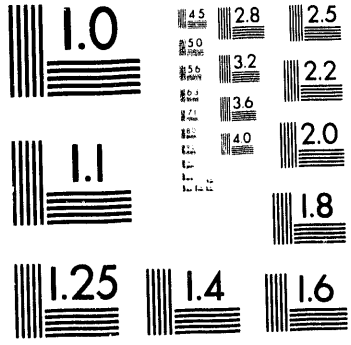
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ISSUES IN RECYCLING AND DISPOSAL OF RADIOACTIVELY CONTAMINATED MATERIALS

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ABSTRACT

The Department of Energy's present stock of potentially re-usable and minimally radioactively contaminated materials will increase significantly as the Department's remediation activities expand. As part of its effort to minimize wastes, the Department is pursuing several approaches to recover valuable materials such as nickel, copper, and steel, and reduce the high disposal costs associated with contaminated materials. Key approaches are recycling radioactively contaminated materials or disposing of them as non-radioactive waste. These approaches are impeded by a combination of potentially conflicting Federal regulations, State actions, and Departmental policies. Actions to promote or implement these approaches at the Federal, State, or Departmental level involve issues which must be addressed and resolved. The paramount issue is the legal status of radioactively contaminated materials and the roles of the Federal and State governments in regulating those materials. Public involvement is crucial in the debate surrounding the fate of radioactively contaminated materials.

BACKGROUND

History of Recycle Efforts

Many of the DOE process systems which utilized radioactive materials, or which have been exposed to radiation fields, have themselves become, in one form or another, radioactively contaminated. Tons of metals, concrete and other building materials have been contaminated. While large quantities of these materials have been disposed in DOE burial sites, others have been stored or stockpiled awaiting final disposition. Materials in storage or stockpiled consist primarily of metals: nickel, aluminum, copper and both carbon and stainless steel.

Efforts to recover these materials have only been successful for materials which are surface contaminated. The Scientific Ecology Group (SEG) has been working with the DOE for the past several years to recycle metals within the DOE complex. SEG is using proprietary technologies for the decontamination of both scrap metals and reusable equipment. The focus of the work for the DOE is decontamination of both stainless and carbon steel for a variety of uses including specialized shield blocks for Los Alamos National Scientific Laboratory, and numerous types of canisters, drums, boxes and other equipment used in the storage, transportation or disposal of other radioactive materials. Of the 5,000,000 pounds of scrap metal SEG has melt refined since July 1992, only 500,000 pounds were DOE material. (Arrowsmith, 1993)

The Department ha earlier released 94 tons of steel scrap from the turbine, generator, and other structural components of the Experimental Boiling Water Reactor. Cobalt 60 was the dominant nuclide. The release criteria were the surface contamination guidelines Nuclear Regulatory Commission's Regulatory Guide 1.86 as adopted by DOE Order 5400.5. (OECD-NEA

1991)

Early efforts by the Department of Energy to expand the recycling release criteria for RSM beyond the 1.86 guidelines were unsuccessful. A 1979 request for an exemption from NRC licensing requirements for smelted alloys with residual technetium-99 of 5 parts per million and low enriched uranium of 17.5 parts per million was rejected in 1986. (NUREG-0518, 1980; 51 Federal Register 8842) The request was rejected on several grounds: the comments from the public generally opposed the exemption because of the potential for the introduction of radioactive material into consumer products; the calculated individual doses identified in the request were not justified in terms of ALARA (as low as reasonably achievable); and the exemption request did not adequately evaluate the potential industrial, scientific, and technical effects of radioactive contaminants in metals. (51 Federal Register 8842) The lack of a decontamination or release standard for volumetrically radioactively contaminated materials

Distinct, yet not independent, issues arise regarding the recycling of radioactively contaminated materials. First, guidelines do exist in the form of NRC Regulatory Guide 1.86 for the recycling of metals that have surface contamination. There are no standards for volumetrically contaminated metals. However, many of the processes which have been developed for the reduction of surface contamination for subsequent processing of these metals into useful products, transform surface contamination into volumetric contamination. This dilemma will only be resolved when a release standard is developed for volumetrically contaminated materials.

Regulatory History

The existing domestic regulatory structure affecting the recycling of radioactively contaminated materials or their disposal as non-radioactive includes Nuclear Regulatory Commission (NRC) Regulatory Guide 1.86, the NRC exemption process of 10 CFR, and DOE Order 5400.5, Radiation Protection of the Public and the Environment. The Regulatory Guide allows unrestricted release of surface contaminated materials decontaminated to the Guide's levels. The NRC has the authority under 10 CFR to exempt items containing radioactivity from regulatory control on a finding that the health and environmental impacts of the radioactivity are disproportionate to the cost of maintaining regulatory control. The DOE Order allows the 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. These regulatory provisions are being reassessed and new proposals for residual contamination levels are being actively pursued by Federal agencies including NRC and the Environmental Protection Agency (EPA) as well as DOE.

The adverse public reaction to NRC's 1990 proposed below regulatory concern (BRC) policy (55 Federal Register 27522) culminated in Congressional revocation of that policy by

enacting Title 29 of the Energy Policy Act of 1992 and NRC withdrawal of the policy statement in August of 1993. (58 Federal Register 44610) As a result of public opposition to its 1990 BRC, NRC initiated a consensus building process to establish an acceptable below regulatory concern policy; that approach was abandoned in December 1991 after several key public interest groups chose not to participate in the process. In 1993, NRC embarked on an enhanced participatory rulemaking process to establish radiological decommissioning criteria for structures and soils at its licensed facilities; the final rule is expected in 1995. Although these criteria will not have automatic applicability to DOE's activities, they are important for two reasons: DOE could elect to voluntarily implement them or the EPA could endorse and adopt the criteria as generally applicable standards. They would then be in force at DOE facilities.

Under its authority to establish generally applicable environmental standards, EPA is in the process of establishing cleanup standards for radioactively contaminated sites and management standards for radioactive wastes. These standards would apply to DOE facilities. In establishing these standards, EPA is closely observing the NRC rulemaking with the objective of achieving maximum possible consistency between the standards established by both agencies.

This inter-agency effort to harmonize management standards for radioactively contaminated materials is paralleled in DOE's work with EPA. The agencies are cooperating in an effort to establish an inventory of DOE's radioactive scrap metal (RSM), identify decontamination and recycling technologies, undertake dose/risk modelling for recycled RSM, and investigate the costs and benefits associated with various options for dealing with RSM. (MacKinney, 1993) DOE and NRC are also working cooperatively to develop risk-based approaches for surface contamination limits.

In Order 5400.5, DOE had previously adopted NRC Regulatory Guide 1.86 as an acceptable guideline for releasing materials which were surface contaminated. In its proposed codification of parts of that Order at 10 CFR 834, DOE pointedly excluded those guidelines from the proposed rule because they "are not internally consistent." (58 Federal Register 16268 at 16277) The proposed rule does not specify surface or volume activity levels for the release of property with residual radioactivity; it stipulates these materials can be released when "the authorized limits established for release of the material and survey techniques used to characterize the property are approved by DOE." (58 Federal Register 16268 at 16276)

The guidelines in Regulatory Guide 1.86 are also being re-evaluated by EPA and NRC. The guidelines are being questioned because they are based upon the sensitivity limits of the technology available in 1974 as opposed to being strictly health or risk based (Winston, 1993) and were never intended to be used as a release guideline for recycling purposes (MacKinney, 1993). The Regulatory Guide has, however, evolved into a release guideline. It may be replaced with findings originating from NUREG/CR-5512, Residual Radioactivity Contamination from

Decommissioning.

International organizations recognize the need for a uniform system of release standards to facilitate the transboundary movement of contaminated materials and consumer products made from these materials. 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 1991) The Organization for Economic Cooperation and Development (OECD) has created a Task Group on Recycling and Reuse to study and make recommendations on recycling contaminated materials.

ISSUES RELATED TO RECYCLING AND DISPOSAL OF RADIOACTIVE CONTAMINATED MATERIALS

Recycling radioactively contaminated materials or disposing of them as non-radioactive wastes requires varying degrees of interaction among Federal regulatory agencies such as NRC and EPA, State governments and regulators, and the Department. The actions of any of these parties and public opinion can elicit reactions from the other parties and will raise policy issues that must be addressed in order to achieve the recycling or disposal goal. The following discusses potential actions and reactions of Federal regulatory agencies (defined as NRC and EPA), the States, and the Department and the policy issues they raise.

Federal Regulatory Action and Possible State Reaction: Establishing Unrestricted Release Limits

Federal regulatory agencies can identify a residual level for contaminated materials or the consumer products made from these materials that allows for unrestricted release of these materials or products into the public domain. Release levels could be developed for surface and volumetrically contaminated materials. The quantity of contaminated materials which could be recycled or disposed in municipal landfills depends upon the stringency of the release levels.

States can react to this Federal action by 1) establishing more stringent residual levels or release requirements, or 2) requiring the disposal of any materials which would have been considered low-level wastes as of October 24, 1992 (the date on which the Energy Policy Act became law). The first reaction would be based upon States' traditional powers to protect the health and welfare of their citizens. The second, which would effectively preclude any recycling, would be founded in Title 29 of the Energy Policy Act of 1992 which created section 276 of the Atomic Energy Act (AEA). Under this new provision of the AEA, States are authorized to "regulate, on the basis of radiological hazard, the disposal or off-site incineration of low-level radioactive waste" if the NRC exempts these wastes from regulation. Prior to passage of the Energy Policy Act, several States had already passed laws requiring disposal of any material which was classified as low-level as of the date of the State law's passage.

This possible Federal action and State reaction raises a policy issue related to the legal

status which should be given the contaminated materials problem. Is the problem of sufficient national scope to claim that a Federally established unrestricted release level precludes the ability of States to establish more stringent residual levels or requirements? Generally, if a Federal law or regulation has completely controlled all aspects of an issue the States are restricted from regulating that issue. Are radioactively contaminated materials like garbage and thus protected from undue state regulation by the commerce clause of the Constitution? Under a series of Supreme Court cases, garbage has been declared a commodity in the stream of commerce and is thus protected from states' efforts to control it in ways that would unjustifiably interfere with its interstate movement. Should regulations establishing release levels be considered in the same light as most environmental protection laws and the Occupational Health and Safety Act which encourage or at least allow states to pass more stringent release levels? Several of the major environmental laws (Clean Air Act, Clean Water Act, and the Resource Conservation and Recovery Act) and the Occupational Health and Safety Act establish Federal standards as "floors" or minimum requirements and allow States to establish "ceilings" which are more stringent. Ultimately, these issues will be resolved by the courts but the judicial process will probably only be triggered after a regulatory agency has issued a final rule on residual contamination standards.

Federal Regulatory Action and Possible State Reaction: Establishing Restricted Release Levels

The Federal regulatory agencies could establish levels for contaminated materials and the consumer products made from them which allow restricted release. These materials or products could only be utilized by specified users such as Federal facilities (DOE or DOD operations) or nuclear power plants. Storage and disposal casks and shielding blocks are among the suggested uses for restricted release materials.

It is unlikely that States would react negatively to this Federal activity. States appear to have limited ability to control or influence Federal facilities' choices to utilize contaminated materials or products made from them in their internal operations. The same reasoning applies to nuclear power plants because they are licensed to operate by the Federal government rather than states.

The concern that arises here revolves around the potential amounts of contaminated materials which could be recycled. Does the quantity of contaminated materials exceed the needs of Federal facilities and the nuclear industry for products made from these materials? Does the limited size of the market for restricted use materials make the recycling endeavor cost ineffective? Answers to these questions demand a realistic contaminated materials inventory, a needs assessment of possible end users of these materials, and an accurate cost and benefit assessment.

Federal Regulatory Action and Possible State Reaction: Maintain the Regulatory Status Quo

10 CFR Exemption for Recycling or Disposal as Non-Radioactive

The NRC could be petitioned to allow recycling or disposal of some radioactive contaminated material as non-radioactive under its 10 CFR authority. This could be done on an case by case or class basis.

If the NRC approved a request to dispose of minimally contaminated radioactive materials in a municipal landfill, States with laws requiring disposal in an NRC licensed disposal facility of any materials classified as low-level as of the laws' passage could invoke that law. If the NRC approved a recycling request states could rely upon their health and protection powers to establish more stringent standards.

The policy issue again is one of the ability of states to pass health and safety laws to protect their citizens in the face of a Federal agency decision that certain residual radioactive contamination levels are appropriate for recycling purposes or disposal as non-radioactive. The courts will be the final arbiter.

Site by Site Residual Contamination Decisions

The EPA determines the cleanup standards for facilities on the National Priorities List (NPL). The allowable residual radioactive contamination levels chosen by EPA for cleanup standards could either expedite or eliminate opportunities for recycling of contaminated materials or their disposal as non-radioactive.

It is DOE policy to involve states in cleanup decisions and that policy will continue. States could press for residual contamination standards which expedite or eliminate recycling or disposal opportunities.

The issue here is that site-by-site residual radioactive contamination standards can result in un-predictable amounts of recyclable materials because release limits for residually contaminated materials could be variable. This uncertainty regarding the supply of contaminated materials could affect the cost effectiveness of recycling. This same un-predictability of cleanup standards would affect efforts to predict cleanup costs because disposal in a NRC licensed facility could be required for materials at one site but not for similarly contaminated materials at another site.

Departmental Decision to Recycle Materials for Internal Use

DOE could establish a policy to recycle its own contaminated materials for internal use. It would also need to determine the limits for release and the survey techniques supporting the levels. The Department would probably voluntarily seek some consensus with NRC and EPA on those levels and techniques.

States would probably not object to this action. This approach also appears to have the

support of environmental groups. (Mariotte, 1993)

An issue here is whether DOE operations can accommodate all the contaminated materials it already has plus those it will generate in the future. Another question is whether recycling for DOE internal use only would be cost effective given the relatively low cost of disposal at Federal sites.

Departmental Decision to Release Contaminated Materials

The Department could allow the release of its volumetrically contaminated materials under its present authority in DOE Order 5400.5. The proposed rule at 10 CFR 834 also grants DOE this authority and extends it to surface contaminated materials. DOE could authorize releases of contaminated materials upon its development and approval of release levels and the survey techniques used to characterize the materials. These materials could be released into the public domain or DOE could restrict them to the nuclear energy industry or activities related to DOE operations.

A DOE decision to release materials for restricted use is unlikely to be challenged by the States or the NRC or EPA if the Department sought some consensus from those agencies when developing its release levels and survey techniques. The unrestricted release of these materials could be met with opposition by States and EPA unless EPA agrees to the release limits.

State Action and Possible Federal Reaction:

Approve Recycling or Disposal as Non-Radioactive

States can allow the recycling of contaminated materials or allow their disposal in municipal landfills. This could be done on a case by case or class basis. If the NRC or EPA determined that the State determination was egregious, the agency could attempt to veto the approval.

State by state decision making in these matters can result in non-uniformity of release levels or levels allowing for disposal as non-radioactive. Non-uniformity of release levels can lead to uncertain quantities of materials available for recycling which could affect the cost effectiveness of recycling. Non-uniformity of contamination levels allowing disposal as non-radioactive wastes also affects efforts to predict disposal costs because disposal in a NRC licensed facility could be required for materials in one state but not for similarly contaminated materials in another state.

CASE STUDIES: RECYCLING AND DISPOSAL AS NON-RADIOACTIVE

In order to reduce quantities of radioactive and mixed waste requiring disposal, the DOE San Francisco Operations Office has undertaken a systematic approach to classifying specific batches of material containing measurable amounts of radioactivity as suitable for disposal or recycling. The approach involves measuring radioactivity levels to assure that they are not of concern from a public health standpoint and obtaining the concurrence of the State of California

and the Environmental Protection Agency. California is a NRC agreement state. In the three cases described below, DOE San Francisco Operations has received all necessary approvals for the recycle or disposal in municipal landfills of selected materials containing detectable amounts of radioactivity. The only non-concurring party to-date is DOE.

In one instance, 110 cubic yards of activated concrete was generated at the Stanford Linear Accelerator Center from removal of a shielding structure and installation of iron shielding. The primary contaminants were Na^{22} and Co^{60} (the concrete contained rebar) and the total level of activity was less than 25 pCi/g. The California Department of Health Services (DHS) was petitioned to grant an exemption for disposal of the material as non-radioactive waste. DHS collected and analyzed independent samples of the material and used the NRC computer code, IMPACTS-BRC, to determine the impacts of disposal of the material in a municipal landfill in the City of Half Moon Bay. The analysis indicated that the maximum dose to an individual would be 1.9 mRem to a transportation worker and that the dose rate to an intruder would be 0.1 mRem/yr. On the basis of these estimates the DHS declared the waste exempt from 10 CFR Part 61 licensed burial requirements.

Another situation involved the disposal of 2 m^3 of non-RCRA radioactive hazardous waste oil. The oil contained PCB's and approximately 15,000 pCi/l of tritium (the drinking water standard is 20,000 pCi/l). The impacts of incineration and disposal of the oil were analyzed using the NRC computer code IMPACTS-BRC. The results indicate that the radiological impact to workers, the public, and the environment is negligible. Disposal as ordinary hazardous waste was approved by the State and EPA on that basis. This disposal opportunity is also more cost effective than disposal as a radioactive waste.

A third example involved 140 metric tons of radioactive, high purity copper generated at the Lawrence Berkeley Laboratory. The principal activation isotope is Co^{60} and analyses indicate that the individual lifetime health risk could be 6×10^{-9} excess cancer fatalities. Recycling of the material has been approved by the State and EPA and would provide the following benefits:

- Release of storage areas for other purposes,
- Return of a valuable resource to use,
- Reduce the demand for mining and processing virgin material,
- Conserve valuable waste disposal capacity,
- Recover the monetary value of the copper (about $300,000).

As these examples illustrate, the recovery of contaminated materials through recycling or their disposal in protective and economically efficient methods can be demonstrated and agreed to by regulatory authorities. However, reaching agreement on the general concept of recycling radioactively contaminated materials or disposing of them as non-radioactive may not be so

easily achieved unless public participation is meaningfully engaged.

ROLE OF PUBLIC PARTICIPATION

The force of public participation on government entities as they make decisions affecting the disposition of radioactively contaminated materials cannot be underestimated. The BRC ordeal is proof of the power of an angered public; the NRC's experience to date with the enhanced participatory rulemaking process is evidence of the public's willingness to participate meaningfully in the decision making process.

Meaningful public participation requires that government officials and regulators understand how a broad spectrum of people perceive and respond to risk. For many people, the perception of the degree of harm in something such as recycling radioactively contaminated materials may far exceed the assessment of harm as developed through a computer model. That perception may arise because people may place greater emphasis on the magnitude of the potential hazard than on its probability of occurrence or because they believe they have no control over their exposure to the potential hazard. (Kluk, 1992) Yet it is that perception of harm that will motivate people to resist recycling of contaminated materials or allowing their disposal as non-radioactive.

CONCLUSION

Adverse public perception could stymie Federal efforts to issue residual contamination standards or lead State governments to resist efforts by the Federal government to advance recycling of contaminated materials or their disposal as non-radioactive. Government entities will need to understand risk perception and identify methods to meaningfully engage the public in discussions of radioactively contaminated materials in order to realistically determine the fate of these materials. Due to DOE's very strong interest in recycling some of its radioactively contaminated materials or disposing of them as non-radioactive the Department should develop a policy that supports judicious recycling and disposal, allows for concurrence of supportable recycling and disposal decisions made by States, and encourages meaningful participation by the public.

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