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CONSIDERATIONS IN RECYCLING CONTAMINATED SCRAP METAL AND RUBBLE

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Presented At:

DOE Facility Deactivation, Decontamination, Decommissioning & Dismantlement--A Pressing Need for Technology Development

A DOE-ERWM Technology Development Workshop

Charleston, South Carolina

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Abstract

Management options for the Department of Energy's increasing amounts of contaminated scrap metal and rubble include reuse as is, disposal, and recycling. Recycling, with its promise of resource recovery, virgin materials conservation, and land disposal minimization, emerges as a preferred management technique. Implementing a cost effective recycling program requires resolution of several issues including: establishing release limits for contaminants, controlling use of recycled materials; creating effective public communication programs; developing economical, reliable assay technologies; managing secondary waste streams; expanding availability of unrestricted markets; and solving conflicting legal considerations.

Background

Quantities of Contaminated Materials

Precise quantities of the Department's present stock of contaminated materials are unavailable; an estimated 1.5 million tons of radioactive scrap metal (RSM) is presently in storage at DOE sites nationwide (Radioactive Scrap Metal Recycling). The approximate composition of this RSM in metric tons is: aluminum, 162,000; copper, 32,400; nickel, 204,000; and steel, 1,094,000 (Lilly). Approximately 129,000 tons of RSM are in open scrap yards at the Feed Materials Production Center and the Oak Ridge, Paducah, and Portsmouth Gaseous Diffusion Plants (Radioactive Scrap Metal Recycling).

DOE annually generates an additional 15,000 tons of RSM (Murphie). Activation of large scale decommissioning projects will significantly increase RSM generation. The Oak Ridge Gaseous Diffusion Plant alone is expected to generate approximately 775,000 tons of RSM in a ten year period (Murphie).

Approximately 320,000 tons of rubble, primarily concrete, will be generated within the next several years. The five major process buildings of the Oak Ridge Gaseous

Diffusion Plant contain about 20 million square feet of concrete surfaces that are potentially contaminated with uranium to varying degrees (Report on Defense Plants Wastes).

Contamination Sources and Release Limits

Surface contamination consists of a several-micron thick layer of radioactivity that adheres to the metal or concrete surface and is not readily removed by ordinary decontamination techniques. Surface contaminated materials which have been decontaminated to NRC established guidance can be freely reused or recycled and released to the public. Surface contaminated materials which cannot be decontaminated to these release guidelines can be reused on a restricted basis, disposed, or treated (smelted or crushed) and recycled for restricted use.

The acceptable surface contamination release limits of NRC Regulatory Guide 1.86 and the ALARA -- As Low As Reasonably Achievable -- process were adopted for DOE's residual radioactive materials management program through DOE Order 5400.5, Radiation Protection of the Public and the Environment in February 1990. Order 5400.5 is in the process of being issued for public comment as proposed 10 CFR 834. The proposed rule will not include the surface contamination guidelines found in the Order; DOE and NRC are developing surface contamination guidance to replace those guidelines (DOE/EA-0559).

Volumetric contamination results from melting surface contaminated metals or activation of materials during operation of nuclear reactors and accelerators. Although technology is available to reduce activity levels of volumetrically contaminated materials to near background (Technical Reports Series No. 293), the United States does not have an accepted release standard for these materials.

It should be noted that DOE Order 5400.5 allows for release of volumetrically contaminated materials pursuant to Office of Environment, Safety and Health approval of the release criteria and the survey techniques used to determine that the criteria are met. No RSM release approvals have been made to date.

Management Options for Contaminated Materials

Reuse

Reuse involves decontaminating (if necessary) tools, barriers, shielding, and equipment and subsequently reusing them in their existing form. As a materials management option, the effectiveness of reusing contaminated articles depends upon the economic feasibility of assaying contamination levels, decontaminating surfaces, verifying remaining contamination levels, identifying a use for the decontaminated articles, and transporting them to their new destination.

Land Disposal

Land disposal of contaminated materials avoids some of the technological, social, and political issues associated with the reuse or recycling of these materials. Presently, RSM and contaminated concrete, regardless of the level of contamination, are disposed of in compliance with low-level waste regulations. Disposing of minimally contaminated materials as though they were low-level waste increases the demand on limited, low-level waste disposal capacity and raises the costs of managing those materials with negligible potential harm. If land disposal becomes the preferred management option by default, the issue of permissible radioactive contamination levels for commercial landfills should still be addressed in order to lower disposal costs.

Land disposal obviously precludes any RSM recycling, and results in greater use of virgin materials and increased energy consumption associated with their use. Land disposal is also becoming more difficult due to public perceptions regarding the health and environmental hazards associated with it. Recycling could significantly reduce the quantities of materials requiring land disposal and minimize the associated environmental degradation.

Recycling

Recycling contaminated materials (i.e. smelting or crushing them for use in manufacturing or construction) returns them to the market, reduces reliance on virgin materials, and decreases the demand on landfill capacity. Another benefit in some cases is removal of national security classification requirements. The following issues must be resolved cost effectively for the benefits of recycling to be realized.

ISSUES ASSOCIATED WITH RECYCLING CONTAMINATED MATERIALS

Development of a Volumetric or Mass Based Unrestricted Release Limits

Efforts by the United States to develop contamination release limits for volumetrically contaminated materials have been unsuccessful to date. NRC, EPA, and DOE are involved in these efforts.

NRC Activity

In 1990, NRC published a proposed policy recommending a maximum individual dose criteria of 10 mrem per year from radioactively contaminated materials that are likely to impact only a small number of people and 1 mrem per year for those that impact a large population. In response to public opposition, this proposal is being reconsidered. NRC is proceeding with development of volumetric contamination release limits below which regulatory controls are unnecessary; however, release of materials meeting these limits would only be applicable to nuclear material licensees (Environment Reporter). DOE could choose to adopt these limits in its residual radioactive materials management release policy in DOE 5400.5.

The NRC has the authority to grant exemptions from its requirements either at the request of licensees or on its own initiative. Through the licensing process in Title 10 of the Code of Federal Regulations, the NRC has exempted specific items such as uranium in fire detection units and thorium in finished aircraft engine parts from regulatory disposal controls (Ryan). The basis for these exemptions is the minimal impact of the contamination in these items and the disproportionate cost of maintaining regulatory controls.

EPA Activity

In 1989, EPA developed draft regulations which included identification of a radioactive exposure level having sufficiently low radiation hazard to allow disposal without regulatory controls, i.e., at commercial landfills. The draft identified 4 mrem per year as a maximum exposure level for such disposal (Ryan); final action on the draft has not occurred and EPA has not identified a schedule for issuing final regulations.

The United Kingdom has developed a mass concentration standard for unrestricted release of contaminated scrap metal of 0.4 Bq/g (10.8 pCi/g), and similarly, Germany uses a 0.37 Bq/g (9.9 pCi/g) standard (Murphie). A European Community directive indicated that materials with radioactivity levels below 100 Bq/g would not be considered radioactive waste (Ryan). The International Atomic Energy Agency has proposed unrestricted release levels for recycling scrap metal from 0.2 Bq/g (5.4 pCi/g) for alpha emitters to 1 Bq/g (27 pCi/g) for high energy beta gamma emitters (Guetat).

Controlling Use of Recycled Materials

To allay consumer fears, first use restrictions could be placed on the use of RSM in items such as cook ware, eating utensils, and childrens' furniture. While first use restrictions would reduce concerns regarding exposure to radioactive contamination from such items, the costs of implementing and monitoring these restrictions would have to be factored into the cost effectiveness of the initial recycling decision.

Under this concept, items manufactured from RSM would be restricted to specified users if activity levels are slightly above release limits. To maintain the integrity of the restrictions, a manifest system could be developed to accompany the product. In this way, the initial and subsequent holders or recyclers of the materials would be apprised of product limitations. Developing and maintaining a manifest system could decrease the cost-effectiveness of recycling but may increase its public acceptability.

Another concern is that materials derived from smelted RSM may never be appropriate for some products because of deleterious scientific and technical consequences. For example, residual radioactivity can affect large scale integrated circuits, photographic film, and low background radiation counters (Kato). A manifest system for RSM based materials could help address this problem.

Public Perceptions of Contaminated Materials and Their Recycling

Regulatory assurances that levels of radiation are safe are not automatically accepted by the public; effective risk communication requires a thorough understanding of public attitudes about risk. For example, people may place greater emphasis on the

magnitude of the potential hazard than on the probability of occurrence (thus an action may be rejected even though the probability of cancer to any individual is miniscual), they may perceive any involuntary exposure to radiation -- beyond that normally received for medical or health reasons -- as dangerous and not worth it, or they may feel they have no control over exposure to products made from recycled RSM. Companies and organizations supporting RSM recycling will need to create effective risk communication programs.

Economical and Reliable Assay Technologies

Cost-effective characterization of contaminated materials requires accurate, reliable, and relatively uncomplicated techniques for contamination assessment. Accuracy is necessary in the decision stage of materials management to realistically determine whether reuse, disposal, or recycling is most appropriate. Accuracy is also necessary at the post-treatment stage to determine if appropriate contamination release levels have been reached. The technology required for accurate assessment must also be economically feasible.

Management of Secondary Waste Streams

The treatment processes for recycling contaminated metals and rubble result in contaminated secondary waste streams. For example, smelting metals can be highly effective in reducing the level of certain kinds of radionuclides (uranium and plutonium). In the melting process, the resulting slag as well as slag crucibles, ducts, and liners could become contaminated (Technical Reports Series N. 293). The cost of managing these secondary waste streams must be factored into the costs associated with recycling.

Market Availability

There must be a ready market for contaminated materials and for articles manufactured from recycled materials. Excluding surface contaminated materials that meet NRC 1.86 guidelines, the only potential U.S. markets at this time for recycled contaminated materials are the nuclear industry and DOE facilities. The limited nature of this market for decontaminated materials may hinder recycling them.

Selected Statutory Considerations

State Laws

Under the authority of the Atomic Energy Act (AEA), states can, with the approval of NRC, become "agreement states" and regulate byproduct material, source material, and small amounts of special nuclear material. The agreement state program must be "compatible" with the NRC's regulatory program. Agreement states must adopt verbatim NRC Division I Rules regarding maximum permissable dose limits, the definitions of basic radiation terminology, and legal terms. Agreement states would appear to be bound by an NRC definition of materials that do not require regulatory control.

States could, however, rely on their traditional public health and safety protection powers to enact regulatory programs which provide a more stringent standard than NRC's. In reaction to the possible issuance of an NRC below regulatory concern ruling, several states (including Illinois, an agreement state) enacted legislation stating that any NRC below regulatory concern ruling would not modify the state definition of low-level radioactive wastes. This waste would still have to be sent to regulated low-level waste sites for disposal. There is minimal likelihood that these states would allow materials which the NRC considers below regulatory concern to be used as recycled materials -- especially in the sense of unrestricted release.

Congress is presently considering two bills, H.R. 645 and S. 1111, which would allow states to control any radioactive wastes that the NRC may eventually consider to be below regulatory concern.

CERCLA

Contamination limits for cleanup of DOE sites on the National Priorities List (NPL) are negotiated among DOE, EPA, and the affected state. This negotiation is in accordance with the CERCLA provision that cleanup standards adhere to all regulations that are applicable or relevant and appropriate under the circumstances -- ARARs.

In negotiating cleanup limits for NPL sites, states could prefer land disposal of contaminated materials -- even those which are minimally above background. Recycling may not be an option for cleanup at NPL sites.

EPA is charged with making final decisions on cleanup limits. Thus, EPA's position on the level of contamination requiring removal for delisting is a factor in determining what materials are acceptable for recycling.

Conclusion

DOE must seek innovative techniques for managing the current and projected inventory of RSM and concrete resulting from D&D of its facilities. Because of limited land disposal capacity and the need to minimize environmentation degradation, recycling is an attractive alternative. Several issues must be resolved in order to implement an effective recycling program, including establishing release limits, gaining public acceptance, improving technology, and addressing possible state and local opposition. Resolving these issues and developing a successful recycling program will require the cooperative efforts of Federal and state agencies and industry.

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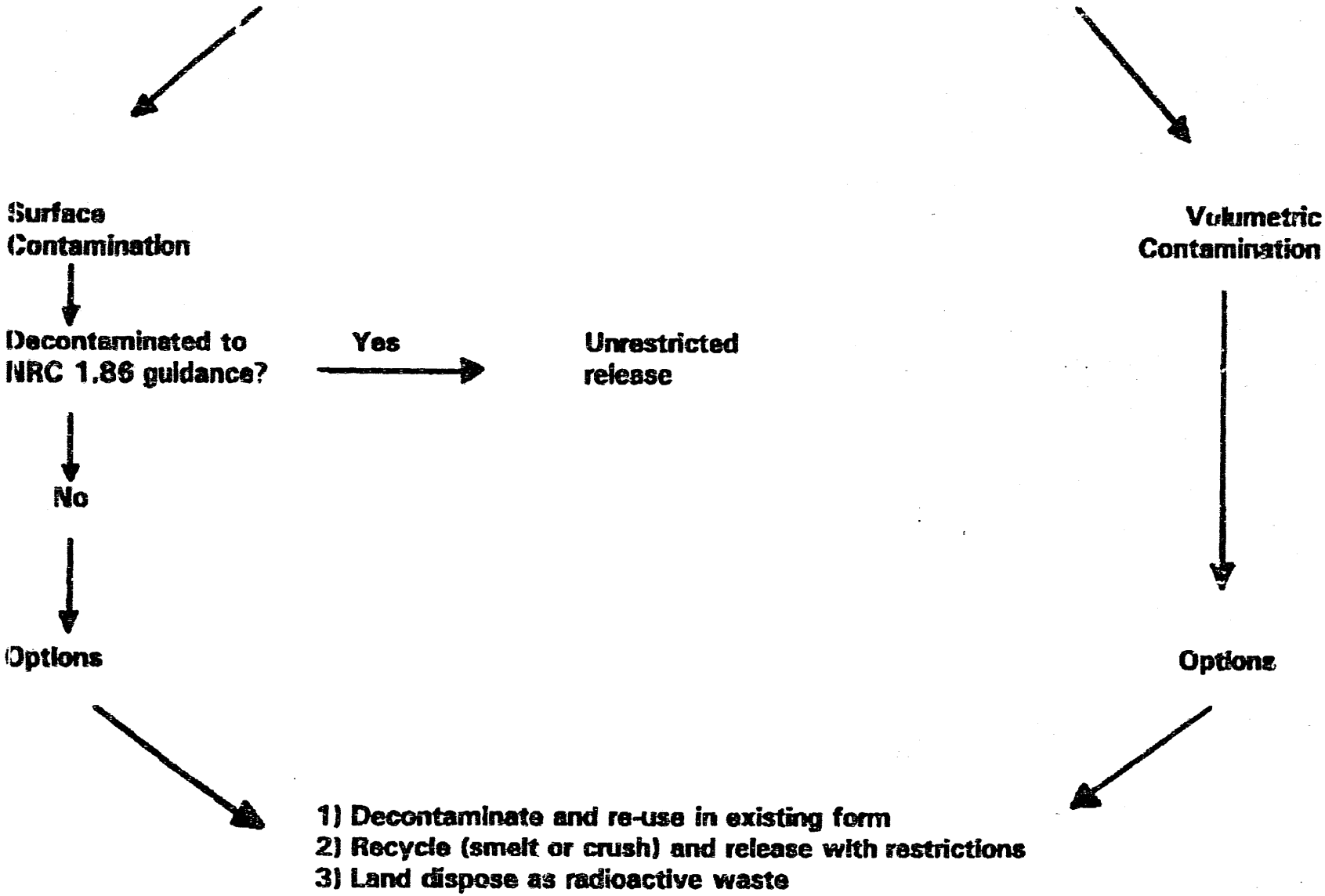
CURRENT MANAGEMENT OPTIONS FOR CONTAMINATED MATERIALS



DOE QUANTITIES

CURRENT

1.5 MILLION TONS (APPROXIMATELY) OF RADIOACTIVE SCRAP METAL (RSM) PRESENTLY IN STOCK

-ESTIMATED COMPOSITION (IN METRIC TONS):

NICKEL	204,000
STEEL	1,094,000
COPPER	32,400
ALUMINUM	162,000

FUTURE

15,000 TONS RSM GENERATED ANNUALLY

775,000 TONS EXPECTED FROM K-25 PLANT

320,000 TONS OF BUILDING RUBBLE -- PRIMARILY CONCRETE -- EXPECTED FROM D&D

CONTAMINATION SOURCES AND RELEASE LIMITS

SURFACE CONTAMINATION

THIN LAYER (SEVERAL-MICRONS) OF RADIOACTIVITY NOT READILY REMOVED BY ORDINARY DECONTAMINATION TECHNIQUES

UNRESTRICTED RELEASE IF DECONTAMINATED TO NRC REG. GUIDE 1.86 LIMITS

DOE ORDER 5400.5 ADOPTS NRC 1.86 LIMITS AND ALARA (AS LOW AS REASONABLY ACHIEVABLE) - ORDER 5400.5 BEING PROPOSED AS 10 CFR 834

CONTAMINATION SOURCES AND RELEASE LIMITS (cont'd.)

VOLUMETRIC CONTAMINATION

SOURCES

- MELTING OF SURFACE CONTAMINATED MATERIALS
- ACTIVATION OF MATERIALS DURING REACTOR OR ACCELERATOR OPERATION

RESTRICTED RELEASE OR DISPOSAL ONLY (NO ACCEPTED U.S. UNRESTRICTED RELEASE LIMIT)

DOE ORDER 5400.5 ALLOWS RELEASE WITH EH-1 APPROVAL (NO REQUESTS FOR APPROVAL TO DATE)

MANAGEMENT OPTIONS

REUSE

- DECONTAMINATE AND REUSE ARTICLES IN EXISTING FORM
- ASSAY AND DECONTAMINATION COSTS COULD BE PROHIBITIVE

RECYCLING

- INVOLVES SMELTING OR CRUSHING FOR USE IN MANUFACTURING OR CONSTRUCTION
- REDUCES RELIANCE ON VIRGIN MATERIALS
- DECREASES LAND DISPOSAL NEEDS
- NEGATIVE PUBLIC OPINION

LAND DISPOSAL

- INCREASES NEED FOR LIMITED, LAND DISPOSAL CAPACITY
- INCREASES USE OF VIRGIN MATERIALS
- MAY PRECLUDE RECYCLING

ISSUES ASSOCIATED WITH RECYCLING

DEVELOPMENT OF VOLUMETRIC OR MASS BASED UNRESTRICTED RELEASE LIMITS

NRC

- PUBLISHED PROPOSED MAXIMUM INDIVIDUAL DOSE CRITERIA IN 1990 (10, 1 MREM PER YEAR)
- RECONSIDERING PROPOSAL DUE TO PUBLIC OPPOSITION
- MAY LIMIT APPLICABILITY TO NUCLEAR MATERIAL LICENSEES

EPA

- DRAFTED LIMIT OF 4 MREM PER YEAR MAXIMUM EXPOSURE AT NON-RADIOACTIVE WASTE DISPOSAL SITES IN 1989
- NO SCHEDULED ACTION ON THE DRAFT

ISSUES ASSOCIATED WITH RECYCLING (cont'd)

DEVELOPMENT OF VOLUMETRIC OR MASS BASED UNRESTRICTED RELEASE LIMITS (cont'd.)

INTERNATIONAL ACTIVITY

- MASS CONCENTRATION LIMITS FOR UNRESTRICTED USE

  UNITED KINGDOM - 0.4 Bq/g (10.8 pCi/g)

  GERMANY - 0.37 Bq/g (9.9 pCi/g)

- EUROPEAN COMMUNITY DIRECTIVE DEFINED RADIOACTIVE WASTE

  ABOVE 100 Bq/g (2700 pCi/g)

- INTERNATIONAL ATOMIC ENERGY AGENCY PROPOSED UNRESTRICTED RELEASE LIMITS FOR RSM

  ALPHA EMITTERS - 0.2 Bq/g (5.4 pCi/g)

  HIGH ENERGY BETA GAMMA EMITTERS - 1 Bq/g (27 pCi/g)

ISSUES ASSOCIATED WITH RECYCLING (cont'd)

CONTROLLING USE OF RECYCLED MATERIALS

FIRST USE RESTRICTIONS

- LIMIT USE OF RSM IN COOKING/EATING UTENSILS, CHILDREN'S FURNITURE

SPECIFIC USERS

- ITEMS WITH CERTAIN ACTIVITY LEVELS WOULD BE USER RESTRICTED

- MANIFEST SYSTEM TO APPRISE USERS OF RESTRICTIONS

PRODUCT RESTRICTIONS

- RESIDUAL RADIOACTIVITY MAY HAVE TECHNICAL CONSEQUENCES FOR SOME PRODUCTS (LARGE SCALE INTEGRATED CIRCUITS, LOW BACKGROUND RADIATION COUNTERS)

ISSUES ASSOCIATED WITH RECYCLING (cont'd)

PUBLIC PERCEPTIONS

MAY NOT ACCEPT GOVERNMENT DETERMINATION OF SAFE RADIATION LEVELS

EFFECTIVE RISK COMMUNICATION PROGRAMS ARE REQUIRED

ASSAY TECHNOLOGIES

TECHNOLOGIES MUST BE:

- ACCURATE
- RELIABLE
- RELATIVELY UNCOMPLICATED
- ECONOMICALLY FEASIBLE

ISSUES ASSOCIATED WITH RECYCLING (cont'd)

MANAGEMENT OF SECONDARY WASTE STREAMS

SMELTING/CRUSHING CREATE SECONDARY WASTE STREAMS

MANAGING SECONDARY WASTE STREAMS COULD IMPACT COST EFFECTIVENESS

MARKET AVAILABILITY

MARKETS NEEDED FOR

- CONTAMINATED MATERIALS
- PRODUCTS MADE FROM SUCH MATERIALS

CURRENT MARKET FOR PRODUCTS FROM

- SURFACE CONTAMINATED MATERIALS THAT MEET NRC 1.86 GUIDANCE (UNRESTRICTED RELEASE)

- MATERIALS VOLUMETRICALLY CONTAMINATED OR ABOVE NRC 1.86 GUIDANCE (RESTRICTED USE) WITHIN NUCLEAR COMMUNITY

ISSUES ASSOCIATED WITH RECYCLING (cont'd)

SELECTED LEGAL CONSIDERATIONS

STATE LAWS

STATES COULD LEGISLATE LAND DISPOSAL OF CONTAMINATED MATERIALS, PRECLUDING RECYCLING

CERCLA

STATES, EPA, DOE NEGOTIATE CONTAMINATION LIMITS FOR NATIONAL PRIORITIES LIST SITES

- STATES MAY PREFER LAND DISPOSAL OF CONTAMINATED MATERIALS
- EPA COULD REQUIRE CONTAMINATION LIMITS THAT REDUCE QUANTITY OF MATERIALS ELIGIBLE FOR RECYCLE

CONCLUSION

COOPERATIVE EFFORT REQUIRED AMONG FEDERAL AND STATE AGENCIES AND INDUSTRY

DATE
FILMED
8/18/92