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INFORMAL REPORT

POLYMER SOLIDIFICATION NATIONAL PROGRAM

Letter Report on FY 1992 Activities

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Executive Summary

Brookhaven National Laboratory (BNL) has developed several new and innovative polymer processes for the solidification of low-level radioactive, hazardous and mixed wastes streams. Under DOE sponsorship, polyethylene and modified sulfur cement solidification technologies have undergone steady, gradual development at BNL over the past nine years. During this time they have progressed through each of the stages necessary for logical technology maturation: from process conception, parameter optimization, waste form testing, evaluation of long-term durability, economic analysis, and scale-up feasibility. This technology development represents a significant investment which can potentially provide DOE with both short- and long-term savings.

Since many facilities throughout the DOE complex are experiencing or anticipating performance and environmental compliance difficulties with current cement solidification systems, the main objective of this program is to facilitate coordination of a national effort for implementing polymer solidification processes throughout the DOE complex. Activities in FY 1992 focused on the exchange of information with DOE waste management personnel, federal and state regulatory agencies, and the commercial sector. The purpose of these exchanges was to: 1) provide a broad forum to transfer technology information developed within DOE, and 2) solicit input from DOE sites on potential applications for these innovative technologies.

The results of this effort highlight the need for further investigation of polymer solidification applications to help solve DOE's environmental restoration and waste management problems. Numerous waste streams at virtually every site throughout the DOE complex have been identified as needing improved treatment. Preliminary compatibility with thermoplastic polymer processes has been established for many generic and site-specific waste types. The overwhelming response from DOE waste management personnel contacted for this study was that additional work is needed in order to:

- Confirm treatability of site-specific DOE mixed wastes by means of polymer solidification processes.

- Conduct "cold" pilot- or full-scale demonstrations using surrogate DOE mixed wastes.

- Conduct "hot" full-scale demonstrations prior to process implementation.

Program support continuity must be maintained in order to accomplish these goals and fully realize the potential benefits of this technology. A number of sites (e.g., WHC, WSRC, ORNL, INEL, LANL) have already requested BNL assistance in conducting waste treatability studies for polymer solidification. In addition, several sites and DOE contractors have expressed interest in assisting in the further development of polymer technologies. Collaborative efforts such as those already underway with RFP, Ames Laboratory and the Grand Junction Project Office will expedite the enhancement of polymer solidification technology and facilitate technology implementation throughout the DOE complex.

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Introduction

In response to EM-30, EM-40, and EM-50 waste management needs, Brookhaven National Laboratory (BNL) has been developing several new and innovative polymer processes for the solidification of low-level radioactive, hazardous and mixed wastes streams. The polyethylene encapsulation system has been developed from process conception through parameter optimization, waste form testing, and scale-up feasibility. This process has been shown to be effective for improved treatment of several DOE "problem" wastes including aqueous salt solutions (e.g., nitrates, sulfates, borates, chlorides), sludges, incinerator ash and ion exchange resins. Recent efforts have focused on sodium nitrate salts which are a high volume mixed waste generated at many facilities throughout the DOE complex including Rocky Flats Plant (RFP), Westinghouse Hanford (WHC), Los Alamos National Lab (LANL), Oak Ridge National Lab (ORNL), Savannah River Plant (SRP), and West Valley. RFP has been working with BNL to implement this technology as a replacement for their current cement solidification process.

The scope of the Polymer Solidification National Effort (TTP No. CH321202) was developed as a result of a meeting held at DOE HQ on January 9,1992 between representatives of the Office of Technology Development (OTD) and their advisory staff, BNL and RFP. Since many facilities throughout the DOE complex are experiencing or anticipating performance and environmental compliance difficulties with current cement solidification systems, the main objective of this program is to facilitate coordination of a national effort for implementing polymer solidification processes throughout the DOE complex. In addition, since RFP has identified polymer solidification to meet mandated Federal Facilities Compliance Agreements, BNL also provided direct technical assistance in a companion effort (TTP No. CH321204) to RFP for unresolved technical issues.

Activities in FY 1992 for coordinating a national polymer solidification effort focused on the exchange of information with waste management personnel throughout the DOE complex, federal and state regulatory agencies, and the commercial sector. The purpose of these exchanges was to: 1) provide a broad forum to transfer technology information developed within DOE, and 2) solicit input from DOE sites on potential applications for these innovative technologies. Information was gathered and exchanged through a series of site visits to DOE facilities, meetings held at BNL, communications via telephone, fax, and mail, presentations at waste management seminars, meetings and conferences, and participation in technical workshops and expert working groups. Table 1 lists specific technology exchange activities that contributed to this effort. Highlights of these activities are described below.

Table 1. Summary of BNL Activities to Coordinate National Efforts for Polymer Solidification

ACTIVITY	LOCATION	DATE	PURPOSE
DOE Site Visits:			
Oak Ridge	Oak Ridge, TN	May 8, 1992	Technology transfer and Needs Assessment
Westinghouse Hanford	Richland, WA	June 29 - July 1, 1992	"
Los Alamos National Lab	Los Alamos, NM	July 8, 1992	"
Rocky Flats Plant	Golden, CO	Oct. 2, 1991	"
Meetings With Personnel from:			
Westinghouse Savannah River Co.	BNL	Nov. 20, 1991	Technology transfer and Needs Assessment
RFP, DOE OTD	DOE HQ	Jan. 9, 1992	Establish Polymer Solidification National Effort
Pacific Nuclear Systems	BNL	May 27, 1992	Technology transfer, potential CRADA
WHC WRAP Technology Section	WHC	June 30,1992	Polyethylene treatability studies for 183-H Pond sludge
Ames Laboratory	BNL	May 28, 1992 Oct. 12 - 16, 1992	Development of on-line QA/QC monitoring for polyeth. process
Radian Corp.	BNL, Radian	April 27 - 28, 1992	Technology transfer, potential CRADA
Geotech, Grand Junction	BNL	Oct. 5, 1992	Polyethylene Encapsulation Full-scale Tech Demo

Presentations/ Discussions			
ACS	Atlanta, GA	Oct. 1 - 3, 1991	"Long-Term Durability of Polyethylene..."
NASA 2001	San Jose, CA	Dec. 3 -5, 1991	"Waste Management Technology Development and Demonstration..."
Waste Management '92	Tucson, AZ	March 2 - 5, 1992	"Polyethylene Encapsulation of Mixed Wastes, Scale-up Feasibility,"
EPA/DOE Seminar Series on Radioactive Waste Site Remediation	Seattle, WA	July 21 - 22, 1992	"Polymer Solidification of Low-Level Radioactive, Hazardous, and Mixed Wastes"
"	Albuquerque, NM	July 23 - 24, 1992	"
"	Atlanta, GA	Aug. 18 -19, 1992	"
"	Chicago, IL	Aug. 20 -21, 1992	"
Workshops/ Technical Support			
WHC Tank Waste Remediation System	Richland, WA	June 29 - July 1, 1992	Polymer encapsulation presentation. Core member of TWRS working group on LLW Forms.
UST-ID Technical Support Group on Final Waste Form	Salt Lake City, UT Dallas, TX		Core member of TSG
MWIP Technical Support Group on Final Waste Form	Salt Lake City, UT Dallas, TX Gaithersburg, MD		Core member of TSG

DOE Site Visits/Meetings

Site Visit to Rocky Flats Plant: Golden, CO October 2,1991

P. Colombo and P. Kalb traveled to Rocky Flats to meet with RFP Technology Development and Operations staff on October 2, 1991. RFP personnel provided a briefing on current waste treatment needs and problems. A tour of the Liquid Waste Treatment Operations Facility was presented by N.P. Cypher, Technical Support Manager for this facility. Discussions were held concerning the polyethylene technology demonstration. Rationale for not holding the demonstration at RFP as originally planned was discussed and the benefits of holding the demonstration at an alternate site were agreed upon. BNL developed a draft of a revised TTP CH-2027 and submitted it to M. Lankford for review on October 14. Colombo and Kalb met with OTD staff on November 14 to review the revised scope of work. BNL and RFP representatives met with OTD staff and their advisors on January 9, 1992 to discuss the coordination of future polymer encapsulation efforts. It was agreed at this meeting that BNL would receive funding to support coordination of national efforts for polymer solidification through TTP 321202 and provide technical support to RFP through TTP 321204.

Meeting with Westinghouse Savannah River Company: BNL, November 20, 1991

BNL staff met with C. Langton, H. Burns, D. Burns, and E. Orebaugh from Westinghouse Savannah River Co. (WSRC) on November 20, 1991 to discuss applicability of polymer solidification for mixed waste scrubber solution (blowdown). About 360,000 gal. of blowdown will be generated annually by the Consolidated Incineration Facility (CIF), currently in the design phase. This waste is expected to contain about 20 wt% solids consisting of chloride salts and ash, with radioactive and hazardous contaminants. It is anticipated that variability in waste chemistry will present QA/QC difficulties and potential product failures if conventional cement solidification is adopted. Estimated metals concentrations in the blowdown are presented in Table 2.

WSRC conducted a survey of potential solidification systems for potential application at the CIF. A report of their findings entitled, "Consolidated Incinerator Facility Blowdown Treatment Study" was written subsequently and a paper entitled, "Waste Treatment Evaluation for Aqueous Secondary Waste From Mixed Waste Incineration" was presented at the 1992 Incineration Conference in Albuquerque, NM, May 11 - 15, 1992. Based on the anticipated properties of CIF scrubber blowdown waste and a technical review of potential waste stabilization systems, the WSRC report concludes that "The best potential treatment (which is currently available) for the CIF blowdown is solidification with thermoplastic polymers." [1] Their conclusions took into account such factors as ease of processing, quality assurance/quality control, waste form performance, and cost effectiveness. WSRC is continuing to pursue thermoplastic polymer processes and plans to initiate treatability studies using surrogate CIF waste solutions. A follow-up meeting with WSRC representatives concerning BNL assistance in investigating treatability of CIF wastes in thermoplastic polymers is scheduled for November 13, 1992 at BNL.

Table 2. **Concentration of Metals In Westinghouse Savannah River Co. Consolidated Incinerator Facility Blowdown Solution**

Metal	Blowdown Metal Concentration (PPM)
Ag	100
As	50
Ba	100
Cd	25
Cr	100
Hg	50
Ni	100
Pb	750
Sb	100
Se	100
Ti	100
Zn	100

Site Visit to Martin Marietta Energy Systems:
Oak Ridge, TN May 8,1992

P. Kalb and P. Colombo visited Oak Ridge on May 8, 1992 and met with Martin Marietta Energy Systems (MMES) representatives from Central Waste Management, K-25 Technology Division, K-25 Central Neutralization Facility (CNF), K-25 Waste Management Division, and Y-12 Process Design. The BNL presentation included a technical overview on polymer solidification processes, and a brief report on technology status and demonstration plans. Discussions that followed focused on the types of waste applicable to this technology at each MMES facility and potential cooperative efforts to enhance, demonstrate, and transfer the technology across the DOE complex. Participants each completed a short survey form to help document needs and capabilities. Completed surveys are included in the Appendix. Respondents identified several site-specific MMES waste streams as potentially applicable to polymer encapsulation including:

- salts/other aqueous streams, (e.g., chloride salts from aqueous scrubber streams). Near term volumes are approximately 40 m^3/yr; volumes expected to increase to about 140 m^3/yr after 1995.

- sludges (e.g., Central Neutralization Facility, (CNF) sludges)

- ash/other particulates (e.g., TSCA incinerator ash). Near-term volumes (1992 - 1994) between 30 - 60 m^3/yr; expected to be 150 - 375 m^3/yr after 1995.

- ion exchange resins.

Considerable interest was expressed for the proposed BNL full-scale technology demonstration in FY-93. Several respondents expressed interest in working cooperatively with BNL to further the development, demonstration, testing, and evaluation of polymer encapsulation technologies.

In addition to the interest expressed during this site visit, BNL has had communications with Y. Fields and J. Prazniak, MMES, Y-12 facility. A 55 gal. drum of bio-denitrification sludge was shipped to BNL and is currently being stored awaiting waste-specific treatability studies - although there currently are no funds to support such a study.

Site Visit to Westinghouse Hanford Co.:
Richland, WA June 29 - July 1, 1992

P. Kalb attended the DOE/Westinghouse Hanford Co. Tank Waste Remediation System (TWRS) Technology Workshop (Richland, WA, 6/29 - 7/1) and participated as a core member of the LLW Technical Working Group. TWRS is tasked with developing a technology plan for remediation of the Hanford tanks in support of Tri-Party Agreement milestones. The purpose of this workshop was to provide technical input to TWRS management on the baseline treatment technology (cement grout for LLW), enhancements to the baseline technology, and

potential alternative technologies to be pursued. Polymer solidification is among 6 alternative technologies that were recommended for further development.

Site visit activities were coordinated in conjunction with participation in the TWRS LLW Technical Working Group. Thus, a talk was presented on polymer solidification and the current effort to coordinate national needs and development throughout the DOE complex. Representatives from both Westinghouse Hanford Co. and Pacific Northwest Laboratories were in attendance, as well as other DOE personnel participating in the TWRS workshop. The BNL presentation included a technical overview on polymer solidification processes, and a brief report on technology status and demonstration plans. Discussions that followed focused on the types of waste applicable to this technology at Hanford and potential cooperative efforts to enhance, demonstrate, and transfer the technology across the DOE complex. Participants completed a short survey form to help document needs and capabilities. Respondents identified several site-specific Hanford waste streams as potentially applicable to polymer encapsulation including:

- Salts/other aqueous streams, (e.g., single-shell and double-shell tank slurries): Hanford SST inventory is about 200,000 MT (predominantly $NaNO_3$- see Table 3 for estimated chemical constituents) with a total radioactive inventory or about 60 MCi. About 35 wt% of the SST LLW is in the form of saltcake. Liquid Effluent Treatment Facility (LETF) salt cake contains mostly $(NH_4)SO_4$ as shown in Table 4. The volume of this waste is estimated at around 10,000 ft^3/yr.

- Sludges (e.g., salt sludge residues in single-shell tanks, 183-H solar evaporation pond sludges): SST salt sludge fractions are estimated at about 60 wt%. 183-H Basin Sludge contains nitrates and sulfates. The composition of several types of 183-H Basin Sludge are also presented in Table 4. The volume of this waste resulting from cleanup efforts is estimated at around 3900 ft^3/yr.

- Ash/other particulates: Potential Waste Receiving and Processing 2A feed is estimated at 2300 ft^3/yr.

- Ion exchange resins

- Contaminated soils

- Solid wastes

Considerable interest was expressed for the proposed BNL full-scale technology demonstration in FY-93. Survey responses are included in the Appendix..

P. Kalb met with representatives of Westinghouse Hanford Co. Waste Receiving and Processing (WRAP) Technology Section during the WHC site visit (6/30/92) to discuss possible BNL involvement in the treatment of four separate sludges resulting from the 183-H solar evaporation pond. Waste-specific treatability studies and waste form performance evaluation would be required to compare polyethylene encapsulation with other options including thermosetting resins and hydraulic cement grout. A draft Statement of Work was

written to initiate this effort, but the project is currently on hold pending determination of where funding support will be established. Based on previous discussions with WHC personnel, a letter was issued from K. Bracken, Director of the Waste Management Division of the Richland Operations Office to the President of Westinghouse Hanford Co. formally requesting that a drum of 183-H basin sludge be shipped to BNL for treatability studies.

Table 3. Estimated Mass of Nonradioactive Chemical Components of Existing SST Wastes[a]

Chemical	Total Bulk Sludge (t)	Total Bulk Saltcake (t)	Interstitial Liquid (t)
$NaNO_3$	20,000	110,000	2,500
$NaNO_2$	3,000	2,300	1,900
Na_2CO_3	1,700	730	70
NaOH	4,200	2,000	740
$NaAlO_2$	950	1,900	1,500
Na_2SO_4	740	1,700	
Na_3PO_4	12,500	2,100	280
Cancrinite	2,700		
$Al(OH)_3$	2,300		
$Ce(OH)_3$	320		
$Cr(OH)_3$	190		
$Cd(OH)_2$	5		
$Fe(OH)_3$	1,200		
$Sr(OH)_2$	50		
$BiPO_4$	380		
$CaCO_3$	320		
F^-	800		5
Cl^-	40		
Hg^-	0.9		
MnO_2	190		
$Ni_2Fe(CN)_6$	500		
$P_2O_5 \cdot 24WO_3 \cdot 44H_2O$	20		
$ZrO_2 \cdot 2H_2O$	430		
Organic Carbon			200
H_2O	26,000	14,000	4,800
TOTAL	79,000	135,000	12,000

[a] This table taken from Reference [2].

Table 4. Approximate Composition of Westinghouse Hanford Co. Waste Receiving and Processing Facility (WRAP-2A) Surrogate Wastes[a]

Component	Waste Type 1 LETF Salts	Waste Type 2 Basins #1,#2 Sludge	Waste Type 3 Basins #3,#4 Sludge	Waste Type 4 Basin Crystal Solids
Silver (ppm)		218	190	
Barium (ppm)			24	100
Beryllium (ppm)		6	2.3	
Cadmium (ppm)			6	
Chromium (ppm)	187.5	900	390	500
Copper (ppm)	201.0	130,000	112,000	63,000
Mercury (ppm)	9.2	1.3		
Nickel (ppm)	46.5	100	130	400
SUBTOTAL (ppm)	444.20	131,225.30	112,742.30	84,000.00
Ammonium (%)	22.83			
Fluoride (%)		6.0	1.3	7.1
Nitrate (%)	1.1	13.5	26	1.6
Sodium (%)		20.0	24	22.9
Sulfate (%)	64.61	20.2	3.7	35.5
Water (%)	10.0	21.58	25.03	24.5
SUBTOTAL (%)	98.54	81.28	80.03	91.60
Inerts (%)	1.42	5.6	8.7	2.0
TOTAL (%)	100.00	100.00	100.00	100.00

a) Adapted from Reference [3]

Site Visit to Los Alamos National Laboratory:
Los Alamos, NM July 8, 1992

P. Colombo and P. Kalb completed a site visit to Los Alamos National Laboratory on July 8, 1992. In conjunction with this site visit, they met with the Solid Waste Group of the Technical Assessment and Selection Panel (TASP), chaired by L. Austin of LANL. This EM-30 group was meeting to discuss the Complex 21 Flowsheet, baseline treatment technologies and alternative/improved treatment technologies. BNL presented a technical overview on polymer solidification processes, and a brief report on technology status and demonstration plans. The group then discussed six final waste form technologies (hydraulic cement, polyethylene, modified sulfur cement, vitrification, ceramics, and metals) and their relative strengths and weaknesses for treatment of several types of generic DOE wastes including liquids, treatment sludges (nitrates and chlorides) evaporator bottoms, incinerator ash, scrubber solution and lead. Both polyethylene and modified sulfur cement were highly ranked for several key waste streams.

BNL also met with representatives from LANL Waste Management and Nuclear Technology and Engineering Divisions. Participants completed a short survey form to help document needs and capabilities. Representatives from Waste Management (Incinerator Operations/ Waste Treatment Technology) indicated they have several streams that may be applicable to polyethylene encapsulation including:

- salts and other aqueous streams
- sludges (1500 drums in storage, about 1 drum/day generated),
- ash and other particulates (about 4,500 lbs/yr anticipated when incinerator is returned to service)
- residues from a wet oxidation process that uses ferric chloride.

During discussions at LANL, Waste Management personnel expressed interest in "being able to send compositions/samples to BNL for encapsulation, testing and product evaluation." Copies of survey responses are included in the Appendix.

Other Communications With DOE Site Personnel

Interest at EG&G Idaho

Telephone communications have been held with P. Shaw, EG&G Idaho on potential use of polyethylene and modified sulfur cement for remediation of buried waste at EG&G. They sampled about 300 lbs of RFP nitrate salt from a drum and placed in (40) 7 - 8 lb Nalgene jars. The top portion reportedly had some cement powder and the bottom had a 1/2 in thick disk of solidified cement (some H_2O had gotten in). It dates back to 1972 and was produced by a drum dryer at RFP. The top is in small chunks and crystalline. The bottom is in bigger

chunks. The bulk density is 0.6 (top) Rad analysis shows no gamma dose, < 1 pCi of Pu and Am, about 100 pCi of natural U. A small drum containing about 10 lbs of the salt was shipped to BNL for potential use in future treatability studies, although no support is currently in place to fund these efforts.

Interest at DOE Weldon Springs Site

BNL was contacted by G. Schmidt, M-K Ferguson, Inc., prime contractor at the DOE Weldon Springs Site. Schmidt attended the EPA Seminar Series on Radioactive Site Remediation held in Chicago where P. Kalb presented a talk on polymer solidification of mixed wastes. In addition to over 200,000 cubic yards of contaminated sludge in several pits, there are numerous mixed wastes being stored in a RCRA storage area that require treatment. Based on the information presented at the seminar, Schmidt felt polymer solidification may provide a successful alternative to conventional technologies for some of these waste streams. Additional literature on the process was forwarded and follow-up discussions on applicability of polyethylene to Weldon Springs waste are planned.

Interest at Westinghouse Materials Company of Ohio

BNL was contacted by D. Herman, Program Manager, Westinghouse Materials Co. of Ohio. They are currently investigating potential treatment options for waste streams requiring remediation including 8,000 - 9,000 yd^3 of K-65 uranium ore residues and about 500,000 yd^3 of filter sludge, currently buried in pits. Fluor-Daniel is taking over as prime contractor at this site. Herman requested additional information on BNL's polyethylene and modified sulfur cement technologies and requested BNL conduct a site visit to brief waste management personnel. A tentative date of December 15, 1992 was scheduled for this visit.

Results of Site Visit Surveys

In conjunction with DOE site visits a short survey was distributed in order to:

- help document the major "problem" mixed waste streams throughout the DOE complex that are potentially amenable to improved treatment by polymer solidification, and

- assess the importance and programmatic impact of conducting the proposed full-scale demonstration of the polyethylene encapsulation process using surrogate wastes at BNL in FY 1993.

Copies of the completed survey responses are included in the appendix. Respondents were asked to to comment on applicability of the polyethylene process to site-specific waste streams, identify particular waste streams where it might be applicable, estimate generation rates and/or storage volumes, evaluate the importance of the proposed demonstration, and indicate interest in participating in further efforts to develop and implement these processes.

A total of 19 surveys were completed and results are summarized below.

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

# of Respondents:

Yes	No
[18]	[1]

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

# of Respondents:

[15] Salts and other aqueous streams

[16] Sludges

[10] Ash and other particulates

[9] Ion Exchange Resins

[2] Others

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

# of Respondents:

[12] For application at your facility?

[8] For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

# of Respondents:

Yes	No
[16]	[0]

Meetings/Presentations

EPA/DOE Seminar Series on Radioactive Site Remediation:

- **Seattle, WA July 21 - 22, 1992**
- **Albuquerque, NM July 23 - 24, 1992**
- **Atlanta, GA August 18 - 19, 1992**
- **Chicago, IL August 20 - 21, 1992**

P. Kalb participated in the EPA/DOE sponsored seminars on Radioactive Site Remediation held in Seattle WA (July 21 - 22), Albuquerque, NM (July 23 - 24), Atlanta, GA (August 18 - 19), and Chicago, IL (August 20 -21). He presented a talk on "Polymer Solidification of Low-Level Radioactive, Hazardous, and Mixed Wastes." EPA organized the seminar series which was jointly sponsored by DOE. DOE/EM support for participation in this activity was outlined in an April 7,1992 letter from Clyde Frank.

The seminar featured presentations on soil characterization and treatment, decontamination, and several potential treatment options for LLW/mixed wastes including in-situ grout, polymer solidification, in-situ vitrification, incineration, compaction, and bioremediation. Several hundred people attended from EPA, DOE, national laboratories, state environmental agencies, universities, and the commercial sector. Attendees filled out conference evaluation forms rating the potential relevance of each technology, likelihood of application to site remediation efforts and quality of the presentation. Hundreds of evaluation forms have been compiled and confirm broad interest within DOE, EPA, NRC, state agencies, and commercial vendors for polymer solidification of radioactive, hazardous, and mixed wastes. Over 180 requests for additional information on the polymer encapsulation system were received and processed. A data base of individuals and organizations that have expressed interest in this process will be maintained to facilitate future coordination of efforts and communicate significant events such as the proposed full-scale polyethylene encapsulation technology demonstration. Those contacts made as a result of the seminar series that have been followed up by additional discussions are included in the overall List of Contacts for the Polymer Solidification National Program, included in the Appendix.

Miscellaneous Presentations:

P. Kalb presented several papers on polymer solidification in an effort to provide technology transfer and solicit potential new applications for these processes. A paper entitled, "Long-Term Durability of Polyethylene for Encapsulation of Low-Level Radioactive, Hazardous, and Mixed Wastes," was presented at the American Chemical Society (ACS) Symposium on Emerging Technologies for Hazardous Waste Management, Atlanta, GA, October 1 - 3, 1991. This paper was peer reviewed and will be published in a soon to be released ACS book. A paper entitled, "Waste Management Technology Development and Demonstration Programs at BNL," was presented at Technology 2001, The Second Annual National Technology Transfer Conference and Exposition, San Jose, CA, December 3 -5, 1991. Contacts were made at both of these meetings with staff from federal facilities and the commercial sector who are interested in polymer solidification. P. Kalb, J. Heiser, and P. Colombo presented a poster paper entitled, Polyethylene Encapsulation of Mixed Wastes,

Scale-up Feasibility," at the Waste Management '92 Meeting, Tucson, AZ, March 2 - 5, 1992. Presenters met with interested staff from several DOE facilities and the commercial sector concerning process viability and applicability to diverse mixed waste streams. Additional information was sent in response to requests from interested parties attending each of these meetings.

Cooperative Efforts

Cooperation With Ames Laboratory

BNL is cooperating with Ames Laboratory in the development of an on-line Transient Infrared Spectrometer (TIRS) for the polyethylene encapsulation process. This system is designed to provide real-time data on waste loading composition for improved process control and quality assurance. Ames Laboratory developed this technique and used the BNL bench-scale extrusion process to test feasibility and optimize monitoring performance. BNL provided process equipment and technical assistance in set-up and process operation. Roger Jones (Ames) met with BNL personnel on May 28, 1992 to discuss project feasibility and logistics. Jones and John McClelland (Ames) conducted initial testing of the on-line monitor at BNL on October 12 -15, 1992. Data were taken at varying nominal waste loadings between 20 and 70 wt% nitrate salt. The TIRS successfully identified nitrate peaks in proportion to waste loading. Additional work remains in order to calibrate the monitoring technique and provide reliable real-time data.

Potential Cooperative Research and Development Agreements

Pacific Nuclear Services (PNS), a commercial waste management vendor, has expressed interest in the polyethylene encapsulation process for treatment of ion exchange resins. A representative of PNS visited BNL on May 27, 1992 to discuss this technology, Discussions were held with our staff and with the BNL Technology Transfer Division on possible cooperative research and development efforts. BNL Technology Transfer has committed $50K in DOE/EM CRADA funds allocated to BNL in support of this effort and PNS is willing to provide equivalent funding. Final negotiations on the scope of work for this effort are underway.

BNL was contacted by Radian Corp., Austin TX, an environmental consulting and waste management company interested in BNL's modified sulfur cement encapsulation process. Radian has an interest in developing and marketing this technology and has written a draft proposal for a Cooperative Research and Development Agreement with BNL. A copy of this proposal was forwarded to OTD (attention K. Hain) and a CRADA Proposal Brief has been written and sent to William Noel as per Clyde Frank's briefing letter of August 21, 1992. BNL has submitted two TTPs for further development and testing of this process which would be compatible with this potential CRADA.

Cooperative Effort with DOE Grand Junctions Project Office

P. Kalb and P. Colombo met with R. Walker, Geotech, Inc. (subsidiary of Chem-Nuclear Environmental Services, Inc.), representing the DOE Grand Junction Projects Office, Grand Junction, CO. at BNL on October 5,1992. Geotech has been requested by Clyde Frank to facilitate OTD Technology Demonstrations for innovative environmental restoration and waste management technologies. Geotech selected the polyethylene encapsulation process from among many DOE technologies currently being developed for near-term technology demonstration. BNL has proposed hosting a full-scale technology demonstration of the polyethylene process using surrogate mixed wastes in FY 1993. Discussions with Walker covered BNL experience in developing the process, outstanding issues, and strategies for implementing the full-scale demonstration.

BNL Production-Scale Polyethylene Encapsulation Test Facility

At the request of DOE HQ, the 4.5 inch production-scale polyethylene extruder was shipped from RFP to BNL on November 9, 1992 for use in demonstrating process scale-up, and "cold" pilot process feasibility prior to "hot" testing. Plans for FY 1993 incorporated in BNL's TTP include use of this equipment to demonstrate polyethylene encapsulation of nitrate salt waste using a surrogate waste that closely resembles actual salts in chemical and physical composition. An appropriate BNL location has been procured and BNL administrative approval obtained. This facility will be maintained beyond completion of the nitrate salt demonstration to provide scale-up information for the treatment of other mixed wastes, based on the results of on-going bench-scale treatability studies. This demonstration (and continued "cold" pilot-scale demos with additional waste streams, as identified) will provide valuable information on the viability of this process for mixed waste generators, both within DOE and the commercial sector. However, BNL is currently awaiting resolution of funding support for these activiites, as no FY 1993 DOE support is in place to continue. Funds are needed to install and operate the production-scale extruder and to conduct the "cold" demonstration with surrogate wastes.

Preparation of Informational Video on Polyethylene Encapsulation

BNL prepared a 9 minute informational video on the polyethylene encapsulation process to assist in effectively disseminating information to a broad audience. The video provides a general overview of the technology, how it works, potential waste applications, and comparisons with conventional hydraulic cement processes. Copies of the video are available from BNL by contacting:

- Peter Colombo, Technical Program Manager, 516-282-3045 or
- Paul Kalb, Principal Investigator, 516-282-7644

Public Outreach Activities

A feature article on BNL's polyethylene encapsulation process entitled, "Plastics Improves Safety, Efficiency of Waste Disposal", was published in the journal, *Plastics and You,* (Summer 1992). This quarterly review of innovations in plastics is a joint initiative with The Society of the Plastics Industry. BNL provided background information for the article by participating in interviews and supplying several reports and videotape describing the process.

Summary and Conclusions:

BNL's efforts conducted over the past nine months highlight the need for further investigation of polymer solidification to help solve DOE's environmental restoration and waste management problems. Numerous waste streams at virtually every site throughout the DOE complex have been identified as needing improved treatment. Preliminary compatibility with thermoplastic polymer processes has been established for many generic and site-specific waste types. The overwhelming response from DOE waste management personnel contacted for this study was that additional work is needed in order to:

- Confirm treatability of site-specific DOE mixed wastes by means of polymer solidification processes. Experience has shown that variations in individual waste streams make it essential to conduct confirmatory testing on specific waste streams or waste stream surrogates that closely reflect actual waste in chemical and physical composition. In addition to assuring process feasibility for individual wastes, this effort is needed to provide comparative data on waste loading potential, waste form performance, and economic viability for use in selecting optimized treatment technologies.

- Conduct "cold" pilot- or full-scale demonstrations using surrogate DOE mixed wastes. Such efforts provide the opportunity to conduct "shake-down" testing, confirm full-scale waste form performance, and assure that all facets of the technology operate as expected, prior to full-scale testing of actual waste streams. As described above, BNL will be equipped and staffed to conduct such scale-up work.

- Conduct "hot" full-scale demonstrations prior to process implementation.

A number of sites (e.g., WHC, WSRC, ORNL, INEL, LANL) have already requested BNL assistance in conducting waste treatability studies for polymer solidification. In addition, several sites and DOE contractors have expressed interest in assisting in the further development of polymer technologies. Collaborative efforts such as those already underway with RFP, Ames Laboratory and Geotech will expedite the enhancement of polymer solidification technology and facilitate technology implementation throughout the DOE complex.

Under DOE sponsorship, polymer solidification technologies have undergone steady, gradual development at BNL over the past nine years. During this time they have progressed through each of the stages necessary for logical technology maturation: from process conception, parameter optimization, waste form testing, evaluation of long-term durability, economic analysis, and scale-up feasibility. This technology development represents a significant investment which can potentially provide DOE with both short- and long-term savings: cost-effective, improved waste treatment has obvious near-term advantages, while improved long-term performance will obviate the need for costly environmental remediation activities. However, to fully realize such savings, technology development activities must be completed and further application of the technology to DOE mixed wastes streams must be thoroughly examined.

REFERENCES

1. Burns, H.H., "Waste Treatment Evaluation for Aqueous Secondary Waste From Mixed Waste Incineration," WSRC-MS-92-143, presented at the 11th Annual Incineration Conference, Albuquerque, NM, May 11 - 15, 1992.

2. Boomer, K.D., et al, "Functional Requirements Baseline for the Closure of Single-Shell Tanks," WHC-EP0338, Westinghouse Hanford Co., Richland, WA, June 1990.

3. Burbank, D.A., "Draft Statement of Work for BNL Polyethylene Immobilization Technology, Waste Form Qualification Testing," Westinghouse Hanford Co. WRAP Technology Section, May 28, 1992.

APPENDIX

List of Contacts for Polymer Solidification National Program
Updated: October 30, 1992

The following list of individuals from DOE, EPA, state agencies, and the commercial sector is presented to demonstrate the level of interest in polymer solidification processes and BNL's efforts to demonstrate these technologies at full-scale. The list is not exhaustive - BNL responded to several hundred individuals who requested additional information on these technologies. Only those organizations which responded with follow-up discussions are represented here.

Westinghouse Hanford/PNL :

Jim Berger	OTD TPM
Roger Gilchrist	UST-ID Coordinator (WHC)
Tom Gates	UST-ID
Paul Scott	UST-ID Technical Support Group Coordinator (PNL)
Felicia LaBarge	UST-ID
John Cruse	UST-ID
Larry Bagassen	PNL
Bruce Higley	WHC
Paul Sliva	PNL
Dewey Burbank	WHC Waste Receiving & Processing
Kent Weingardt	WHC Waste Receiving & Processing
Wayne Ross	WHC Waste Treatment Technology (Also EM30 Mixed Waste Treatment Project
Jim Hunter	WHC, Manager, Chemical Processing Engineering
Joe Westsik, Jr.	Process Development Section
Jeff Voogd	WHC, Manager, Grout Technology
Jerry Cammann	WHC, Manager, Technology Applications & Testing
Steve Burnham	Tank Waste Remediation Systems (TWRS)
Steve Schaus	Tank Waste Remediation Systems (TWRS)
Laura Johnson	WHC
Wilbur Greenhalgh	WHC, Chemical Process Engineering Group
Jim Field	WHC
Randal J. Roberts	WHC
David Lini	

Idaho National Engineering Lab

Kennith Merrill	Buried Waste-ID Coordinator
Kevin Kostelnik	BW-ID Program Manager
Peter Shaw	EG&G Idaho
Ross Darnell	EG&G Idaho
Jeffrey Mousseau	Engineering Department
Ron Hover	
N. Morcos	

Los Alamos National Lab

Larry Austin	Group Leader, Nuclear Material Process Technology (nitrate operations)
Jerry Veazey	Nuclear Materials Technology Division
Leon Borduin	Nuclear Technology & Engineering Div. (Also, EM-30 Mixed Waste Treatment Project)
Stan Zygmunt	Section Leader, Incinerator Operations/Waste Treatment Technology Application
Ron Nakoaka	Mixed Waste IP Technical Support Group on Waste Form
Carolyn Gooley	
Micheline Devaurs	EM-30 Representative
Stanlev T. Kosiewicz	

Oak Ridge National Lab

A. Malinauskas	OTD TPM
Jan Berry	Mixed Waste Integrated Program Coordinator
T.J. Abraham	MMES Central Waste Management Div.
David Hutchins	MMES, Project Manager, Central Waste Management Div.
John Prazniak	MMES Y-12
Yolanda Fields	MMES Y-12
Steven Inman	MMES Waste Mgt. Division K-25
Paul Osborne	MMES Technology Division
William Bostick	MMES Technology Division
Vidkie Gilbert	MMES Waste Mgt. Division K-25
Bruce Barritt	MMES Waste Mgt. Division K-25
Greg Boris	MMES - Process Design Y-12
Cindy Kendrick	
Dianne D. Gates	
Mike Morris	

Westinghouse Savannah River Co.

Christine Langton	Interim Waste Technology
Heather Burns	Process Engineer, Consolidated Incinerator Facility
Dan Burns	Senior Engineer, Interim Waste Technology
Marshall Looper	Manager, Interim Waste Technology
Michael Meyer	Interim Waste Technology
Steven T. Wach	Special Projects Mgr., Waste Management Engineering
A.W. Wiggins, Jr.	Technical Manager, ETF/CIF, Waste Management Technology
Errol Orebaugh	Interim Waste Technology
Samuel T. Goforth	
Carrie A. Amacher	
Pamela B. Barnard	

EG&G Rocky Flats Plant

Andrea Faucette	Technology Development/Waste Projects
Jeff Petersell	Technology Development/Waste Projects
Dick Saiki	
Jack Blakeslee	OTD TPM
Tom Nolan	Technology Development
Bob Yudnich	Technology Development/Waste Projects
Norman Cypher	Liquid Waste Treatment Facility
Ed Lee	
Michael Connell	Technology Development/Waste Projects
Donald Anderson	ES & TS
Boyce Logsdon	Technology Development/Waste Projects
Davis Vigil	ES & TS
Kirk Lindahl	Materials Development

Lawrence Livermore National Lab

Martyn Adamson	Leader, Waste Treatment Section, Advanced Processing Tech.
Richard Van Konynenburg	

Sandia National Lab

Phillip Pohl	
Margaret S.Y. Chu	
Paul J. Nigrey	Division 6322 Technical Staff

Argonne National Lab

Jim Cunnane	Chemical Technology Div.
Dileep Singh	Materials and Components Technology Div.
Mike Wilkey	
Melissa Goyette	
Jas. S. Devgun	R&D Program Coordination Office

Westinghouse Materials Co of Ohio

Donald Herman	Program Manager
Robert J. Skalka	

Federal and State Agencies:

U.S. DOE

Tom Gerusk	U.S. DOE, EM-452
Paul Beam	U.S. DOE - EM-451

U.S. NRC

Bobby Eid	
Nick Orlando	LLDR/LLWM/NMSS 5-E-4

U.S. EPA

Edwin Barth	Center for Environmental Research Information, Cincinnati
Carlton Wiles	Center for Environmental Research Information, Cincinnati
Arturo Duran	Denver, CO
Jack Cowart	WMD RCRA RLS, Atlanta, GA
Steve Sandler	Region IV
Maxwell J. Knowpson	Region IV
Richard W. Hammond	Region IV
Gene Jabolonowski	Chicago
E. Newman Smith, Jr.	EPA HQ
Eric M. Glatstein	RCRA Enforcement Branch Region 5

U.S. Army Corps of Engineers

Chung-Rei Mao

Georgia

Donald N. Montgomery	Environmental Protection Division
Alan J. Giles	Environmental Protection Division

North Carolina

Robin Haden	NCDRP

South Carolina

Keith Collinsworth	SCDHEC

Louisiana

Jason Talbot	Radiation Protection Division

Tennessee

C. Nick Carter	Department of Environment & Conservation

Kentuky

Kevin Imes	Department of Environmental Protection

New Mexico

John Hostak	Environment Department, Hazardous & Radioactive Materials Bureau

Illinois

Joseph Klinger	Head, Licensing Section, Illionos Dept. of Nuclear Safety

Commercial Vendors:

Fluor Daniel, Inc.
Cyrus I. Rhee
Amar Bumb

Geotech, Inc. (subsidiary of Chem-Nuclear Environmental Services)

Russell Walker	Senior Staff Scientist

Clemson Technical Center, Inc. (Division of Chemical Waste Management)
Steve Hoeffner

Radian Corp.

Richard Harris	Vice President, Corporate Development
Willis Weigand	Senior Scientist

Geraghty & Miller, Inc.

Nicholas Valkenburg	Vice President, Hydrogeologist
Suthan Suthersan	Director, Remediation Services

LICON Corp.
Rod Williamson

Pacific Nuclear Systems (SC)
Steven Miller
Wes Caughman
Paul Denault

Pacific Nuclear (WA)
Charles J. Temus

Scietific Ecology Group

Bud Arrowsmith	President
Tim Hallman	Incinerator Technical Advisor
Dewey Large	Manager, Government Services
James D. Gibson	

SAIC, Idaho

John Mayberry	SAIC, Mixed Waste IP Technical Support Group on Waste Form
David Dalton	
Ray Geimer	

SAIC Oak Ridge
Cassandra Anthony
William McNeill

MK Ferguson Weldon Springs Site
Glen Schmidt

MK Ferguson of Idaho Co.
Ann M. Tyson

Chemical Waste Management
Gary Benda

Chem-Nuclear Systems, Inc.(Subsidiary of Chemical Waste Management, Inc.)
Robert Anderson

BNFC, Inc.
Livingston Parkhill

Site Visit Survey Responses

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: STAN Eggmont
Ron Nakaoka

Facility/Site: LANL

Position: SECTION LEADER

Waste Management Responsibilities: INCIN. OPERATION / WASTE TREATMENT TECHNOLOGY APPLICATION

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No

   Comments:
   We have several streams that may be applicable.
   Characterization data has not been obtained as most.

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams: rate not determined

   ☑ Sludges: 1500 drums in storage, 1 drum per day generation
   up to 60% water

   ☑ Ash and other particulates: 45000 LBS/yr anticipated future generation

   ☐ Ion Exchange Resins:

   ☑ Others: residues from a wet oxidation process that uses ferric chloride
   rate not yet determined

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☐ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☑ Yes ☐ No

   Comment:
   We would really like to be able to send compositions / samples
   to you for encapsulation and testing (product evaluation

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Cyrus Rhee Facility/Site: A/E, Fluor Daniel, Inc

Position: Director, Chemical Engineering

Waste Management Responsibilities:

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☒ Yes ☐ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☒ Salts and other aqueous streams:

   ☒ Sludges:

   ☒ Ash and other particulates:

   ☒ Ion Exchange Resins:

   ☐ Other::

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☒ For application at your facility?

   ☒ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☐ Yes ☐ No
   Comment:

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Gerry Vaadeya **Facility/Site:** LANL TA-55

Position: Staff Member

Waste Management Responsibilities: TRU

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No

   Comments:

   Possible problem w/ TRU due to high gas generation

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams: only if can be used

   ☑ Sludges:

   ☐ Ash and other particulates: w/ TRU

   ☑ Ion Exchange Resins:

   ☐ Others: No LLW in these categories

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☑ For application at your facility? if ok for TRU

   ☐ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☑ Yes ☐ No

   Comment:

   IF TRU OK

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: MARTYN ADAMSON Facility/Site: LLNL

Position: Leader - Waste Treatment Section, Adv. Processing Technologies Program

Waste Management Responsibilities: → R&D of waste treatment processes

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☒ Yes ☐ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☐ Salts and other aqueous streams:

   ☒ Sludges:

   ☐ Ash and other particulates:

   ☒ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☐ For application at your facility?

   ☒ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☒ Yes ☐ No
   Comment:

   this would have to be referred to someone else at LLNL (in Waste Operations)

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Steve Wach Facility/Site: SRS

Position: Manage Special Projects, Waste Mgt Engineering

Waste Management Responsibilities: Solid Waste

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams:

   ☐ Sludges:

   ☑ Ash and other particulates:

   ☐ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☑ For application at your facility?

   ☑ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☑ Yes ☐ No
   Comment:
   Interested in general review & comment especially as applicable to the SRS Consolidated Incinerator Blowdowns & Complex 21.

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Rao Vamma Facility/Site:

Position: MST-DD / RF/ LATD LANL

Waste Management Responsibilities: MS E540

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☐ Yes ☒ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☐ Salts and other aqueous streams:

   ☑ Sludges:

   ☐ Ash and other particulates:

   ☐ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☐ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☑ Yes ☐ No
   Comment:

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: DEWEY BURBANK Facility/Site: HANFORD MSIN: H1-60

Position: PRINCIPAL ENGINEER PHONE: 509-372-0855 FAX: 509-372-1164

Waste Management Responsibilities: WASTE RECEIVING & PROCESSING (WRAP) MODULE 2A WRAP TECHNOLOGY SECTION

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☒ Yes ☐ No

   Comments: CURRENTLY EVALUATING THERMOSETTING POLYMERS FOR MANY OF THE WRAP 2A FEED STREAMS.

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☒ Salts and other aqueous streams: C-018 (LETF) SALT CAKE $(NH_4)_2SO_4$ EST. 10,000 CU.FT/YR

   ☒ Sludges: 183H SOLAR EVAPORATION BASIN CLEANUP 3900 CU.FT/YR
   SODIUM NITRATE/SULFATE SALTS, HIGH COPPER

   ☒ Ash and other particulates: POTENTIAL FUTURE WRAP 2A FEED EST. 2300 CU.FT/YR

   ☒ Ion Exchange Resins: C-018 & L-045 LIQUID EFFLUENT TREATMENT FACILITIES EST. 2100 CU.FT/YR

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☒ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☒ Yes ☐ No

   Comment: TOTAL PROJECTED VOLUME OF WRAP 2A FEEDS IS 630,000 CU.FT.

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Wayne Ross Facility/Site: Hanford / PNL

Position: Senior Project Manager

Waste Management Responsibilities: R+D+D - Waste Treatment Technology

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☒ Yes ☐ No

   Comments: I favor glass based forms as the primary waste form. Polymer based forms may be useful for secondary wastes not compatable with the primary for

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☒ Salts and other aqueous streams:

   ☐ Sludges:

   ☐ Ash and other particulates:

   ☐ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☐ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

   N/A

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☐ Yes ☐ No

   Comment:

   N/A

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: JERRY CAMMANN Facility/Site: WESTINGHOUSE HANFORD

Position: MGR., TECHNOLOGY APPLICATIONS & TESTING

Waste Management Responsibilities: IN SITU ISOLATION & STABILIZATION TECHNOLOGIES

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No

   Comments:
   WOULD LIKE TO HEAR THOUGHTS ON IN SITU APPLICATION POSSIBILITIES (I.E., TANK RESIDUALS FOLLOWING RETRIEVAL)

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams:

   ☑ Sludges:

   ☐ Ash and other particulates:

   ☐ Ion Exchange Resins:

   ☑ Others: CONTAMINATED SOILS, SOLID WASTES, APPLICATION TO SUBSURFACE BARRIERS (ESPECIALLY MOD. SULFUR CEMENTS)

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☑ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☑ Yes ☐ No

   Comment:
   ESPECIALLY APPLICATION TO TANK WASTE RESIDUAL STABILIZATION & POTENTIAL APPLICATION OF MOD. SULFUR CEMENTS FOR SUBSURFACE CONTAINMENT.

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: JEFF VOGEL **Facility/Site:**

Position: MNGR, ELECT TECHNOLOGY

Waste Management Responsibilities: HANDLED LLW

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams:) salts certainly, aqueous streams may be stretching the technology.

   ☐ Sludges:

   ☐ Ash and other particulates:

   ☐ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☐ For application at your facility?

   ☑ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☑ Yes ☐ No
   Comment: Dependent upon class of waste you're trying to demonstrate selection

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Micheline Devaurs Facility/Site: DOE HQ EM-36/LANL

Position: Detailee to John Tseng

Waste Management Responsibilities: LLW/[redacted] grout for Hanford site supporting EM-36 @ LANL responsible for ER cleanup at former Pu processing site.

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☒ Yes ☐ No

   Comments: Provided that long-term stability (esp. in terms of biodegradation) is adequately demonstrated)

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☒ Salts and other aqueous streams:

   ☒ Sludges:

   ☐ Ash and other particulates:

   ☐ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☒ For application at your facility? For Hanford

   ☐ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☒ Yes ☐ No

   Comment: Close coordination w/ Hanford [redacted] to ensure your demo. is also a proof-of-concept for application at as wide a range of DOE complex sites as possible. I'd also be interested in working with you from DOE HQ perspective to try and achieve the above.

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Jim Hunter **Facility/Site:** Westinghouse Hanford

Position: Manager, Chemical Process Engineering

Waste Management Responsibilities: Technology evaluation, application for fault & solid waste

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☒ Yes ☐ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☒ Salts and other aqueous streams:

   ☒ Sludges:

   ☐ Ash and other particulates:

   ☒ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☒ For application at your facility?

   ☒ For application at other facilities within the DOE complex?

4. Would you be interested in participating in a national program to demonstrate, test, and evaluate polymer encapsulation processes for your site-specific wastes?

   ☒ Yes ☐ No
   Comment:

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Jan Terry **Facility/Site:** [illegible]

Position: Group Leader

Waste Management Responsibilities: Mixed Waste [illegible] Program Coordination - tech oversight

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☒ Yes ? ☐ No

   Comments: Need [illegible] criteria where [illegible] method waste [illegible] to meet [illegible]

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☐ Salts and other aqueous streams:

   ☒ Sludges:

   ☐ Ash and other particulates:

   ☐ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☐ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

   [illegible]

4. Is your facility interested in working cooperatively with BNL to further the development, demonstration, testing and evaluation of polymer encapsulation processes for your site-specific wastes.

   ☒ Yes ☐ No

   Commnent:

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: David A. Hutchins **Facility/Site:** Central Waste Management Program, Martin Marietta Energy Systems, Oak Ridge

Position: Mixed Waste Coordinator

Waste Management Responsibilities: TSCA ash strategy; Final Waste Form development

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1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No

   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams: wet scrubber blowdown sludges - chloride salts ~ 40 m³/yr now temp; ~ 140 m³/yr after 1995.

   ☑ Sludges: CNF sludges?

   ☑ Ash and other particulates: 30 - 60 m³/yr 1991-1994; 150-325 m³/yr after 1995.

   ☐ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☑ For application at your facility?

   ☑ For application at other facilities within the DOE complex?

4. Is your facility interested in working cooperatively with BNL to further the development, demonstration, testing and evaluation of polymer encapsulation processes for your site-specific wastes.

   ☑ Yes ☐ No

   Commnent: Potentially.

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: P.E. OSBORNE **Facility/Site:** K-25 SITE

Position: TECH. ASSOCIATE

Waste Management Responsibilities: WORK FOR OTHERS

---

1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☐ Salts and other aqueous streams:

   ☑ Sludges:

   ☐ Ash and other particulates:

   ☑ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☑ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

4. Is your facility interested in working cooperatively with BNL to further the development, demonstration, testing and evaluation of polymer encapsulation processes for your site-specific wastes.

   ☐ Yes ☐ No
   Commnent:

   I DO NOT DEAL DIRECTLY WITH THIS, BUT MY DEPARTMENT MIGHT BE INTERESTED IN THIS

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: Steven Inman **Facility/Site:** K-25 - Waste Mgt. Div.

Position: Project Engineer

Waste Management Responsibilities: Assessment of TSD facilities capabilities [illegible]

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1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No
   Comments: TSCA Incinerator ash & sludge, CNF sludges after treatment of liquid wastes

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams:

   ☑ Sludges:

   ☑ Ash and other particulates:

   ☑ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☑ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

4. Is your facility interested in working cooperatively with BNL to further the development, demonstration, testing and evaluation of polymer encapsulation processes for your site-specific wastes.

   ☑ Yes ☐ No
   Commnent:

Please send me copy of reports relative to this presentation
Very interesting - Thanks.

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: GREG BORIS 9733-3, MS 8035 **Facility/Site:** Y 12

Position: ENGINEER (615) 574-3122

Waste Management Responsibilities: SOLIDIFICATION EXPERIENCE

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1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☒ Yes ☐ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☒ Salts and other aqueous streams:

   ☒ Sludges:

   ☐ Ash and other particulates:

   ☒ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☒ For application at your facility?

   ☒ For application at other facilities within the DOE complex?

4. Is your facility interested in working cooperatively with BNL to further the development, demonstration, testing and evaluation of polymer encapsulation processes for your site-specific wastes.

   ☒ Yes ☐ No
   Commnent:
   NOT SURE HOW, BUT YES.

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: BARRETT, BRUCE **Facility/Site:** K-25 OR,

Position: WASTE MGMT DIV

Waste Management Responsibilities: WASTE MINIMIZATION
WASTE REDUCTION -

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1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No
   Comments:

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams:

   ☑ Sludges:

   ☑ Ash and other particulates:

   ☑ Ion Exchange Resins:

   ☐ Others: We have chloride salts Not Nitrate at K-25
   Mostly From Steam Plant Softners & TSCA Incinerator -

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☑ For application at your facility?

   ☐ For application at other facilities within the DOE complex?

4. Is your facility interested in working cooperatively with BNL to further the development, demonstration, testing and evaluation of polymer encapsulation processes for your site-specific wastes.

   ☐ Yes ☐ No
   Commnent:

Coordination of National Effort for Polymer Solidification of DOE Mixed and LLW

Your assistance in completing this survey is appreciated. Please provide information in the space provided. If additional space is needed, attach a separate sheet.

Name: [illegible] **Facility/Site:** Central Waste Facility

Position: [illegible]

Waste Management Responsibilities: - Treating waste characterization from generators to CWF
- [illegible] waste Packages from CWF

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1. Based on the information presented by BNL and your general knowledge, do you think that the polyethylene encapsulation process is potentially applicable for wastes currently generated at your site or wastes resulting from environmental restoration activities?

   ☑ Yes ☐ No
   Comments: Specifically TSCA + CWF sludges

2. If so, please identify the types of waste potentially applicable from the list below, and provide approximate generation rates and/or storage volumes, if known:

   ☑ Salts and other aqueous streams:

   ☑ Sludges:

   ☑ Ash and other particulates:

   ☐ Ion Exchange Resins:

   ☐ Others:

3. BNL has proposed conducting a full-scale technology demonstration of the polyethylene encapsulation process in FY 1993 using a surrogate waste that closely resembles an actual nitrate waste in chemical and physical properties. Would this technology demonstration help you evaluate the potential viability of this process:

   ☐ For application at your facility?

   ☑ For application at other facilities within the DOE complex?

4. Is your facility interested in working cooperatively with BNL to further the development, demonstration, testing and evaluation of polymer encapsulation processes for your site-specific wastes.

   ☐ Yes ☐ No
   Commnent:
   Perhaps in the future

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