Shifting the Paradigm for Management of NRC Class B and Class C Waste – 9268

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ABSTRACT

The closure of the Barnwell SC disposal facility to all but the Atlantic compact members, presents technical issues and political challenges that require the nuclear industry to reconsider its options and strategies for the management of waste streams that generate B/C waste. The technical challenge is to modify practices at nuclear facilities to minimize or prevent the generation of wastes that have no disposal path. The political challenge revolves around establishing and nurturing a public climate that considers nuclear generation a key component in our future energy plans. This translates into the need to continue the safe and cost effective operation of existing facilities, provide assurances that waste generation will be effectively managed for new facilities, and to do so within the existing regulatory framework and guidance.

INTRODUCTION

On June 30, 2008 the State of South Carolina ordered Energy Solutions, the operator of the Barnwell SC disposal facility, to close this facility to all but the Atlantic compact members. This has resulted in the loss of routine access to Barnwell disposal capacity of NRC Class B and Class C waste for all but the states of Connecticut, New Jersey, and South Carolina. It should be noted that the Northwest Interstate Compact continues to provide disposal access for the 8 states of Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Washington and Wyoming as well as the 3 Rocky Mountain Compact states of Nevada, Colorado and New Mexico. Recent developments have also improved the outlook for the 2 Texas Compact states, Vermont and Texas. However, this situation leaves 34 states without access to disposal for NRC Class B and Class C waste. This unfortunate, but long foreseen event presents not only a technical issue but a political challenge as well, and has required that the nuclear industry reconsider its options and strategies for management of waste streams that generate B/C waste.

The political challenge revolves around establishing and nurturing a public climate that considers nuclear generation a key component in our future energy plans. This translates into the need to continue the safe and cost effective operation of existing facilities, provide assurances that waste generation will be effectively managed for new facilities, and to do so within the existing regulatory framework and guidance. Any suggestion that the regulatory limits be modified or relaxed would provide anti-nuclear activist groups with ammunition to further impede the progress towards new nuclear generating capacity.

The technical challenge is to modify practices at nuclear facilities to minimize or prevent the generation of wastes that have no disposal path. This issue extends to the construction of new nuclear facilities because regulatory guidance governing the designs must provide a mechanism for minimizing all waste generation, including Class B and Class C.

The industry has responded with some recent process offerings that demonstrate our ability to be flexible and creative in addressing these industry wide challenges. However, we need to further focus our attention on the full spectrum of wastes that are currently without a path to disposal and reconsider our process mentalities. The industry spent the last 30 years finding ways to reduce waste volume by increasing the concentration of activity on smaller and smaller volumes. Since the NRC waste classification is a concentration based limit, derived from the associated dose implication in a disposal environment, it is incumbent upon us to effectively manage concentrations to optimize waste loading while limiting concentrations in the final disposal package to achieve Class A waste whenever practical. Several things are necessary to achieve the desired results. First and foremost is to establish a well defined and closely monitored program to sample, analyze, and quantify the nuclide distributions in all of our various waste streams. It is no longer acceptable to assume an unnecessarily conservative position in terms of waste classification because the ALARA, logistic, regulatory, and financial implications of storing significant amounts of radioactive material at commercial facilities are not conducive to safe and cost efficient operation and present an extremely negative public perception of commercial nuclear power.

WMG conducted research and investigation into the actual waste generation and disposal data collected from a vast majority of the operating commercial U.S. nuclear facilities since the inception of 10 CFR 61 and its attendant Branch Technical Positions. This research indicates that greater than 90 % of the volume of organic Class B and C waste currently generated can be effectively managed using a combination of emerging AND existing process technologies to achieve Class A concentrations within the confines of the existing regulatory framework. This will result in 90 % less waste requiring ongoing storage and monitoring at both operating facilities and decommissioning sites.

The details of this paper will address the summarized results of the historical data review and demonstrate how newly developed WMG Inc technology combined with existing and emerging processes, modified (and in some cases abandoned) technology can significantly reduce the volume of NRC Class B/ C waste placed in storage at either onsite or offsite facilities.

THE POLITICAL CHALLENGE

Title 10 Code of Federal Regulations – Energy Part 61.55 (10CFR61.55) [1] identifies the isotopes that must be considered when classifying waste. 10CFR61.56 specifies the physical characteristics of waste that make it suitable for shallow land disposal. These regulations and the accompanying Nuclear Regulatory Commission (NRC) Branch Technical Positions (BTP) [2][3][4] have stood as the "rules and regulations" of low level radioactive waste (LLRW) disposal for many years.

The elimination of disposal options for Class B and Class C waste, has led some within the industry to seek a quick fix by encouraging the NRC to modify 10CFR61 or reinterpret it through the issuance of a modified concentration limits or a new BTP that would allow a much looser application of the provisions for concentration averaging. The faulty logic is this, "if a licensee can average activity over the volume of a disposal container, why can't a disposal facility average the activity over the volume of a trench, disposal cell, or even an entire facility?"

While this logic might technically be considered the equivalent of what is being done in a 55 gallon drum or cask liner, albeit on a much larger scale, it would be irresponsible to attempt to change the long standing regulatory criteria and guidance for application simply because they are suddenly more difficult to comply with. Any suggestion that the regulatory limits be modified or relaxed would provide anti-nuclear activist groups with a credible argument that the industry cannot manage its current waste generation and should therefore be prevented from any consideration of new generation. Their subsequent participation as interveners would delay any rule making changes and could further impede the progress towards the licensing of new nuclear generating capacity.

The primary political challenge facing our industry is to ensure that waste generation will be continue to be effectively managed for both existing and new facilities, and to do so within the existing regulatory framework and guidance.

THE TECHNICAL CHALLENGE

The technical challenge is less daunting. We as an industry need to modify practices at nuclear facilities to minimize or prevent the generation of wastes that have no disposal path. This issue extends to the construction of new nuclear facilities because developing regulatory guidance governing the new plant designs must provide a mechanism for minimizing all waste generation, including Class B and Class C. The industry has responded with some recent process offerings that demonstrate our ability to be flexible and creative in addressing these industry wide challenges. The application of these technologies will aid in the reduction of a significant portion of Class B and Class C wastes, however, we need to further focus our attention on the full spectrum of wastes that are currently without a path to disposal and reconsider our process mentalities.

THE OLD PARADIGM

The industry spent the last 30 years finding ways to reduce disposed waste volume by increasing the concentration of activity on smaller and smaller volumes. In the past, the NRC, the Institute for Nuclear Power Operations (INPO), and the Electric Power Research Institute (EPRI) would monitor and analyze waste volumes by plant. Licensees were graded or ranked based on their *disposal* volume not necessarily on generation volumes. Generators with low *disposal* volume were acknowledged for their good waste reduction practices. Higher volume generators were censured.

Waste processing companies were willing to invest money in super-compactors, incinerators, foundries, and other volume reduction equipment. With disposal pricing primarily based on volume, and by processing waste from many sources, they achieved economies of scale and profited from the volume reduction. The licensee was credited with a lower volume of waste while spending the same or less for the disposal. The result was a financial “win-win”, with the added perception of environmental responsibility. Less waste was being created.

In the mid 1990’s , the disposal facility at Barnwell closed to out-of-compact generators in response to generator states conformance with progress milestones established in the Low Level Waste Policy Amendments Act. At that time, no other disposal options were available for most generators. On-site storage facilities were constructed at almost every nuclear power plant. With alternative disposal options years away, making the most of available storage space was paramount and further supported the volume reduction philosophy.

The result was decreasing volumes of waste with increasing concentrations of radionuclides. The lower volumes and higher concentrations translated into less overall waste, but more Class B and Class C waste.

THE NEW PARADIGM

The disposal facility at Barnwell has again closed to out-of-compact generators as of June 30, 2008. This time, however, generators still have the ability to dispose of Class A waste at the facility in Clive, Utah. This is a critical difference.

Since the NRC waste classification is a concentration based limit derived from the associated dose implication in a disposal environment, it is incumbent upon us to effectively manage radionuclide concentrations. Volume reduction has become secondary to concentration management as generators strive to create wastes that have disposal options.

It is no longer acceptable to volume reduce for perception, or to assume an unnecessarily conservative position in terms of waste classification. The ALARA, logistic, regulatory, and financial implications of storing significant amounts of radioactive material at commercial plants are not conducive to safe and cost efficient operation. The concept of maintaining approximately sixty geographically scattered interim storage facilities present an extremely negative public perception of how the commercial nuclear power industry handles LLRW.

The new goal is not to manage the size, but to manage the radionuclide concentration in LLRW so that the final form meets Class A concentration limits and retains a disposal option. Several things are necessary to achieve the desired results. First and foremost is to establish a well defined and closely monitored program to sample, analyze and quantify the nuclide distributions in all of our various waste streams. Armed with this knowledge, Waste Management personnel can be proactive and ***manage*** Class A waste as it is generated, as opposed to reactively ***dealing*** with Class B or Class C waste after it has been created.

HISTORICAL DATA REVIEW

Proper management of plant B/C waste generation requires a very detailed understanding of both the historical as well as current production mechanism and activity loading rates of various process waste streams.

WMG conducted research and investigation into the actual waste generation and disposal data collected from a vast majority of the operating commercial U.S. nuclear facilities since the inception of 10 CFR 61 and its attendant Branch Technical Positions.

Waste Class information from over 3500 shipments was reviewed over the past 5 years to determine the typical nuclide distribution, the10 CFR Part 61 classification drivers and the average, maximum and minimum concentrations of waste shipped. It should be noted that there was a very wide range of concentrations reviewed. The packaged waste concentrations as determined from the fraction of the Class A limit varied from a low of less than 1E-9 to a maximum Class A fraction of over 443. It is recommended that facilities establish a loading range as a function of classification driving nuclide to limit concentrations of generated waste to remain within the factor of ten criteria for concentration averaging.

The vast majority of the resin waste shipped, or approximately 96% was NRC Class A waste and the average Class A fraction is about 2.6. Even with higher concentrations of waste shipped during the last year of the study, 92% of the material was still Class A.

As expected, the classification status of the population of waste reviewed was driven primarily by Cs-137 and Ni-63 under Part 61 Table 2. These are relatively long lived nuclides and the classification status won’t change appreciably during long term storage. Since these radionuclides have volume based concentration limits, it is the volume of the final waste form, or volume of solidification agent added that dictates the final waste class.

REGULATORY PERSPECTIVE

Waste acceptance at the Clive, Utah disposal site is governed by the site Waste Acceptance Criteria (Ref. 1). The WAC refers to the State of Utah license R313-15-1008 (Ref 2) for waste classification limits. The License refers directly to 10 CFR Part 61 and the NRC's May 1983 Technical Position on Radioactive Waste Classification. Unlike the Barnwell site criteria and license, the Clive license relies solely upon the NRC guidance and does not impose any additional restrictions on concentration averaging or solidification. The May 1983 Technical Position clearly states:

> "*Radionuclide concentrations should be determined based on the volume or weight of the final waste form. Samples may be taken for analysis either from the final waste form or from the waste prior to processing into a final waste form (e.g., from any intermediate process step). Samples taken prior to final processing should enable the results of the sample analysis to be directly translated to the final waste form*"…

Furthermore, the 1995 Branch Technical Position on concentration averaging section C.3.2 states:

> "*Classification of evaporator concentrates, filter backwashes, liquids or ion exchange resins solidified in a manner to achieve homogeneity or meet the stability criteria of 10 CFR 61.56 should be based on solidified nuclide activity divided by the volume or weight of the solidified mass.*"

Therefore, solidification may be an alternative for to that portion of the resin that results in Class B or C waste packages. There are no regulatory limits imposed for how much cement can be used in the mixture or the extent to which the waste concentrations can be reduced with addition of cement. The regulatory guidance focuses on achieving a stable waste form and the lower the waste to binder ratio is, the more stable the mixture becomes. Historically it has been economic considerations that have driven waste generators to maximize the waste loading in each container.

EMERGING *AND* RESURGING TECHNOLOGIES

VES Solidification

The Vinyl Ester Styrene solidification process is a topically approved mechanism for converting readily dispersible ion exchange resins into a free standing monolith for stable storage or disposal. Previous efforts and experience focused on maximizing waste loading as a function of minimizing overall waste volume disposed. This process provides a waste form exceptionally suited for long term storage but concerns associated with the inability to reprocess in the event that future disposal criteria differed significantly from current standards cause apprehension within the industry. The previous cost benefit analyses limited use of this technology. Similar concerns prevented application of this technology to filter encapsulation consistent with the BTP because it would limit individual container volumetric waste loading and was considered unnecessary while disposal access remained available for B/C waste. However, in today's environment this technology is especially well suited to the packaging of filters and concentration averaging of the container activity over the entire waste volume (or mass in the case of transuranic content).

Short Loading Resins

An ever increasing body of experience is available in the commercial industry that supports the concept of short loading resin vessels to maximize utilization of the resin ion exchange capacity during specified run times. The intention is to reduce volumes of historically B or C waste streams by optimizing the loading during operating cycles. Although this has been demonstrated to be effective in reducing volumes it is not in and of itself a strategy to prevent B/C waste generation and should be considered in concert with other strategies and technologies.

FiltrSavr™

FiltrSavr™ is a newly developed software application that integrates with a facilities new or existing tele-dosimetry to provide real time, on-line NRC waste class information. This software significantly enhances the users' decision making ability and allows much finer control of filter generation relative to desired waste class. Site waste stream specific nuclide distribution information and filter specific dose modeling are used as input parameters to provide the user a graphical depiction of the status of in-service filters. Loading rates over time are used as a basis for projection to waste class break points and historical information allows for scheduling of filter changes to optimize site specific loading strategies. Filters may be scheduled for removal as Class A, or concentration averaging information may be applied to establish a percent of waste Class B or C limit that will result in NRC Class A concentrations in the final waste package. This technology can be used in concert with VES solidification to maximize process effectiveness and minimize B/C filter generation.

Blending Within the BTP

Blending of homogeneous waste within the confines of the BTP has long been recognized as an acceptable practice. In fact the BTP recognizes that operational efficiencies and ALARA methodologies can take precedence over consideration of the factor of ten limitations on concentration averaging similar waste forms from varied sources. The existing regulatory guidance provides a reasonable framework for blending of homogeneous waste forms such as ion exchange resins. Plant operators can take advantage of further opportunities for blending by having a detailed understanding of the nuclide composition and generation mechanism of waste that are currently classed as B and C waste.

SUMMARY

Our review of actual industry data indicates that greater than 90 % of the volume of organic Class B and C waste currently generated can be effectively managed using a combination of emerging technologies AND existing technologies to achieve Class A concentrations within the confines of the existing regulatory framework. This will result in 90 % less waste requiring ongoing storage and monitoring at both operating facilities and decommissioning sites.

REFERENCES

1. Code of Federal Regulations Title 10, Part 61 (October 1, 2008)
2. U.S. Nuclear Regulatory Commission, "Branch Technical Position on Radioactive Waste Classification" (May 11, 1983)
3. U.S. Nuclear Regulatory Commission, "Branch Technical Position on Waste Form" (January 1991)
4. U.S. Nuclear Regulatory Commission, "Branch Technical Position on Concentration Averaging and Encapsulation" (January 17, 1995)