance to the sites. The expertise in safeguards procedures developed by the U.S. facilities needs to be documented and exported to the developing safeguards countries. These are the new missions for the N15 Standards Committee.

The effort of Yvonne Ferris to rescue, revise and reaffirm N15.36 and N15.41 needs to be commended. Without her effort, both standards would have expired.

Status of N15 standards

Ten N15 standards remain active. The ones in good condition are:

- N15.36-*Nondestructive Assay Measurement Control and Assurance*: It was approved in July 1994 and requires no further action until 1999.
- N15.41-*Guide to Nuclear Facility Measurement Control*: It was reaffirmed in July 1994 and requires no further action until 1999. Revision of the standard to meet International Standards Organization criteria is being evaluated.
- N15.28-*Guide for Qualification and Certification of Nuclear Safeguards and Security Personnel*: It requires no action until 1996.
- N15.50-*Measurement Control Program — Nuclear Materials Analytical Chemistry Laboratory*: It needs to be reviewed and planned actions declared to ANSI during 1995.

Action is required on the following standards:

- N15.10-*Classification of Unirradiated Plutonium Scrap*: It needs to be reaffirmed or revised by 1997.
- N15.18-*Mass Calibration Techniques for Nuclear Material Control*: It requires reaffirmation or revision by 1998.
- N15.19-*Volume Calibration Techniques for Nuclear Material Control*: It requires revision by 1998 (revision in progress). Revision of this standard is focused on making N15.19 an international ISO standard.
- N15.20-*Guide to Calibrating Nondestructive Assay Systems*: It requires reaffirmation or revision by 1997.
- N15.22-*Calibration Techniques for Calorimetric Assay of Plutonium-Bearing Solids Applied to Nuclear Materials Control*: It requires reaffirmation or revision by 1997.
- N15.54-*Radiometric Calorimeters — Measurement Control Program*: It requires reaffirmation or revision by 1998.

One standard is under preparation as a new standard: N15.55-*Guide to Measurement Control for Volumetric Measurement.*

Two standards are in crisis conditions:

- N15.1-*Classification of Unirradiated Uranium Scrap*: It is an expired standard whose redevelopment period expires in June 1995. No committee is actively working on this standard.
- N15.53-*Guide to Mass Spectrometry Measurement Control*: It is a proposed standard whose new development period expires in June 1995. No committee is working on this standard.

Bruce Moran, chair
INMM N15 Standards Committee
Martin Marietta Energy Systems
Oak Ridge, Tennessee, U.S.A.

Strategic Planning

The INMM Executive Committee appointed a committee to develop a strategic plan for the organization. The purpose of the plan is to lay out a path for the Institute for the next 10 years. The Strategic Planning Committee had two working sessions and hopes to have a draft of the plan available for the Executive Committee meeting at the INMM 36th Annual Meeting, July 9–12. Following are drafts of the vision and mission statements, on which the Strategic Planning Committee would like feedback.

Vision

Our vision is to be the leading technical professional society to develop, advocate and communicate responsible nuclear materials management principles and practices throughout the world.

Mission

Our mission is to promote the development and implementation of responsible nuclear materials management principles and practices in support of domestic and international nuclear materials security, safety and nonproliferation issues.

We have and use our expertise in the areas of international safeguards, materials control and accountability, nonproliferation and arms control, physical protection, transportation, and waste management.

We will work with international and national organizations, governments, universities and industries to form professional partnerships to address these issues.

Committee members

Members of the Strategic Planning Committee are:

- Obie Amacker (509) 376-4544, e-mail o_amacker@pnl.gov;
- Debbie Dickman, (509) 376-3658, e-mail da_dickman@pnl.gov;
- Charles Pietri, (708) 252-7947, e-mail charles.pietri%ch@mailgw.er.doe.gov;
- Ruth Kempf (516) 282-7226, e-mail kempf@bnl.gov; and
- Shelley Kops (312) 761-0644, fax (708) 679-8185.

I am at (505) 845-8710, e-mail dlmanga@salx367.sandia.gov. Please contact any one of us to express your thoughts on this effort.

When the Strategic Plan is finalized, it will be shared with INMM members.

Dennis Mangan, chair
INMM Strategic Planning Committee
Sandia National Laboratories
Albuquerque, New Mexico, U.S.A.

Divisions: Packaging & Transportation

On July 11, the INMM Packaging and Transportation Division will host two sessions at the INMM 36th Annual Meeting, July 9-12. Included in these sessions are 15 presentations discussing topics such as lessons learned, quality assurance, regulatory issues, emergency response, package designs and related hardware concerns.

As the government continues to decommission its facilities and clean up its sites, the packaging and ultimate transportation of the residual nuclear materials and wastes becomes increasingly important. As the newly appointed chair of the division, I am soliciting INMM members who are interested in serving as members of the division and participating in the planning of the division's future. If interested, please see me at the Annual Meeting or contact me at E.R. Johnson Associates Inc., 9302 Lee Highway, Suite 700, Fairfax, Va. 22031; phone (703) 359-9355 .

Billy Cole, chair
INMM Packaging and Transportation Division
E.R. Johnson Associates Inc.
Fairfax, Virginia, U.S.A.

Divisions: Physical Protection

The INMM Physical Protection Division met during the 35th Annual Meeting in July. About 20 people attended the division meeting, which featured guest speaker Joe Barry from the Systech Group.

On Nov. 2-3, the division held a workshop titled "Cost-Effective Security" in Oakland, Calif. Workshop Co-Chairs Scott Strait, Greg Davis and Don Wentz, all from Lawrence Livermore Laboratory, did an excellent job of organizing and conducting the workshop.

The next Physical Protection Division meeting will be July 13, immediately after the INMM 36th Annual Meeting.

J.D. Williams, chair
INMM Physical Protection Division
Sandia National Laboratories
Albuquerque, New Mexico, U.S.A.

Waste Management

The INMM Spent Fuel Management Seminar XII was held Jan. 11-13 at Loew's L'Enfant Plaza Hotel in Washington, D.C. More htan 120 people attended the seminar, which covered topics such as spent fuel storage technologies, burnup credit as applied to spent fuel storage and transportation, the multipurpose canister, siting and licensing issues, regulatory and waste management system status, and utility views. Approximately 15 percent of the attendees were from foreign countries.

A presentation from Daniel Dreyfus, director of the U.S. Department of Energy's Office of Civilian Radioactive Waste Management, kicked off the meeting. (See page 13.) Richard Stallings, the U.S. Nuclear Waste Negotiator, presented a luncheon talk to bring attendees up-to-date on the activities of the negotiator's office for the past year. (See page 15.)

The division met on Jan. 26 to develop session topics and a list of potential speakers for the INMM 36th Annual Meeting on July 9-12. The sessions include a short waste-management plenary session; low-level radioactive waste managemen;, high-level waste and spent fuel disposal; spent fuel storage, transportation and packaging; and environmental restoration. Potential speakers were contacted and many abstracts were already submitted.

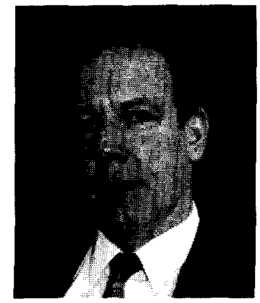
Other items discussed at the meeting included the status of the proposal put forth by Pierre Saverot at the July 1994 division meeting that the INMM, through the Waste Management Division, sponsor a low-level waste management technical workshop in Europe. This technical workshop would be similar in format to the annual Spent Fuel Management Seminar. A draft program was circulated in Europe and the United States to determine whether interest exists in this type of technical workshop. Saverot believes there is interest and that further steps should be taken to set up the workshop. It is tentatively scheduled for the spring of 1996 and would be held near a low-level waste storage and disposal site in France or Spain. A proposal for this workshop will be submitted soon to the INMM Executive Committee.

The interest of the Japanese to hold a Spent Fuel Management Seminar in Japan was also discussed.

The Waste Management Division continues to work on the development and printing of a monograph on spent fuel storage technology.

E.R. Johnson, chair
INMM Waste Management Division
E.R. Johnson Associates Inc.
Fairfax, Virginia, U.S.A.

Chapters: Vienna



David Sinden, special safeguards advisor to Hans Blix, director general of the IAEA.

The guest speaker at the Vienna Chapter's December luncheon was David Sinden, special safeguards advisor to Hans Blix, director general of the International Atomic Energy Agency.

Sinden first described his own career in the Canadian safeguards program and the events that shaped it. One of them was the realization as a Canadian inspector that because of material blending, bilateral safeguards were not viable and, hence, the NPT was essential. The explosion of an atomic device by India in May 1974 had an enormous impact on Canadian thinking. Also important were the experiences of the Canadian SSAC in interacting with IAEA inspectors.

Looking to the future, he noted that the present 93+2 Program marks a new willingness to strengthen safeguards, especially with the provision of more information, including information from outside inspections. He did not feel that a great deal more money was needed, but that financing must be more stable than the present series of sporadic contributions.

In closing, he considered possible IAEA responsibility for U.S. and perhaps Russian weapons material being transferred to domestic use, and that there might be a role for the IAEA in a test ban treaty.

Ed Kerr
Vienna, Austria

Pacific Northwest

The INMM Pacific Northwest Chapter has been quite active in community and professional acitvities. Dr. Steve Schlegel spoke at the chapter's winter dinner meeting in December. He recently visited the Mayak facility in Russia as part of the U.S. reciprocal delegation for a Russian visit to the United States. He showed slides and discussed his visit, including information about facility layout and mission.

The chapter participated in a number of community events this spring. It provided monetary and administrative support to the Engineer's Week festivities and provided judges and monetary support to both the Annual School Science Fair and the College Science Bowl.

Dr. Hal Undem spoke at the spring dinner meeting in March and gave a presentation on recent developments in tags and seals technology. Undem has been involved in a number of development activities for several years, and he presented the results of these studies and information about ongoing studies.

The chapter scheduled a technical symposium for mid-September to be held at the Pacific Northwest Laboaratory Auditorium. A dinner meeting will follow the technical presentations.

The chapter constitution and bylaws are being rewritten to make them consistent with national and are scheduled for completion in late summer.

Dean Scott, chair
INMM Pacific Northwest Chapter
Westinghouse Hanford Co.
Richland, Washington, U.S.A.

Southeast

The officers and members-at-large began discussions for a potential event in the spring. Possibilities include a dinner with guest speakers. Treasurer Lori Borwnell already acquired this year's funds, and the chapter used minimal funds from last year. This combined money can toward the event.

The chapter made a big effort to encourage presentations for the INMM 36th Annual Meeting, July 9–12. Ten abstracts were submitted from the Savannah River Site alone.

Mary Rodriguez, chair
INMM Southeast Chapter
Westinghouse Savannah River Site
Aiken, South Carolina, U.S.A.

U.S. Department of Energy Takes New Approaches in Waste Issues

Daniel A. Dreyfus
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
Washington, D.C., U.S.A.

Presented at the INMM Spent Fuel Management Seminar XII
Jan. 11–13, 1995
Washington, D.C., U.S.A.

Introduction

Last year, I attended your meeting and outlined some of the actions we would be taking to reblue the Civilian Radioactive Waste Management Program. We took those initiatives.

I'm sure you are aware that the U.S. national policy on radioactive waste storage and disposal is likely to be the subject of debate and, perhaps, revision during 1995. Many of you will be actively participating in the Congressional action, and I want to be as helpful as possible in giving you information that will be useful.

During the past year, we significantly restructured our program. We defined two major "business centers" — the Yucca Mountain Site Characterization Project and the Waste Acceptance, Storage and Transportation Project. We also created a management component for the program that provides integration and support to the director and the projects. We defined our goals and laid a course to meet them.

In the past year, the achievement that probably is most important to the future success of our program is the increased level of financial support that has been provided. Congress, acting on its belief that we can and will achieve our objectives, agreed to the administration's proposed 40 percent increase in funding for fiscal year 1995, despite severe governmentwide budgetary restrictions. Most of the additional funding we received for fiscal year 1995 was allocated to Yucca Mountain Site Characterization activity. I am hopeful that the future funding profile proposed with our fiscal year 1995 budget can be attained, even though we must expect much more restrictive deficit controls in the years ahead. The future funding for the program *will* be a major legislative initiative in the coming Congressional session.

Our old way of doing things was no longer supportable. There was no possibility that it would be funded at the required level; it did not provide targets for early convergence of the multifaceted scientific activities; and it did not provide adequate means for measuring annual cost and progress. The issue was not *if* a new approach is needed, but whether one could be found that would accomplish the objectives of the Nuclear Waste Policy Act within practical resource limitations and schedules.

The new approach is scientifically sound and reasonably achievable given our resource limitations. We set forth explicit tasks and associated the tasks with target dates and costs. We will control progress against those measures.

This new approach is a result of extensive replanning and has involved collaboration with external parties, including Congress. We will shortly begin disseminating a Program Plan, documenting the new approach.

Yucca Mountain Site Characterization Project

We can pursue the site suitability determination at Yucca Mountain, and the subsequent licensing of a repository, within the general statutory and regulatory parameters that we now have. I believe that the effort can be performed in a scientifically and socially defensible manner, remain within rational requirements for cost control and make demonstrable progress that meets meaningful target dates.

In the past, we have been criticized that the site evaluation program had become excessively complex and costly and was making little progress toward a decision point. Now, we must gain the confidence of our oversight bodies that the new program approach is neither oversimplified nor schedule driven, and that our target for initial convergence on a technical site suitability determination in 1998 will be based on sufficient data.

I do not mean to imply that I am confident of the ultimate outcome. The undertaking is fraught with uncertainties. The physical characteristics of any geologic setting are inherently complex, and the technical challenges of very long-term predictive modelling are unprecedented. Our mission is to do an honest and competent job of collecting sufficient data, doing rational analyses and making the showing necessary for the regulatory and political decisions to proceed.

Our repository investigation plans for 1995 are ambitious.

They include preparing the documentation necessary to support decisions on five of the higher-level findings on the qualifying and disqualifying conditions of the Yucca Mountain site necessary to reach a determination on the site's technical suitability.

We consider the technical site suitability determination to be a management tool to facilitate program planning, establish priorities, allocate resources and reach logical convergence on the scientific program. It will also enable the director to respond more substantively at an early date to questions about the probable adequacy of the site from a technical point of view. It is not a secretarial action or a final agency action. It does not preempt or replace the regulatory determinations.

After that determination, we will continue to conduct additional tests and perform additional analyses, first to provide a basis for our Environmental Impact Statement and then for our license application. Meaningful investigations will continue throughout the construction and operation of the repository to ensure that it performs as predicted.

We also will begin the formal National Environmental Policy Act process for the repository by initiating scoping activities for the required Environmental Impact Statement. We will continue construction activities for the Exploratory Studies Facility.

The waste disposal concept we are developing calls for in-drift emplacement of large, robust, multibarrier waste packages in a repository. We have not, at this time, progressed to the point where we can decide on a design thermal load. We therefore plan to develop a design for the repository and waste package, including the multipurpose canister, or MPC, that is flexible. We plan to complete the repository waste package Title 1 design in 1997, prior to any commitment to fabricate and deploy MPCs.

Waste Acceptance, Storage and Transportation Project

During the last year, progress was made on the concept of MPCs as part of the waste management system. A conceptual design report was issued, and the public had several opportunities to comment on this endeavor, including a scoping process on the Environmental Impact Statement to support a decision on the fabrication and deployment of an MPC-based system.

As you know, these MPCs are intended to be used with overpacks for the transportation, storage and disposal of commercial spent nuclear fuel. The canister's design specifications incorporate provisions for satisfying transportation and storage requirements and for compatibility with disposal requirements to the extent possible.

In 1996, we intend to complete the MPC Environmental Impact Statement and Record of Decision, as well as complete the subsystem design.

In 1998, we expect to have certificates of compliance for the storage overpack and receive formal approval from the department to deploy MPCs.

We do not see MPCs as a cure-all for short-term waste management issues. This technology, however, does serve an important purpose in any scenario of short- and long-term management of spent fuel. It is important for efficient at-reactor storage, away-from-reactor interim storage and, of course, ultimate disposal.

Another area of specific interest to the INMM is the transportation of spent fuel. Our pace in this area of the program is currently guided by repository availability in 2010. We intend to be prepared, however, to meet an earlier schedule, should interim storage become available. I expect the 104th Congress to consider interim storage in its assessment of national waste management policy. The first major legislative initiative is already introduced. The NARUC resolution also signals the major components of the debate.

In the coming year, we will also be completing the rationalization of our contractor arrangement and implementing our new management structure and program approach.

Conclusions

It has been said that those who forget history are destined to repeat it. Current rhetoric often distorts or omits mention of the history of interim storage, but we should not forget it. For any of you who think the department never has acted on near-term storage, allow me to correct that impression. In 1982, Congress authorized and directed the department to select and propose a site. The department did so and was promptly sued by the state selected. An injunction was granted. The department fought the suit and won. Then, in the 1987 amendments, Congress nullified the choice of the site and, for all practical purposes, revoked the department's authority to pursue an alternative.

It is certainly timely for Congress to readdress this issue. The program needs guidance, and probably new authority, to define its role in the near-term management of commercial spent fuel. But, unless that guidance and authority sets forth a feasible approach and provides the tools to pursue it, the celebration will be short-lived and history soon repeated.

We intend to participate actively in the congressional action on the policy for near-term management of spent fuel and address the constraints imposed on the use of the Nuclear Waste Fund.

I encourage you all to follow and assist this very important policy discourse as it plays out.

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Developments in Spent Fuel Storage

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It's good to be back again. I was here one year ago and saw a part of Washington I had never seen before, even in the eight years I served in Congress. Ice storms were upon us and the Potomac was frozen. As an introduction to my remarks, I used an overhead of a picture from the front page of the Washington *Post*. It was a picture of a tug boat breaking the ice and towing a boat filled with oil to one of the oil-fired power plants to provide electricity and all the goodies that go with it to the Washington, D.C., Maryland and Virginia areas. And I thought, how ironic that here we are in 1994 talking about our energy future and the need to resolve some of these problems, and the problem was brought smack in the face of the nation's capitol.

I remember the gas company paying people to stay in hotels because the company did not have enough natural gas to heat their homes. It was really an interesting time, and I hoped at that point the case could be made that what really saved the area was nuclear energy. Those reactors continued to generate power and were the unsung heroes of the time. Well, a year has passed. The weather is a little better this year, but the problems are still with us.

This past year as the negotiator has been a very fascinating experience. I thought I would tell you about where we have been, what we have done and the future as I see it.

I took this position above the warnings from friends that I was going into a no-win situation. In fact, one fellow said, "The good thing about this job, Stallings, is the expectations are so low that even if you have a little success, you will be perceived as a hero." And there is something to that. Everywhere I have gone, the response has been that this is an impossible task.

In fact, I found it interesting that shortly after I took on this position and started reshaping the program, a number of people essentially gave up on the whole idea of a voluntary host. In particular, a number of the utilities and people in government said, "Look, the voluntary process just does not work. It is a failure. The only way to solve this problem is through some kind of government mandate like we have done at Yucca Mountain." I do not see a great success story or any foresightedness in that approach. But in this country, we are not known for patience. So, after a couple of years of experimenting with the voluntary process, a number of people said, "This thing just does not work. We need government to solve this problem for us."

I think we see this approach in the bill Sen. J. Bennett Johnston, D-La., introduced in the beginning of January that would change the rules and put the monitored retrieval storage (MRS) site in Nevada. I guess the assumption is that we have already outraged the whole state once. They can only get so mad, so what is another shot at them?

But I think the bottom line is that the Nuclear Waste Negotiator's Office is based on some principles we learned from the Cold War. First of all, forced sitings and government mandates are not the best way to go, and when you ignore public participation, you lay great groundwork for future lawsuits and opposition. I still believe very strongly in the negotiation process, and I still believe it can be successful under the right circumstances if given the time.

The point that I need to make is that 1994 was a very difficult year to talk about a voluntary process to site an MRS for the main reason that it was an election year. And we found very early on in our conversations with the political leadership around the country that they were not opposed. But for heaven's sake, they said, keep it out of the campaign and do not force us to take some positions we will regret later.

I spent a couple of days at the Western Governors' Conference, visited with a number of chief executives of many western states and found several very receptive individuals. But the bottom line was, "Look, we are engaged in a tough election campaign, or the election campaign in our state is very intense — 1994 is not the year to solve this problem."

But 1994 was a good year for us; we made some progress. I spoke with a number of people I met during my years in

Congress who were successful in siting difficult projects in their own areas. And the message from them was very clear. They said, "The past experience of the Negotiator's Office has been a trash-for-cash operation, and you have to get away from that. Political leaders and public opinion makers are not going to respond to the trash-for-cash notion." I am always reminded of the New York garbage scow a couple of years ago going up and down the coast as far as South America trying to find a place to dump New York's garbage. The idea that somehow a state will take another region's garbage for a few dollars is not going to sell well. And so if you are trying to conduct a voluntary siting, you have to move away from that kind of thinking.

So we hosted a roundtable and brought people from around the country to talk about high-level spent fuel. Is it a waste product? Is disposal the only thing you can do with it, or are there any other options? Are there ways to add value? We found that there are some real opportunities in that area. In fact, the roundtable was much more successful than I had hoped it would be. We had some tremendous papers presented, and we are still investigating a number of the options provided.

My home and my office are in Boise, Idaho. During the spring of 1994, I invited a number of people familiar with U.S. Department of Energy facilities and involved in nuclear projects around the country to join me in a working group to investigate what a storage facility could offer. If you are not talking in terms of trash for cash, how do you make this approach?

We came to the conclusion that we must fashion this project as an economic opportunity for a region. Not only can there be some research into better ways of handling radioactive materials, but some related projects as well. There are transportation possibilities, maybe helping to design or oversee the multipurpose canister projects. There is a whole variety of things that could be involved in this package. And then, as we developed this idea, I brought into the equation a friend of mine who has vast political experience into the equation. I said, "Let's talk about this. You were a governor — how would a package like this appeal to you?" With his guidance, we put together a real economic opportunity for a number of communities around this country.

A while back, the Washington *Post* ran a little story on my nomination [to the position of U.S. nuclear waste negotiator]. It said that I had been nominated by the president to be the nuclear waste negotiator, but do not look soon for any local community to accept or to volunteer to host a waste facility. You know, I found that to be wrong. It is not the local communities that create the problems for us. I have working groups in probably a half-dozen communities in different regions of the nation that would be eager to host a facility this week if they could get by the statewide political opposition.

In most of those instances, the groups have been involved with different phases of the industry. They have either been associated with a national laboratory, involved in the extraction of uranium or involved in some type of military operation in which nuclear projects and equipment were used and the experience was long and productive. And so the notion of local communities willing to step forward and help resolve this problem is very real. They exist out there, and they are eager to work with us.

So with this package and with the knowledge that these local communities exist, I spent a great deal of 1994 visiting with the political leadership in a number of states and again found a remarkable level of success. I think that if we are going to be successful in siting this facility, it will be in 1995. We are far enough away from elections that the emotional spitting match will not be there. I think people are starting to recognize the crisis that the industry is undergoing. We saw last year the fight in Minnesota [about siting a spent fuel facility in the state]. That environment is going to continue in other states this year and next year. So, all of these forces seem to be coming together to make 1995 the year that this program can be successful.

We are working with a band of Native Americans in the western Utah desert — the Skull Valley Band of Goshutes, a small tribe that is looking for some economic opportunities on the reservation. In fact, we were successful in signing a cooperative agreement with them, the University of Utah and the county of Tooele, in which the reservation is located. There is tremendous interest out there. But, the governor of Utah is not one which I have been successful in getting to look at the options.

The point that I think we made in a number of these states is that it really boils down to a political decision. We are not hearing arguments about safety, at least from those who have followed this issue and understand exactly what we are talking about. The issues are not safety or transportation. The issues are perception and whether the state political leadership has the courage to take on something that on the surface may appear unattractive, but, once people study and understand, they recognize that those issue really are nonissues.

So we have the framework of a very solid economic development package. And the growing conviction on the part of the country's leadership that an MRS is safe, does not create transportation threats and, in fact, will not be a landfill that is going to pollute the groundwater or have long-term radioactive consequences. It is a very viable, clean industry with some tremendous potential for not only the region but for the entire state.

I spent time outlining our package before groups such as the League of Women Voters. And again, these groups were very responsive. There is a lot of misinformation, a lot of questions and a lot of things they don't understand. But as you talk to them and talk about dry cask storage and the opportunities that exist, the response has been, I think, very positive.

And so I come to you at the end of a five-year experiment and the voluntary siting of a very difficult facility with a mixed report. In the past five years we did not select any site. If you judge on the results of [former nuclear waste negotiator] David Leroy's and my five years in this position, you might come to the same conclusion held by a number of members of Congress, some utilities obviously and other professionals in the business. And that is, this system does not work. You cannot get people to volunteer for something this difficult. You have to slam it down somebody's throat.

But it is too early for that kind of conclusion. I think the next few months can make a difference. If it does not work, then obviously a solution like Sen. Johnston is proposing will become the law of the land because this problem cannot continue to fester. You cannot continue to have this material backing up at the nuclear power stations around the country. We need some kind of solution and if I am not successful, then it will be some kind of mandated solution.

Stallings then gave the audience an opportunity to ask questions.

Q: I like this idea of bringing in the university. This is the first time I heard about this new dimension in that approach. Do you see more of this happening in other locales?

Stallings: I think it is absolutely essential. I think that the one group the public trusts is the universities. The public does not have a lot of faith in politicians, government bureaucrats or contractors, but they do respect the university community. This was really brought to our attention when we visited the Fort St. Vrain facility in Colorado. The utility contracted with a state university to monitor and verify what the utility was saying. It resolved a lot of the public's skepticism.

So we brought the University of Utah into the equation in Utah to study two things: the economic impact of our package on the state and the transportation issue. The University of Utah already put together a very sophisticated transportation model, and so their expertise in this area was really very helpful to us. The model would work pretty well in many of the western states because many of them have the same characteristics as the state of Utah.

Tooele County also contracted with the University of Utah to apply the state economic impact studies to the county. We think it is going to be very helpful to understand what this really means. Is this something that a handful of people will benefit from out in the western desert? Is it something that only the Goshute tribe will benefit from? Or will there be real benefits to the Wasatch mountain range area of Utah? So far, my conversations with the two professors working on this project were extremely positive. Of course, that economic package is looking better to more people as the Utah air base is being debated for closure. Economic downturns in communities create a little more interest in what we are talking about.

Q: It strikes me that this sounds like a "spoonful of sugar makes the medicine go down" model. I am just curious as to how you differentiate this from what David Leroy was doing, or is indeed what you are doing a matter of perceptual difference only?

Stallings: I think it is more than perception. I am not criticizing Leroy for this because I build on his experiences. I think his problems were centered on the basis that he came into a community with a black box and said, "Here, you want new schools, roads, a hospital? How about a junior college? You name it, we will give it to you." It is sort of like the automobile sales person who a deal so great that you do not have to pay for the car. He will give it to you and something to go along with it. And you think, "Wait a minute. Something is wrong here."

We have purposely stayed away from that. We talked about specific benefits. For example, there will need to be a transportation facility to track the movement of the spent fuel. It could very easily be located in the state. You are talking about fairly high-tech stuff, but it does not take much to tap into that. A satellite downlink with some good computers could pretty well track the spent fuel traveling across the country. That does provide some jobs and is tied directly to this project. We are looking at rather extensive archives and a visitors' center to go along with it. And then there will be some basic research going on.

Former Idaho Governor Cecil Andrus said, on a number of occasions, that Idaho is not going to be a dumping ground for nuclear waste material, but if we do something with the material while it is there, he would not have problems with that. That sort of became the genesis for this package that we are developing. And in some states it works better than others. I mean, if you have a state with a national laboratory, it is much easier to get to that kind of approach than in what we call a green field. But even there, in talking with political leadership, they say, "You have got to help us develop the notion that this is going to be research, something which we are developing and the nation is going to benefit from, but it is not going to be a permanent repository."

And so, we work very hard to try to reach those goals. Some people are going to suggest that the perception still is that this is a money-for-waste kind of deal. I'm not sure we will ever convince these skeptics, but those who look at it closely are impressed and will continue to be so. I think that is going to be the key to our success.

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The Use of Burnup Credit for Criticality Control for the Multipurpose Canister System

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Abstract

The U.S. Department of Energy's ongoing effort to demonstrate criticality safety for multipurpose canister systems that use burnup credit in addition to more conventional criticality control techniques is discussed. Because the multipurpose canister is a component of storage, transport and disposal systems, it must satisfy three sets of technical and regulatory design requirements. The general technical and regulatory considerations related to criticality safety design and burnup credit are highlighted. The principal issues related to criticality control, including the use of burnup credit, are identified, and the department's approach to resolving these issues is presented.

Introduction

The Nuclear Waste Policy Act (NWPA) and its 1987 amendment (NWPAA) identify the U.S. Department of Energy (DOE) as being responsible for establishing a federal waste management system (FWMS) to dispose of spent fuel and high-level radioactive waste. DOE established the Office of Civilian Radioactive Waste Management (OCRWM) to execute this responsibility. The NWPA and the NWPAA require DOE to conduct its FWMS activities in full compliance with U.S. Nuclear Regulatory commission (NRC) rules and regulations. DOE's activities in this regard must be licensed or certified by the NRC, as appropriate.

To assure development of an efficient FWMS, OCRWM is working to identify and resolve selected technical and regulatory issues that would benefit the program. One such issue is the use of burnup credit, which accounts for the reduced reactivity of spent nuclear fuel in designing systems for criticality control. A study conducted early in the program indicated that the use of burnup credit for transportation of spent fuel was technically feasible and economically beneficial.[1]

Recently, OCRWM initiated the use of a multipurpose canister (MPC) concept for the FWMS. The MPC is a sealed canister that contains several spent fuel assemblies and is a common component for transport, storage and disposal systems. It basically replaced the spent fuel assembly as the unit of waste. The MPC is a multiassembly system that incorporates provisions for criticality control and requires an integrated approach to criticality control for storage, transportation and disposal of spent fuel. Burnup credit is an important part of this approach.

Background

Light water reactor systems, which are used by the U.S. commercial nuclear power industry, employ fuels with low concentrations of fissile uranium (typically less than 5% initial concentration of U-235 by weight). Because of this low concentration of fissile material, and the fact that U-235 is not an efficient absorber of fast neutrons, light water reactor fuel can only sustain a nuclear chain reaction if water is present to slow these neutrons (moderate them) so they are more readily captured. The fission process, which is fundamental to nuclear power production, consumes the fissile uranium (U-235) and produces new isotopes, including various actinides and fission products. The actinides produced include fissile materials (e.g., Pu-239 and Pu-241) and neutron absorbers (e.g., Pu-240 and Pu-242). Of the hundreds of fission products that are neutron absorbers, only a small number are significant.

OCRWM will receive into the FWMS spent fuel that has been discharged from a reactor and cooled five years or more. This older fuel has undergone significant and rapid decay of its gamma and heat-emitting radioactive contents. Furthermore, the neutron absorbers have begun to stabilize. The reactivity potential of the spent fuel continually decreases for about 300 years after discharge from the reactor.

The next phase in this process is a slight, but continued increase in reactivity potential spanning the period from about 300 years to 30,000 years. This increase is primarily a result of the decay of Pu-240, which is a nonfissile neutron absorber.

The second peak in reactivity potential, which occurs at about 30,000 years after discharge, does not exceed the value at five years after discharge. The next phase exhibits a continued decrease in potential reactivity due to the decay of the fissile Pu-239. The last phase has been evaluated to about 300,000 years.

Criticality Control, Criticality Safety and Burnup Credit

Criticality safety systems for transport and storage are designed so that two failures must occur simultaneously for a criticality event to be possible. For dry light water reactor fuel systems, an unspecified failure is assumed that results in water flooding the fuel region. Light water reactor fuel systems are subcritical without water; therefore, this assumption is necessary if a redundant criticality safety system is to be considered.

Having assumed a flooded system, a safety system is designed to provide criticality control. This may include limits on fissile content and concentration, addition of neutron absorbers surrounding the fuel or geometric spacing to increase neutron leakage. Generally, a combination of these criticality control measures are used.

Transport, storage and waste packages, including MPCs, are designed and used to specific limits of fissile content and internal configuration. For multi-assembly configurations, fuel baskets are used to limit neutron interaction between assemblies by controlling geometry. The basket will typically include neutron absorbing materials. Baskets may also use flux traps to control neutron interaction between adjacent fuel assemblies.

A flux trap is a gap built into a basket that is activated if water should flood a spent fuel/basket region, forming a layer of water surrounded by neutron absorbers. The flux trap configuration increases the effectiveness of the neutron absorbers by slowing the neutrons in the water gap, enhancing their likelihood of capture in the surrounding neutron absorber plates. The disadvantages of flux traps include a tendency to complicate basket design, as well as increasing the unit volume for fuel assemblies, thereby reducing capacity.

The use of burnup credit recognizes the reduced reactivity of spent fuel. Its use affords the designer the choice of reducing reliance on the external options already mentioned in designing criticality control systems.

Regulatory Requirements

The NRC's requirements for transportation, storage and disposal of spent fuel are contained in 10 CFR Parts 71, 72 and 60, respectively.[2] These regulations simply require subcriticality of the systems in question. The regulations are not specific on how subcriticality should be assured and do not preclude the use of burnup credit for demonstrating criticality safety. However, in the case of commercial light water reactor spent fuel, there has been a long-standing practice of assuming that spent fuel is unburned or fresh for the purpose of evaluating criticality safety for transportation (i.e., the fresh fuel assumption). For disposal of spent fuel, there is no precedent because no Part 60 facilities are licensed.

Criticality is the achievement of a self-sustained nuclear chain reaction. The multiplication factor, k, which is the measure of criticality, is the ratio of neutrons present at a given time to those present one average neutron lifetime earlier. When $k < 1$, a system is subcritical. Criticality is achieved when $k = 1$. The parameter used as the measure of criticality for finite systems (e.g., reactors, casks, etc.) is k_{eff}.

It has become a customary practice in the United States to design transport casks and storage systems with a 5% criticality safety margin (i.e., $k_{eff} \leq 0.95$). For OCRWM activities at a 10 CFR Part 60 licensed repository, NRC's rules require a 5% criticality safety margin (i.e., $k_{eff} \leq 0.950$.[2]

OCRWM's Burnup Credit Activities

OCRWM's burnup credit activities support hardware and facility design efforts. From the mid-1980s until 1993, the primary focus was on NRC certification of transport casks that would use burnup credit for criticality safety design. The transportation activities have included the design of casks using burnup credit and development of basic technical data to support those design efforts.[3,4] During this period, the waste package design team had been evaluating the use of burnup credit for long-term disposal, but on a schedule more appropriate for waste package design. The waste package efforts have been focused on design concepts. Because of the schedule for addressing criticality safety and burnup credit for waste package design, there has not been a need to develop basic specific data to support disposal of spent fuel. The advent of the MPC has changed the situation.

OCRWM plans to begin deployment of MPC by 1998 and intends to use burnup credit as part of the criticality control for storage, transportation and disposal of spent nuclear fuel in MPCs. MPCs are sealed upon loading and are most beneficial if the MPC is not reopened after sealing. As a result, it is important to resolve the issue of burnup credit for storage, transportation and disposal prior to NRC approval and deployment.

The MPC concept being envisioned uses baskets with neutron absorbers along with burnup credit for criticality control of spent PWR fuel for transport and storage, but no burnup credit for spent BWR fuel. For the early period of disposal, while waste package, MPC and fuel integrity are expected to be maintained, the burnup credit approach used for transport would be applicable. However, for long-term disposal considerations, burnup credit may be needed for both BWR and PWR spent fuel, and somewhat different approaches may be needed to demonstrate subcriticality (e.g., probabilistic risk assessment methods).

OCRWM/NRC Technical Exchange Meetings

To accelerate resolution of the issue of using burnup credit as part of criticality control, OCRWM and the NRC have initiated a series of technical exchange meetings. Four technical exchange meetings were held over the past year (since November 1993) to address OCRWM's ongoing burnup credit activities.

Although OCRWM had been holding informal discussions with NRC on their ongoing burnup credit activities since about 1988, the formal technical exchange meetings provide opportunity to discuss the activities comprehensively, and obtain feedback from NRC.

OCRWM also planned to develop a comprehensive topical report on the use of burnup credit for the storage and transportation of spent fuel for submittal to NRC by the end of 1994. Based on feedback from the NRC, submittal of this topical report was delayed. A separate report will be developed for submittal to NRC in 1996 to address criticality control for a repository. Burnup credit would be an integral part of the criticality control strategy for a repository.

As a result of the technical exchange meetings, a number of specific technical concerns were identified by NRC. These include availability of isotopic data, benchmarking of criticality analyses methods for spent fuel, the effects of axial variation in burnup on criticality analyses (and effects) and verification of loading of burnup credit systems.

Knowledge of the specific isotopes and their concentrations are needed to perform criticality safety analyses for spent fuel. For fissile isotopes and neutron absorbing isotopes, absorption data must also be known (e.g., cross-section data). A great deal of this type of data already exists for fission products.[5] NRC suggested that OCRWM should enhance the existing fission product data.

Benchmarking of criticality safety analyses against appropriate critical experiments is the normal practice for design of nuclear transportation and storage systems. Laboratory-type experiments are available for fresh fuel, mixed oxide fuel (containing uranium and plutonium oxides) and several fresh fuel experiments having fuel doped with gadolinium, a specific fission product that is a strong neutron absorber. There are no laboratory critical experiments for spent fuel in cask-life configurations. However, OCRWM proposed and evaluated a number of appropriate reactor restart critical experiments for use in benchmarks for spent fuel casks.[6] NRC has questioned the use of reactor restart criticals for spent fuel casks.

An unavoidable result of neutron leakage at the top and bottom of a reactor core during power operations is underburning of the spent fuel ends. The NRC identified this early on as a potential concern in using burnup credit.[7] For PWR reactors, which are controlled by borated water, the axial distribution of burnup is fairly uniform over the central region of fuel with a sharp decrease at the ends. The resulting increased reactivity at the ends is the so-called "end effect." OCRWM believes that the end effects can be conservatively bounded in performance of criticality safety analysis, and developed several approaches to demonstrate that this is so.[8] This will be addressed in a topical report and remains to be reviewed by the NRC.

The loading of any storage container, transportation cask or MPC requires administrative controls and reliance on utility records. The utility records are subject to NRC rules and regulations under 10 CFR Part 50 and are considered to be accurate. Administrative controls for loading MPC or other storage and transport systems are subject to the same rules and are considered reliable. The NRC staff responsible for transportation cask certification has suggested that utility records and administrative controls alone may not be sufficient for transport casks which use burnup credit and have recommended using measurement to verify cask loading procedures. OCRWM continues to believe that utility records and administrative controls that are subject to NRC's 10 CFR Part 50 licensing are adequate, but recognizes that the loading of burnup credit systems is a new activity. A verification method using passive gross gamma and neutron measurement of individual spent fuel assemblies has been identified by OCRWM.[9] The device identified by OCRWM was later used by the Electric Power Research Institute and others to perform proof of principle tests.[10]

In addition to the technical discussion and comments provided during the technical exchange meetings, the NRC has provided specific comments related to OCRWM's approach to certification of MPCs that use burnup credit. The NRC believes that pursuit of burnup credit could jeopardize the overall MPC schedule and advised pursuit of a non-burnup-credit system initially. They also suggested possible pursuit of burnup credit on a limited basis. For example, one might ignore the fission product neutron absorbers.

OCRWM believes that the small MPC system, which does not use burnup credit, already provides a non-burnup-credit alternative. However, OCRWM is assessing the merits of initially pursuing a burnup credit on a limited basis. If this course is followed, OCRWM would revise its approach to pursuit of burnup credit for storage and transportation of spent fuel for MPCs by using a staged approach. The comprehensive topical report now being developed would be replaced by an initial topical report that would address the actinides alone, that is, fissile actinides and significant neutron-absorbing actinides. At the same time, OCRWM would continue to develop data on fission product neutron absorbers. Once approval of stage one is obtained, a revised topical report addressing fission products would be submitted to the NRC.

Although the technical exchange meetings have focused on criticality control for storage and transportation of spent fuel, the subject of criticality control for disposal was discussed. OCRWM proposed an approach to demonstrating criticality control that includes burnup credit and considers system performance during three repository time phases. Much of the data and methodologies developed for storage and transportation would be transferable to disposal. However, some additional data will likely be needed. Of special importance is the treatment of burnup credit for spent BWR fuel, which is not done for storage and transport, but is expected to be needed for long-term considerations in disposal.

The first of the three time phases occurs during repository preclosure; it would use the same analysis approach used for storage and transportation. This phase has a duration of about 100 years. The spent fuel, waste package and MPC are expected to maintain initial design integrity throughout this period. The second time phase covers the period between postclosure and substantially complete containment. This phase has a duration which covers about the first 1,000 years. The spent fuel, waste package and MPC are expected to maintain initial design integrity through the beginning of this period. Therefore, the same analysis approach used for storage and transportation can be used initially, but, at some point in time, yet to be determined, analysis would switch to a probabilistic risk assessment approach. Finally, for the postcontainment, isolation phase, the integrity of the spent fuel, waste package and MPC are not expected to be maintained sufficiently. At that point, a probabilistic risk assessment approach will be relied on exclusively to demonstrate adequate criticality control.

Although NRC has not taken a position on this proposed approach of demonstrating criticality safety, early indications are that of agreement in principle with the proposal.

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Spent Fuel Management in the Former Soviet Union and the Eastern European Countries

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■

Abstract

There is a total of 66 nuclear power plant units in the former Soviet Union and eastern European countries, with a generating capacity of more than 44,000 MWe. Changes in politics and trading relationships are affecting spent fuel management policies. This paper describes the various approaches to the back-end of the nuclear fuel cycle adopted in these countries and reports data on the amount of spent fuel discharged from the nuclear power reactors with a summary table. Various types of interim storage facilities under consideration are described with a table for the away-from-reactor (AFR) spent fuel storage capacities for the countries of the former Soviet Union and eastern Europe.

The Nuclear Materials and Fuel Cycle Technology Section in the Division of Nuclear Fuel Cycle and Waste Management of the International Atomic Energy Agency (IAEA) is responsible for organizing work concerning the management of spent fuel from power plants and research reactors, providing a forum to exchange and disseminate information on the storage of spent fuel from research and test reactors. An account is given of IAEA programs and recent publications.

1. History

In the 1970s, the Soviet Union and almost all socialist countries in Europe launched extensive nuclear programs. They constructed mostly WWER-type units, pressurized water reactors with many primary loops and horizontal steam generators, lacking some safety features of the western-made nuclear power plants. The Soviet Union, on its own territory, also constructed RBMK-type plants (the infamous Chernobyl type).

Typically, the power plants to be built in the socialist countries were of the WWER-440 type, with a nominal electric capacity of 440 MW. Each of these units has a spent fuel storage pool with a capacity to store the discharge of three years' operation and a full core reserve in a so-called reserve rack. Such power stations were constructed in Bulgaria, Czechoslovakia, the German Democratic Republic (GDR) and Hungary. One power generator from Finland (Imatran Voima — IVO) also built two units at the Loviisa site. Poland and Romania started the construction of WWER units, but the work was stopped at one stage. A system of joint manufacturing of nuclear components was organized within the COMECON system. The design, construction and commissioning of the nuclear power plants, and the import of the main components were regulated by so-called intergovernmental agreements, where the main supplier, i.e., the Soviet Union, among others, guaranteed the fresh fuel supply for the plants.

In those years, fuel cycle cost calculations contained a high credit for the plutonium and uranium residual in the spent fuel. Thus it was clearly an asset bound for recycling, after decay cooling, and the availability or guarantee of reprocessing was never questioned. Technologies were developed for the transport of spent fuel. The COMECON countries, all signed the international agreement on regulations for the transport of spent fuel by rail or ship.

In the early 1980s, about 10 units were already operating outside the Soviet Union, and another six to eight were in the final stage of construction, when the first cracks appeared in the wall. In letters, first from the Minister of Trade, and later from the Prime Minister of the USSR, all heads of states operating or constructing nuclear power plants were notified that the Soviet Union could only transport the spent fuel after a minimum of at least five years of cooling. However, the existing technologies could not provide the necessary cooling time for the discharged spent fuel. As an interim measure, a wet storage facility for 600 tHM fuel was designed to be constructed by the states at their own cost.

Such away-from-reactor (AFR) facilities were constructed in Bulgaria, Czechoslovakia, the GDR and at some power plants of the Soviet Union. IVO of Finland constructed a pool storage system of its own design. Hungary investigated the available options and simply reracked the at-reactor storage pools. During the negotiations, some countries managed to send spent fuel back to the Soviet Union.

2. Nuclear Power Plant and Spent Fuel Data

2.1. Number of nuclear power plants

Altogether, 73 nuclear power plant units of the Soviet design were constructed in the former Soviet Union and in the former socialist countries of eastern Europe, with a generating capacity more than 50,000 MWe. Two units were shut down in Armenia and five units are mothballed in Germany. Two units of Chernobyl do not generate any more spent fuel. Thirteen more Soviet-designed units are under construction in the Czech Republics, Russia, the Slovak Republics and in Ukraine.

Romania is constructing five CANDU units, the first of which will be connected to the grid soon. There are two more countries to be mentioned: Finland and Slovenia. The Loviisa nuclear power plant in Finland has two WWER-440 units. Slovenia, which belongs to the geographic region, has a single-unit nuclear power plant supplied by Westinghouse.

The breakdown by countries and unit types is shown in Table 1 below.

2.2. Spent fuel data

A typical WWER-440 unit discharges about 120 spent fuel assemblies, a WWER-1000 about 55 assemblies and an RBMK-1000 about 450 assemblies each year.

The weight of one year's discharge is 14 tHM for a WWER-440 unit, 25 tHM for a WWER-1000 unit, and 58.5 tones for an RBMK-1000 unit.

The spent fuel inventories in the countries are shown in Table 2 on page 26.

The at-reactor storage pools of the power plants are usually filled to their design capacity. As mentioned earlier, some countries constructed a wet AFR storage facility. These buildings consist of four storage pools (one of them is reserve), and the necessary services, such as cask unloading, water cooling, and filtering. Spent fuel is stored in the baskets that are used also during transportation, i.e., the fuel itself is not handled directly after loading of the basket. At all RBMK plants, similar storage units exist.

In those countries that do not have such wet storage facilities, or where they are reaching the design capacity, new AFR projects are being reviewed or actually constructed. All these designs use the dry storage principle.

According to the available information, three countries decided to construct metal cask storage with CASTOR casks, one country selected the MVDS, and one nuclear power plant chose the VSC design. The selection by the electric utility of a dry vault design was announced for two RMBK plants, but the final decision is delayed. Further decisions can be expected in the near future. For some countries that already

Table 1: Number and type of reactors in the geographical area

Country	Type of Reactor	No. of Units	Remarks
Armenia	WWER-440	2	presently shut down
Bulgaria	WWER-440	4	
	WWER-1000	2	
Czech Republic	WWER-440	4	in operation
			under construction
Finland	WWER-440	2	altogether four in the country
Germany	WWER-70	1	all units mothballed
	WWER-440	4	
Hungary	WWER-440	4	
Kazakstan	BN-350	1	fast breeder
Lithuania	RBMK-1500	2	
Romania	CANDU-600	5	under construction
Russia	RBMK-1000	11	
	BN-600	1	fast breeder
	EGP-12	4	small heating plants
	WWER-440	6	
	WWER-1000	7	
	BN-800	2	fast breeder, under construction
Slovak Republic	WWER-440	4	in operation
		4	under construction
Slovenia	Westinghouse PWR	1	
Ukraine	RMBL-1000	2	Chernobyl
	WWER-440	2	
	WWER-1000	10	in operation
	WWER-1000	5	under construction

selected one mode of storage, a further extension is usually also foreseen, and the new type can be different from the one previously selected.

3. Spent fuel management approaches

The collapse of the Soviet Union and the changes in the politics and trading relationships of the newly formed states also affected their spent fuel management policies. Russia now requires payment for the services in hard currency at a "world market price" level. There are also some legal problems with the licensing of spent fuel transport through the newly formed states and the subsequent reprocessing in Russia. The preparation of a decree was started in Russia in 1993 that forbids the import of radioactive wastes from abroad; but the question as to whether spent fuel is waste has not yet been answered. Since the introduction of the new prices, only Finland and Hungary signed contracts for spent fuel reprocessing services. Two former Soviet states — Armenia and Ukraine — were also able to ship some spent fuel back under special conditions.

These are the main factors that lead to the changes in the spent fuel management policy of these countries. While reprocessing was the basic solution for all the WWER plants, at present only Finland has a valid contract for further reprocessing and can probably still send some spent fuel to Russia. But even this agreement is challenged by the Finnish authorities on environmental protection grounds. At least six of the countries involved have plans to develop direct disposal, while the others are delaying the decision.

The spent fuel management options presently selected by these countries are summarized in Table 3 on the far right.

4. Highlights of related IAEA activities

The need for extended storage of irradiated fuel has resulted also in the need to investigate the safety aspects of long-term storage. For most of the countries, information about the behavior of the spent fuel is not always readily accessible from the country of origin. Also, there are benefits to be derived from impartial assessments of technological concepts, operating experience, and safety and regulatory aspects of irradiated fuel management, before important decisions are made concerning possible long-term solutions.

To fulfill these requirements, the IAEA has started a new program: The Irradiated Fuel Management Advisory Program (IFMAP). IFMAP was first started to provide advice in the area of irradiated fuel storage and on developing national programs, particularly for the countries of eastern Europe. The Nuclear Materials and Fuel Cycle Technology Section in the Division of the Nuclear Fuel Cycle and Waste Management of the IAEA is responsible for organizing this work.

- In 1992 and 1993, an IAEA team assisted the Hungarian utility and Regulatory Authority to select and evaluate a spent fuel interim storage option.
- In 1993, the IAEA started a project to assist in the formulation of spent fuel storage policy in Romania.
- In the framework of another technical cooperation project, the selection of the technology for a regional spent fuel storage facility for the Czech Republic was studied, with the analysis for long-term spent fuel storage and the possible options for the Slovak Republic. This latter project is financed by the Spanish government.
- In 1994, a group of experts visited the Ukraine to provide advice on the establishment of the regulatory system and licensing of the storage installations.
- Discussions are held to organize a review of the spent fuel management policy in Armenia, which is planning to restart one of the power station units, previously shut down after an earthquake in 1989.

The IAEA started to organize inter-regional and regional training courses. In 1994, a regional training course was offered especially for the countries of eastern Europe, and 20 experts from nine countries were selected to participate. The course was held in Madrid, with financial support from the Spanish government.

An inter-regional course was held in 1993 in Paris and

Table 2: Spent fuel inventory (tHM) in the eastern European countries, in the Soviet-made power reactors of Finland, Germany and in the Republics of the former Soviet Union in 1994.

Country	AR	AFR	Total
Armenia	30	–	30
Bulgaria	300	285	585
Czech Republic	230	140[1]	370
Finland	80	100	180
Germany	–	560	560
Hungary	360	–	360
Lithuania	800	–	800
Russia[2]	2,200	4,000	6,200
Slovak Republic	160	470[3]	630[3]
Slovenia	170	–	170
Ukraine	2,270	1,430[4]	3,700

1 This fuel is in the AFR in the Slovak Republic and will be taken back.

2 Spent fuel is stored at both reprocessing plants (Chelyabinsk: WWER-440, fuel = 250 tHM; Krasnoyarsk: WWER-1000, fuel = 1000 tHM).

3 Including the 140 tHM spent fuel from the Czech Republic.

4 RBMK fuel.

Table 3: Spent fuel management approaches[5] selected in the different countries of the area.

	Deferred Decision	Direct Disposal	Reprocessing
Armenia	x	–	x
Bulgaria	x	–	x
Czech Republic	–	x	–
Finland	–	x	x
Germany (East)	x	–	–
Hungary	x	–	x
Lithuania	x	–	–
Romania	–	x	–
Russia	–	x	x
Slovak Republic	–	x	x
Slovenia	x	–	–
Ukraine	x	x	x

[5] Some countries have different spent fuel management approaches for different fuel types. In some countries, one spent fuel management approach is presently being followed but future options applying different approaches are being evaluated.

another will be held in 1995 in the United States and Canada. The inter-regional courses are open to all interested developing Member States. Usually there are about 25 participants, all from countries with nuclear power plants.

The preparation of three IAEA Safety Series documents on the safe interim storage of spent fuel from power reactors was recently finished. The first is a safety guide on design of spent fuel storage facilities, the second is a safety guide on operation, and the third is a safety practice document on the safety assessment for spent fuel storage. It is expected that they will also be useful to countries in licensing their storage installations.

The drafting of a new safety guide on the design, operation and safety of spent fuel storage for research and test reactors is presently under way.

Technology Logic Diagrams

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Abstract

A planning and management tool was developed that relates environmental restoration and waste management problems to technologies that can be used to remediate these problems. Although the Technology Logic Diagram has been widely used within the U.S. Department of Energy's Office of Environmental Restoration and Waste Management, it can be modified for use during the planning of any waste management and environmental cleanup effort.

I. Introduction

The Office of Environmental Restoration and Waste Management (EM) in the U.S. Department of Energy (DOE) is confronted with the challenge to manage and cleanup waste at more than 100 contaminated facilities in the United States and territories without draining national resources. Management tools are needed to ensure that EM can carry out this mission by using the most technically sound and cost-effective means possible. One such tool used within the EM organization is the Technology Logic Diagram (TLD).

The TLD is a planning and management tool that relates DOE environmental restoration and waste management problems to technologies that can be used to remediate these problems. TLDs provide the mechanism to:

- identify programmatic and institutional drivers that may affect EM needs identification and/or technology development activities;
- identify specific EM problems;
- assess whether state-of-the-art technologies from the private sector, DOE complex, or other Federal agencies can potentially meet those needs;
- identify EM technology gaps; and
- provide input to developing a long-term technology development strategy that can be integrated with the EM cleanup mission.

In fiscal year 1991, EM selected the Hanford Site to use the TLD process to identify and characterize linkages between DOE-EM needs and research activities. This effort resulted in the publication of a report[1] that served as a model to help other DOE sites define their research and development and demonstration, testing, and evaluation needs. Oak Ridge National Laboratory (ORNL) modified the TLD approach used at Hanford and applied the methodology to problems at its K-25 site.[2] Subsequent TLD efforts were applied to environmental restoration (ER) and decontamination and decommissioning (D&D) problems at the Idaho National Engineering Laboratory (INEL).[3,4]

EM's Mixed Waste Integrated Program (MWIP) recently developed a TLD[5] on selected low-level mixed waste streams identified in DOE's Mixed Waste Inventory Report (MWIR). The logic diagram provided a number of benefits to the MWIP and potential users. The benefits included, but were not limited to, assisting the MWIP in identifying national low-level mixed waste technology development needs and providing waste stream managers at DOE sites generating Site Treatment Plans with a valuable resource to make informed technology selection decisions. Ultimately, the mixed waste TLD facilitated strategy discussions within the EM organization.

II. Description of TLD

A portion of the INEL ER TLD is shown in Figure 1 on page 29. The logic diagram flows from left to right and consists of 11 columns of input data or information called *logic elements*. The progression flows through the logic elements, beginning with EM goals and ending with implementation needs. The first several logic elements (column headings) are considered the filter of the diagram. The purpose of the filter is to identify and assess the problem being addressed and regulatory factors that may influence resolution of the problem. The filter portion of the TLD is made up of the following columns:

EM Goals. EM Goals have three components: cleanup legacy, prevent future insult, and develop environmental stewardship. These problems are shared to varying degrees by all operations of the DOE complex. Technologies that do not contribute to these goals are not further evaluated in the TLD.

EM Problem. This column contains areas agreed to by EM and DOE for D&D, remedial action (RA), and waste management. These EM problems are used to organize the diagrams.

Site Problem. The Site Problem column is used to describe the generic waste problem being addressed by this section of the TLD. In the example, the site problem is the clean-up of radioactive tanks and soils from Operable Unit (OU) No. 2-05 at the INEL.

Problem Area/Contaminants. There are three items specific to the waste stream identified in the Problem Area/Contaminants column: the waste types, specific contaminants, and forms and volumes.

Reference Requirements. Point levels accepted by the U.S. Environmental Protection Agency (EPA), DOE, and other Federal agencies are identified in the Reference Requirements column. Windows of opportunity for technology development, release criteria, or minimum contamination levels are also shown in this column.

The last several logic elements are considered the technology portion of the diagram. The purpose of this portion of the diagram is to identify candidate technologies and any technical or institutional needs that must be addressed prior to their use. The technology portion of the TLD consists of the following columns:

Subelements. The functional components that may need to be addressed when solving a problem are included in the Subelement column. Examples of environmental restoration activities that can be categorized as subelements are characterization, retrieval, biological and chemical treatment; thermal and physical treatment; and capping.

Alternatives. The Alternatives column defines the general technology approaches that may be applied to the problem. For example, alternatives for the subelement, thermal and physical treatment, might be physical separation or incineration.

Technologies. Specific technical solutions are identified in the Technologies column. All appropriate technologies that can be used to accomplish the alternative are listed under this logic element.

Status. The Status column provides information on technologies identified in the previous column, including availability and historical performance. The following categories have been used to describe the availability of technologies:

Accepted: Technology is accepted by industry or regulators, and the technology has been used. Accepted technologies may still have some science and technology needs to adapt them to the identified problems or to improve their performance.

Demonstration, Testing, and Evaluation (DT&E) Needed: Technology is available but not demonstrated or accepted for the specific problem identified. Additional DT&E is required prior to implementing the technology.

Research and Development (R&D) Needed: Technology is under laboratory-, bench-, or pilot-scale testing or at a conceptual stage. Significant development is required for technology utilization.

Science and Technology Needs. This column identifies perceived needs in science and technology (S&T) where support could be applied to develop an "immature" technology, improve performance, or adapt to the specific identified need. Science needs are related to the fundamental understanding of the scientific phenomena that form the basis for the technology. These needs are typically for laboratory- or bench-scale experiments, and, when possible, experiments addressing specific areas of uncertainty are suggested. Technology needs relate to improvements that make a current technology more economical to apply, safer, or more efficient. The demonstration of a technology on a site-specific problem is classified as a technology improvement need.

If scientific needs are specified, it should be understood that the needs of technology development or improvement are necessary to implement newly developed scientific understanding. Likewise, testing a technology development opportunity implies that technology improvements are needed.

Implementation Needs. Specialized needs are evaluated for both development of a technology and deployment of a mature technology. These needs are evaluated in areas of:

- resources such as financial or personnel;
- hardware such as process equipment, development equipment, and computers;
- software such as models, procedures, and computer programs;
- facilities such as laboratories, shops, and buildings; and
- specialized training. An estimate of the process cost is given. Only extraordinary needs are highlighted, i.e., needs that require a long lead time or unusual procurements such as line items for facility construction.

Logic elements of the TLD can be customized for specific waste management/environmental restoration efforts. For example, logic elements of the MWIP TLD were modified to display only the information required by program managers and other users. A portion of the MWIP TLD is given in Figure 2 on page 30.

Information contained in each of the TLDs was compiled by nationally and internationally recognized scientists and engineers from both the federal and private sectors with expertise in various aspects of ER/D&D. These individuals served on technical teams and were tasked to identify and evaluate technologies to characterize, treat, and dispose of wastes at each site. However, the most critical step in the TLD process is working with the appropriate waste manager and understanding the specifics of each ER, D&D, or MW problem and the regulatory requirements associated with the need.

III. Benefits of TLDs

Since their publication, the INEL and ORNL K-25

Environmental Restoration and Decontamination and Decommissioning TLDs have proven useful to a variety of individuals and programs. Requests continue to be received at the rate of one or two each month for copies of the INEL TLDs or for information contained in them. Almost all of these requests come from private industry. Requests continue to be received from contractors at DOE sites. The original distribution of these documents is shown in Table 1 below.

Table 1: INEL TLD Distribution[6]

	DOE	DOE Contractors	Private Sector	Other
ER TLD	43%	47%	8%	2%
D&D TLD	28%	52%	16%	4%

A recent request for INEL TLD information is typical of many received. It came from the manager of the INEL Central Facilities Area (CFA), Waste Area Group. The manager recently attended a meeting in which potential solutions to a contamination problem at one of the CFA buildings were discussed. A fuel oil leak had occurred from an underground storage tank and had contaminated a large volume of soil underneath the building. Various techniques for shoring up the building while the contaminated soil was removed were discussed. They even discussed the possibility of having to remove the building to clean the soil.

The CFA manager called to see if the ER TLD contained references to in situ technologies that could remediate the soil without an impact on the building structure. A quick review revealed two potential technologies that appear to be well-suited for this problem — vapor vacuum extraction and in situ bioremediation. The names of vendors who supply these types of technologies were provided to the manager. He later reported that they plan to obtain and implement a particular vapor extraction technique on this problem in spring 1995.

Summary

The TLD is a flexible planning tool that summarizes waste management and environmental restoration problems, identifies technical solutions to these problems, indicates those technologies that provide the most appropriate solutions, and identifies areas where technology development is most needed. Because of their format and content, TLDs will prove useful to managers while selecting technologies to characterize, treat and dispose of wastes at their respective sites.

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Figure 1: Example of the ER INEL TLD.

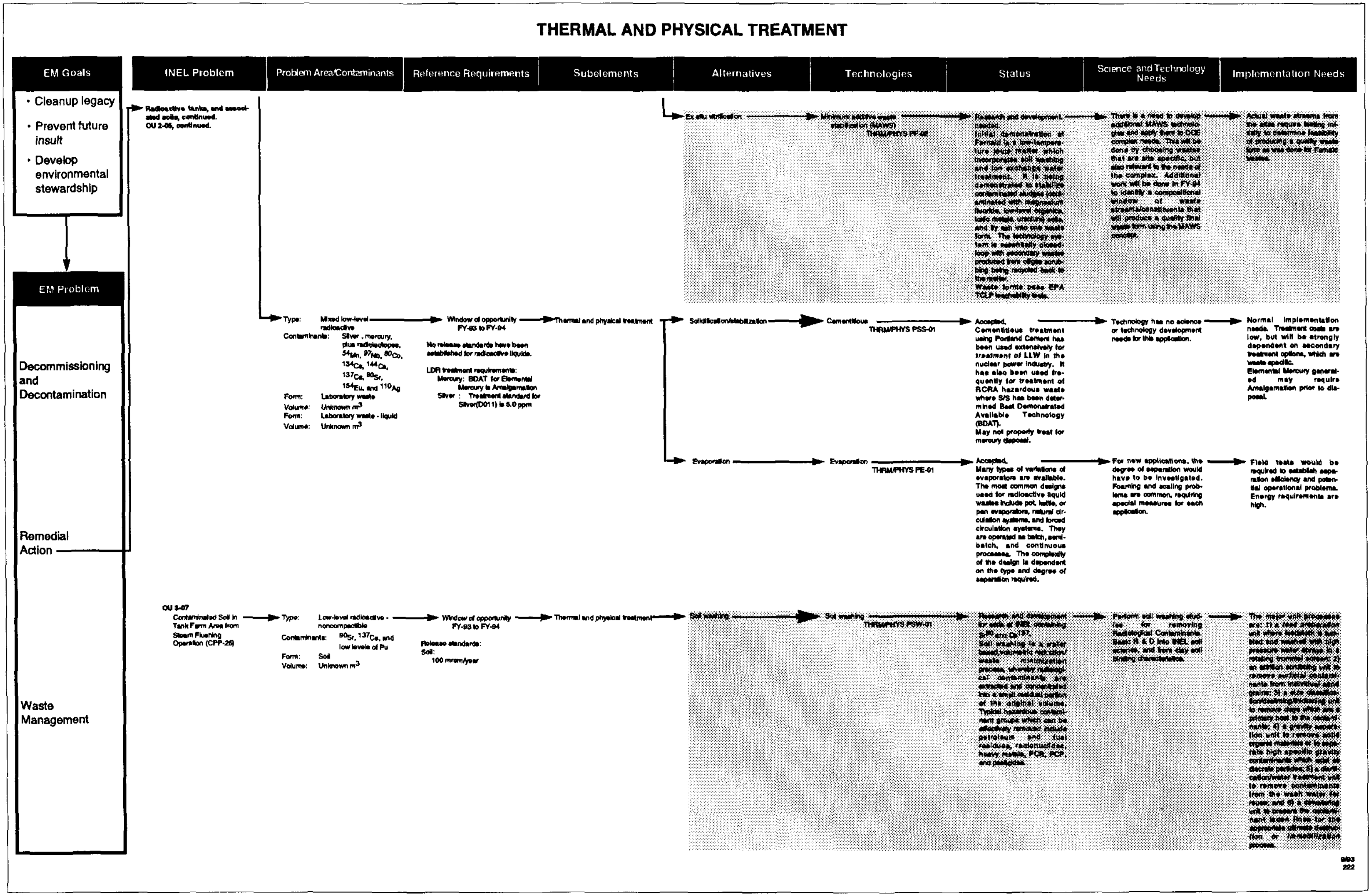


Figure 2: Example of the MWIP TLD

Filter information

Mixed Waste Integrated Program Logic Diagram

Name: LANL Spent Solvents **MWIR#:** 2145 **Subelement:** Treatment

Matrix: Aqueous - Halogenated Organic Liquid / 2110 **Site:** Los Alamos National Laboratory

Waste Stream

Waste Stream Description

This waste stream consists of spent halogenated solvents.

Problems Presented by Waste Stream

The LDR treatment for this waste stream is organic destruction followed by stabilization of residues. This waste stream is very small in volume (8.9 cubic meters) and therefore will not justify the construction of a new facility for organic destruction. Since the radiologic characteristics for this waste stream are not known, it is difficult to match this stream to an existing DOE incineration facility. If TRU radionuclides are present, the Controlled Air incinerator at LANL is the only facility that may be able to treat this waste stream. If TRU nuclides are not present in the waste stream it may be treated at either the TSCA incinerator at Oak Ridge or at the SEG incinerator, which is a commercial facility. The extent of the effect of fluorides present in the waste stream must be determined to ensure that are no problems arising from reactions with the refractory lining of the incinerator. In general, additional characterization data on this waste stream will be required, especially with respect to its radiologic properties.

Treatability Group

Radiological Constituents:
MLLW-CH
Pu-239
U-238

Contaminants:
F001: Spent halogenated solvents used in degreasing
1,1,1-trichloroethane
Trichloroethylene
Methylene chloride
Chlorinated fluorocarbons

Matrix:
Liquid

Technology information

Mixed Waste Integrated Program Logic Diagram

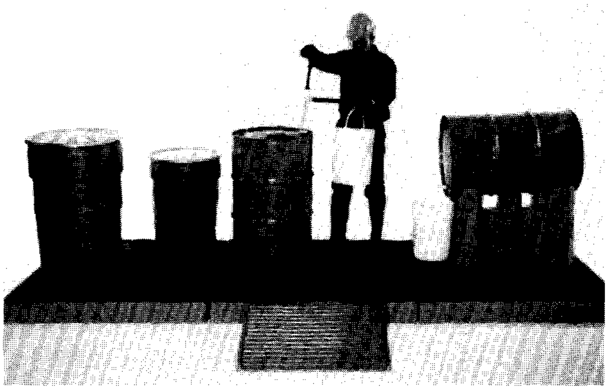
Name: LANL Spent Solvents **MWIR#:** 2145 **Subelement:** Treatment

Matrix: Aqueous - Halogenated Organic Liquid / 2110 **Site:** Los Alamos National Laboratory

Alternative/Technology	Status	Science and Technology Needs	Implementation Analysis
CHEMICAL TREATMENT ALTERNATIVE – Dehalogenation Chemical dehalogenation using alkaline polyethylene glycol (APEG) or potassium hydroxide with polyethylene glycol (KPEG). Chemical dehalogenation systems mix wastes with a dehalogenation reagent such as APEG or KPEG and heat them in a reactor vessel. The dehalogenation reaction replaces halogens with polyethylene glycol, rendering the compound non-hazardous and generating a chlorinated-liquid secondary waste stream. The technology is most effective for wastes contaminated with halogenated-semivolatile organic compounds and is best suited for small volume waste streams. The KPEG process involves the catalytic reaction of a phase transfer catalyst with the halogenated compound to promote the reaction. The reaction is effective with a temperature of 70oC and a duration of 15 minutes to 1 hour. If a large amount of water (>20% by volume) or other reactants are present, the reaction times can be as high as 12 hours.	Chemical dehalogenation technology has been used on many chlorinated organics but its effectiveness on other halogens, especially fluorine, needs to be evaluated. Subsystems required Centrifuge system to separate precipitated salts Filtration system Organic solidification Projected performance Good dechlorination Uncertainty about treatment of fluorocarbons Chlorinated waste stream contains RCRA-listed compounds that would continue to characterize the treated waste as RCRA-regulated Chloride salts produced from the treatment of the RCRA-listed wastes would also be RCRA-regulated	Technology integration must be demonstrated on this waste stream especially concerning treatment of fluorides. Characterization of both of the output streams would be required to determine if they are RCRA regulated.	Higher than normal implementation needs. Treatment residues consisting of filtered salts and dehalogenated organic liquids will require stabilization. The required subsystems are commercially available and the subsystems are not complicated or numerous. Input Waste Stream Characterization Information Needed Identification of any TRU levels in the waste. Characterization of waste to ensure that water content does not exceed 20% by volume (see identificaiton of TRU waste levels in characterization subelement beginning on page L-9). Waste Streams Produced Chloride salts that will require stabilization. Organic liquids without chlorides that require stabilization or other treatment. Chloride salts, organic liquids, and radioactive contamination in liquids.
THERMAL TREATMENT ALTERNATIVE – Organic Destruction Liquid Injection Incinerator Liquid waste material is introduced into the combustion chamber by specially designed nozzles. Different nozzle designs result in various droplet sizes which mix with air and fuel as needed. Following combustion, the resulting gases are cooled and treated to remove particulates and to neutralize acid gases. Operating temperatures range from 2000oF. The stream could also be injected into the second combustion chamber of any of several varieties of incinerators.	post-treatment stabilization of ash residuals using cement is accepted by industry and commercially available. Subsystems required Large offgas treatment system, including acid gas scrubber, particulate filters, and ash-handling system Stabilization system for treatment residuals such as flyash and spent scrubber solution Projected performance Good organic destruction Reaction of hydrogen fluoride (HF) with refractory materials may be a problem Post-treatment stabilization of ash residuals using	Technology must be demonstrated on this waste stream, but the technology is well established.	Normal implementation needs. The first implementation issue is determination of the TRU level in the waste. The result will impact the treatment alternative selection. Treatment residue will require treatment/stabilization prior to disposal. Liquid injection incineration technology and the required subsystems as described above are commercially available. The large number of subsystems required make this technology relatively complicated and labor intensive, however the modular design of the incinerator and use of a wide variety of secondary fuels lower operational costs. Input Waste Stream Characterization Information Needed Identification of any TRU waste.

Customize a Secondary Containment Storage Pad

The Ultra-SpillDeck from UltraTech International Inc. allows users to customer design their own secondary containment storage pads. Four-drum and two-drum modules are available that can be positioned to yield an unlimited number of shapes and configurations to meet specific needs.



Modules connect to each other with bulkhead fittings, allowing leaked materials to flow from one module to the next. An optional loading ramp is available. For more information, contact UltraTech at (800) 353-1611.

Vindicator Lock Receives UAL Approval

Underwriters Laboratories approved the Vindicator Lock II as a high-security electronic lock. The lock uses a two-step access method, requiring the user to present an electronic key plus enter a personal identification number. The lock also features an internally stored audit trail of the most recent 4,700 events. For more information, contact the Vindicator Corp. at (512) 314-1200.

WIPP Transportation Contract Awarded to Colorado Company

Colorado Allstate Transportation (CAST) will support transportation activities at the Westinghouse Electric Corp. Waste Isolation Pilot Plant (WIPP) in New Mexico and several locations nationwide.The contract contains options for four additional years, making the possible total value of the award $1.655 million over five years. CAST is considered a small business under the Federal Acquisition Regulations.

In other Westinghouse news, the Westinghouse Energy Systems Business Unit won a multimillion-dollar contract to provide design, engineering, licensing and initial on-site advisory services for Korea Electric Power's Kori Unit 1 replacement steam generators. Work on the project is already underway and will be completed in 1998. Kori Unit 1 is a Westinghouse 587 MWe, 2 loop plant that went into commercial operation in April 1978.

Toll-free WIPP Number Established

The U.S. Department of Energy's Carlsbad Area Office established a toll-free telephone number to access information on the Waste Isolation Plant (WIPP) and the National Tranuranic Waste Program.

Stakeholders, educators, government agencies and the public can call (800)336-WIPP to reach the WIPP Information Center. Telephone lines are staffed from 7:30 a.m. to 4:30 MT, Monday through Friday. After 4:30 and on weekends, callers can listen to prerecorded updates. Available information includes announcements of upcoming meetings, program information, answers to specific questions about the WIPP and transuranic waste management and information on the availability of program documents.

Canberra Supplies Air Monitors to International Atomic Energy Agency

Canberra Industries received an order from the International Atomic Energy Agency for 12 Alpha Sentry Continuous Air Monitors (CAMs). They will be installed in the IAEA laboratories in Seibersdorf, Austria, located near IAEA world headquarters in Vienna. The CAMs will be used to ensure the safety of scientists and technicians working in the laboratories by monitoring the air and alarming on exposure to airborne radioactive particulates.

ADVERTISER INDEX

June 4–6
22nd Annual Meeting and International Conference on Nuclear Energy, Ponte Verde Inn & Club, Ponte Verde, Fla. *Sponsor*: World Nuclear Fuel Market. *Contact*: Donna Cason, Administrative Director, World Nuclear Fuel Market, 655 Engineering Dr., Suite 200, Norcross, GA 30092; phone (404) 447-1144.

June 4–7
35th Annual Conference of the Canadian Nuclear Association and 16th Annual Conference of the Canadian Nuclear Society, Saskatoon, Canada. *Sponsors:* Canadian Nuclear Association and Toronto Canadian Nuclear Society. *Contact:* S. Caron, Canadian Nuclear Society, 144 Front St. West, Suite 725, Toronto, Ontario, M5J 2L7 Canada.

June 25–29
Annual Meeting of the American Nuclear Society, Philadelphia, Pa. *Sponsor:* American Nuclear Society. *Contact:* Meetings Department, ANS, 555 N. Kensington, La Grange Park, IL 60525; phone (708) 352-6611.

July 9–12
INMM 36th Annual Meeting, Marriott Desert Springs Resort, Palm Desert, Calif. *Contact*: Barb Scott, INMM headquarters, (708) 480-9573; e-mail, bscott5465@aol.com.

September 3–9
Fifth International Conference on Radioactive Waste Management and Environmental Remediation, Berlin, Germany. *Sponsors:* American Society of Mechanical Engineers, American Nuclear Society and Kerntechnische Gesellschaft e.V. *Contact:* L. Friedman, ASME Headquarters, 345 East 47th St., New York, NY 10017-2392; fax (212) 705-7856.

September 11–14
ANS International Conference on Evaluation of Emerging Nuclear Fuel Cycle Systems, Versailles, France. *Sponsors:* American Nuclear Society, Societie Francaise d'Energie Nucleaire and Organization for Economic Co-Operation and Development. *Contact:*CE/Saclay, B. Siccard, DCC-Bldg 121, F-91191, Gif-sur-Yvette, France; fax (33-1) 69 08 48 35.

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Papers should be submitted in *triplicate*, **including a copy on computer diskette.** All popular Macintosh and IBM word processing formats are acceptable. If you have questions regarding your computer software's compatibility contact Greg Schultz, (708) 480-9573.

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  2. Jones F.T., *Title of Book*, New York: McMillan Publishing, 1976, pp.112-118.
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