NATIONAL INITIATIVES ON CLEARANCE OF MATERIALS

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ABSTRACT

Currently there is no established regulatory release mechanism that would permit disposal of materials and equipment with very low levels of residual radioactive materials except in low-level radioactive waste disposal sites. A National Academies/National Research Council report released in 2002 estimated that the disposal cost of bulk materials (concrete and metal) from decommissioning of the nation's nuclear power plants would range from $4.5 billion to $11.7 billion depending on the low-level radioactive waste disposal site chosen. If some regulatory mechanism was in place and slightly radioactive material could be sent to local landfills (such as RCRA Subtitle C sites), the disposal cost could be decreased to $0.3 billion to $1 billion. Thus, clearance of solid materials is an issue that has significant economic consequences for decommissioning projects where large quantities of such materials are generated. An established regulatory mechanism could remove economic burdens on such projects while maintaining the public health and safety standards.

Major initiatives to develop guidelines for the disposition of materials containing very low levels of residual radioactive materials are being undertaken by the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE). The U.S. Environmental Protection Agency (EPA) has also taken some steps in this area under their Clean Materials Program. A review of all these initiatives highlights the need for one national standard, preferably dose based, thus allowing site-specific application through derived radioactivity limits. Thus, interagency cooperation and agreement are necessary at the federal level. Consensus is necessary with standard writing organizations, professional societies, public and other stakeholders.

This paper provides an overview of recent developments in the United States in the area of clearance of solid materials, a brief comparison to international activities, and a discussion of key points for consensus building that is necessary for any initiative to succeed.

ECONOMIC SIGNIFICANCE OF THE ISSUE

The cost dimension of the issue of clearance of solid materials shows why this issue is so important. A resolution of this issue is especially critical to the current and future decommissioning of the nuclear power reactors. Of the estimated total cost of approximately $40 billion for the nation's nuclear power plants, about $30 billion had been collected into decommissioning funds by the end of year 2000. Based on the estimates in the National Academies report [1] the disposition cost of bulk materials (concrete and metal) from decommissioning of the nation's nuclear power plants could range from $4.5 billion to $11.7 billion based on the current costs and depending on the LLW disposal site chosen. If regulatory mechanism were in place and slightly radioactive material could be sent to licensed landfills instead of low-level radioactive waste burial sites, the disposal cost for the above would decrease to between $0.3 billion and $1 billion. Clearly, the costs associated with the lack of a federally approved release mechanism are substantial.

NUCLEAR REGULATORY COMMISSION INITIATIVES

The U. S. Nuclear Regulatory Commission is the primary agency for licensing and regulating the possession of source, byproduct and special nuclear materials and the construction, operation and decommissioning of production and utilization facilities that make or use special nuclear materials. The NRC began reexamining its approach for control of solid materials at licensed facilities in 1999. The rulemaking efforts for the release of solid materials at licensed facilities were initiated with the publication of an Issues Paper in June 30, 1999 [2]. As a part of this effort, the NRC prepared a number of documents related to alternatives and issues on this subject, sought public input on these issues and alternatives by requesting written or electronic comments and by holding several public meetings. Several NRC reports have been published that address some of this information. These include:

1. NUREG/CR-6682 [3], entitled "Summary and Categorization of Public Comments on the Control of Solid Materials," published in September 2000,which provides a summary and characterization of public comments received on the June 30, 1999, Issues Paper:

2. NUREG-1725 [4], "Human Interaction with Reused Soil: An Information Search," published in January 2002, which provides background information on uses of reused soil in the United States as input to analysis of potential scenarios that could occur if soil is removed from licensed facilities; and

3. NUREG-1761 [5], "Radiological Surveys for Controlling Release of Solid Materials." published in November 2002.

The issue of clearance of materials is also related to the site release criteria because, under the NRC License Termination Rule, 10 CFR 20 Subpart E (10 CFR 20.1402) [6], it is possible to terminate the license for the site with decontaminated structures intact so long as the dose criteria for unrestricted release of the site are met. The NRC requirements include a dose criterion of 0.25 mSv/y (25 mrem/y) to an average member of the critical group and the application of ALARA. It should be noted that release of debris from these structures prior to license termination with these same residual levels of radioactivity is not permitted under existing regulations. The requirements under 10 CFR 20 Subpart K necessitate that the licensee demonstrate the absence of licensed radioactive material prior to release of material from a licensed site.

On August 18, 2000, the Commission provided direction to the NRC staff regarding the next steps for proceeding with improving the control of solid materials. The Commission approved the staff's recommendations to:

(1) Defer a final decision on whether to proceed with rulemaking,

(2) Proceed with a National Academies study on possible alternatives for control of solid materials [since completed],

(3) Continue the development of a technical information base necessary to support a Commission policy decision in this area, and

(4) Stay informed of international initiatives in this area, related EPA and U.S. Department of State activities, and potential import and trade issues.

The National Academies were asked by the NRC to conduct a study of alternatives on the control of solid materials. In March 2002, the National Academies submitted its report [1] entitled, "The Disposition

Dilemma, Controlling the Release of Solid Materials from Nuclear Regulatory Commission Licensed Facilities." Based on a review of this report and NRC staff recommendations, the Commission directed the NRC staff to proceed with an enhanced participatory rulemaking on control of solid materials.

To move the process forward, the NRC has taken a number of steps. These include a Federal Register Notice published in February 2003 on Scoping for Environmental Issues (68 Fed. Register 9595, Feb. 28, 2003) and publication of the NUREG – 1640, Vol. 1 and Vol. 3 in June 2003 (which have been available as draft NUREG report since 1999. See Reference 33).

The NRC staff also conducted a public workshop at Rockville, Maryland, on May 21-22, 2003 [7], to solicit stakeholder views on alternatives. It also provided an opportunity for NRC for the National Environmental Policy Act (NEPA) scoping process for preparation of a General Environmental Policy Impact Statement (GEIS). Although wide range of views were expressed, a large number of participants felt that the NRC should develop release criteria for materials and equipment containing both surifical and volumetric distributions of radioactive materials. A dose-based approach generally was favored over a measurement-based system or a risk-based approach.

A proposed NRC rule is scheduled in 2004.

DEPARTMENT OF ENERGY INITIATIVES

The Department of Energy conducts atomic energy defense and research and development activities at various sites around the United States. Prime contractors who manage and operate the sites carry out these activities. DOE Order 5400.5, "Radiation Protection of the Public and Environment" [8], provides requirements for the conduct of these activities to provide protection of members of the general public and the environment. Chapter IV of Order 5400.5 and supporting documents contain requirements for the release of materials and equipment.

DOE's process for the release of property or materials requires:

(1) Development of site-specific *Authorized Limits* that will control doses to 0.25 mSv (25 mrem) or less in a year, and

(2) Comparison of alternatives in an "As Low As Reasonably Achievable (ALARA)" analysis. The 0.25 mSv release criterion is equivalent to the NRC's requirements for release of decommissioned nuclear facilities [6].

Many DOE cleanups are conducted under regulations other than DOE' s; particularly those conducted under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA) [9]. An individual risk range of 10^{-6} to 10^{-4} per lifetime is the acceptable range for CERCLA remedial actions [10]. DOE believes that the use of a 0.25 mSv (25 mrem) annual dose limit plus the ALARA process to derive authorized limits for cleanups generally gives risks within the CERCLA risk range when risk factors from Federal Guidance Report No.13 [11] are used.

In addition to dose-based site-specific authorized limits, DOE has approved surface activity guidelines for use as authorized limits for structures and personal property. The values are in Figure IV-1, "Surface Contamination Guidelines" of DOE Order 5400.5 [8] and are generally equivalent to the guidelines issued by U.S. Atomic Energy Commission, the predecessor to NRC, in Regulatory Guide 1.86 [12]. These values were based upon measurement capabilities (in 1974) – they are not directly tied to a dose or risk limit or a specific exposure scenario. Consequently, the level of protection provided by these limits varies with the radionuclide.

There are no generic DOE concentration-based or activity-based release standards for levels of radionuclides distributed throughout a volume of material. Alpha- and weak-beta emitting radionuclides pose a particular problem and, in the absence of dissolution and wet chemistry, only the surface layer is likely to be measured. Because of these factors, the DOE requires that proposed release criteria for volumetrically contaminated materials undergo a case-by-case evaluation and approval by the DOE Office of Environment, Safety and Health.

Since January 2000, when a Secretary of Energy Memorandum put a moratorium on the recycle of contaminated metal from DOE sites, and October 2000, when the DOE published a notice on Control of Releases of Materials with Residual Radioactive Contamination from DOE Facilities, the DOE has prepared a draft Programmatic Environmental Impact Statement (PEIS). The PEIS analyzes a range of standards and cost-effective policy options for the release of potentially radioactive scrap metal from DOE sites for recycling and/or disposal in a manner protective of human health and the environment. The PEIS provides a means to satisfy the requirements of the National Environmental Policy Act.

Currently, the moratorium on the release of volumetrically contaminated materials and a suspension on the release of scrap metals for recycling from DOE facilities continue [13]. These activities are awaiting development of national standards by the Nuclear Regulatory Commission.

ENVIRONMENTAL PROTECTION AGENCY INITIATIVES

The EPA efforts under the Clean Materials Program [14] are for ensuring a clean metal supply. The EPA program consists of three components, each of which addresses one of the potential origins of contamination. Of these components, the EPA efforts are focused on the Orphan Sources Initiatives and the Foreign Trade and Imports Initiative; the Domestic Clearance Initiative is currently suspended.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)[9], commonly known as Superfund, was enacted by Congress on December 11, 1980. This provided broad Federal authority to EPA to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. The EPA's individual dose criteria for release of a site are 0.15 mSv/y (15 mrem/y) with an additional groundwater pathway limit of 0.04 mSv/y (4 mrem/y) [10]. As stated above, NRC's 10 CFR Part 20, Subpart E criterion is 0.25 mrem/y (25 mrem/y). The inconsistency in radiation site cleanup standards at NRC and EPA has been the subject of a GAO Report published in July 2000 [15].

Both agencies have been working to achieve consensus in this area and a recent step has been the signing of a Memorandum of Understanding (MOU) between the two agencies in October 2002 [16], entitled "Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites". EPA and NRC developed this MOU to identify the interactions of the two agencies for the decommissioning and decontamination of NRC-licensed sites and the ways in which those responsibilities will be exercised. EPA and NRC believe that implementation of the MOU between the two agencies will ensure that future confusion about dual regulation does not occur regarding the cleanup and reuse of NRC-licensed sites. Thus, one of the purposes of the MOU is to ensure that sites remediated under NRC regulations are not subsequently listed by EPA on the National Priorities List (NPL) for additional cleanup under the Superfund.

A limited category of radioactive materials is excluded from CERCLA consideration. They are:

- Releases from a nuclear facility licensed by the NRC and covered under NRC financial protection provisions.

- Releases from one of 17 uranium tailings sites specifically designated in the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA)[17].

The exclusion of these substances does not exclude other types of radioactive materials. However, it is the EPA policy not to list releases of radioactive materials from facilities with a current license issued by the NRC (e.g., certain medical facilities, manufacturing plants, research laboratories). These facilities are under the authority of the NRC that is responsible for requiring and overseeing cleanup at these sites. All other types of radioactive materials sites, including state licensees and former NRC licensees, are eligible for the National Priorities List under CERCLA.

EPA has developed an electronic calculator [18] that can derive Preliminary Remediation Goals (PRGs) for radionuclides at CERCLA sites with radioactive contamination. The "Radionuclide Preliminary Remediation Goals (PRGs) for Superfund" electronic calculator has standardized exposure parameters and equations that should be used for calculating radionuclide PRGs for residential, commercial/ industrial, and agricultural land use exposures, tap water and fish ingestion exposures, and migration of radionuclides through the unsaturated (vadose) zone. EPA has issued additional and revised guidance on CERCLA cleanups [19-21].

Source, byproduct and special nuclear materials regulated under the Atomic Energy Act are not included as solid wastes regulated by EPA under the Resource Conservation and Recovery Act (RCRA) [22]. However, EPA's consideration of disposal options for managing and disposing of waste that is both chemically hazardous and radioactive ('mixed' waste) stems from the hazardous waste components which are regulated under RCRA.

On November 18, 2003, EPA published an Advance Notice of Proposed Rulemaking (ANPR) [23] to collect public comment on alternatives for disposal of waste containing low concentrations of radioactive material ('low activity' waste). The ANPR discusses a variety of disposal alternatives as well as various regulatory and technical options for ensuring protection of public health and the environment. The public may submit comments to EPA on the issues raised by the ANPR until March 17, 2004, which is 120 days from the date of the notice's publication in the Federal Register.

They are evaluating the conditions under which some hazardous waste landfills with Resource Conservation and Recovery Act Subtitle C permits might accept certain mixed and other 'low-activity' radioactive waste for disposal. The most important condition will be protecting public health and the environment. One reason EPA thinks RCRA hazardous waste landfills could be used to dispose of low-activity radioactive waste is that the hazardous component of mixed waste is already regulated under the Resource Conservation and Recovery Act, or RCRA.

The ANPR is intended to stimulate public consideration of these issues and does not propose regulatory language or a specific regulatory approach. Because this action affects the Nuclear Regulatory Commission and its Agreement States as well Department of Energy facilities, EPA has worked with them in developing the ANPR . The Nuclear Regulatory Commission published a notice referring its licensees to the EPA ANPR and requesting their comments being sent to EPA [24]. After considering the comments received on this ANPR, EPA will determine whether to proceed with proposed and final standards.

SCIENTIFIC SOCIETIES / INDUSTRY ORGANIZATIONS ACTVITIES

The Health Physics Society prepared the ANSI/HPS N13.12 standard [25] in 1999, which was approved as a standard by the American National Standards Institute and endorsed by the Health Physics Society [26] and the American Nuclear Society [27]. The ANSI standard provides both surface and volumetric

radioactivity standards for clearance of equipment, materials, and facilities. The standard uses 10 μSv/y (1 mrem/y) as the dose criteria and the surficial levels are comparable to past practices. However, the standard has not been accepted or endorsed by any regulatory agency to date.

The National Technology Transfer and Advancement Act of 1995 [28] requires Federal agencies to use technical standards that are developed or adopted by voluntary consensus standard bodies unless the use of such a standard is inconsistent with applicable law or otherwise is impractical. Therefore, the ANSI N13.12-1999 standard at least has to be considered in any Federal agency action to establish release standards for residual radioactive materials.

The Nuclear Industry Institute (NEI) has represented the nuclear industry viewpoint on this issue with participation at NRC workshops and involvement in the rulemaking process. In the latest step, the NEI provided comments to NRC on the scoping process for environmental issues with a letter dated June 30, 2003 and a meeting was held with the NRC on clarification of these comments on September 10, 2003.

The metal and concrete industries have generally opposed the NRC rulemaking effort on the clearance of metals and concrete materials for recycling.

RELATED INTERNATIONAL ACTIVITIES

The International Atomic Energy Agency (IAEA) and the European Commission (EC) have established a release criterion of 10 μSv/y (1 mrem/y). Some relevant documents are IAEA-TECDOC-855 [29], Safety Series No. 89 [30], European Commission Radiation Protection Directives 89 [31] and 96/29/EURATOM [32]. The amount of activity related to 10 μSv/y (1 mrem/y) is considered "negligible radioactivity" and it is taken as the criterion for clearance (unrestricted release into the environment).

NEED FOR BETTER AGREEMENT

The national and international approaches mentioned above are inconsistent as far as their application in the field is concerned. Such inconsistencies could cause major problems in the recycle and reuse of materials, for example, in the international commerce that involves millions of tons of steel in imports and exports.

The IAEA and the EC standards are based on 10 μSv/y (1 mrem/y) criterion. The ANSI N13.12 standard also uses this criterion. The values derived from NRC's NUREG-1640 [33] differ significantly from EC and IAEA values. For example, a comparison of clearance levels for ^{60}Co shows that the NUREG-1640 value is an order of magnitude more restrictive than the IAEA (IAEA-TECDOC-855[30]) value. For surficial guidelines, NUREG-1640 is not consistent with the existing NRC Regulatory Guide 1.86 or the 1999 ANSI standard. For example, it provides a much more restrictive value of 280 dpm/100 cm^2 for ^{60}Co as compared to a value of 5000 dpm/100 cm^2 in Regulatory Guide 1.86 [12]. The comparable value in the ANSI N13.12 standard [25] is 6000 dpm/100 cm^2.

There are several underlying reasons for such inconsistencies:

(1) Various criteria are formulated differently and are intended for slightly different purposes. There are differences between a risk-based approach, a dose-base approach and a measurement-based approach for deriving the numerical levels for release of materials with residual radioactive contamination.

(2) The scenarios and exposure parameters used to relate concentration to dose are not standardized.

(3) The radiation protection system adopted by national authorities is not uniform. The U.S. is working primarily with standards and dose factors derived from International Commission on Radiological Protection (ICRP) Publications 26 and 30 [34,35]. Most other countries including those in the European Community and most international agencies (IAEA and the Nuclear Energy Agency) have adopted the 1990 ICRP 60 recommendations [36].

(4) The capability to detect and measure residual contamination varies considerably among different radionuclides and whether the contamination is surficial or volume-distributed.

CONCLUSIONS

The basic problem with standards for release of materials and equipment with residual radioactive materials is not that these standards do not exist, but rather there are many such standards which differ in their technical and regulatory bases, underlying dose criteria and translation into measurable units. The problem is accentuated in the U.S. by the division of responsibilities for radiation control between several Federal agencies with differing mandates and statutes. The primary agencies with jurisdiction over release standards are the Nuclear Regulatory Commission and the Environmental Protection Agency. The Department of Energy regulates its own activities and the national laboratories. The Department of Transportation has jurisdiction over transportation of low-level radioactive materials and the Occupational Safety and Health Administration (OSHA) in the Department of Labor regulates radiation exposure of workers from sources other than those regulated under the Atomic Energy Act. All of these may affect the disposal of low-level radioactive materials. There is some coordination of these efforts under the Interagency Steering Committee on Radiation Standards (ISCORS) but no consensus position has been reached and no Federal standard has been proposed.

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FOOTNOTES

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