Reflections Upon the Nuclear Transport Regulations as They Have Emerged Over the Past Several Decades

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INTRODUCTION

Prior to 1968, the nuclear transport regulations in the USA might have been characterized as not being very comprehensive. This all changed, however, in late 1968, when a major milestone was reached. Each of the two major regulatory agencies, the USDOT and USAEC finalized very major amendments to 49CFR [1] and 10CFR [2], to incorporate the international standards as then existing in the 1967 edition of the International Atomic Energy Agency's (IAEA) Safety Series No. 6. Since 1968, one other major revision to U.S. regulations took place in 1983 when the DOT [3] and now NRC [4] each promulgated extensive amendments based now upon the 1973 IAEA Safety Series No. 6 standards. Another major revision by those two agencies is also expected in 1990 when amendments based on the 1985 version of the IAEA standards are scheduled to be finalized.

Notwithstanding the above, during the past two decades, a number of other very important regulatory changes have emerged from DOT and NRC, which were neither related to, nor were based upon any specific existing IAEA standard. In some instances, they were based directly upon a specific mandate from the Congress, and in others, they were the result of a perceived need as a result of some event or other consideration. In this paper, the author, who was directly involved with the processing of a number of those rule-makings, briefly reflects upon some of them, recollecting the major issues which were their driving force and impacts of their adoption.

The author concludes with a discussion of several on-going issues, which in his view, may impact on future USA regulations.

* The views represented in this paper are solely those of the author and should not be construed as being those of the Nuclear Regulatory Commission or its staff.

These reflections begin with a recounting of two major incidents, the first on December 31, 1971 and the other on April 5, 1974. Each involved shipments of radioactive materials on passenger-carrying aircraft and each had the impact of causing an issuance of a new regulation.

The first event was and remains, probably, the most widely publicized nuclear transport incident ever recorded. It involved contamination which spread from a leaking package being carried in the cargo hold of a passenger-carrying aircraft.

During a flight from New York City to Houston, about 250 c.c.(32 Ci.) of molybdenum-99 liquid leaked from a Type B package which had originated in Tuxedo, NY. It contaminated the cargo hold and many of the pieces of luggage from that flight as well as later flights. Before the contamination was discovered and reported several days later, the aircraft had made a total of nine flights into eleven cities, carrying over 900 passengers. After removal from service, the aircraft was decontaminated under the supervision of public health officials. Due to cases being reported of contaminated luggage of passengers in a number of cities, the air carrier, in cooperation with government and state agencies, established monitoring locations in the various cities. Through telephone contacts and press releases, passengers were afforded the opportunity to have their luggage monitored for contamination and decontaminated, if necessary.

Subsequent investigation of this incident indicated that the leakage was caused by improper packaging due to inadequate provision for liquid contents in the containment system of the package, as well as a faulty closure. Storage of the package on its side during stowage in the cargo hold was also a contributing factor. As a result of the Federal investigation, the shipper was assessed with a substantial civil penalty. This incident received very extensive world-wide media coverage.

Special studies of the event were done by the Congressional Joint Committee on Atomic Energy and the National Transportation Safety Board [5]. The DOT developed and issued several new regulations requiring more specific quality control measures prior to shipments and specific leak testing of the containment system prior to shipment of any type B package of liquids destined for air shipment. The NRC also published requirements for licensees' procedures for pickup, receiving, and monitoring of packages for contamination and radiation.[6] More than anything else, however, this event was a "changing of the era" in that it created a heightened awareness by the public on the existence of nuclear transportation generally. Up until that time, the nuclear transportation community had enjoyed the "luxury" of remaining out of the spotlight from the increasing public awareness and anti-nuclear sentiment which was emerging in the early seventies, focusing on nuclear power plant siting and environmental issues.

The second event involved the shipment of a Type B quantity as a 32 Ci. Iridium-192 special form source in a source changer device aboard a passenger-carrying aircraft. Due to an improper source change procedure by the shipper prior to shipment, the package as offered for transport, contained the source in an unshielded position, causing a high radiation dose rate from the package. After delivery to Washington, D.C. National Airport by the radiographer in his own vehicle, the package then went on a passenger-carrying aircraft to Atlanta,Georgia, then on to Baton Rouge, Louisiana via another aircraft. Upon arrival, it was delivered to the consignee's facility by a local carrier. An abnormal situation was first detected when the consignee's area radiation monitor alarmed as the delivery truck backed up to the loading dock.

Whereas, the first event was a contamination problem, this one involved external radiation. Each involved passenger-carrying aircraft and each received world-wide media coverage. This incident was investigated by two Federal agencies, who each subsequently levied civil penalties against the consignor for the packaging violations. It was also investigated by a Congressional subcommittee. Shortly thereafter, that played a large part in causing the insertion of a specific provision in the Hazardous Materials Transportation Act (HMTA). That provision [7] directed the DOT to issue a regulation within 120 days which would prohibit the carriage of any non-medical or non-research radioactive materials on passenger-carrying aircraft. An interesting sidelight to that law was its establishment of the 0.002 uc/gm regulatory definition of "radioactive material" as the baseline for its applicability. What this meant was that the new "end-use" restriction would also prohibit non-medical and non-research limited quantity, excepted packages from carriage on passenger-carrying aircraft. As a way of continuing to permit such shipments, the DOT exercised the exemption authority of the same Act and issued a statutory exemption for two years on May 3, 1975. It has been renewed in the regulations every two years since that time [8]. In order to eliminate this administrative rule-making burden, it will be necessary to obtain a legislative revision to the Act.

In 1974 the DOT finalized an extensive parcel of miscellaneous radioactive materials rule changes, [9] which had been under development since the issuance of the extensive amendments in 1968 to adopt IAEA regulations. Several of these are discussed below. Prior to 1974, authorized DOT specification type A packages included a "laundry list" of DOT <u>design</u> specification boxes, drums, and cylinders, which had been deemed to meet the type A test conditions without further testing. Since 1968 the DOT Specification 7A <u>performance</u> specification had also been listed as an authorized package. DOT had received some reports that failures of certain of the <u>design</u> specifications had occurred under transport conditions less severe than the type A tests, e.g. during a fall of three feet off the back of vehicles. Responding to these reports, DOT "delisted" all of the design specifications, leaving the DOT Spec. 7A as the only authorized type A packaging. One very important "string" was attached, however. Its use now could only be under a provision that each shipper must retain on file a complete documentation of the

analysis describing the tests or evaluations which had been made to determine compliance with the performance requirements. Implementation of this new requirement has proven to be a real challenge to shippers, package suppliers and also to the regulators, as well. In this regard, the generic work which has been done by Mound Laboratories, under DOE auspices, in 1975 and again in 1987, [10] has been a noteworthy contribution to the art and science of performance standards implementation into hazardous materials transport regulations. It is interesting to note that IAEA regulations do not contain any equivalent to the U.S. requirement for the shipper to "prove his case" when using a "self-approved" type A package. In the author's view, the IAEA would do well to adopt such a requirement into the international standards.

Another outwardly minor, but in effect, a very important amendment involved a simple one-word change of an "or" to "and." Whereas type A packages containing liquids had been required to withstand either a 30' drop test or be provided with double absorbents, such packages were now required to meet both requirements, by means of this one-word change. As a practical matter, many, but not all shippers of small liquid-containing packages, e.g. literally millions of packages of medical radioisotopes, did in fact utilize absorbents. The 30' drop test alone was recognized by itself to be an insufficient impact test for such packages, which are typically lightweight--they bounce! Absorbent materials therefore provide a practical safeguard against the possibility of quality control deficiencies, such as a loose cap on a vial lid. Consequently, the addition of this requirement to provide liquid absorbents has proven to be a highly effective (including cost-effective) means of of assuring safety and liquid containment for literally millions of packages in the normal transport environment. This requirement was also adopted into IAEA standards upon the recommendation of the USA.

The 1974 amendments also included the publication of several new "DOT SPEC" Type B/fissile package designs and associated content authorizations to complement the two which had been published earlier, e.g., the DOT-6L and DOT-6M. These new specifications included the DOT-20WC round "wooden overcoat," the DOT-21WC square "wooden overcoat," the DOT-20PF and DOT-21PF series of protective overpacks for shipment of cylinders of enriched uranium hexafluoride.

These few DOT specification type B/fissile packages have in the author's view become "museum pieces," since no new specifications have been published in DOT regulations for over fifteen years. Serious questions have been raised as to whether there should be such specifications in the regulations at all or whether all such packages should only be those which are specifically NRC-certified. Questions have also been raised as to whether the existing specifications meet all of the current standards. I understand that DOT, in April 1988 and again in April 1989, listed on its annual regulatory agenda, a future advanced notice of proposed rulemaking to request public advice on this issue.

I am sure that most of us are well aware that nuclear transportation in the USA is jointly regulated at the Federal level by two agencies-DOT and NRC. Prior to late 1979 the NRC program for inspection and enforcement was a minimum program. The reason for this, of course, being that NRC regulations in 10CFR71 dealt only with the package and package approval standards for type B/fissile packages, i.e., any quantities exceeding type A or fissile-exempt.

Following a very heightened public concern expressed by three state governors in mid-1979 over continuing deficiencies in the quality of low-level waste shipments to the burial sites in their states, the NRC Chairman made commitments to those governors to take actions to assure that the quality of such shipments by NRC licensees would improve. One of the actions was the issuance of an amendment in late 1979, specifically 10CFR71.5(a), [11] which had the immediate effect of adopting the shipper requirements of 49CFR as direct NRC requirements on its licensees. Practically speaking, as a result of that amendment, the NRC inspection program was immediately expanded to include all DOT requirements applicable to type A, limited quantities, LSA, etc. A bulletin was also issued to all generators or shippers of low level wastes. That bulletin requested all licensees to immediately carry out certain actions to improve their low-level waste and transportation programs.

Thus, as a result of this one paragraph amendment, during the past decade, inspection of transportation activities of all its licensees, e.g. reactors, fuel facilities and materials licensees, has become an integral part of the routine NRC program for inspection of radiation protection. Regional inspectors are provided with training in NRC and DOT regulations and appropriate inspection procedures and guidance have been developed. A system and policy for processing of penalties for violations of transport regulations has been issued, including escalated sanctions, such as civil penalties, when appropriate [12].

Any reflections on major transport regulatory actions of recent memory would be quite incomplete without some mention of the DOT's regulations for routing of Highway Route Control Quantities (HRCQ), the now famous Docket HM-164. In 1976, New York City amended its health code regulations so as to, in effect, create an embargo on the transport of most types of non-medical radioactive materials, especially spent fuel, in or through the City. This action directly impacted spent fuel shipments from Brookhaven National Laboratory and future shipments from the Shoreham Station, each of which are located on eastern Long Island, having no alternative land route from the area, except to travel through the City. Brookhaven responded to the New York City embargo by petitioning the DOT for an administrative ruling as to whether the Code was inconsistent with, and therefore pre-empted under the authority of the HMTA. DOT subsequently ruled that the New York City Code was not inconsistent and therefore, not pre-empted. This ruling was based on a determination that the Code was, in effect, a routing regulation. This being the case, since there were no regulations on the

books to require routing controls for spent fuel shipments, it could not be inconsistent with regulations that did not exist. The DOT then proceeded to establish a rulemaking to implement such routing regulations, e.g.Docket HM-164. This effort culminated in early 1981 [13], when nationally applicable standards for highway routing, driver training and route plans were published. Since the New York City Code was inconsistent with these new Federal regulations, it was automatically pre-empted. This whole story does not end there, however. Since the start of the HM-164 docket, there have been many rounds in what has now become a 12-year battle over the routing rule and related issues. Much has been published elsewhere describing these rounds and your author wouldn't attempt to get into any more details herein. Suffice it to say, however, the winner of the latest round may have been the City. In 1985 the DOT denied an application to the City for a waiver of statutory pre-emption of their health code embargo banning shipments through the city. In December 1988, the U.S. District Court for the Southern District of New York vacated the DOT decision and remanded it to them for a decision. The applicable Pre-emption Determination Docket has since been reopened and public comment invited on March 28, 1989.

In May 1980, the DOT finalized revisions to 49CFR [14] to incorporate hazardous materials identification numbers for each of the hazardous materials proper shipping names listed in the regulations. This effort really began in earnest about five years earlier, shortly after DOT had published a massive amendment consolidating the regulations for all modes of transport into a single CFR-Title 49. Previously they had been codified in three separate CFR's. In the 1975 amendment, a new uniform RADIOACTIVE placard was also adopted for all modes of transport. The 1980 amendments included hazardous materials identification numbers for the radioactive materials proper shipping names. These numbers have since been required on package markings and shipping papers and are used in conjunction with a separate "Emergency Response Guidebook for Initial Response To Hazardous Materials Incidents," which was first issued in 1980 and has since been revised in 1984 and 1987. The principal objective of the new regulations was to improve the capabilities of first response emergency personnel, such as firemen, police, etc., to quickly identify hazardous materials and to assure accurate transmission of information to and from the scene of a hazardous materials transport emergency. This system has proven to be an invaluable component of overall emergency response planning, and related training programs of local and state agencies.

During the past 15 years, the NRC has issued two very significant regulations affecting the shipment of plutonium. The first of these, now codified as 10CFR 71.63, was first published in June 1974 [15], requiring that any quantity of plutonium exceeding 20 Ci. must be shipped as a solid. Further, such quantities must be packaged in a

separate inner container placed within an outer packaging which meets the regulatory tests for normal and accident conditions. Release limits were specified for the inner and outer packagings. The initial proposal for this regulation would have required the inner containment to be "special form," however, in the final rule, this was later modified to the above requirement for double containment. Certain forms of plutonium were excepted from the requirement, e.g., reactor fuel assemblies and metal or alloy. There can be no doubt that this "form of plutonium" regulation has had a very significant impact on the design and development of the TRUPACT package which will be used for shipments of transuranic waste to the Waste Isolation Pilot Plant (WIPP). DOE is obtaining NRC certification for this package.

The other plutonium amendment, now codified as 10CFR 71.88, sets forth requirements for the air transport of plutonium. In 1975, as a Congressional mandate, e.g., the "Scheuer Amendment" [16], the NRC was precluded from licensing any air shipments of plutonium until it had certified that it had..."developed and tested a safe container which will not rupture under crash and blast testing equivalent to the crash and explosion of high flying aircraft." An Order was then issued to effect this mandate. The NRC then funded the development and testing by Sandia Labs of the PAT-1 package and DOE funded the PAT-2 package. Each was subsequently certified. The Order was later superceded by the present provisions now codified in 10CFR 71.88.

Neither of these two regulations on plutonium shipments have had any substantial impact on commercial shipments of plutonium, since, in the absence of any industry for reprocessing of spent fuel, there are very few shipments of plutonium taking place domestically. These regulations do however, represent very significant differences of USA standards from international standards.

Another activity relating to "PAT" type packages is that which is currently underway as a result of the "Murkowski Amendment" [17] to the Omnibus Budget Reconciliation Act of 1987. This Amendment mandated certain additional design and test criteria applicable to certification of any packagings intended for transport of plutonium by aircraft through U.S. airspace from one foreign nation to another.

Finally, some mention should be made of several possible future regulations which are looming on the horizon. By late 1990 it is anticipated the Federal regulations in 49CFR [18] and 10CFR [19] may have been amended so as to incorporate the IAEA standards in the 1985 edition of Safety Series No. 6. Several of the features therein, if adopted by the USA could have a substantial impact on domestic transportation of nuclear materials. The probable revision of the requirements for low specific activity materials (LSA) could significantly impact shipments of low level wastes. In effect, LSA materials would have to be so limited that the dose rate from unshielded material outside its packaging does not exceed 1 rem/hr at three meters. A large number

of present "greater than Type A LSA materials" are now shipped in NRC-certified type A packages, e.g., filters, spent resins, etc. Many such materials could have unshielded dose rates exceeding the new limit, and therefore, be required to be shipped in Type B packings. In lieu of that, the quantity of material in each package could be reduced, but at the expense of increasing the total number of shipments. A further complication is the fact that the current inventory of available certified Type B waste casks in this country is quite small.

The other possible change which could impact transportation operations, would be the regulatory adoption of the new IAEA quantitative limitations on annual exposures to occupationally exposed transport workers. These standards establish three tiers of annual exposure levels. As a practical matter, adoption of regulations to implement such limits could radically change the nature of the carriers presently used for transport of nuclear materials, particularly non-exclusive use shipments. Whereas, common or contract carriers are presently exempted from licensing, in the author's view, it does not appear credible that such carriers could be expected to exercise the necessary occupational radiation exposure monitoring programs in the absence of additional specific regulation imposing additional operational controls. Such controls might only be achievable and enforceable by means of commitments made to some form of a licensing or registration system.

Uranium hexafluoride (UF_6) packaging requirements have been the subject of considerable discussion by the IAEA and its advisory groups during the past five years. The main discussion has been with regard to whether or not Safety Series No. 6 should contain additional standards to address the non-radioactive hazard characteristic of this material. Several consultant reports and a technical document [20] have been issued. The bottom line of these reports is that a recommendation has been made to the Agency that the transport regulations should be amended to include certain new requirements, including one which would require that bare cylinders of natural and depleted (UF_6) be provided with fire resistance. Thus far, this requirement is still being deliberated and has not been formally adopted into Safety Series No. 6. If it is, the major implication of any subsequent adoption into U.S. regulations is that protective overpacks would be required for all cylinders of natural and depleted UF_6. Enriched UF_6 cylinders are already provided with fire resistant protective overpacks as a result of the fissile material packaging requirements.

CONCLUSIONS

The evolution of the nuclear transport regulations over the past two decades in the U.S.A. has been quite dynamic. This paper has reflected on a number of the significant amendments during that period which were not generated as a result of the two major actions in 1968 and 1983 which were intended to maintain harmonization between U.S.A. standards and the IAEA standards in Safety Series No. 6. To a certain extent, several of these U.S.A. changes have even moved in the opposite direction of harmonization. What about the future? What is in store

for this regulatory evolution over the next two decades? The author predicts that the emerging regulations will continue to be quite dynamic. He would also predict that the largest impacts on the development of new standards will be those resulting from institutional issues, rather than technical issues or actual transport safety experience. A likely candidate for a regulation-generating source will be institutional issues surrounding the expected surge of transportation after the turn of the century associated with the operation of a national repository for spent fuel, with or without a monitored retrievable storage facility.

REFERENCES

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[14] Federal Register, 45 F.R. 34560, May 22, 1980, Dockets HM-126 A&B, HM-145 A&B, HM-159, and HM-171
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