NOV 7 1979

DISTRIBUTION:
NMSS r/f
WM r/f
WMHT r/f
WMHT file
MKnapp
MBell
RBrowning
JMartin
EAWick & r/f
RDSmith
CBishop

Dr. Donald G. Schweitzer
Director, Division of Waste Management
Nuclear Energy Department
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, New York 11973

Dear Dr. Schweitzer:

This letter is to request technical assistance from BNL under Task 6 (Alternative Waste Forms for Low-Level Wastes) of our SOEW No. 50-79-92 dated September 26, 1979. This work entails evaluating alternative packages for dewatered resins, dewatered filter sludges and low-level wastes solidified with urea-formaldehyde. This assistance is to provide guidance to the NRC and the State of South Carolina in determining whether various packages meet proposed interim criteria for the low-level waste disposal site at Barnwell, South Carolina. We estimate the effort on this sub-task to be two man-months. A statement of work and the proposed interim license criteria are enclosed.

Please submit a letter report by ~~January 1,~~ Feb 10, 1980. The report should discuss the pros and cons of the various concepts and identify the preferred alternatives. The evaluation should be based upon information developed in prior work by BNL, information available in the literature, laboratory tests and data provided by the NRC.

Please call me if you have any questions on this sub-task.

Sincerely,

Everett A. Wick
High-Level Waste Technical
Development Branch
Division of Waste Management

Enclosures:
1. Statement of Work
2. Proposed interim license criteria

OFFICE ▶	WMHT EAW	WMLL	WMHT	WMHT		
SURNAME ▶	EAWick:ett	RDSmith	MKnapp	MBell		
DATE ▶	10/26/79	10/6/79	10/7/79	10/7/79		

STATEMENT OF WORK

Sub-task Title - Evaluation of Alternative Packages for Dewatered Resins, Dewatered Filter Sludges, and Urea-Formaldehyde Solidified Low-Level Wastes.

Background

The purpose of this project is to guide NRC and the State of South Carolina as to whether various packages can meet proposed general interim criteria specified in draft license interpretations for the low-level waste disposal site at Barnwell, South Carolina. Dewatered resins, dewatered filter sludges, and urea-formaldehyde solidified wastes are restricted in the license interpretations (Enclosure 2). Resin and filter sludge wastes containing more than one microcurie per cubic centimeter of isotopes with half-lives of 5 years or greater must be stabilized by solidification or by an equivalent method of packaging. Urea-formaldehyde solidified wastes must be shipped with a container, package liner, or coating which is not corrosively attacked by the liquids normally associated with urea-formaldehyde solidified wastes. The draft license interpretations also specify the effective dates for the interim criteria and when the criteria expire.

Sub-task Requirements - To be completed by ~~December 1~~ Feb. 10, 19~~79~~80:

1) Compare the properties of unsolidified dewatered resins and filter sludges disposed in various containers (such as reinforced concrete and stainless steel drums) to wastes solidified with concrete, Dow polymer, and bitumen (and consider the usual package as well).

2) Determine which package alternatives are available "off the shelf," e.g., septic tanks, burial vaults, storm drain piping, and identify their limitations and possible means of adapting or improving them for this use.

3) Determine the conditions under which the burial package could serve as a transportation shield, and whether it would meet DOT requirements.

4) Evaluate potential corrosion resistant liners, containers and container coatings for wastes solidified with urea-formaldehyde.

Effort - 2 man-months

Reporting Requirements

BNL shall submit a letter report to the NRC project manager on ~~December 1~~ Feb. 10, 19~~79~~80. The report shall identify the merits and drawbacks of various container concepts and shall identify the preferred alternatives. The report shall be based upon information developed in prior work by BNL, information available in the literature, laboratory tests, and data provided by the NRC.

Enclosure 1

Suggested changes to draft letter to Bruce Johnson, President of Chem Nuclear.

Paragraph 3: Delete and replace with:

With respect to license conditions 25 and 31, the terminology "no detectable free standing liquids" will be defined as less than 1% liquid by volume until December 31, 1980. Effective January 1, 1981, waste packages shall contain only trace quantities (not more than 0.5% or 1 gallon per container; whichever is less) of free standing liquids. Any liquids present in waste packages which are allowable until December 31, 1980 shall be non-corrosive with respect to the container. Effective January 1, 1981 the allowable trace quantities of liquid shall be non-corrosive.

Paragraph 4: Delete and replace with:

It is the goal of South Carolina to enhance the stability of the waste forms consigned for burial. To that end, resins (with an activity greater than one microcurie per cubic centimeter of isotopes with half lives greater than 5 years) disposed of after July 1981 must be stabilized by solidification or an equivalent method such as packaging dewatered resins in a high integrity container, e.g. reinforced concrete.

Enclosure 2

STATEMENT OF WORK

Sub-Task Title: Scoping Study of the Alternatives for Managing Wastes Containing Chelating Decontamination Chemicals

Background

The purpose of this project is to provide guidance to NRC as to which waste management alternatives are most promising for chelating decontamination wastes. The questions of how chelates behave in the disposal environment and how to manage them, are expected to be of greater significance in the future. This is because the generation rate of chelating decontamination wastes is increasing as power reactors age and require major cleanup operations to reduce exposure to plant personnel. For example, the waste from one cleanup operation could contain several tons of chelating decontamination chemicals. NRC's concern is that chelates may persist in the disposal environment. Then they could enhance the migration and plant uptake of radionuclides and toxic metals. These effects have been observed near liquid waste disposal pits at Oak Ridge. They have never been observed at any licensed disposal sites, and this may be attributed to several factors including the site conditions, the waste form (solid rather than liquid), and relatively low concentration of chelating decontamination chemicals in the commercially disposed wastes. In this scope of work, BNL shall gather data which provides background on how chelating decontamination chemicals have leached from wastes at licensed disposal sites, and shall evaluate properties of potential waste forms. BNL shall identify the alternatives for managing these wastes, review the potential drawbacks and benefits of each and make recommendations. The work will include a review of literature on chelate decomposition and the effects of chelates on soil leaching, waste leaching and uptake of radionuclides and toxic metals by plants. BNL will determine the concentrations of chelating decontamination chemicals in leachates from existing low-level waste disposal sites. This will provide the first in-situ data on this subject from licensed disposal sites. Laboratory tests to measure performance of solidified decontamination wastes will be done as necessary to supplement prior work by BNL. Means of artificially decomposing chelates and associating chelates with inert metals shall be tested to supplement the information available in the literature.

Sub-Task Requirements - To be completed by May 15, 1980

1. Analyze trench waters from Maxey Flats, West Valley, Sheffield (if available) and Barnwell (if available) disposal sites for concentrations of nitrilo-acetic acid (NTA), ethylenediamine tetracetic acid (EDTA), and diethylene triamine hexacetic acid (DTPA) - minimum sensitivity 0.01 ppm.

2. Through a literature survey and supplementary laboratory work, evaluate the benefits and drawbacks of decomposing or fixing chelating chemicals (including NTA, EDTA, DTPA and TTHA*) by the following techniques:

   a. application of heat;

   b. oxidation by peroxide and ozone;

* tetraethylene triamine hexacetic acid

c. exposure to light;

d. bacterial decomposition;

e. substitution of a non-toxic radioactive ion which is not likely to be replaced by long-lived radioisotopes or toxic metals; and

f. other techniques as identified by BNL.

3. Evaluate the drawbacks and benefits of solidifying chelating decontamination solutions in various matrixes available today, and disposing of them at wet eastern sites and at dry western sites. Consideration shall be given to the long term performance of the waste solid and the potential for interaction with other wastes disposed of in the same trench.

4. Determine the compatibility of solidified wastes and containers, including, for example, coated containers and polyethylene lined containers.

Effort - 9 man-months

Reporting Requirements

BNL shall submit four letter reports, one for each sub-task requirement, to the NRC project manager on or before May 15, 1980. The reports shall identify the merits and drawbacks of various management options for chelating decontamination wastes and shall identify the preferred alternatives.

DRAFT

Branch Technical Position: Disposal of Wastes Containing Chelating Agents

A. Background

Chelating agents are chemicals widely used in the nuclear industry for cleaning and decontaminating. In a June 30, 1978 "Science" article, Duguid, Means and Crerar identified EDTA (probably the most commonly used chelating agent) complexes of cobalt-60 in seep waters a few hundred feet from a liquid waste disposal pit at Oak Ridge National Laboratory. In this article they point out the possibility for chelating agents to form stable, soluble complexes with transition metals, rare earths and transuranics. Complexed isotopes may migrate with water passing through soil much faster than isotopes in a positive ionic (cation) form. The cation form is the chemical state which is most readily absorbed by soils, and is typically the form which was used in tests to determine the ability of disposal site soils to absorb radionuclides, serving as a migration barrier or attenuating medium. Studies indicate that chelating agents may be expected to persist in the disposal environment since they are more resistent to biodegradation in dark, anoxic environments, which are typical of the disposal conditions.

Other complications may arise from disposal of chelating agents. For example, chelating agents from one waste package may accelerate the leach rate of radionuclides and metals from other wastes. Chelating agents may also remove previously absorbed radionuclides from soil, leaving them in a soluble, chelated state. And similarly, naturally

DRAFT

occuring metal contaminants in soils may be solubilized and migrate offsite. Chelating agents are also known to influence plant uptake of trace metals. They are used in agriculture to increase the uptake of trace metals as plant nutrients. Studies have shown that the uptake of transuranics is increased in the presence of chelating agents.

Our concern is that over the long term the many potential drawbacks of chelates may accelerate the movement of contaminates through environmental pathways at land disposal sites. At dry sites we are concerned that chelates may interact with wastes of higher activity and longer half-life, and promote the spread of contaminants into soil near the wastes, making a more difficult monitoring situation.

In the short term we shall require that reasonable measures be taken to alleviate the potential effects of chelates. We feel that this step is necessary to reduce potential for migration and especially since the generation rate of these wastes is expected to increase greatly as LWR's age and require decontamination to reduce personnel exposure.

B. Position

1. Restricted decontamination wastes shall be disposed in arid or semi-arid disposal sites to minimize the potential for contact of water and waste, thereby limiting the potential for migration and plant uptake.

II. Restricted wastes shall be segregated from:

a) transuranic wastes

b) high specific activity sources

c) type B and large quantity shipments of radionuclides in transport groups I, II and III

Segregation means to maintain a marked buffer of at least 10 feet for soil between restricted wastes and the wastes listed above. The buffer would limit the potential for interaction of chelates with other wastes. The buffer zone will also provide a neutral zone if monitoring the performance of the restricted wastes is desired.

III. All chelating decontamination wastes including restricted wastes shall be solidified and meet the BTP on free liquids. This is the required practice for liquid wastes. The solid provides a barrier to release of the wastes.

IV. All restricted decontamination wastes shall have the quantities of chelates specified on the shipment record. The individual components (NTA, EDTA, DTPA and TTHA) and the number of kilograms of each shall be specified

C. Definition of Restricted Chelate Decontamination Waste

1. Restricted chelate decontamination wastes means all shipments containing 55 gallons or greater of decontamination wastes containing .1% or greater of chelating agents. Smaller quantities of restricted chelating decontamination wastes and containers

DRAFT

of miscellaneous wastes with traces of decontamination wastes are excluded. Shipments of smaller containers of restricted chelate decontamination waste whose volume sum is greater than 55 gallons, are included.

Restricted chelating decontamination wastes contain .1 percent or greater of the chemicals, NTA, EDTA, DTPA or TTHA* and any combination thereof. The concentration limits apply to the wastes prior to solidification, dilution by solidification media is not considered.

*Chelating chemicals NTA, EDTA, DTPA, & TTHA are abbreviations for: Nitriloacetic acid; Ethylenediamine Tetracetic acid; Diethylene Triamine Pentacetic acid, and Tetraethylene Triamine Hexaacetic acid, respectively.

DRAFT

REFERENCES

1. Nishita, H. Oct. 1979, A Review of Behavior of Plutonium in Soils and Other Geologic Materials. NUREG/CR-1056. UCLA 12-1193

2. Wildung, R. E. and T. R. Garland 1975. Relative Solubility of Inorganic and Complexed Forms of Plutonium-238 and Plutonium-239 in Soil. Battelle, Pacific Northwest Lab. Annu. Rep. 1974. BNWL-1950 (PE-2), pp 23-25

3. Christian, C. W., E. B. Fowler, G. L. Johnson, E. H. Rex, and F. A. Virgil 1958. Soil Absorption of Radioactive Wastes at Los Alamos. Sewage Ind. Wastes 30: 1478 - 1489

4. Electric Power Reg. Institute, March 1979. Literature Review of Dilute Chem. Decontamination Processes for Watercooled Nuclear Reactors. Battelle, Pacific Northwest Labs. EPRI NP-1033. Project 828-1.

5. Richard, W. H. and Rogers, L. E. Oct. 1977 Ecology of the 200 Area Plateau Waste Management Environs: A Status Report. Battelle, Pacific Northwest Labs. PNL-2253, UC-11.

6. Wiggins, D. J. and J. A. Franz. May 1978. Mobility of Organic Complexes of Some Non-TRU Fission and Activation Products: A Selective Review. Battelle, Pacific Northwest Lab. PNL-2607, UC-70.

7. J. O. Duquid, Status Report on Radioactivity Movement from Burial Grounds in Melton and Bethel Valleys. ORNL-5017.

8. Jeffrey L. Means, Tanya Kucak and David A. Crerar, Relative Degradation Rates of NTA, EDTA and DTPA and Environmental Implications. Princeton Univ.

9. Belly, R. I., J. J. Lauff and C. T. Goodhue. Dec. 1974. "Degradation of Ethylenediamine-tetraacetic Acid by Microbial Populations from an Aerated Lagoon", Research Lans, Eastman Kodak Co. Applied Microbiology. June 1975, pp. 787-794. Vol. 29, No. 6.

10. Haines B. Lockhart, Jr. and Rose V. Blakeley, 1975. "Aerobic Photodegradation of X(N) Chelates of (Ethylenedinitrilo) Tetracetic Acid [EDTA]: Implications for Natural Waters.", Eastman Kodak Co.

11. James M. Tiedje, "Influence of Environmental Parameters on, EDTA Biodegradation in Soils and Sediments", J. Environ Qual., Vol. 6, No. 1, 1977.

12. Tiedje, James M. March 1975. "Microbial Degradation of Ethylenediametetracetate in Soils and Sediments." Mich. State Univ., Applied Microbiology, Aug. 1975 Vol. 30, No. 2.

13. Means, Jeffrey L., David A. Crerar and James O. Duguid. June 1978. "Migration of Radioactive Wastes: Radionuclide Mobilization by Complexing Agents". Princeton Univ. & Battelle-Columbus Lab. Science, June 1978, AAAS, Vol. 200.

DRAFT

REFERENCES (continued)

14. Lomenick, T. F., D. G. Jacobs and E. G. Struxness, Jan. 1967, "The Behavior of Strontium-90 and Cesium-137 in Seepage Pitts at ORNL" Oak Ridge National Labs. Health Physics, 1967 Vol. B pp. 897-905.

15. Arthur Wallace. "Increased Uptake of Am-241 by Plants Caused by the Chelating Agent DTPA". UCLA. Health Physics, 1972 Vol. 22 pp. 559-562.

16. Francis, C. W. 1972, "Plutonium Mobility in Soil and Uptake in Plants: A Review." ORNL. J. Environ Quality, Vol. 2, No. 1, 1973

17. S. P. Mathur and Schnitzer, "A Chemical and Spectroscopic Characterization of Some Synthetic Analogies of Humic Acids". Soil Sci Svc. Am J., Vol. 42, pp. 591-596

18. J. O. Duquid, "Earth Sciences," ORNL-5257.