RECENT CHANGE TO U.S. REQUIREMENTS FOR TRANSPORTATION OF PLUTONIUM

W. H. Lake (1), F.P. Falci (2), D.R. Hopkins (2), P. Krishna (3), and C. Macaluso (1)

(1) DOE, 1000 Independence Ave., SW, Washington, D.C. 20585, USA
(2) IEC, 8905 Copenhaver Drive, Potomac, MD 20854, USA
(3) TESS, Inc., 2650 Park Tower Drive, Vienna, VA 22180, USA

SUMMARY

The paper describes the historical background for the U.S. Nuclear Regulatory Commission's (NRC's) rules regarding double containment for plutonium bearing solids, and discusses the Department of Energy's (DOE's) petition to the NRC for a change to the rule. The discussions address DOE's reason for petitioning for a change to the rule, the basis for the original double containment rule, and the NRC's basis for the proposed rule. Implications of the proposed rule on transportation activities in the U.S. are also considered.

INTRODUCTION

The NRC's regulations for transport of radioactive material generally follow those recommended by the International Atomic Energy Agency (IAEA); however, there are several notable differences. The NRC's requirement for double containment of plutonium bearing solids is one such difference. The rule, which was promulgated in the early 1970's, was done so in anticipation of a reprocessing fuel cycle for the U.S. nuclear power industry. The U.S. position on this matter is unique. It has not been followed by other nations, even nations that use reprocessing to recycle nuclear fuel. Although the U.S. decided not to reprocess, the rule, which includes several specific exemptions, has remained unchanged until now.

The NRC published a proposed rule and request for comments for Requirements for Shipping Packages Used to Transport Vitrified High-Level Waste (U.S. Federal Register, 1997). The proposed rule adds a fourth element to three exemptions already identified in the rule. It exempts canistered vitrified high-level waste from the NRC's double containment requirements for plutonium which are found in 10 CFR 71.63, (NRC, 1996). Currently, the rule exempts reactor fuel elements, metal or metal alloys, and other plutonium bearing solids

that the Commission determines should be exempt from the double containment requirements. This third category provides opportunity for the Commission to exempt specific forms on a case-by-case basis.

The recent proposed rule was the NRC's response to a petition for rulemaking submitted by the U.S. Department of Energy (DOE) in 1993. The NRC could have responded by exercising the general exemption of 10 CFR 71.63 (i.e., the Commission's determination for exemption). Both options were considered by the NRC. DOE did not indicate a strong preference for either option, and had submitted separate requests for each.

HISTORICAL BACKGROUND

In the early 1970's, the U.S. was preparing for eventual commercial reprocessing of spent nuclear fuel, an activity that had previously been exclusively performed by the federal government. At the time, commercial and government activities related to atomic energy were conducted under the authority of the U.S. Atomic Energy Commission (AEC). Commercial activities were regulated by the AEC's Directorate of Licensing (DL) while activities such as weapons production and research and development for commercial or government use were conducted by the AEC's General Manager (GM).

It was determined by the AEC that commercial reprocessing would result in a significant increase in transport of plutonium over what was already being done to support AEC activities. Plutonium was then typically shipped as plutonium nitrate which is a liquid solution of plutonium in nitric acid. The main concern expressed by some at the AEC was that if released, the nitrate solution would be quite mobile due to its liquid state. It was also determined that plutonium oxide which is a solid, but powdered, compound of plutonium, was a good candidate to serve as an alternate shipping form of plutonium for reprocessing. Critics of the powder form of plutonium oxide argued that it too was mobile or dispersable as well as highly respirable. In addition to these questions, other secondary criticisms of either form were abundant. Considerable discussion followed on this subject as to which, if either, form was preferable, and if the then existing regulations were adequate for the increased transport of plutonium expected once commercial reprocessing of spent fuel began.

When a plutonium transport rule was finally adopted into the Federal Regulations, the AEC no longer existed. In 1975 the AEC was replaced by the Nuclear Regulatory Commission (NRC) which succeeded the DL, and the Energy Research and Development Administration (ERDA) which succeeded the GM. To complete this short history of the AEC and its successors, it should be noted that ERDA was expanded and made a cabinet department when the Department of Energy was formed in 1978.

The final rule which was issued in June 1974, by the AEC, forbids the transport of liquid forms of plutonium that exceeds 0.74 terebequerels (TBq) (20 curies), and requires that solid forms, exceeding the same quantity limit, be doubly contained (U.S. Federal Register, 1974). The notice of the final rule indicated that the reason for requiring double containment for the plutonium oxide powder was its respirability. The notice also recognized two common forms

of plutonium that were determined not to be highly respirable, and therefore, were exempted from the double containment requirement. It was further recognized that other forms of solid plutonium, not yet identified, may have similar properties of low respirability. The final rule included exemptions for reactor fuel elements, metal or metal alloys, and other solid plutonium forms, which were not considered in the proposed rule, but could, if so determined by the Commission, be exempt from the double containment requirement (U.S. Federal Register, 1973).

THE PETITION FOR RULEMAKING

In November 1993, DOE petitioned the NRC to amend the transport regulations by specifically exempting canisters containing solid plutonium in vitrified glass from the double containment requirements of 10 CFR 71.63. On 18 February 1994, the NRC published DOE's petition (U.S. Federal Register, 1994), announcing its availability under NRC docket number PRM-71-11, and requesting public comment on the petition.

Three comments were received on the petition. The comments were from the U.S. Environmental Protection Agency (EPA); Nye County, Nevada (site of the proposed US repository at Yucca Mountain); and the Idaho National Engineering Laboratory Oversight Program of the State of Idaho. EPA was required to review the petition by US law, but had no specific comments or objections. Nye County agreed with DOE's petition. The State of Idaho suggested that the petition was premature because it did not specify parameters or performance standards for the HLW canisters.

A meeting was held between the NRC and DOE staffs on 1 June 1995, to explore the possibility of using the existing regulation to seek a Commission determination of exemption for the canistered HLW. Although this option of the rule for plutonium transport had never before been exercised, NRC expected it to be more expeditious than continuing with rulemaking. The DOE agreed with NRC that use of the existing rule would be easier and faster, and indicated its intent to do so, in a letter dated 25 January 1996. This was followed by submittal of a request for such a determination of exemption on 16 July 1996, but with a request not to terminate the rulemaking on the issue, but rather to hold that process in abeyance until a decision was reached.

The NRC staff prepared a Commission paper requesting approval to proceed with its recommended approach for making the exemption determination requested by DOE. The Commission denied the NRC staff's plan and directed that this policy issue be addressed by rulemaking. In response to the Commission's directive, NRC staff prepared and published the proposed rule (U.S. Federal Register, 1997)

NEED AND BASIS FOR THE PETITION

DOE's need for the requested exemption from double containment for canistered vitrified HLW is its expectation of shipping this material form from several DOE facilities to a DOE operated repository in the near future. In terms of operations, the exemption would simplify

preparation, loading and unloading of casks, thereby reducing worker exposure and operating costs. For cask design, the avoidance of an additional containment boundary will avoid possible complications that lead to reduced capacity. Assuring cask efficiency by maximizing capacity, minimizes the number of shipments, and reduces exposure, risk, and cost. The exemption is being sought now because DOE is beginning to produce canisters of HLW and will soon be seeking certification of cask designs to transport HLW.

The DOE's primary technical basis for seeking exemption from double containment for canistered HLW is that it is not highly respirable. Since the rule does not address or provide a measure of acceptable respirability for exemption, the demonstration could not be direct. The demonstration employed is a comparison of the behavior of the canistered vitrified glass to that of reactor fuel elements under normal and accident conditions of transport. Using this approach it is argued that fracture resistance and characteristics of particles generated from the vitrified glass are comparable to those for reactor fuel pellets, and that stainless steel canister walls are as good as, if not better than, those of reactor fuel cladding.

THE PROPOSED RULE

The rule on special requirements for plutonium shipments are found in 10 CFR 71.63. The proposed rule 10 CFR 71.63 is presented here in its entirety:

"Sec. 71.63 Special requirements for plutonium shipments.

(a) Plutonium in excess of 0.74 TBq (20 Ci) per package must be shipped as a solid.
(b) Plutonium in excess of 0.74 TBq (20 Ci) per package must be packaged in a separate inner container placed within outer packaging that meets the requirements of subparts E and F of this part for packaging material in normal form. If the entire package is subjected to the tests specified in Sec. 71.71 ("Normal conditions of transport"), the separate inner container must not release plutonium as demonstrated to a sensitivity of 10^{-6} A_2 /h. If the entire package is subjected to the tests specified in Sec. 71.73 ("Hypothetical accident conditions"), the separate inner container must restrict the loss of plutonium to not more than A_2 in [one] week. The requirements of this paragraph do not apply to solid plutonium in the following forms:
(1) Reactor fuel elements;
(2) Metal or metal alloy;
(3) Sealed canisters containing vitrified high-level waste that meet the design criteria in 10 CFR 60.135(b) and (c); and
(4) Other plutonium bearing solids that the Commission determines should be exempt from the requirements of this section."

The changes to 10 CFR 71.63 are the addition of 71.63(b)(3), and the renumbering of 71.63(b)(4) which was 71.63(b)(3). The addition of the exemption for canistered HLW is conditioned on the canister satisfying the requirements for contents of a disposal waste package which are NRC's requirements established for repository licensing under 10 CFR 60 (NRC, 1993). These require the waste to be in solid form, in sealed containers, and that

particulate waste forms be consolidated to limit the availability and generation of particulate. In adding these Part 60 requirements the NRC reasoned that although they limit particulate to reduce possible leaching, which is different from the transportation concern of limiting particulate for respirability, they serve similar purposes and have similar results. Furthermore, the NRC believed that the additional requirements address the comment of the State of Idaho.

IMPLICATIONS OF THE PROPOSED RULE

The NRC's proposed rule responds to and satisfies DOE's petition for rulemaking which requested exemption from the double containment requirements for canistered HLW. The one potential complication to the revised rule is the fact that it ties Part 60 repository licensing to Part 71 cask certification when the exemption is used. The concern arises from the fact that canister production and approval for shipment are likely to occur before a repository is licensed and a waste package approved. This would require coordination between the NRC staffs responsible for Part 60 repository licensing and Part 71 transportation cask certification. At a minimum, this might delay the process due to administrative issues related to coordinating the two regulatory activities. In the extreme, consideration of the contents of the waste package for transport certification prior to the beginning of repository licensing could prove to be a somewhat more complicated regulatory issue. However, neither of these concerns seem onerous, and the discussion that accompanied the proposed rule in the Federal Register makes the Commission's intent on this issue sufficiently clear, which should help the NRC staff resolve any issues that might arise.

The fact that NRC has proposed a rule which modifies the double containment requirements for plutonium bearing solids has provided a model for use when other plutonium forms arise that are believed to be worthy of exemption. That is, they are essentially non-respirable. The discussions included in the Federal Register on the proposed rule also provide additional insight into NRC's reason for promulgating the rule in 1974.

The DOE is currently determining its inventory of plutonium, and will be making decisions related to disposition of this material. Some of these decisions will involve the best form for these materials considering such things as storage, transport, and disposal. DOE and NRC both need to consider the efficiency of addressing exemptions for the many and varied forms of plutonium bearing solids that may be identified on a case-by-case basis. A good alternative to this case-by-case approach is to address the underlying concern more directly. That is, devise a performance based requirement for plutonium that uses dispersability, respirability and other particle data as an indicator for exemption.

CONCLUSIONS

Although the U.S. has abandoned earlier plans to reprocess spent nuclear fuel, the special rules for shipment of plutonium that are unique to the U.S. transport regulations remain. This rule, which became effective in 1974, required all shipments of plutonium in excess of 0.74 TBq to be in solid form and doubly contained. For practical reasons, the NRC exempted reactor fuel elements, metal or metal alloys, and other forms as determined by the

Commission to warrant exemption. Although respirability was given as the basis for the two specific exemptions included in the original rule, quantitative criteria for exemption was never provided.

The NRC's current proposed rule which was developed in response to DOE's petition for rulemaking, exempts canistered HLW from the double containment requirements of 10 CFR 71.63. Because a quantified exemption criteria was never established, DOE used a comparative argument to demonstrate that canistered vitrified HLW was similar to the already exempt spent nuclear fuel with regard to its integrity and respirability.

The NRC's processing of DOE's petition, and its proposed rule, demonstrates a willingness to consider exemptions to this special rule for plutonium. The proposed rule and its accompanying discussion is an important step towards developing a quantitative criteria for exemption to the double containment requirement. Should the double containment rule for plutonium persist, the NRC should consider establishing quantitative criteria that are based on respirability for exemption of plutonium forms.

REFERENCES

U.S. Federal Register, Vol. 62, *Nuclear Regulatory Commission, 10 CFR 71, Requirements for Shipping Packages Used To Transport Vitrified High-Level Waste*, pp 25173-25174, 8 May 1997.

U.S. Federal Register, Vol. 59, *Nuclear Regulatory Commission, 10 CFR 71,[Docket No. PRM-71-11], U.S. Department of Energy, Receipt of a Petition for Rulemaking*, pg. 26608, 18 February 1994.

U.S. Federal Register, Vol. 39, *Atomic Energy Commission [10 CFR Part 71] Packaging And Transportation Of Radioactive Material, Form for Shipping Plutonium*, pg. 20960, 17 June 1974.

U.S. Federal Register, Vol. 38, *Atomic Energy Commission [10 CFR Part 71] Packaging And Transportation Of Radioactive Material, Form for Shipping Plutonium*, pp 20482-20483, 1 August 1973.

NRC, United States Nuclear Regulatory Commission, Rules and Regulations, Title 10, Chapter 1, Code Of Federal Regulations - Energy, Part 71, *Packaging and Transportation of Radioactive Material*, 1 April 1996.

NRC, United States Nuclear Regulatory Commission, Rules and Regulations, Title 10, Chapter 1, Code Of Federal Regulations - Energy, Part 60, *Disposal of High-Level Radioactive Wastes in Geological Repositories*, 29 October 1993.

H:\DOC\PTFP-237.WPD