CLEARANCE OF BULK MATERIALS FROM D&D - LIFE AFTER THE NAS REPORT

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ABSTRACT

Lack of consistent free release standards for solid materials has been an issue that has been around for several decades. The Nuclear Regulatory Commission (NRC) has had specific and dose-based standards for the release of liquids and gases for several decades, but no regulatory mechanisms for the release of solid materials from a nuclear power plant. Even though free releases of small quantities of solid materials continue under existing guidelines from operating plants, the regulatory void creates major difficulties for the bulk materials that result from decommissioning projects. For the nation's fleet of nuclear reactors the cost of this regulatory void could be as high as $10 billion. The NRC has recently resumed the enhanced rulemaking process that was originally initiated in 1999 but was deferred pending a study by the National Academy of Sciences (NAS)/National Research Council. The NAS report and recommendations were issued in March 2002 and the NRC decided in October 2002 to resume the rulemaking process. This paper provides an overview of the developments in this area. It specifically discusses the applicability of ANSI N13.12 as a consensus standard that should be seriously considered for adoption as a regulatory standard.

INTRODUCTION

The road to establishing a standard for the clearance of solid materials has been slow and little has changed in the short-term as a result of the National Academy of Sciences report issued on March 21, 2002 (1). As background, this was the latest major development in the NRC initiatives on this issue. The NRC had initiated a rulemaking effort on this subject with the publication of an Issues Paper in 1999 (2). In stakeholder meetings conducted as a part of the enhanced rulemaking process, the NRC experienced strong opposition to this rulemaking from several environmental groups, some of whom labeled it as a " son of BRC", as well as, from the metal and concrete industries, who are adamantly opposed to recycling of such materials. On the other hand, the nuclear industry and the professional societies see an urgent need for rulemaking, because the regulatory void (no clear mechanism for releasing solid materials, which may have slight residual radioactivity) creates economic burdens on the nuclear sites, especially the decommissioning projects, where large quantities of such materials are generated. The cost of treating these materials as low-level radioactive waste (LLW) is prohibitive. The regulatory framework of using the 20.2002 submissions or Technical Specification changes has inherent limitations. So does the application of RG 1.86, a 1974 document (3), which has limitations because it provides only surficial criteria, (no volumetric criteria), and because the criteria are measurement based, rather than risk or dose based.

With the issue unresolved, the NRC turned to NAS/National Research Council for advice in August 2000, which formed the Committee on the Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities. The Committee studied this issue for a year and a half, solicited input from nearly forty groups and individuals.

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The report and recommendations were released in March 2002. The NRC staff studied the recommendations of the NAS Committee and issued a SECY paper to the Commission. The commission decided in October 2002 to resume the rulemaking effort.

This paper provides an overview of the national developments in this area, a summary of the international activities, and the applicability of ANSI N13.12 (4) as a consensus standard to the issue of clearance of bulk materials.

COST DIMENSION OF THE ISSUE

The first and obvious question on the issue of clearance of materials is why is this issue that important. A resolution of this issue is especially critical to the current and future decommissioning of the nuclear power reactors. The cost of decommissioning a full size reactor is approximately $500 million and the operators/owners collect decommissioning funds under the NRC requirements through levy on electricity rates over the operating life of the reactor. Of the estimated total cost of approximately $40 billion for the nation's fleet of nuclear power plants, about $30 billion had been collected into the decommissioning funds by the end of year 2000. Thus, decommissioning funds for most of the reactors are considered adequate. The decommissioning costs for commercial power reactors vary with the size of the reactor, its type, regulations, cleanup criteria, application of technologies, and access to a disposal site. To release a decommissioned site without restrictions certain NRC release criteria must be met. However, an important aspect of site restoration involves the removal of large amounts of debris that may or may not have small amounts of residual radioactivity.

Based on the estimates in the NAS report (1), disposition 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 local landfills (Subtitle D or RCRA Subtitle C), the disposal cost for the above would range from $0.3 billion to $1 billion. Clearly, the cost of this regulatory void is substantial.

LACK OF A CLEAR MECHANISM AND CURRENT INDUSTRY ALTERNATIVES

The License Termination Rule, 10 CFR 20 Subpart E (10 CFR 20.1401-1406), which was published in July 1997 (5) and became applicable to all decommissioning projects in August 1998, sets a total effective dose equivalent (TEDE) limit of 25 mrem/y (0.25 mSv/y) to an average member of the critical group for unrestricted release of a decommissioned site. It also requires that doses are kept as low as reasonably achievable (ALARA). It should be noted that the NRC regulations in 10 CFR 50 also require reactor licensees to submit Post-shutdown Decommissioning Activities Reports and License Termination Plans to support the decommissioning of nuclear power facilities.

The termination of a reactor operating license under the provisions of 10 CFR 20, Subpart E is permitted with trace levels of licensed radioactive materials remaining providing that the residual radioactivity does not result in a calculated TEDE exceeding 25 mrem per year. Thus, it is possible to terminate the license for the site with decontaminated structures intact. However, release of debris from these structures prior to license termination with these same residual levels of radioactivity is not permitted under existing regulations.

10 CFR 20, Subpart K, 20.2001, requires that licensed radioactive material be disposed of only through (i) transfer to an authorized recipient, (ii) decay in storage, (iii) release in effluents within the limits in 20.1301, or (iv) as authorized under 20.2002, 20.2003, 20.2004, or 20.2005. Subpart K does not provide a regulatory basis for demonstrating the absence of licensed radioactive materials when they could potentially exist.

Since there is no regulatory basis for demonstrating the absence of licensed radioactive materials, the NRC has provided guidance on how hard to look on levels for both surface and bulk material contamination for items and material to be released from restricted areas. However, this guidance was not developed for the disposal of demolition debris during a decommissioning project. Furthermore, if this guidance is used, a licensee is always subject to a third party using more sensitive instrumentation and identifying residual radioactivity on or in materials that had been released from the site. This would result in a violation of 10 CFR 20.2001.

The two potential mechanisms under the current regulations could include: 10 CFR 20.2002 submissions, or license amendment submissions. However, the 20.2002 submissions have been used for disposing small quantities of materials from operating reactors, generally on-site; these have not been used for a decommissioning project. Under the 20.2002, the material is still classified as radioactive material, which essentially excludes the potential use of the local landfill disposal.

A license amendment is another potential alternate approach which will consist of a request to NRC for license amendment that will essentially establish the site-specific release criteria for solid waste materials from the site, similar to the established limits for gas and liquid releases following a methodology similar to the Off Site Dose Calculation Manual.

The NRC position on the above regulatory mechanism is unclear when it comes to the disposition of bulk materials from decommissioning. Thus, neither of the two mechanisms is available in practice for a decommissioning project. Given the intensity of political and public reaction to the issue of release of solid materials, such mechanisms do not provide the regulatory answer to this issue.

The current practical alternatives available to the industry for the disposition of bulk materials are limited to (a) treating bulk materials as radioactive waste; (b) processing bulk materials under some available state-licensed program. The current cost for LLW disposal can range from $100-$500/ ft^3 and treating bulk materials as a LLW is not a feasible option because of the prohibitive cost. The other industry alternative that is the currently available involves processing the bulk materials through the "Green Is Clean" (GIC) program in Tennessee, a NRC agreement state. However, processing of materials through such a program still leads to substantial costs in transportation and disposal, and it is also not clear how long such a mechanism will continue to be available. Overall, the costs to disposition bulk materials from a decommissioning project could be anywhere between 10 to 20 % of the total project costs depending on the approach.

NATIONAL AND INTERNATIONAL DEVELOPMENTS

Defining some level at which the residual radioactivity can be considered as "trivial", and hence be subject to no further regulation, has been an issue since the 1980s. The NRC efforts culminated in the Below Regulatory Concern (BRC) policy of 1990, which was short-lived because of the immense controversy it generated. The U.S. Congress intervened in 1992, after the NRC had suspended the policy on its own.

Consensus on the issue has continued to elude and rulemaking efforts at federal agencies and departments, such as the NRC, EPA and the DOE, have remained on-again and off-again.

In 1999, the NRC embarked on enhanced rulemaking efforts for the clearance of solid materials. A number of stakeholder meetings were held around the country and at the NRC headquarters. While the nuclear industry and the professional societies were in favor of establishing such a rule, the NRC experienced intense opposition from certain public and industry groups. The metal and concrete industries were opposed to the rulemaking because of concerns of recycling material that may have residual radioactivity. In August 2000, the NRC turned to NAS for a study of the issue and recommend alternatives for controlling the release of solid materials. The NAS/National Research Council established a committee, which studied the issue, solicited input from various stakeholder groups, and issued a report in March 2002. In October 2002, the NRC decided to resume the rulemaking process.

In practice, the NRC licensees at nuclear power plants have performed free release of small quantities of materials under the no detectable concept. For solid items this requirement had the licensees survey all accessible areas with a hand held small area Geiger Mueller detector or equivalent in low background environments. A Minimum Detectable Count Rate (MDCR) would be calculated and any detected counts above the MDCR would be considered unacceptable for release. The process was open to error by several avenues: it addressed surface areas only; the process was open to technician survey error; detector efficiency variance due to changes in geometry; varying radionuclide mixes; variation in background levels; and the items themselves may have inaccessible areas making the process nonviable.

Past clearance methodologies for solid materials and the release of radiologically contaminated sites have relied primarily on the use of surficial contamination guidelines given in the Regulatory Guide 1.86 (3). This guide, which was developed by the Atomic Energy Commission in 1974, provides a Table of Acceptable Surface Contamination Levels for various radionuclides, including natural and enriched uranium, transuranics, and fission products. The guide does not give volumetric contamination guidelines. The surface contamination levels are stated in terms of measurable radioactivity levels but these values are not dose-based. The same basis levels are also included in the NRC Policy and Guidance Directive FC 83-23 (6). Surficial contamination guidelines have been used for license termination not only for NRC licenses but also in Department of Energy (DOE) projects. For Beta-Gamma emitters (except Sr-90 and others noted in Table 1 of the Regulatory Guide 1.86), the acceptable average surface contamination level is 5000 dpm/ 100 cm^2.

During its efforts early in the rulemaking process in 1999, the NRC published a comprehensive draft regulatory guide, NUREG-1640 (7), which was a culmination of efforts in this area over the past several years. It systematically defines the methodology for clearance and covers both surficial as well as volumetric guidelines. The NRC has also recently released for comment a draft report, NUREG 1761, on radiological surveys for controlling release of solid materials (8).

Another important and related regulatory developments in the decommissioning area is the publication of the License Termination Rule in 1997 (5) that sets a dose limit of 25 mrem/y to an average member of the critical group for unrestricted release of a decommissioned site (10 CFR 20.1402). The methodology for compliance with the rule is based on pathways analysis modeling and a Final Status Survey of the site under MARSSIM (9). For decommissioning projects, it is a potential option for the licensees to decontaminate structures as necessary and include them in the final status survey. Once the site license is terminated, the structures can be left intact or demolished.

Other developments have also taken place at the national and international level. The American National Standards Institute (ANSI) published a standard (developed by the Health Physics Society), ANSI N13.12 (4) in October 1999, which provides both surface and volumetric radioactivity standards for clearance of equipment, materials, and facilities. The standard uses 1 mrem/y as the dose criteria and the surficial levels are comparable to past practices. Nevertheless this standard is not accepted or endorsed by any regulatory agency as yet.

The DOE has also initiated efforts to establish their criteria in the area of materials release through a publication of notice of intent in the Federal Register on October 12, 2000 (10). The DOE Order 5400.5 is being amended with additional chapters that cover the issues of release of materials and property with residual radioactive contamination. The EPA has related efforts in their "Clean Materials Program". However, one national standard is desirable, rather than multiple standards, and thus, interagency cooperation and agreement are necessary at the federal level.

On the international scene, International Atomic Energy Agency (IAEA) and the European Commission (EC) have established an essentially dose based criteria of 1 mrem/y (10 μSv/y), even though the derived mass-specific and surface-specific levels may vary in different countries. Some relevant documents are IAEA-TECDOC-855 (11), Safety Series No. 89 (12), and European Commission Radiation Protection 89 (13). Another draft Safety guide DS 161 is in the developmental stages. The IAEA uses the concept of "exclusion", "exemption" and "clearance". The amount of activity related to 1 mrem/y is considered "negligible radioactivity" and it is taken as the criterion for clearance. By contrast, the NRC guidance does not define a dose level for clearance.

INCONSISTENCIES IN APPROACHES

The national and international approached mentioned above are inconsistent as far as their application in the field is concerned. While the European standard is based on the 1 mrem/y (10 μSv/y) criteria, the NRC, by contrast, has not defined this dose level for clearance. The draft NUREG 1640 gives dose factors in terms of μSv/y per Bq/g and μSv/y per Bq/ cm^2 but does not specify a dose level.

The values derived from draft NUREG-1640 differ significantly from EC and IAEA values. For examples, for Co-60 (and the dose criteria of 1 mrem/y), the EC value for clearance of all metals is 1 Bq/g (0.6 Bq/g in Germany), it is 0.04 Bq/g in draft NUREG-1640, which is 25 times more restrictive. Similarly, a comparison with IAEA values for Co-60 for all materials shows that the draft NUREG-1640 value is an order of magnitude more restrictive (0.039 Bq/g as compared to 0.3 Bq/g from IAEA). For surficial guidelines also, draft NUREG-1640 compares inconsistently with Reg. Guide 1.86. For example, for Co-60, it provides a much more restrictive value of 280 dpm/100 cm^2, as compared to a value of 5000 dpm/100 cm^2 in the guide. The comparable value in the ANSI N13.12 standard is 6000 dpm/100 cm^2.

Inconsistencies in the release criteria (and the proposed criteria) at the national and international level could lead to major problems in the recycle and reuse of materials, for example the international commerce involves millions of tons of steel in imports and exports. In developing a program for the release of equipment, recyclable metal, and concrete from a decommissioning project, these regulatory developments must now be taken into account and a consistent approach defined.

BEYOND THE NAS RECOMMENDATIONS

The disappointing thing about the NAS report was the lack of a clear-cut recommendation on the necessity of regulatory development for the clearance of solid materials. The bottom line from the Committee could be summarized in their own words "since the current case-by-case approach seems to be working, there is not a strong, unified impetus for change". In developing its recommendations, the Committee states that it was guided by two compelling findings:

1. The current approach to clearance is workable and is sufficiently protective of the public health that it does not need immediate revamping.
2. Broad stakeholder involvement and participation in NRC's decision-making process on the range of alternative approaches is critical as the NRC moves forward.

The Committee has listed seven recommendations that can be summarized as (in abbreviated form): 1) The NRC should devise a new decision framework that would develop, analyze, and evaluate a broader range of alternative approaches; 2) The NRC decision-making process on the range of alternatives should be integrated with abroad-based stakeholder participatory decision-making process; 3) The NRC should adopt an overarching policy statement describing the principles governing the management and disposition of slightly radioactive solid material; 4) While considering either clearance or conditional clearance, a dose-based standard should be employed as the primary standard; 5) An individual dose standard of 1 mrem/y (10 μSv/y) provides a reasonable starting point; 6) For dose-based alternative approach, the NRC should use the conceptual framework of draft NUREG-1640; 7) The NRC should continue to review, assess, and participate in the ongoing international efforts in this area.

Preserving a status quo simply means postponing an issue that will clearly need an eventual resolution. In the meantime, a disconnect continues with the developments in this area at the international organizations (IAEA and EC) and the national consensus bodies (such as the ANSI).

The NRC's recent decision to resume the rulemaking effort is a step in the right direction. However, given the fact that the rulemaking process has been a "slow go approach" since 1999, NRC should seriously evaluate the adoption of ANSI N13.12. The ANSI/HPS standard N13.12 is an existing national standard (issued in October 1999) that provides the best hope for consensus among stakeholders. The National Technology Transfer and Advancement Act of 1995 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.

From the collective experience so far, it is clear that the clearance issue remains controversial. A substantial consensus among stakeholders is necessary to move the process forward. The issue has been the subject of debate at numerous recent conferences as well as at the committees of ANS, CRCPD, HPS, NEI and other organizations. The IAEA has also an active forum on the release of materials & facilities from control (clearance) under the Decommissioning Issues on the RASANET.

An important first step in consensus building is the interagency cooperation at the federal level. Key points in building a consensus and moving the process forward can be summarized as follows:

- Interagency effort at the federal level and adoption of one national regulatory standard
- Full stakeholder involvement and building trust with public groups

- Separate recycling issues from disposal issues since consensus is more achievable on disposal of bulk materials
- Cost benefit assessment of alternatives
- Consistency with standards that are already available
- Consistency with international standards
- Dose based standards; 1 mrem/y (10 μSv/y) is a reasonable basis for consensus
- Revise overly conservatism assumptions in the draft NUREG-1640 analyses
- Comparison of NORM/TENORM levels to those expected from application of dose based standards for the disposal of bulk materials from decommissioning; international concept of "trivial dose"; and no adverse impact on public health & safety
- Derived levels based on dose limit, risk assessment methodology, and the disposal option
- Environmental stewardship and preserving national LLW disposal capacity.

The ANSI N13.12 is an existing consensus standard that offers the best opportunity for resolution of the clearance issue. The federal regulatory agencies should seriously evaluate the adoption of this standard as a regulatory standard. The National Technology Transfer and Advancement Act of 1995 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.

CONCLUSIONS

Disposition of bulk materials from decommissioning is a substantial part of the overall decommissioning cost, in the range of 10-20% under the current options. Considering that these materials have only residual or no radioactivity, it is not an issue of radiological risk; it is instead an issue of a regulatory void. The costs related to disposal of bulk materials as radioactive waste or processing such materials through special options are a burden on decommissioning projects that does not need to be there.

An individual dose criterion of 1 mrem/y (10 μSv/y) offers a reasonable basis for deriving site-specific volumetric clearance levels. This is also a criterion that is scientifically and internationally accepted for such application. The ANSI/HPS standard N13.12 is an existing national standard based on the dose criterion of 1 mrem/y (10 μSv/y) that the NRC should consider for adoption as a regulatory standard.

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