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July 26, 2002

Secretary, U. S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
Attention: Rulemaking and Adjudications Staff
By Overnight Courier and internet (http://ruleforum.llnl.gov)

Dockets Unit
U. S. Department of Transportation
Room PL 401
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By Overnight Courier and internet (http://dms.dot.gov)

Proposed Rulemakings Of NRC And DOT
Concerning IAEA Publication TS-R-1
And Compatibility With IAEA Safety Standards:
Amendments To
NRC Regulations In 10 CFR Part 71 (NRC Docket RIN-3150-AG71)
and
DOT Regulations In 49 CFR Part 171 et al. (DOT Docket RSPA-99-6823 (HM-230))

Dear Ladies and Gentlemen:

Enclosed you will find the comments of J. L. Shepherd & Associates in the above-captioned rulemakings. Please enter them into the rulemaking docket.

Sincerely yours,

Donald P. Irwin
Counsel for J. L. Shepherd & Associates

Enclosure

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July 29, 2002

COMMENTS OF J. L. SHEPHERD & ASSOCIATES ON
PROPOSED RULEMAKINGS OF NRC AND DOT
CONCERNING IAEA PUBLICATION TS-R-1
AND COMPATIBILITY WITH IAEA SAFETY STANDARDS:
AMENDMENTS TO
NRC REGULATIONS IN 10 CFR PART 71
(NRC DOCKET RIN-3150-AG71)
AND
DOT REGULATIONS IN 49 CFR PART 171 ET AL.
(DOT DOCKET RSPA-99-6823 (HM-230))

I. INTRODUCTION AND SUMMARY OF COMMENTS

J. L. Shepherd & Associates ("JLS&A") appreciates this opportunity to comment on the proposals by the U. S. Nuclear Regulatory Commission ("NRC") and Department of Transportation ("DOT") to amend their regulations dealing with the transportation of radioactive materials, in order to achieve harmonization with the current standards promulgated by the International Atomic Energy Agency ("IAEA"), referred to as TS-R-1.[1] JLS&A commented previously by letter dated September 29, 2000 on a prior version of the current rulemaking proposals and, except for the issue discussed below, relies still on its comments in that letter (Exhibit 1 hereto). JLS&A has no difficulty with many of the current proposals and applauds the obviously careful coordination of effort between the NRC and DOT. Given the close relationship between the NRC and DOT proposals and the rulemakings in which they are being made, JLS&A is filing these comments jointly with both agencies as a matter of efficiency. These comments relate to both the rulemaking proposals and the draft regulatory assessments published with them.

JLS&A's current comments are focused on one issue: the proposal by both NRC and DOT, pursuant to TS-R-1, to eliminate the use of all packages designed to earlier standards than the 1985 version of IAEA Safety Series 6. JLS&A recognizes that there are numerous types of packages manufactured to several generations of pre-1985 standards. JLS&A is concerned with only one of them: packages manufactured to IAEA 1967 Safety Series 6 requirements, referred

[1] NRC's proposed regulation, Compatibility with IAEA Transportation Safety Standards (TS-R-1) and Other Transportation Safety Amendments, is published at 67 Fed. Reg. 21390-21484 (April 30, 2002). DOT's proposed regulation, Hazardous Materials Regulations: Compatibility with the Regulations of the International Atomic Energy Agency, is published at 67 Fed. Reg. 21328-21388 (April 30, 2002). The IAEA standards are IAEA Safety Standards Series, Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised), Requirements No. TS-R-1 (ST-1, Revised) (Vienna, 2000).

to herein as "1967 Specification" packages,[2] as used for shipment of Type B quantities of special form radioactive material. The NRC proposal would extend an existing ban on construction of further such packages holding an NRC Certificate of Compliance ("COC"), and would ban further use of existing such packages three years after the date of effectiveness of the regulations.[3] The DOT proposal would also immediately ban further construction of 1967 Specification packages, and would ban further use of existing packages within two years.[4] The ban would be effective for both international and U.S. domestic shipments. After these dates, the only means of certifying new transportation packages (either new designs or recertifications of 1967 designs) would be via new Certificates of Compliance issued by the NRC.

JLS&A's comment may be summarized as follows:

1. There is no compelling safety case to be made for the proposed elimination of 1967-Specification packages. There is no demonstrable harm to be avoided by "sunsetting" these packages; there is no demonstrable safety gain to be achieved by requiring their replacement with newer designs. Packages built pursuant to NRC COCs have an excellent safety record. So have packages built pursuant to DOT Specifications 7A/20WC. Both NRC and DOT agree that the current level of safety is satisfactory. This proposed change may be legitimately needed for uniform regulation of international shipments, but is not needed for safe, uniform regulation of domestic shipments.

2. Applied to domestic shipments, it is likely to have far different effects than those intended. It will impose high, probably unbearable costs for JLS&A and other small but important business entities operating this area. Thus, rather than simply phasing out a widely used and serviceable but older class of container, it will either substantially weaken firms like JLS&A or literally drive them out of business with no ready successors.

3. It may be literally impossible to qualify devices built for shipment as DOT Specification 7A packages in DOT Specification 20WC containers at any cost because these devices

[2] Various other types of pre-1985 package specifications include specifications, some of them predating 1967 Safety Series 6, initially issued by the former interstate Commerce Commission, the former Bureau of Explosives, and other agencies. These comments do not address them.

[3] See 67 Fed. Reg. 21406 at col. 3, 21429 col. 3, 21430 col. 3 (§ 71.19). In this regard, the actual proposal is not, despite NRC's suggestion, really "grandfathering," which, as the NRC observes, "typically includes provisions that allow: (1) Continued use of existing package designs and packagings already fabricated, although some additional requirements may be imposed; [and] (2) completion of packagings that are in the process of being fabricated or that may be fabricated within a given time period after the regulatory change...." 67 Fed. Reg. 21404 col. 3. Rather, it is a timed ban.

[4] See 67 Fed. Reg. at 21342 col. 1 (§ 173.416), 21355 col. 2.

lack the "QA Paper" required under the NRC's regulations at 10 CFR Part 71, as implemented by the NRC Staff. The same is also true of packages built pursuant to NRC COCs prior to implementation of the Part 71 QA program. As a result, literally thousands of Type B quantity sources, which have been shipped in 1967 Specification packages and which cannot be shipped economically if at all in any other licensed packages, will become stranded at hundreds of disparate current locations throughout the country. While "workarounds" of various kinds are technically imaginable, their costs seem likely to be prohibitive. The result will be that these packages will have to be maintained and kept safe indefinitely from radiological and safeguards/security standpoints. This is not a sensible result at any time, particularly one of heightened concerns about terrorism.

4. The NRC's draft Regulatory Analysis, by omitting any evaluation of conversion costs to the industry, has misperceived the effect of this provision; DOT, by relying on the NRC's analysis, has the same problem. Neither agency has advanced a substantial health-and-safety argument, or indeed any substantial argument other than consistency with IAEA requirements (which are not binding under U.S. law), for compelling the elimination of these workhorse containers from continued use in U.S. domestic commerce, and JLS&A believes that there is no such argument to be made. It is useful to incorporate technical advances in equipment into regulations, but not sensible to require costly change with respect to adequate existing equipment absent significant offsetting safety or other statutory-policy justifications not present here. JLS&A urges that NRC and DOT modify this proposal, as applied to 1967-Specification containers used for Type B special-form shipments, so as to limit the proposed changes to international shipments only. NRC has expressed a willingness to depart from IAEA standards for domestic purposes where benefits do not justify costs; JLS&A suggests that this is such a case. JLS&A also points out that given the absence of a compelling health and safety rationale, the proposal must be judged on the basis of whether it is sufficiently fulfills other statutory purposes to justify the costs that it imposes, and suggests that a reviewing court might not find such a justification.

5. JLS&A and numerous other participants in this market sector are small entities within the meaning of the Regulatory Flexibility Act, 5 U.S.C. § 601 *et seq.*, and the NRC's regulations at 10 CFR § 2.810, would be adversely affected by the proposed rule, and neither agency's draft Regulatory Analysis accounts for this fact.

II. <u>JLS&A'S INTEREST IN THIS RULEMAKING</u>

JLS&A would be significantly and adversely affected by the proposed elimination of 1967 Specification packages for domestic special form Type B shipments of radioactive material. A brief introduction to JLS&A and its business follows:

- Since 1967, JLS&A has been in the business of designing, manufacturing, servicing, shipping and disposing of devices – principally, calibrators and irradiators – that use Type B quantities of Cobalt-60 or Cesium-137 sources (greater than 10.8 curies of Co-60 or 54.1 curies of Cs-137). The radioactive sources are manufactured in "special form", which means that they are shaped, controlled and contained in their own substantial, accident-resistant, tested metal casing.[5] The actual device consists of the special-form source, a surrounding heavy metal (lead, tungsten, DU) radiological shield, and an external housing (made of steel).[6] The housing and the shielding are integral to the device itself, and are shipped as part of it. However, for NRC and DOT regulatory purposes they are part of the "packaging" surrounding the source.[7]

- As outlined in more detail below, virtually all of the devices manufactured or serviced by JLS&A use sources that contain Type B quantities of radioactive material. Some are shipped in packagings approved under a Certificates of Compliance issued by NRC. The vast majority of devices, however, are designed to qualify under DOT regulations as DOT Type 7A packages which, when fitted with a metal jacket and contained in a DOT Specification 20WC overpack, may be used to transport Type B quantities of radioactive material in special form.[8]

- While transportation of these devices is regulated by NRC or DOT, depending on their configuration, their manufacture is regulated by the State of California, as an Agreement State, under its delegated authority to regulate source material. When manufacture of a device is completed, it is typically trucked to the customer's site. There, it is put into its

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[5] NRC and DOT regulations for qualification of special-form sources are substantially identical and require impact, percussion, bending, heat and leaching tests. 10 CFR § 71.75, 49 CFR § 173.469.

[6] Specimen trays, control drives, instrumentation and indicators, and other peripheral equipment are added for actual operation of the device. They are not typically included in the shipping configuration. See "Typical JLS&A Device Diagram," Exhibit 2.

[7] A "package," as defined by both NRC and DOT regulations (10 CFR § 71.4, 49 CFR § 173.403), includes both a radioactive source and the surrounding "packaging" which makes it safe for shipment. The "packaging" consists of heavy-metal (lead, tungsten, DU) radiological shielding and a housing, and – for actual shipment – an top-layer external container or "overpack." Together, these provide radiological shielding and physical protection of the source, and ensure the physical integrity of the device in use and in transit. The designs used by JLS&A and by numerous other manufacturers include the shielding and housing as an integral part of the device. Thus the device itself includes part of the "packaging" regulated by NRC and DOT.

[8] See 49 CFR § 178.350 (design criteria for 7A packages); 49 CFR § 178.362 (design criteria for 20WC packages); 49 CFR § 173.416(e) (design criteria for authorized Type B packages). DOT Specification 7A is a very flexible design specification. JLS&A devices of this type are actually manufactured to the criteria of former DOT Specification 55, a far more stringent, superseded specification which preceded Specification 7A. The difference between Specification 55 and Specification 7A was that Specification 55 packages were designed to be shippable without need for an overpack: hence, their greater weight, shielding and the like relative to 7As.

operating configuration: specimen tray, drives, controls and instrumentation are added. There it stays, is listed in the Sealed Sources and Devices (SS&D) registry, and can be used, typically in a laboratory environment, without need for further transportation (barring relocation at the customer's instance or a need for service), for on the order of 30 years. At about that point it will need either to be re-sourced or decommissioned. It is then placed again into its shipping configuration and shipped again. Unless it has been relocated in the meantime, these are the only times a device is actually transported. This is the class of device which, if 20WC containers are eliminated, will become untransportable.

- Transportation containers for these devices are designed, within regulatory criteria, to meet the specific properties (size, weight, level of radioactivity, etc.) of the radioactive cargo they carry. Thus there have been numerous types of container designed and approved under the 1967 (or 1985 or 1996 or 2000) IAEA standards, but it is not the case that any such container can contain or safely transport just any cargo: container and cargo designs are matched (though individual devices do not have dedicated shipping containers). As noted above, under NRC and DOT definitions of "package" and "packaging", the radiological shielding and housing of the actual devices is included within the definitions of "packaging," thus tying transportation of devices tightly to the actual external containers designed for their transportation. As a result, eliminating 1967 Specification packagings would make it impossible to transport the types of radioactive sources for which they were designed, unless corresponding new containers are designed, tested and approved.

- There are two types of outer containers, or "overpacks," both designed to 1967 Specifications, used by JLS&A for shipment of these devices: those licensed pursuant to COCs from the NRC, and those designed pursuant to DOT Specification packages. JLS&A owns and uses two overpacks manufactured pursuant to COC 6280[9] and some 15 DOT Specification 20WC overpacks to ship these devices. These containers are made of reinforced plywood, generally with a steel outer casing, in the shape of a right cylinder. Typical containers stand about six to seven feet high and four to five feet in diameter. Empty, these overpacks weigh up to 2000 pounds apiece. Loaded with a device, the DOT 20WCs weigh up to 6000 pounds; NRC COC containers weigh up to slightly over 10,000 pounds. The principal basis for difference in size and weight is a difference in radiological capacity: the contents of 20WCs are limited by DOT regulation to 100 watts of decay heat output; the COC containers have container-specific restrictions. Neither of these container types is designed to transport irradiated reactor fuel.

[9] JLS&A has committed to the NRC, for reasons unrelated to this rulemaking, not to use any of its COC containers further until they have either been qualified under the TS-R-1 standards or exempted from them. JLS&A is the certificated owner of two COC designs in addition to COC 6280. JLS&A owns all of the overpacks manufactured to these COCs.

- The significant majority of JLS&A's business is totally internal to the United States. Currently in the United States there are about 1000 devices designed and manufactured by JLS&A for shipment in 1967 Specification containers, pursuant to either an NRC COC or to DOT Specification 20WC. These devices are found at every nuclear power plant in the country, in universities, hospitals and blood banks, and in other private, government and military research facilities. Depending on the year, between 65% and 85% of JLS&A's shipments are for the benefit of taxpayer-funded sources, meaning that any substantial increase in the cost of shipment of these devices will affect programs as diverse as medicare, medical research, defense and homeland security spending.

- The devices need to be refitted with fresh sources periodically and to be refurbished from time to time. They may also need relocation because of corporate reorganizations, openings of new facilities and closings of old ones, and the like. Eventually, they need to be decommissioned. All of these processes require shipment of radioactive materials. JLS&A performs these types of services not only for its own equipment but also for devices manufactured by various other firms now defunct; for some of them, JLS&A is the only firm in the country possessing all the drawings and other records necessary to make legal shipments. For instance, one obsolete type of device distributed under the aegis of the former AEC is known to be located in at least five high schools and 28 colleges or universities around the country, awaiting shipment for decommissioning. Under the proposed regulations these would be orphaned. There are numerous other similar examples, which could be determined by license searches.

JLS&A agrees with the need for uniformity in international regulation, and thus with the proposal to accept the IAEA's elimination of 1967 Specification containers for international shipments. However, applying it to domestic shipments, where 1967 Specification packages are still in widespread use with an excellent safety record, would impose substantial economic, environmental and safeguards/security costs without any apparent offsetting benefit. NRC and DOT are not legally required to adopt IAEA standards for U.S. domestic purposes; there are no compelling reasons to do so. Under these circumstances, and given the likelihood of substantial harm from applying the ban, JLS&A urges NRC and DOT to reconsider their proposed ban on 1967 Specification packages for domestic shipments.

III. THERE ARE EXCELLENT REASONS TO RETAIN 1967-SPECIFICATION PACKAGES IN SERVICE

1. 1967 Specification Packages Are in Wide Use

Use of 1967 Specification packages remains widespread. JLS&A itself has shipped over 1000 irradiators and calibrators to customers throughout the United States using such packages. Most of these devices have been shipped in packages designed and manufactured pursuant to DOT Specification 20WC. A smaller number have been shipped in packages approved by the NRC under COC 6280. Most of the units ever shipped are still in use. All of these devices need to be periodically re-sourced and refurbished; some occasionally need to be relocated; all eventually need to be removed from service, or decommissioned. JLS&A typically makes close to 200 shipment legs per year for such operations.[10] JLS&A does not own any other overpacks suitable for shipping these devices.

It is not possible to tell from published information exactly many companies routinely use 1967-Specification packages to ship devices or other radioactive sources, or how many such devices and other sources there are.[11] However, JLS&A believes that several other firms in the private sector depend on them to a similar degree as it does; and believes that the U. S. Department of Energy makes widespread use of them for both its Civilian Reactor Waste and Naval Nuclear programs. Based on general industry knowledge, JLS&A believes that there are between 100 and 200 20WC Specification containers in use in the United States today, in addition to the 15 owned and used by JLS&A. On the same basis, JLS&A believes that there are probably between 25 and 50 active 1967 Specification COC containers in service, in addition to the two it owns. If these estimates are accurate, the overall effect of implementation of the proposal to eliminate use of 1967 Specification packages will be on the order of 10 to 15 times that projected by JLS&A for itself.

2. <u>1967 Specification Containers Have an Excellent Safety Record and Neither NRC Nor DOT Sets Forth a Substantial Safety Rationale for Removing Them from Service.</u>

Packages designed and built to 1967 specifications and properly maintained have an excellent safety record over the years. Neither agency alleges any safety problem with their design, which was subjected to 30-foot drop, fire and immersion tests by Sandia Laboratory in 1968[12]. Indeed, the NRC concedes, in its discussion of the proposal to eliminate use of 1967-

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[10] Over half, but not all, of these shipment legs, involve loaded containers. Each complete shipment involves at least two legs.

[11] The SS&D Registry, NUREG-0383, lists active and inactive products for active and inactive vendors, but does not indicate either how many such products have actually been manufactured or how many packages have been made to transport these products. for use with each certificate.

[12] J. A. Sisler, "New Developments in Accident-Resistant Shipping Containers for Radioactive Materials", Sandia Corporation, 1968 (Exhibit 3). The drop and fire tests are consistent with current requirements, cf. id. with 10 CFR § 71.73 (DOT has explicitly adopted NRC stnadards on this issue, see 49 CFR § 173.467). The water-submersion test was for only 3' above the topmost surface. However, because the shielding in 1967-specification inner containers consists of heavy metal in 100% welded containments, independent calculations show that immersion to 10 meters will have no effect on the inner container: Water pressure at ten meters is only 13 pounds per square inch, as contrasted with the 3600 PSI crushing strength of plywood used in 20 WC-5 or 20 WC-6 containers, and the 30,000 PSI yield strength of the steel outer cover of 20 WC-6 containers or the steel outer container of 7A containers. The Sandia tests also did not include a 40-inch fall onto a 6-inch spike. However, the author of the report believed that "meeting this requirement is not considered to be a problem." Independent calculations confirm this conclusion. They show that a steel-jacketed 20 WC-6 container weighing the maximum of

(continued...)

specification containers, that there is no safety benefit to doing so: "In terms of protection of public health and safety, the existing and proposed requirements are believed to be equally protective. Thus, neither an increase nor a decrease in potential health and safety impacts is expected as a result of adopting the proposed administrative changes." 67 Fed. Reg. 21406 col. 2. See also 67 Fed. Reg. 21394 col. 1.

The NRC rulemaking notice lists six changes that have occurred in the regulation of package design since promulgation of the 1967 Safety Series 6 criteria. 67 Fed. Reg. at 21406 (col. 1). While it is true these changes have occurred, all of them have either been accounted for or do not pertain to domestic special form Type B shipments.[13] Design evolutions are inevitable over time; and the fact of these changes does not establish that 1967-specification containers are unsafe or unfit for further use. Nor is any such claim advanced in either rulemaking proposal.[14]

IV. FORCED RETIREMENT OF 1967-SPECIFICATION PACKAGES FROM SERVICE WOULD CAUSE SEVERE HARM

Neither of the rulemaking proposals gives substantial attention to the costs of elimination of 1967-Specification packages. NRC concedes, in its draft Regulatory Analysis, that regulated entities are "expected" to incur

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6000 pounds will crush 2.5" of plywood when dropped onto a spike from 40", and that a 20 WC-5 container weighing the maximum of 4000 pounds will crush 3.5" of plywood. Compared with the minimum of 6" of plywood required by 49 CFR § 178.362-2, it is clear that the 40" drop onto a spike is not a problem for a 20WC-5 or –6 container.

[13] Changes which are irrelevant include immersion tests for Type A packages [67 Fed. Reg. at 21406 col.1, item 3] (the packages at issue here are Type B packages, which were already subject to immersion tests); addition of maximum normal operating pressure [item 4] (Type B packages at issue here do not need, and do not use, venting or active cooling); environmental test conditions [item 5] (Type B packages have always been tested within these parameters). Changes whose intent has been satisfied include use of A_1 and A_2 system and associated containment system performance criteria [items 1 and 2] (all Type B shipments are made in accordance with those limits); and QA requirements [item 6] (All packages approved for use by NRC since 1979 have met NRC QA requirements; the only gap is in documentation for packages designed pursuant to DOT Specifications. Even then, neither NRC nor DOT asserts that these packages, as a class, are inadequate in either design or construction.). For further detail, see JLS&A comment letter, September 29, 2000, at pp. 5-7.

[14] JLS&A understands that DOT has expressed concern about the consistency of some DOT-specification packages with their design documentation or its regulations, and about maintenance of some such containers. This is a valid concern. However, it is a normal licensing and enforcement issue, not one going to the adequacy of the design specification itself. If shippers cannot produce satisfactory documentation, or if their packages are found to be in substandard condition, DOT can compel removal of any such packages from service and take other appropriate action. But this concern is not a rational basis for removal of an entire reliable class of container from service.

costs associated with the redesign of existing packages, as necessary, as well as market adjustments due to reduction in availability, years of service expected from the original design, and expected years of performance from the original package.[15]

However, the draft analysis goes no further. NRC concedes in its rulemaking proposal that it lacks information to quantify these expected costs, and solicits it in rulemaking comments.[16] The rulemaking notice then suggests that such information will be factored substantively into the final decision on whether to adopt the proposed ban:

> The NRC recognizes the importance, from an international commerce standpoint, of having the packaging and transportation regulations in Part 71 compatible with the IAEA's TS-R-1. However, before adoption, the NRC seeks to quantify the impact of adopting these IAEA regulations. Development of the IAEA TS-R-1 did not directly involve the public or include a cost-benefit analysis. In contrast, NRC's practice is to consider costs and benefits in its regulatory analysis, and NRC is prepared to differ from the TS-R-1 standards, at least for domestic purposes, to the extent the standards cannot be justified from a cost-benefit perspective, especially given the current regulations in Part 71 have provided adequate protection of the public health and safety.
>
> Therefore, the NRC is inviting public comments on the IAEA-related issues, Issues 1-11. Specifically, the Commission is soliciting cost-benefit data to quantify the economic impact of harmonizing with the 11 IAEA changes on the domestic commerce and international commerce of packages containing radioactive material. The NRC is interested in determining: (1) whether the benefits of harmonization with the IAEA standards may exceed the costs, or may result in other health and safety problems resulting from dual standards between domestic (Part 71) and international (TS-R-1) requirements, and (2) whether the NRC should adopt only some of the 11 IAEA changes.

67 Fed. Reg. 21394 col. 1. (emphasis supplied).

The proposed prohibition on use of containers manufactured to the 1967 standards would, if applied to domestic shipments within the United States, have severe effects. It would require JLS&A and the other businesses that ship significant quantities of radioactive material in them either to requalify, relicense, and probably rebuild, virtually all of their current shipping containers pursuant to a new COC from the NRC within two years (proposed DOT requirement) or three years (proposed NRC requirement), or to cease shipping. While the total extent and cost of this effort can only be estimated parametrically at this point since it would depend significantly on the flexibility with which NRC would implement its COC reviews, there is no question that it would be substantial, and that it would probably put JLS&A and other small businesses like it out of business. In that case, the proposal would also make devices and sources

[15] NRC, Draft Regulatory Analysis of Major Revision of 10 CFR Part 71, Proposed Rule, NUREG/CR-6713 (April 2002).

[16] 67 Fed. Reg. 21406 col. 2. The NRC also projects its own costs at $3500 for revision of materials, and costs to Agreement States at $1000.

now shipped in these packages not legally shippable in any currently licensed container, thus creating hundreds of sites with thousands of orphan sources that could no longer be used, could not be shipped for orderly disposition, and would have to be maintained and safeguarded indefinitely. The bases for this concern are outlined below.

1. Economic Cost to JLS&A

There are some 1000 devices manufactured by JLS&A, and shipped in either NRC COC or DOT Specification containers built to the 1967 standards, in current use throughout the United States. It is certain that under the proposed regulations JLS&A would have to obtain at least two COCs (one relating to COC 6280, the other to DOT Specification 20WC containers), either to requalify existing containers or to construct new ones meeting the TS-R-1 requirements. It is possible that JLS&A would have to obtain as many as a dozen or so COCs, depending on the NRC's licensing flexibility.[17] The elements of compliance for JLS&A can be itemized as follows:

- It will cost at least $500,000[18] and take upwards of two years[19] to design, test and obtain regulatory approval for a new or requalified COC from the NRC. Thus the cost of redesign/reapproval would range between $1 million and $6 million for JLS&A, depending on the number of new COCs JLS&A would be required to obtain.

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[17] JLS&A's devices are not totally identical: they come in various models designed for customer-specific needs, which vary somewhat in size, dimensions and weight. However, there are two principal model "families", one designed for NRC COC containers and one designed for DOT Specification containers. JLS&A has two virtually identical outer containers manufactured under NRC COC 6280 in active service. It has also about 15 slightly smaller containers, similar but not identical to each other, manufactured to DOT Specification 20WC, in service. The NRC COC containers are intended for shipment of devices in one model "family", without being designed uniquely for specific devices within that "family." The same applies to the DOT Specification containers and devices within the other model "family." Thus, depending on the degree of flexibility granted by the NRC in licensing of new containers or requalification of existing ones, JLS&A would have to obtain anywhere between two and about a dozen new COCs, in order to account for the variations between different device models.

[18] Costs are distributed among engineering and design costs ($100,000-$150,000), fabrication of one or more test prototypes ($50,000 apiece), testing and analysis ($100,000-$150,000) and NRC licensing fees and related costs ($120,000-$200,000).

[19] In the interest of simplicity, the factor of time will not be considered in this evaluation. Obviously, if the NRC finds itself with a large backlog of COC applications, the time required to approve them will increase.

- JLS&A would also have to construct new overpacks to meet the parameters of each new COC.[20] Each one of these would cost about $50,000. Anticipated additional costs here to JLS&A range between $600,000 and $750,000.

- The value of existing overpacks, with a per-unit depreciated value of about $30,000 apiece, would be lost. For JLS&A, this cost component would be approximately $500,000.

Thus the overall cost of compliance for JLS&A would be, at the low end, slightly more than $2 million, and at the upper end, on the order of $8 million. These costs are incurred even if it is assumed that all existing devices will be able to be shipped legally in existing, requalified containers or new COC containers.

JLS&A is a firm with annual revenues and a total net worth in the mid-seven digits. Having to spend approximately one year's total revenues or its total net worth, or several times annual profits, on a short-order backfit that increases neither productivity, profitability nor safety, would be a sufficiently questionable economic decision that the company would, instead, regretfully, probably close its doors and go out of business.

2. Economic Harm to Others

a. Harm to JLS&A Customers

Even if existing JLS&A devices can be legally shipped, JLS&A will need to attempt to pass on its increased costs to its customers. If JLS&A devices cannot be legally shipped, however, customers' costs rise substantially. In that event, the value of these devices is largely or totally lost from the time they need to be re-sourced or refurbished. At an average cost of approximately $50,000 per unit, this means an aggregate cost on the order of $50 million, distributed among several hundred JLS&A customers. This is a realistic scenario:

On those devices which were built to be shipped in DOT-Specification outer containers, the inner containers were built under Quality Assurance standards that were not governed by the NRC's QA program in 10 CFR Part 71, §§ 71.101-71.135. As a result, the documentation or "QA Paper" for these devices may not conform to NRC QA requirements even though actual design, procurement and construction standards may have been identical or equivalent to NRC standards. Thus is would not be possible to document the "pedigree" of such components as the shielding and the housing of these devices, which are integral to the device but technically part

[20] It is possible that outer containers already licensed to 1967 standards under an existing NRC COC could be requalified under the new criteria. However, because of historic differences between NRC and DOT requirements, particularly QA paperwork requirements, it seems unlikely that any DOT-Specification containers built to 1967 standards could ever be certified by the NRC unless the NRC interprets the documentation requirements of Part 71 Subpart H flexibly. Thus all DOT-Specification containers would, in all likelihood, have to be replaced.

of the "packaging" as defined in NRC and DOT regulations (10 CFR § 71.4, 49 CFR § 173.403)). Unless the NRC either amends or relaxes its interpretation of its QA requirements, it appears likely that it will not accept packages initially designed and manufactured to DOT specifications. In that event, the cost of compliance would rise dramatically, as one of three scenarios would follow:

1. Transportation containers would have to be designed[21] that could transport existing devices – which weigh up to 5000 pounds for a model 7A designed to be transported in a 20WC-6 container – without taking any credit for the radioactive shielding or structural housing surrounding the source. Such containers would weigh, in all probability, upwards of 60,000 pounds, thus requiring special highway authorizations and being subject to limited routings; would need a dedicated tractor and a specially designed trailer to transport them; and would be enormously expensive to build – several times the cost of a container that could take credit for the structural properties of the inner container. It is estimated that designing, licensing and constructing such a container, with dedicated tractor and specially designed trailer, would cost upwards of $2,250,000. The cost of succeeding containers, each with its own trailer, would approach $1,000,000 apiece. Shipping costs for these containers would also be an order of magnitude higher than those for current devices ($35,000-$40,000 v. $3000 per trip now for a 20WC). Even then, the transportation rig would be unable to access numerous locations that can now be reached, thus running the risk that some sources would remain stranded no matter what. Thus this alternative, while technically feasible, is physically cumbersome and sufficiently more costly than current shipping modes that many existing customers would be tempted to buy and ship new devices rather than have existing ones re-sources or hauled away for decommissioning.

2. Sources could be transferred at the customer's site from the existing device to a specially designed "transportation container," using a portable hot cell transported to the customer's site. JLS&A has not fully costed out this alternative because it appears to have almost insuperable obstacles. First, most of JLS&A's devices are fabricated with welded end-caps, in order to prevent tampering by unauthorized persons. As a result, removing the source is a difficult, potentially high-exposure process when conducted in the field. Second, setting up a hot cell is an unavoidably expensive business – on the order of $300,000 per installation. Even if devices were designed with screw-on end caps (and some of JLS&A's, though a minority, are) and special shipping containers were designed to operate with them – thus substantially lessening the labor and radioactive exposure associated with a transfer -- it would still be necessary to set up a portable hot

[21] To the best of JLS&A's knowledge, based on a review of the SS&D Registry within the past year, there is no existing licensed transportation container that can be used to transport all, or even a majority, of its sources in their 7A shipping configuration, giving no credit for their shielding. Such existing containers as can transport even some of JLS&A's devices in this fashion are typically used for transporting radioactive waste, and thus are sufficiently contaminated that their use for transporting laboratory equipment, which has been manufactured in a clean room and kept rigorously free of stray radiation, would be highly questionable.

cell. This alternative is prohibitively expensive except in extreme conditions. It is also inconsistent with the ALARA goal of minimizing occupational exposures to radiation.

3. Existing sources in existing devices manufactured to DOT specifications would become unshippable in existing packages, and their value would be lost as of the time their sources next need to be removed. JLS&A has nearly 1000 of these devices in service throughout the US, so the cost to JLS&A's customers, at an average value of $50,000, would be $50 million. JLS&A regards this scenario as the most likely, since the cost of the other two scenarios is likely to deter market entrants.

b. Harm to Third Parties

As noted above, JLS&A is not aware of published data that describe the total number of 1967-Specification containers (DOT- or NRC-approved) in use today in the U.S., or the number of device designs, or the number of actual devices affected by the proposed rule. However, JLS&A believes that the total numbers are on the order of 10 to 15 times its own. In that event, the economic costs projected by JLS&A for itself can be extrapolated as follows:

- costs of design, testing and licensing of new designs: $10,000,000 to $90,000,000
- costs of construction of new overpacks: $6,250,000 to $12,500,000
- loss of value of existing overpacks: $5,000,000 to $10,000,000
- loss of value of existing devices: $500,000,000 to $1,000,000,000.

These are only estimates based on extrapolations, not on real data. Nonetheless, they are based on real knowledge of the industry and make clear that the projection in both NRC's and DOT's rulemaking notices, and of the NRC's draft Regulatory Analysis that they do not expect any significant costs to be associated with the implementation of the rule, is wrong.

3. Environmental and Safeguards/Security Costs

At some point every device containing a radioactive source needs either a fresh source, or refurbishment, or retirement. At that point, if it (or a replacement source) cannot be shipped for service or disposal, it becomes an "orphan source" – inoperable, but immovable. If JLS&A and other firms now relying on 1967-Specification containers are driven from business by the cost of conversion, these devices will become orphan sources. Facility managements, in coordination with state governments (in Agreement States) or the NRC, must then store them safely, indefinitely, keeping them physically secure, protecting personnel against radiological hazards, and guarding against safeguards hazards including, in the current environment, the potential for theft by terrorist individuals or groups and homeland-security issues.

JLS&A's devices are located in literally hundreds of facilities throughout the United States. Other firms' devices are also widely dispersed. Some of these facilities, like nuclear power plants and government installations, are relatively secure; others, like hospitals, blood banks and university laboratories, may not be. At any time, care of these sources requires the availability of space, the implementation of procedures for regular surveillance and inspection, and other ongoing costs, both to entities possessing them and to regulatory agencies. In times of heightened national security, when orphan sources can also become potential terrorist threats, the security cost of continued possession rises substantially. The cost of theft, diversion or other unauthorized misuse by terrorists – socially unthinkable – are enormous, and have not been addressed by IAEA (or NRC or DOT) in making the proposed revisions.

To make matters worse, as long as these devices are unshippable, no entity possessing them can conduct a final radiation survey and terminate its license. Every such licensee must remain indefinitely on NRC or Agreement State rolls. In the meantime, any closure of any facility containing such a device, or any sale or other transfer or conversion, becomes virtually impossible since the current licensee must either remain on the license for the device or transfer it to another qualified potential licensee. This not only greatly complicates normal real estate transactions but basically freezes any facility in its current use and ownership indefinitely.[22]

No attempt has been made here to monetize these costs. However, they are real, and substantial, and the rulemaking notices and draft Regulatory Assessments totally neglect them.

JLS&A is not in a position to conclude that the prospect of creation of potentially thousands of quite radioactive orphan sources around the country -- which it believes is likely – as one collateral effect of the pending proposal constitutes a "major federal action significantly affecting the human environment" requiring a full-blown Environmental Impact Statement under the National Environmental Policy Act, 42 U.S.C. § 4331 et seq." What JLS&A does know is that there has been no consideration of this issue, and that agencies issue rules without such consideration at their peril.

V. THE ADVERSE EFFECTS OF ELIMINATING USE OF 1967-SPECIFICATION CONTAINERS FOR U.S. DOMESTIC SHIPMENTS FAR OUTWEIGH THE BENEFITS OF DOING SO

Both NRC and DOT concede in their rulemaking notices that their proposal to eliminate 1967-specification containers from domestic use does not rest on a health-and-safety foundation. They both concede that current container regulations provide adequate safety and that there will be no net increase in safety from adoption of the new regulations. NRC's closest approach to a relevant argument in favor of elimination of 1967-series containers is its notation of six design changes since 1967-specification packages were first approved, and its conclusion, without any further support, that these changes make it "appropriate to begin a phased discontinuance of these earlier packages (1967-approved) to further improve transport safety." 67 Fed. Reg. 21406 col. 1.[23] As noted above, all of these changes either are irrelevant to Type B

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[22] To illustrate the absurd complications of the orphan source issue, JLS&A is aware of one instance in which a bankruptcy creditor tried to seize a licensed radioactive device from an insolvent licensee and sell it as an asset of the bankrupt estate. JLS&A was asked to intervene, and did so by obtaining an administrative order, to prevent this from happening.

[23] NRC also asserts the proposed revisions would "result in enhanced regulatory efficiency by bringing NRC's requirements in harmony with those contained in TS-R-1." 67

(continued...)

shipments of special-form radioactive materials in domestic commerce, or they have been taken into account. DOT does not advance any substantive arguments of its own, but merely states that it intends to adopt the IAEA position. 67 Fed. Reg. 21339 col. 2.[24]

Thus the health-and-safety rationale for the proposal amounts to two general suggestions: first, that 1967-Specification containers are not fully modern, without pointing out or even hinting at any actual problems with their use; and second, that uniformity with international norms is important in international commerce, without any attempt to establish the necessity of rigorous adherence to international standards for purely domestic U.S. shipments.

Contrasted against these conjectural benefits are three very real facts:

First, the 1967-Specification containers have a long and excellent safety record. There is neither a tangible benefit to be gained nor any demonstrable harm to be avoided by compelling their removal from service.

Second, the benefits of uniformity with IAEA requirements do not necessarily apply to domestic shipments. In the case of shipping containers, they do not apply.

Third, there are very real, and large, costs to removing them from service, whether or not JLS&A and other similar businesses are not driven by it from the field. If they are, the costs mushroom and long-term concerns for the security and safety of the affected devices arise immediately.

VI. <u>NRC AND DOT ARE NOT REQUIRED TO APPLY IAEA STANDARDS TO PURELY INTERNAL U.S. REGULATION AND SHOULD NOT BE BOUND BY THEM IN THIS CASE.</u>

IAEA requirements, or regulations, are not self-implementing: they do not bind the United States, or any member State, unless ratified or accepted by that State's government. Indeed, IAEA recognizes in TS-R-1 that national-level departures from its provisions may be "necessary for solely domestic purposes." TS-R-1, *Foreword.* Consistently, DOT, as the official U. S. Government representative to IAEA, is obligated to participate in international standard-setting forums. 49 U.S.C. § 5120. However, it is obligated to ensure only that U.S. domestic regulations are "consistent with" international standards, and then only "to the extent practicable." *Id.* The statute also allows DOT flexibility to reject any international standard (for either domestic U.S. or international application) that the Secretary of Transportation decides is

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Fed. Reg. 21406 col. 2. This argument is well taken for international shipments but is not applicable to domestic U.S. shipments.

[24] DOT argues that since two international modal organizations, IMO and ICAO, have accepted the IAEA TS-R-1 requirements for international shipments, so should DOT. 67 Fed. Reg. 21339 col. 2. In doing so, DOT acknowledges but, erroneously, totally dismisses any distinction between international and domestic shipments.

"unnecessary or unsafe." § 5120(c). Historically, while the United States has encouraged consistency of regulatory provisions that affect international commerce, it has differed, like all nations, on specific issues from international standards where those issues do not affect international nuclear commerce.

Indeed, both NRC and DOT have recognized this independence with respect to the current rulemaking. After identifying 11 areas of current U.S. regulation where the TS-R-1 rules would suggest change, the NRC proposal takes total or partial exception to three of the TS-R-1 proposals for both U.S. and international shipments.[25] In addition, NRC has proposed to add one provision which it acknowledges is not included within TS-R-1; for this reason, NRC proposes to make this provision applicable only to U.S. domestic shipments.[26] Similarly, DOT, after identifying 10 areas of proposed change in its proposed rulemaking, takes exception to one TS-R-1 proposal; again, the exception proposed by DOT is for U.S. domestic shipments only.[27]

NRC also indicates in its proposed rulemaking notice that it is prepared to depart from total uniformity from international requirements in purely domestic shipments to the extent the international shipment cannot be justified from a cost-benefit perspective, particularly given the adequacy of existing regulations. 67 Fed. Reg. 21394 col.1.

On the record of this rulemaking to date, there is neither a tangible safety benefit to be achieved nor a definable risk to be avoided from the proposed elimination of 1967 Specification packages as applied to domestic shipment of Type B quantities of special form radioactive materials. The only really definable benefit – uniformity in international shipping regulation – by definition does not apply to domestic shipping. The only other asserted benefit – general improvement in safety levels by a process of, in essence, technology-forcing, by limiting the useful lifetime of container designs – is a theoretical argument which, unless supported by facts, should not be applied in a vacuum.[28] JLS&A submits that there are no such facts in the record

[25] These are proposals 1 (Changing US regulations to use the International System of Units only), 3 (Revision of A1 and A2 values), and 10 (Crush Test for Fissile Material Package Design).

[26] The proposal would add a new section § 71.18 to permit a new type of dual-purpose package, type B(DP), for both storage and shipment of spent reactor fuel. It would be restricted to U.S. domestic shipments only. See 67 Fed. Reg. at 21415-17, 21430, 21448-49.

[27] DOT took exception to proposed A1 and A2 values for Mo-99 and Cf-252, for domestic shipments only.

[28] The basis for this argument is a position taken in TS-R-1. None of the underlying support for this position is available from either the NRC or DOT rulemaking records. No U.S. regulatee has had the opportunity to contribute to the IAEA process or even to scrutinize it after the fact. If NRC or DOT wish to insert an IAEA position into their regulations, they should justify it independently. This is particularly the case given the "out" afforded to the Secretary of Transportation to not accept an IAEA position which he does not consider to be "necessary." See. 49 U.S.C. § 5120.

here, nor any in the history of use of these packages. On the other hand, there are substantial costs described above which, both agencies acknowledge, they have not considered to date. They cannot neglect these costs in determining whether to implement this proposal.[29] JLS&A submits that a review of the costs and benefits of this proposal will show that it cannot be justified in terms of cost-benefit analysis, measured either in dollar terms or in benefit to the health, safety and welfare of the American people, or in a comparison of statutory-policy benefits against costs.

VII. THE PROPOSED RULE WOULD HAVE SUBSTANTIAL ADVERSE EFFECTS ON A SUBSTANTIAL NUMBER OF SMALL ENTITIES AS DEFINED UNDER THE REGULATORY FLEXIBILITY ACT

Both NRC and DOT have misassessed the impact of their proposals on small entities protected by the Regulatory Flexibility Act, 5 U.S.C. § 601 et seq. NRC certifies that there will be no "substantial economic impact on a substantial number of small entities, on the basis that:

> This proposed rule affects NRC licensees, including operators of nuclear power plants, who transport or deliver to a carrier for transport, relatively large quantities of radioactive material in a single package. These companies do not generally fall within the scope of the definition of "small entities" set forth in the Regulatory Flexibility Act or the size standards adopted by the NRC (10 CFR 2.810).

67 Fed. Reg. 21442. The NRC's observation is absolutely true of nuclear power plant owners and operators and sometimes true of shipping companies. However, JLS&A is a small entity within the NRC's criteria. So are numerous others of the entities that manufacture or actually transport devices affected by the proposal. Whenever their absolute number, JLS&A believes that they represent a substantial portion, if not the majority, of the entities in this business. Thus, JLS&A believes, the provisions of the Regulatory Flexibility Act are triggered. In any event, the NRC's characterization of nuclear power plant operators as the typical type of entity affected by the proposal under discussion is incomplete: in addition to entities like JLS&A, they include hospitals, research facilities, blood banks, colleges and the like, numerous of which all within the size or income categories of small entities.

DOT, by contrast, concedes that a large number of entities, a potentially significant number of them small, will be affected by the proposed rule, but asserts that imposing international uniformity will offset, for many of them, a higher cost of complying with dual

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[29] The NRC's "backfit rule," contained in Parts 50 (§ 50.109) relating to power plant licensing and 72 (§ 72.69) relating to interim fuel storage facilities, does not literally apply to Part 71. However, the backfit rule merely embodies the generally applicable maxim of administrative law that a change, not required by statute, is justifiable only when the benefits, measured in terms of furtherance of the agency's statutory goals, are "substantial" and any direct and indirect costs of implementation are "justified in view of this increased protection." § 50.109(a)(3).

systems of regulation. DOT also asserts that "the proposed phase-in period of two years following the effective date of the final rule for continued use of currently authorized packagings should provide for a smooth transition to the NRC approval process." 67 Fed. Reg. 21345 col. 3.

DOT's dual-regulation argument, while plausible in the abstract, is not persuasive as to the continuation of use, or not, of an existing class of container for domestic shipments. DOT's argument ignores the fact that in the United States (far more than in Europe), a major proportion of shipments of radioactive materials never cross national borders. For numerous shippers, there simply is no potential for dual-regulation tension. Finally, for reasons set out above, JLS&A believes that the proposed two-year transition period is not adequate.

In short, for different reasons than those relating to the NRC, JLS&A believes that neither NRC nor DOT, for different reasons, can make the required Regulatory Flexibility Act certification on the rule as proposed.

VIII. COMMENTS ON NRC QUESTIONS

The NRC's rulemaking proposal includes lists of general, and comment-specific, questions. JLS&A summarizes below, in response to these questions, relevant portions of the material discussed at greater length above:

1. Comments on NRC General Questions (67 Fed. Reg. 21394 col.1):

(1) Quantitative information on costs and benefits: As outlined above, the costs of permitting continued use of 1967 Specification containers are zero. The costs of requiring their replacement are substantial and have been stated above. The benefits of requiring such replacement for domestic use are, at best, hypothetical and, in the real world, zero.

(2) Operational data on radiation exposures from implementing proposals: JLS&A has illustrated the potential increases in radiation exposure that would be entailed from use of "transfer" containers, and the potential for increased exposure from orphan sources in either normal or accident or safeguards-event circumstances.

(3) Whether proposed changes are adequate to protect public health and safety: New containers, if they could be built feasibly, are adequate. So are existing containers. Radiation risks from orphan sources created by "sunset" on use of existing 1967-specification containers decrease protection of public health and safety protection.

(4) Whether other changes should be considered: With respect to continued use of 1967-Specification containers, JLS&A's proposals are set out immediately below.

(5) How specific risk considerations should be factored into proposed amendments: JLS&A believes that the risks associated with creation of a large class of orphan source containers, while not quantified in terms of rads, person-rem of exposure, or accident frequency,

are real and substantial, and that they should be applied in assessing the costs and benefits of deciding whether to implement a discretionary decision to ban further use of 1967 Specification containers. JLS&A believes that these factors, in combination with compelling administrative and cost considerations, argue overwhelmingly against implementation of this proposed change.

2. Comments on NRC Questions Related Specifically to the 1967-Specification packages (67 Fed. Reg. 21394 col.3):

(1) Under what conditions should packagings be removed from service?

- There is no reason to compel removal of properly inspected, properly maintained 1967-Specification packages from service for U.S. domestic shipments of special form Type B quantities of radioactive material. There is no articulated safety risk being avoided by the proposal. There is no articulated safety gain from adopting it. There will be no higher level of overall safety from adopting the proposal than there is now. Thus current proposal to ban such packages should be limited to international shipments, and there should not be any specific "sunset" date on their use for U.S. domestic shipments.

- There is good reason to require owners and users to inspect and maintain older packages especially vigilantly. NRC and DOT enforcement of compliance will force users, in their own self-interest, either to maintain current containers or convert to newer designs. Either choice will ensure safe and conforming operation.

- It is legitimate to ban further construction of any new 1967-Specification packages, not already contracted for as of the effective date of the regulations containing the proposal.

- Any modification of current requirements must not operate to prevent a device built to be transported in DOT Specification 20WC containers, and which has integral shielding and housing that is part of its "packaging" for regulatory purposes, from being shippable merely because it was not constructed fully under the 10 CFR Part QA 71 rubric. Otherwise, that device will become, overnight, an "orphan source."

- There is a potential for substantial delay in approving new designs or recertifying existing designs. Any "sunset" deadline on use of any package design being phased out under this proposal should permit its continued use pending ultimate decision by the NRC on either recertification of the existing design or approval of a new design, as long as (1) a good-faith, substantially complete application for approval or recertification, as the case may be, has been filed with the NRC at least 12 months before the nominal "sunset date" on use of the existing design, and (2) the application for approval or certification clearly is clearly related in the application to a design which is subject to the "sunset" provision.

- If a specific "sunset" date is chosen, it should be significantly longer than the ones proposed by either NRC or DOT to date. NRC and DOT should agree on a common "sunset" date.

- NRC and DOT should not subscribe to the useful-lifetime limitations for shipping packages implicit in the IAEA's intended biennial review of its regulations. On an ongoing basis, the cost of such forced obsolescence will raise the cost of transportation unwarrantedly.

(2) What are the cost or benefit impacts associated with the proposal to remove B() packages from service?

- There are benefits of uniformity and consistency to adoption of the IAEA standards. As respects use of 1967-Specification containers, they apply to international shipments, and JLS&A does not object to removal of these containers from service in international shipments. They are not necessary for to domestic shipments.

- The benefit of removal of an older design from service is purely hypothetical as long as packages manufactured to that design are properly maintained and are performing their function safely and satisfactorily.

- The economic costs of banning 1967 Specification designs or of forcing owners to requalify containers (including associated devices) built to them to current standards have been discussed above; they are real, substantial, and clearly outweigh the conjectural benefits of implementing this proposal for U.S. domestic shipments.

- The environmental costs of creation of hundreds or potentially thousands of new orphan sources are substantial. Hundreds of sites, some of them not secure, will have to safeguard no longer usable devices indefinitely, imposing costs on them and creating a risk of attack or security threats at readily identifiable sites from terrorist or other malevolent actors. Additional resource costs will be imposed on state and federal regulators, who will need to oversee the adequacy of security of these sites. And these costs will last indefinitely, until a removal mechanism is developed that is perceived as less costly than continuing storage. In the meantime, no facility in possession of one of these devices will ever be able to terminate its license. And sales or other transfers of any such facility will be greatly complicated by the presence of one of these devices, and shutdown will be impossible. Licensees will be unable to perform close-out radiation surveys or ever terminate a license.

IX. JLS&A'S SPECIFIC PROPOSALS

For the above-stated reasons, JLS&A respectfully urges DOT and NRC to modify their rulemaking proposals so as to permit the indefinite continued use of properly maintained existing packages built to 1967 IAEA Safety Series 6 Specifications for the domestic shipment of Type B quantities of special form radioactive material within the United States. In any transitional provisions that the agencies might ultimately issue, JLS&A urges the following provisions:

EXHIBIT 1

(14)

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September 29, 2000

Secretary
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

DOCKET NUMBER PR 71
PROPOSED RULE
(65 FR 44360)

WRITTEN COMMENTS IN ADDITION TO ORAL COMMENTS PRESENTED AT THE 9/26/00 PUBLIC MEETING ON 10CFR PART 71, PROPOSED REVISION COMPATIBILITY WITH ST-1

0442

Issue 1. Changing Part 71 to SI Units Only

General comments.

ST-1 requires use of SI units only on transportation packages and shipper's paperwork, but does not address or prohibit the use of the use of the dual-unit system, as called out in the NRC metrication policy, by member countries for internal use.

Application of SI methodology to other disciplines has not been commonplace. Astronomers do not express the speed of light as 0.3 tetrameters/second or a light-year as 9.5 examillimeters. Federal/state/local authorities do not publish speed limits in terms of __megamillimeters/ hour

Factors for consideration

The changes of relevant documents to SI units for Certificates of Compliance (COC's) and licensing packages to SI units only has major potential cost impact. The possible financial implications for COC certificate holders, part 71 QA program holders and license holders must be addressed separately.

Possible financial implications for COC certificate holders and part 71 QA program holders.

Current COC's in our possession are not issued using SI or dual units. If the NRC Transportation Branch requires that changes in the COC's, the Part 71 Program Plans and implementing documents such as loading/labeling instructions included in the COC approval package and as part of Part 71 QA Program Plan require specific formal review and approval by this entity, not as part of normal reviews, these reviews could easily exceed $15,000.00 per package or Part 71 QA Program Plan review, based on our knowledge of reviews performed for J.L. Shepherd and Associates (JLS&A) and talks with other COC holders. This does not include the time required by the certificate/QA program holder for internal review, audits, making the necessary changes in these programs and interfacing with this branch, which is of equal magnitude to the NRC direct costs.

Template = SECY-067

SECY-02

Consequently the potential cost per COC package or QA review would be $30,000.00 or greater. Because the change from dual-unit to SI units only has no positive impact in reducing radiation exposures to operating or transport company personnel, increasing safety of transport or the safety of the general public, the cost of implementing it could be excessive for achieving no tangible results.

If these formal reviews and approvals are required for a compliance deadline date, there is the potential problem of timely response by the Transportation Branch if each COC package with supporting drawings and instructions and each Part 71 QA Program Plan requires this action, due to the immediate back log volume.

Because ST-1 does not address or prohibit dual-unit systems on the COC's themselves or the implementing documents, we would like to suggest that dual-use units be phased in as the COC's, with their implementing documents and drawings used as part of the COC itself, come up for renewal or package retesting. We would also like to suggest that conversion to dual-use units be voluntary for QA Program Plans and their implementing documents.

Possible costs for NRC/Agreement State license holders.

Part 71 references Part 20, 21, 30, 39, 40, 70, and 73

Implementing this program for transportation could impact all other Parts referenced in Part 71, per the above list. This could require that each holder of a NRC or Agreement State radioactive materials license which incorporates English (better termed traditional or dual-unit systems would be forced to rewrite the license, including all Radiological Safety Programs, and that each licensing agency, NRC or Agreement State, would be forced to re-write their licensing programs and licenses. The Code of Federal Regulations for 10 and 49 would also need to be rewritten in their entirety.

We have discussed this with Radiation Safety Officers at major universities, for example, and they predict that the cost for this conversion would be in the range of $250,000.00-$500,000.00 per year for no tangible reduction of radiation exposure or increase in public health and safety. The overall cost could be in the range of hundreds of millions of dollars. The time to achieve it would be measured in years, not months. The congestion at licensing agencies would be enormous with obvious results.

Risks and safety impacts which might occur in shipments because of possible confusion or erroneous conversion between the currently used English units and SI units

Workers in the transport industry who handle RAM shipments typically do not have four year college degrees, doctorates or other advanced degrees. Most drivers, but certainly not all, have high school diplomas. Typically material handlers do not have high school diplomas and many have only limited literacy in written and spoken English.

The increased complexity of dealing with SI units, especially in dealing with orders of magnitude and with confusing and unfamiliar prefixes, as compared with the English units with which these personnel are familiar, greatly increases the possibility of erroneous conversion and, more importantly, confusion in handling RAM shipments and possible unnecessary radiation exposure to these personnel.

In our production plant, despite repeated explanations, many of our non-radiological workers who have limited educational backgrounds, have serious difficulty in dealing with SI units, although they have good understanding of and deal competently with English units.

We provide Emergency Response training to local police officers and firemen, who typically have two or four year college degrees. Our experience has been that they have an excellent grasp of the English units, but have difficulty in dealing with SI units, especially in dealing with emergency conditions which do not lend themselves to cerebral conversions. This is confirmed by the retired fire captain who does our yearly recertification of hazardous waste operations and emergency response. The difficulty found in SI conversion for emergency response personnel without using dual-units could easily result in unnecessary deaths. Conversion training costs could seriously impact Fire Department and other first responder budgets resulting in decreased responses to other types of emergencies.

As part of the installation of our devices, we also provide radiation and use training. It is interesting to note that the great majority of our customers, both in the USA and overseas, most of whom have advanced college degrees, prefer and use English rather than SI units routinely.

<u>Transition period for conversion to exclusive use of SI units</u>

Using the attempt to convert English to Metric units in the USA for general commerce, which has been attempted for more than 30 years with less than 10% success as a norm, a transition period of 10 years would be a minimum, with the caveat that all workers dealing with these units be trained to be competent in both algebra and mathematical notation. With the lack of educational success with the routine conversion to metric, if SI units were to be used exclusively instead of dual-units, we believe that there could be serious health and safety implications not only for QA Program Plan holders, transporters and licensees, but to the general public as well.

<u>Summary.</u>

The implementation of this program can result in major costs with no positive results in the enhancement of public health and safety or reduction of radiation exposure to radiation workers.

Both the NRC and Agreement States would require significant additions to personnel and budgets for the implementation to SI units only, with increased costs passed onto licensees, with no other increases in services.

We would like to ask if the NRC has interfaced with the CRCPD, heads of Agreement States, NRC Agreement States Programs for impact and cost analysis. Many of the CRCPD members, including Agreement State heads, are under the impression that this proposal only effects shipments and QA Program Plans.

Although we did not get a chance to comment on this issue before the DOT comment period was up, we ask that the DOT also consider these risks in their formulation of compatibility.

Issue 2. Radionuclide Exemption Values

Unless it can be shown that the use of the DOT exemption values have compromised Public Health and Safety these values should be referred to in Part 71. These should be applied to all domestic shipments.

For foreign shipments only the ST-1 exemption values should be adapted in part 71. This standard should not be difficult to implement for foreign shipments.

For domestic shipments the additional costs involved by adapting the ST-1 values could be justified only by possible enhancement of public health and safety related to these shipments.

The adaption of the ST-1 exemption values could create havoc for those using the current DOT values for non-transportation activities such as licensing.

To avoid burdensome and unnecessary costs for these entities, it would be necessary for the NRC to set up a protocol for specifically adapting the DOT values for these applications. Would this cost be offset by enhanced public health and safety?

Issue 3. Revision of A_1 and A_2

For the shipments we make the A_1 and A_2 values as set out in ST-1 are both well-documented and practical for transportation. There seems to be no practical alternative to the adoption of these values.

Issue 4. Uranium Hexaflouride Package Requirements

No comment.

Issue 5. Introduction of Criticality Safety Index (CSI) Requirements

No issues are envisioned in the use of two TI values for a shipment. The use of the CSI index should enhance shipment of this material with minimum burden on the shippers.

Issue 6. Type C Packages and Low Dispersible Material

Currently certified Type B packages which are used for transporting Cobalt-60 for use in process irradiators which have loadings of ≥ 100,000 Ci. (3.7×10^{15} Bq) Co-60 would be restricted from air transport. This would result in the requirement for multiple, typically 3-10 or more shipments, replacing a single shipment under current regulations with large increases in transport costs. These are typically ≥ $1.00/ lb for these air shipments which usually weigh 10,000-15,000 lb.

Does increasing the number of shipments by a factor of 3 to 10 or greater really enhance public health and safety?

Are the increased shipping costs, which would increase overall costs per shipment to operators of process irradiators by ≥ 25%, justified by a program which would actually decrease public health and safety by required multiple shipments?

Because large Curie Cobalt-60 process irradiators are used for medical sterilization and/or food irradiation, besides increasing the number of radioactive materials shipments, Medicare, health insurance and other related medical/first aid/cosmetic costs (bandages and other sterile throw away items) will be greatly increased to reflect higher transportation costs for reloading these irradiators. In the case of food irradiation for the eradication of such bacteria as ecoili and salmonella, would the fledgling public acceptance of this process be destroyed because of increased costs and the presumed perception of greater risk?

Issue 7. Deep Immersion Test.

In practicality the quantities listed would be limited to irradiated fuel elements. Shipment of radioisotopes rarely, if ever, contain these amounts.

It is suggested that the present 10CFR71.61 criteria be maintained and extended to cover all packages with activity levels ≥ 10^5A_2 quantities with the note that this specification is more conservative than the ST-1 requirements. This should eliminate the requirement for special review and certification of US origin package designs.

For non-irradiated fuel element shipments, there should be no impact on availability and shipping costs because there are few, if any , shipments of the required quantities of this material.

With the application to B(U) packages containing A_1 special form sources are these packages exempt from this test or is this an oversight?

Issue 8. Grand fathering Previously Approved Packages

Please note that this section on the "Grand fathering" issue relates only to NRC Type B COC packages. Packages for fissile material and part 71/72 dual use packages for Spent Fuel are not included in our comments.

With reference to the various IAEA publications; Safety Series # 6, 1967 edition, ibid 1973 edition, ibid 1973 edition as amended 1979, ibid 1985 edition as amended 1990 and ST-1, 1996 edition, the date of the edition is not of significance, only the testing requirements for Type B (1969 edition) and type B(U) (subsequent editions) packages.

If a package has been certified under an earlier edition, let us say 1967 or 1973, it should be necessary only to demonstrate this package will pass any revised or additional tests as required under latest edition, ST-1 (1996), and not to recertify the entire package to permit use of the package.

Let us consider the various tests required for Type B and B(U) packages as sequentially listed in the IAEA editions.

Drop I: unchanged 1967-1996 editions.

Drop II: unchanged 1967-1996 editions.

Drop III: added 1985 edition-1996 edition.

This is actually a meaningless test for packages ≥ 500 Kg in that it has identical effect as Drop I for these packages.

For existing COC packages which exceed 500 KG mass no additional testing should be required to meet the 1985-1996 requirement.

For those packages with ≤ 500 Kg mass providing the NRC with test results or calculations proving the capability of these packages to meet this test should permit the NRC to issue a revised certificate reflecting current regulations with reference to this test.

We suggest that all packages of ≥ 500 Kg mass should be automatically "Grandfathered" in.

Thermal Test. Unchanged from 1967-1996 editions with the single exception of the addition of para.728(b) to the 1996 edition. This is not a destructive test. Calculations to show the capability of a package to meet this paragraph are simple.

All existing packages can be "Grandfathered" in using the "last two major revisions" criteria.

Providing the NRC with either test data or calculations proving that an existing COC package meets this requirement should permit the NRC to issue a revised certificate reflecting current regulations with reference to this test.

Water immersion test. Added in 1973 edition and unchanged thru 1996 edition. In fact any COC packages with metal outer surfaces or metal outer surfaces covering solid wood interiors can be easily shown to meet this requirement.Providing the NRC with either test data or calculations showing that these packages meet this requirement should permit the NRC to issue a revised certificate reflecting current regulations with reference to this test.

Because of the time required for manufacturers to test or perform the required calculations to prove that existing COC packages meet all current test requirements as discussed above, estimated at ≤ one year and the time required by the NRC to evaluate this data, unknown, these packages should be "Grandfathered" in for one year plus the time required by the NRC to perform the evaluations and issue the revised certificates for all existing packages.

This would be in order because these packages have an excellent history, no documented releases of radioactive material or radiation resulting from accidental conditions of transport, and meet all current critical criteria as called out in ST-1.

Based on thousands of these types of packages which we have encountered, passing the "Water immersion test" will be no problem and ST-1, para 728(b), the additional "Thermal" test, is already accounted for by wattage limitations placed on these packages by the NRC.

Consequently, public health and safety would not be compromised if these packages are "Grandfathered" in as recommended above.

On the other hand public health and safety could be seriously compromised if these packages are not Grandfathered" in. Because no packages exist which are currently certified to meet ST-1 and which are capable of transporting the thousands of Irradiators and Calibrators containing Type B quantities of radioactive material currently existing in US universities, hospitals, DOD, DOE and industrial facilities, each of these facilities will be unable to ship these type B quantities and become de-facto a long-term high level REPOSITORIES for these type B quantities of RAM.

Is it the intention of the NRC to instantaneously create thousands of long-term REPOSITORIES for large (Type B) quantities of RAM? In my opinion the creation of these REPOSITORIES is not in the interest of public health and safety or of the licensees who possess this material.

The Orphan Source Program, which CRCPD, the USNRC, Agreement States and the USDOT have been working on for the past several years could be placed in jeopardy. Orphan Sources with ≥ Type A_1 or A_2 quantities are shipped in the types of Type B packages under question. Have these Program participants been notified of the potential impact of adoption of ST-1? It is our opinion that cessation of Type B quantities of RAM under the Orphan Source Program (which includes abandoned sources) will seriously impact public health and safety.

Some waste shipments contain greater than Type A_1 or A_2 quantities and are shipped in the types of Type B packages under question. Have waste program participants (brokers, licensees and their regulators) been notified of the potential impact of adoption of ST-1? It is our opinion that cessation of Type B quantities of RAM in these packages (which includes abandoned and orphaned sources) will seriously impact public health and safety. Is it the intention of the NRC to instantaneously create thousands of long-term REPOSITORIES for large (Type B) quantities of RAM destined for land disposal as waste?

The two-year frequency of reviewing and updating ST-1 is somewhat impractical. Typical time to design, fabricate and test a package to meet a revised ST-1 specification is greater than two years followed by the time required by the NRC to evaluate and issue a certificate for the package. If calculations rather that testing are presented to the NRC, this evaluation time must precede fabrication.

Consequently designing a new package and obtaining certification therefore will probably require greater than the two year ST-1 revision periods. No manufacturer is likely to make the investment in designing a new package if is probable that the package requirements for certification will materially change during the design/fabrication/certification period rendering the package obsolete and of no value prior to initial use.

Issue 9. No comment.

Issue 10. No comment.

Issue 11. No comment.

Issue 12. Special Package Approvals.

"Large Objects fall into three categories (as a minimum):

1. Reactor Vessels which contain very large quantities of radioactive material.
2. Miscellaneous materials such activated shielding material or building material removed from decommissioned Cyclotrons, Accelerators etc., which may contain Type B quantities of RAM.
3. Irradiators typically used for research which contain type B quantities of RAM and were fabricated prior to current shipping regulations which are to be shipped for decommissioning.

Revising part 71 to include Category 1, Reactor Vessels, incorporating the risk-informed basis used for the Trojan shipment is feasible; however the adoption of a "Special Arrangement" provision may be more expedient because of the various of types of these Vessels which must be addressed, i.e. those from Power and those from Research reactors.

Revising part 71 to include Category 2 would be difficult because of the variables and associated risks involved.

As discussed at the public meeting, revision of part 71 to include Category 3, old Irradiators to be shipped for decommissioning, should be excluded from this rule making. There are many Cobalt-60 and Cesium-137 irradiators, originally used for research, which are located in the US. Many units of this type have no package markings, or these markings have been removed. Unlike reactor vessels, there are normally no drawing packages available for these units, many of which were one-of-a-kind, rendering a "Special Package Approval" impossible by the NRC.

The majority of the original manufacturers of these packages are now extinct; most were AEC licensees and AEC records, especially for transportation criteria, may be unavailable. These should be subject for possible consideration for a future rule making.

These joint NRC/DOT reviews and "Exemption Certificates" should be provided at no cost to the requester, otherwise the problems and endangerment of public health and safety as discussed previously, especially with concerns to orphan sources, will again be a result of this adoption into Part 71. Currently shippable packages under DOT exemption could become orphan sources.

It should be noted that the DOT exemption review process has worked very well and to our knowledge there has been no release of RAM from the sealed sources during a transportation accident for an exempt shipment. Additionally, it should be noted that historically there have been no reported releases of either radioactive material or excessive radiation from these old packages resulting from accidents in transport although large numbers of shipments were made in these packages.

Issue 13. Expansion of Part 71 QA Requirements ...

10CFR72 relates to Licensing requirements for Independent Storage of Spent Nuclear Fuel and High-level Radioactive Waste only. Issue 13 should only relate to the "Dual-purpose" use of these casks for transportation as well as for storage.

Consistency of QA provisions between parts 71 and 72 should be maintained for dual purpose casks used for storage and transportation of Spent Nuclear Fuel and High-level radioactive waste only.

The following notes are offered for consideration.

The distinction has never been made by the NRC Transportation Branch between the part 71/72 packages used to transport/store for spent fuel, and the Part 71 packages used to transport sealed and "Special Form" radioactive sources as well as other radioisotopes used by both Medical and Industrial entities, and the relative RISKS associated with transportation of these categories of packages. The associated non-reactor licensable activities (Parts 20, 21, 30, 39, 40, 70 and 73 as referenced in part 71) have vast differences between fuel, sealed sources, radio pharmacy, etc., and the risks relative to shipments by these activities, which are completely distinct from spent or irradiated fuel.

We find it interesting that Part 71 and 72 dual cask uses have no cross reference to Part 50 reactor licensees. We suggest that all other licensee types be specifically exempted from participation in Nuclear Power Specific QA activities with this proposed implementation of ST-1. We would like to ask the NRC to carefully consider the cross references in Part 71 for non-reactor activities.

Many holders of part 71 QA programs and COC certificates design, manufacture, maintain and ship only sealed and "Special Form" sources, radio pharmaceutical isotopes, etc. containing radioactive material. This group is not involved in and has no interest in either Part 71 irradiated fuel or Part 72 spent fuel casks or shipments thereof, or with casks for fissile material.

and Issue 14. Adoption of ASME Codes.

The NRC's justification for including ASME Codes, ASME inspections and stamps is based upon problems found during QA/QC inspections performed at manufacturers/users of part 71/72 spent fuel transportation casks. As an extension of a Part 50 licensee QA/QC program, the extension ASME code for the transport and storage of fuel element casks only is not unreasonable.

However, we suggest that the adoption of ASME Codes for 71/71 dual-use spent fuel packages should not be applied to other packages, based on "Risk analysis" comparing Irradiated Fuel Elements" with radioactive sources doubly encapsulated in SS with welded closures and certified to meet the "Special Form" requirements of 10CFR71.75 and .77 and other types of Medical/Industrial packages.

The relative "Risk Factor" for the contained material must be reflected in the requirements for the shipping package. Shipping packages for radionuclide capsules are generally in the form of an inner shielded containment which contains the capsule. This inner containment contains the biological shielding, lead or lead equivalent, contained in an all welded steel containment with substantial wall thickness, typically 1/4" minimum. This inner containment in turn is packaged in an outer containment (overpack)which provides the impact and thermal shielding.

Broaching welds on the outer containment (overpack) by the impact (Drop) tests, if the outer surface is metal, is of consequence only if this would lead to decreased thermal resistance for the subsequent thermal test. Broaching welds on the inner containment is unlikely because the overpack is the impact shield designed to crush sufficiently to reduce deceleration to the inner containment. Even if an inner weld were broached, the lead shielding (worst case) would not be compromised because the thermal shielding in the overpack combined with the heat capacity of the inner containment retains the temperature of the inner containment to below the melting point of lead.

In consequence of the above observations, it should be concluded that the requirement for the ASME welding specification should be applied to part 72 packages to be carried over to part 71 for shipping.

Likewise it should be concluded that the ASME welding specification should NOT be applied to shipping packages for sealed radioisotopic sources.

The ANSI standards for this type of inner containment, and the conditions of 10CFR 71. Subparts E, F & H, plus 36 Subpart C are based on established ANSI, ISO and other radiation related standards. In our opinion, these 10CFR reference standards for sealed sources and radiation related activities are more appropriate and effectual for the packaging and shipment of non-fuel radioactive materials. These activities are not associated with nuclear reactor components in any manner and should not be subject to the risks of reactor and fuel activities.

Issue 15. Adoption of Changes, Tests and Experiments Authority

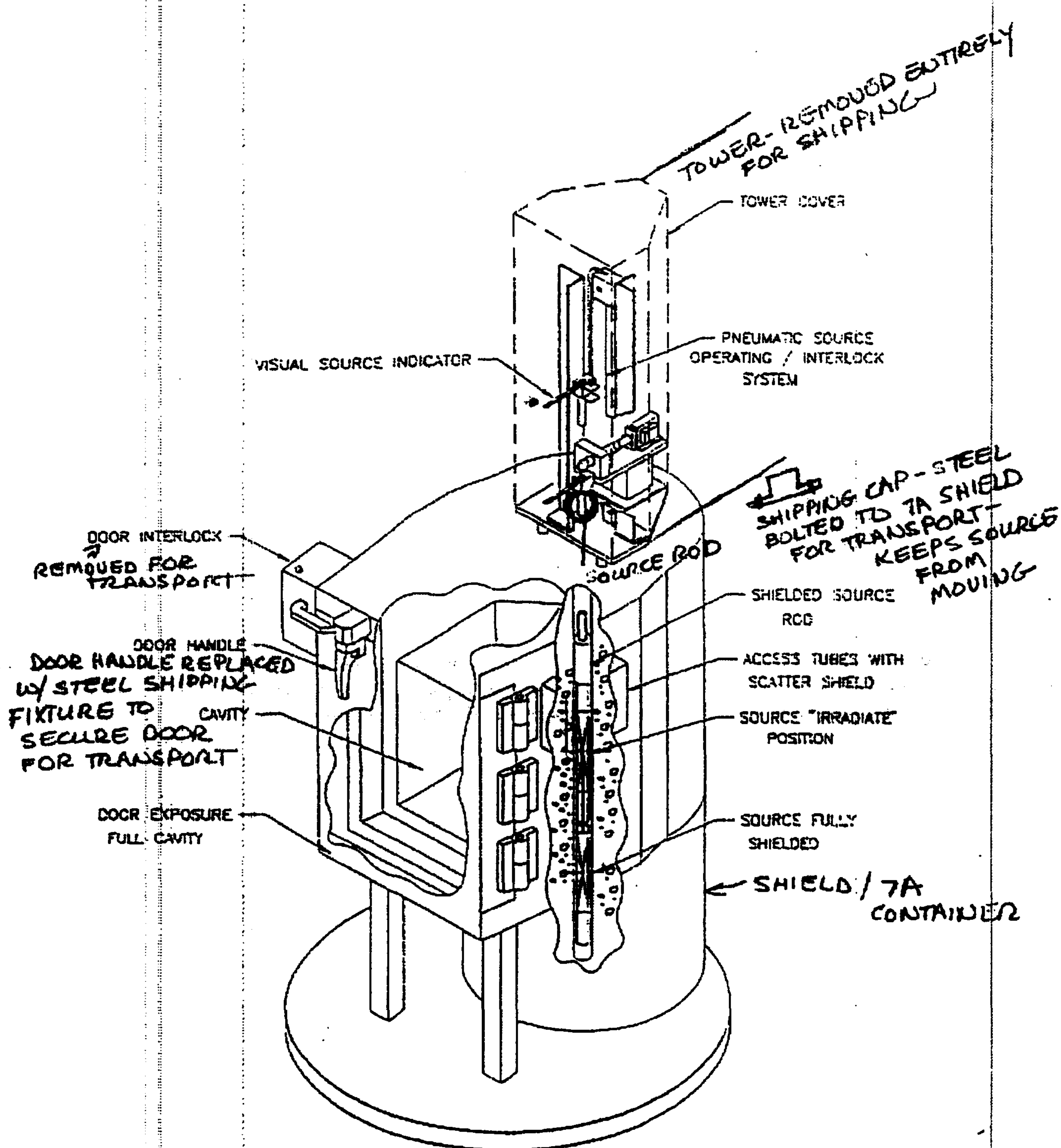
Issues 16 through 18. No comment.

Comments written by:

J.L. Shepherd. President

Mary F.Shepherd. Vice President

EXHIBIT 2



J.L. SHEPHERD and Associates

DRAWN BY	DATE	APPROVED BY	SCALE
D. TRAN	11-17-98	[illegible]	NONE

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EXHIBIT 3

NEW DEVELOPMENTS IN ACCIDENT RESISTANT SHIPPING CONTAINERS FOR RADIOACTIVE MATERIALS

J. A. Sisler

Introduction

The production of radioactive isotopes has greatly increased since scientists have learned how to control the reaction of fissionable materials in numerous types of reactors. With the production of the various isotopes came their commercial utilization. When any product has a commercial application, it is introduced into interstate and international commerce and involves one or more modes of transportation. Because radioactive materials are hazardous in varying degrees, their shipment falls within the purview of certain agencies established by law to regulate shipment in interstate or international traffic.

Both the severe consequences that could result from an accidental release of the more dangerous radioactive materials and the public's fear of this silent, unseen hazard prompted regulatory agencies such as the Interstate Commerce Commission (ICC), the Air Transport Association (ATA), and the Bureau of Explosives (B of E) to meet with their counterparts in other nations to consider proposed regulations to control the shipment of radioactive materials. These proposed regulations impose more severe container requirements upon the user and shipper of radioactive materials. These proposals, establishing criteria for radioactive-material containers for national and international traffic, require that a container survive a series of conditions which might occur during an accident. The conditions for containers of certain classes of radioactive materials are simulated in the following sequence:

1. A 30-foot free fall to an unyielding surface.
2. A 40-inch drop onto a 6-inch-diameter by 8-inch-long carbon-steel spike. The container shall be positioned to cause the maximum damage in both drops.
3. An ASTM standard 1-hour fire.
4. A 24-hour submersion of the container in water to a depth of 3 feet over the uppermost portion of the container without leakage of the contents or loss of any shielding.

Since the 1-hour fire is considered the most severe obstacle to overcome in the above test sequence, the Atomic Energy Commission (AEC) requested Sandia Corporation, with their extensive environmental testing facilities and the knowledge gained in performing numerous open-pit fire tests and radiant heat tests, help in developing containers for shipping radioactive materials that would withstand the above test sequence and to assist in the subsequent formulation of appropriate regulations.

Program Feasibility

At the outset of the container development work, it was decided that existing containers must be retained because the national inventory of radioactive-material shipping containers is so great that it would be wasteful to dispose of this inventory. Consequently, it was decided to develop an outer shell which would enable existing containers to meet the test criteria and, simultaneously, to establish a concept which would permit simpler future container designs.

Since preliminary evaluation of the test parameters indicated that the fire environment presented the greatest design difficulties, maximum effort was concentrated upon controlling the fire environment by means of insulating and ablative materials, or a combination of the two. However, insulating materials were discarded early in the program because of either the difficulties of container fabrication or failure to meet the drop-test criteria. It should be noted, however, that a steel encased, gypsum-cement insulated container successfully passed the fire test.

In considering the use of ablative materials, several factors had to be evaluated: material cost, availability, structural integrity, and ease of fabrication. These factors unerringly pointed to wood as the most suitable material. The mechanics of wood combustion through destructive distillation, the formation of a low-density char with good insulation properties, and the reasonably good insulation characteristics of the wood itself indicated that a full-scale test and development program should be initiated using this material.

Test Program

Drop Tests

To meet the drop-test criterion of a 30-foot free fall to an unyielding surface, Sandia's 185-foot drop-tower complex, capable of handling containers up to 16,000 pounds, was utilized. The containers were dropped from 30 feet onto a reinforced concrete pad with the drop angle controlled. Although only one 30-foot drop is required, the small to medium-size containers usually were dropped three times, once each on an edge, a side, and the bottom. The smaller containers were so slightly damaged by only one drop that the data obtained might have resulted from minor variations in construction rather than from damage. This drop resistance results from the thick wall required for fire resistance. Large containers were generally dropped only once in the most damaging position. However, as a proof test, one 4000-pound container was dropped three times--once at 45 degrees, once on a side, and once on an end.

Because the drop-test criterion of a 40-inch fall onto a 6-inch-diameter spike is a recent addition to the regulation, tests against this requirement have not been performed to date. However, meeting this requirement is not considered to be a problem.

Fire Tests

To meet the test requirement of an ASTM standard 1-hour fire, an open-pit petroleum fire with JP-4 jet fuel (Figure 1) was used, although it must be recognized that this is a more extreme test than required by the ASTM standard curve. It has been found that a minimum fuel area of 400 square feet and a maximum of 2000 square feet[1] was optimum for maximum heat input to the container. The container array was adjusted so that a minimum of 2 to 3 feet of flame would completely surround each container. This is equivalent to an infinite wall of flame and maximizes heat input to the object under test. We have found that in a fire of this size, radiation is the dominant heat-transfer mode. Thus, for computer studies, an 1850°F black-body temperature can be used as the input figure and will give close correlation for a modeling study.[2]

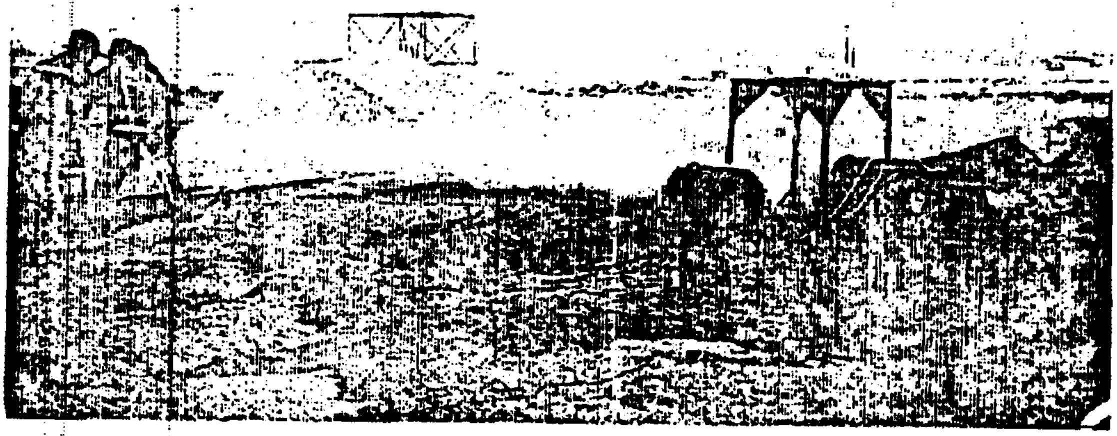

Figure 1. 20 x 20-foot fire test pit and containers immediately following Fire Test 1 (D63-13152)

Water-Submersion Tests

The water-submersion criterion has, with the exception of one test, been largely ignored, basically, because the development concept of this shipping container was an outer shell protecting an inner

[1] B. E. Bader, Heat Transfer in Liquid Hydrocarbon Fuel Fires, Sandia Corporation Report SC-DR-320-63, February 1964.

[2] Ibid.

container from essentially all effects of shock and fire. If this is done, a water-tight seal on the inner container is a simple matter to maintain.

Designs Tested

A number of designs have been examined and found lacking because of high cost, limited application, or other reasons. A few designs that were subjected to test were as follows:

1. Steel container with a special gypsum insulation. This material is a very good insulator, but was difficult to fabricate because of drying problems.

2. Steel container with a zonolite concrete insulation. This material was also difficult to fabricate and failed the fire test because of shrinking and cracking.

3. Wooden containers in cubical shapes. These containers were difficult to build strong enough to survive both the drop and fire tests.

A hollow cylindrical wooden shell was finally selected for encasing an ICC Type 55 or similar shielded container, thus protecting this inner container from the effects of shock and fire (Figures 2 and 3). The shell was constructed from rings of 3/4 inch plywood which were glued together with a strong shock-resistant adhesive and reinforced with cement-coated nails. A full-length bolt ring was also used to add rigidity and to hold the lid (Figure 4). Both the bolts and the nails serve to prevent complete failure of the container if it is cracked in the drop test. For containers of several tons, some cracking is acceptable during the drop test so long as no serious separation of the wood plies takes place. A wall thickness of 4 inches of bare insulating material is necessary to survive a 1-hour fire, although a 3-inch wall will survive a 1-hour fire if a protective sheet-steel outer covering (Figure 5) is used and internal temperatures of up to 300°F can be tolerated for the last 15 or 20 minutes of the fire. If the contents of the inner container are not to exceed 200° to 220°F (i.e., when shipping liquids), a minimum of 6 inches of wood insulation is required.

There are times when requirements other than the fire test affect features of shell construction. Heavy or very dense containers require a thicker wall to survive a 30-foot drop test. The large container in these development tests had 2 by 2 inch rings added (Figures 4 and 6). These rings have two purposes: to facilitate handling; and to absorb a significant portion of the energy of the drop, thus preventing the container wall from splitting (Figure 7). An important consideration in constructing all wooden-shell containers is to assure that the lid joints of the inner container and the outer shell are offset. Another construction feature worth consideration is the addition of a light sheet-metal shell (16 to 20 gage). This type of shell not only offers protection against routine shipping damage, but also protects against a fire environment by preventing the charred wood from sloughing off (Figure 8). However, when a steel shell is used, the shell must be vented to prevent pressure buildup by allowing combustion gases to escape.

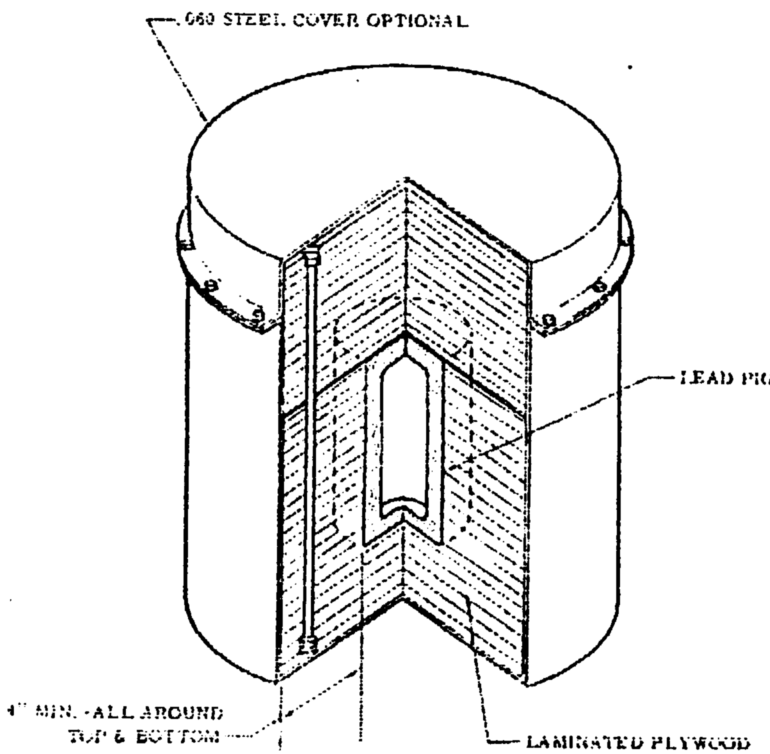

Figure 2. Cutaway view of the small wood insulated container with optional steel shell

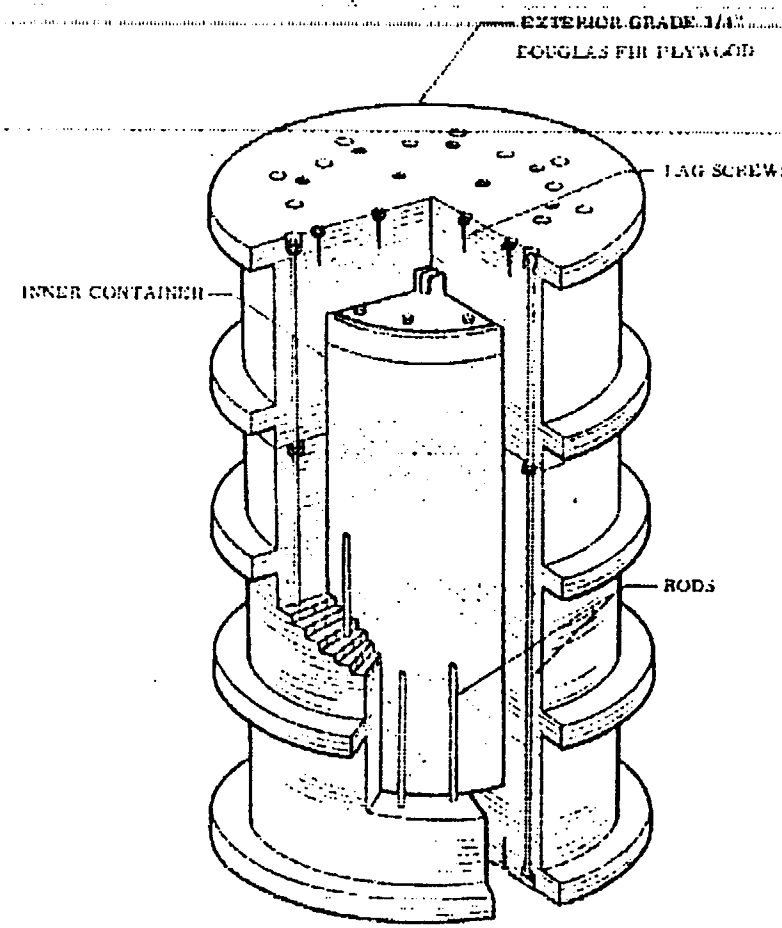

Figure 3. Cutaway view of the 4000-pound container used in SC test and development program; it is representative of large containers in general

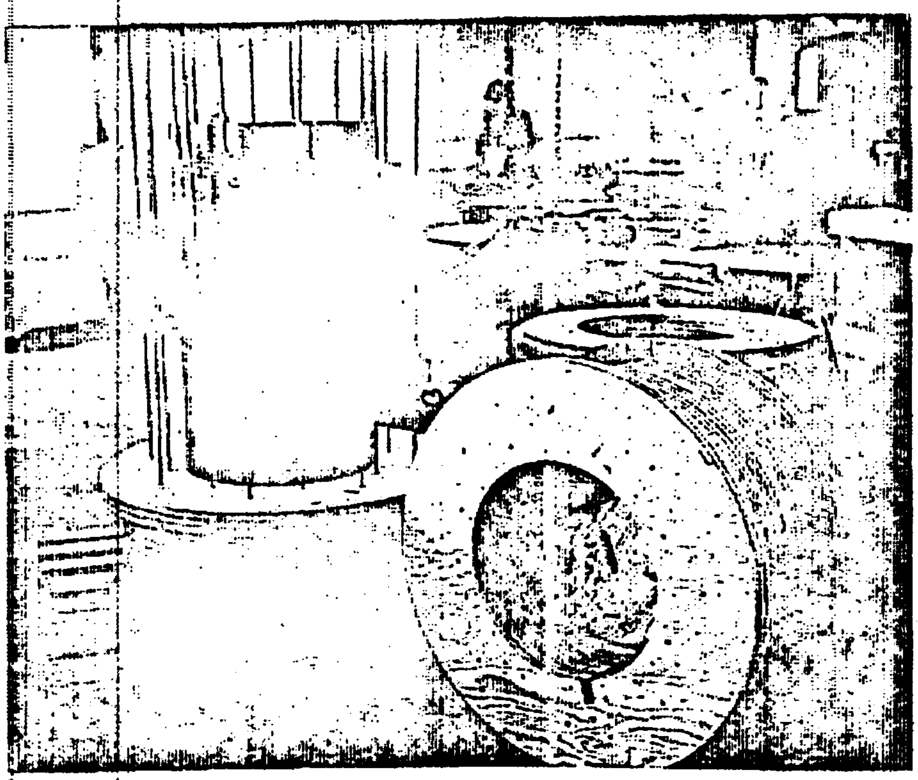

Figure 4. Construction of the 4000-lb container using an ICC-55 shielded inner container (D64-7921)

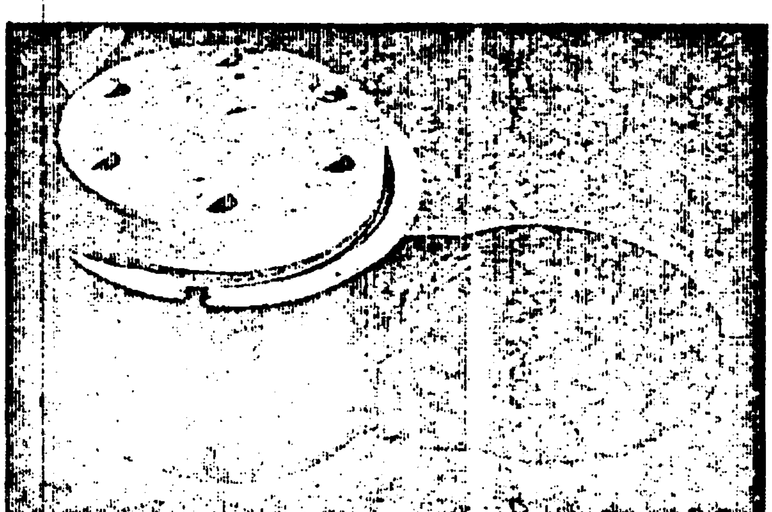

Figure 5. Small 3-inch wall container with steel shell (D63-13101)

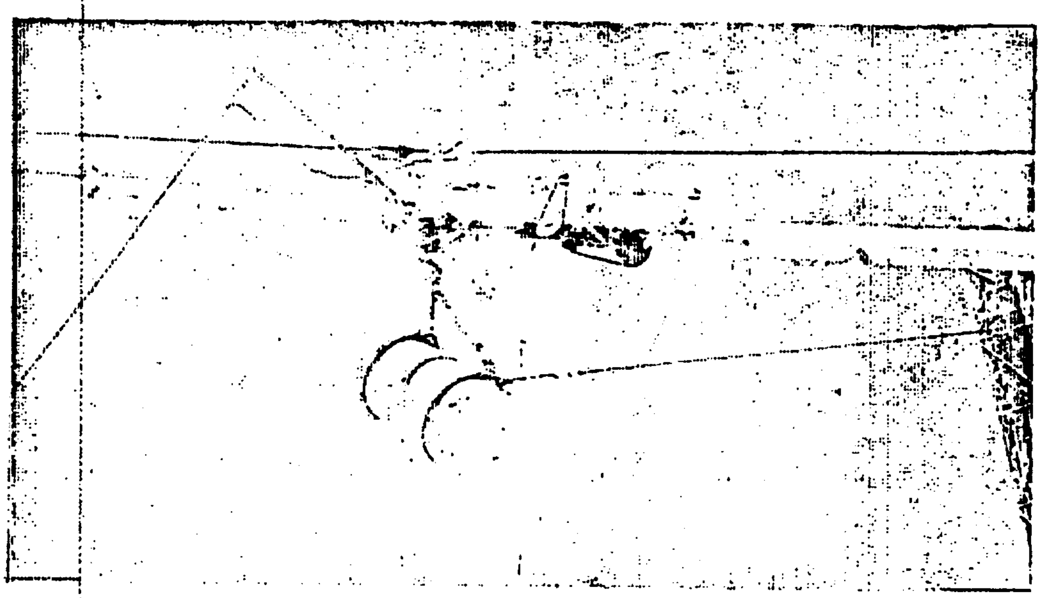

Figure 6. Drop test of second 4000-pound container (D64-9589)

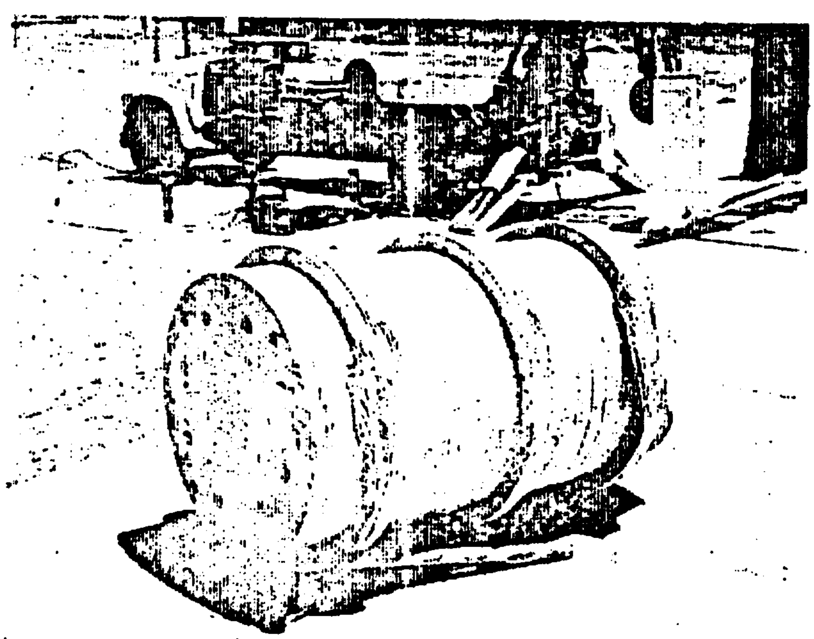

Figure 7. Effects of 45-degree angle drop test of 4000-pound container (D64-9588)

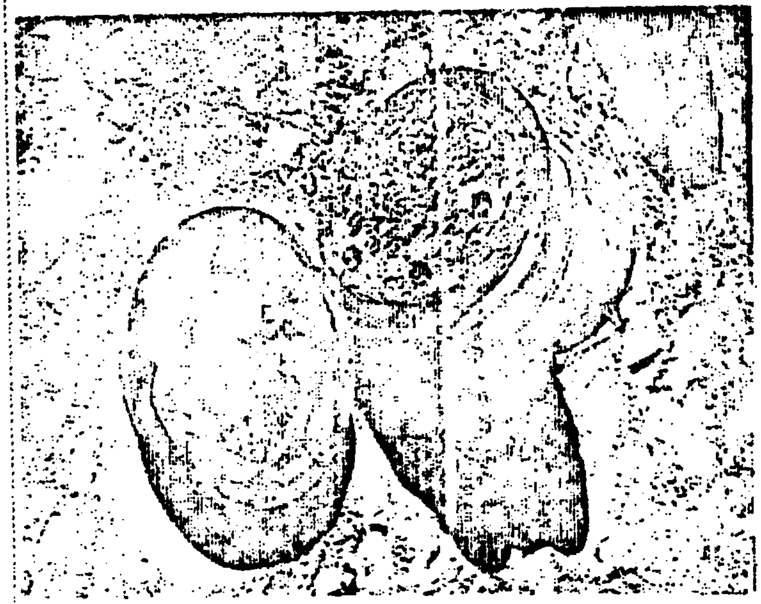

Figure 8. Small 3-inch wall container protected by steel shell showing char layer still intact after Fire Test 1--this container is constructed exactly as shown in Figure 2 (D63-13140)

Test Results

Drop Tests

A number of containers were built with various wall thicknesses and inner diameters. After consultation with several wood research laboratories, four types of materials were tried: Douglas-fir plywood and solid wood, and redwood plywood and solid wood. The Douglas-fir plywood proved to be the most satisfactory material. The solid woods have too great a tendency to split or crack.

The redwood plywood seems to exhibit this tendency to split or crack to a greater degree than the fir plywood, for larger high-density container designs. For containers of 200 pounds gross weight or smaller, it is felt that redwood plywood would be satisfactory. In addition, there are obviously many other types of plywood, and perhaps some pressed-wood-fiber board, that would be equally as effective as Douglas-fir plywood for use in a wooden-shell design. It was not intended to evaluate all possible materials, but only to find one or two good ones that were cheap and readily available.

A number of different adhesives were considered or tried. Resorcinol-formaldehyde, phenyl-formaldehyde, and polyvinyl acetate aqueous emulsion (white glue) appear to be some of the better ones. Each one has its limitations, however. Resorcinol-formaldehyde is a room-temperature curing, exterior grade glue that has high shear strength and strong bonding characteristics, but it must be cured under pressure (150-200 psi) to form a good bond. Phenyl-formaldehyde is an excellent exterior grade adhesive, but it must be cured under heat (200°-250°F) and is difficult to use in bonding very thick layers of wood. Polyvinyl-acetate aqueous emulsion (white "Elmers Glue" type) is the easiest to use, but it should be reinforced with cement-coated nails. It has very high shear strength under dynamic testing conditions but it is temperature and humidity sensitive to some extent and will "cold flow" if subjected to temperatures of 120°F or higher. These characteristics did not appear to be a problem for the Sandia wood-insulation designs because of the reinforcement provided by the cement-coated nails, the full length bolt ring, and the rigidity of the inner metal pig. This combination of adhesive and construction survived the testing program extremely well under the moderately warm and dry desert conditions prevalent in the Albuquerque area, but it would need close examination for use in very large and massive shells being designed for use in the tropics. The ideal construction techniques would utilize a resorcinol-formaldehyde adhesive bonded under pressure and reinforced with cement-coated nails. The use of a full length bolt ring to keep the lid in place is always assumed in this paper. This bolt ring contributes to the stiffness of the shell and helps, with the nails, to prevent a catastrophic failure if some delamination of the plywood takes place as a result of an impact.

The largest container built in this series consists of a 3275-pound ICC-55 steel-lead-steel cylinder encased in a 6-inch-thick plywood shell (Figure 4) with 2 by 2-inch cushioning rings added. The gross weight of this container is 4000 pounds.

Five or more cushioning rings are suggested for containers weighing over 2000 pounds, one cushioning ring layer at each end and three more evenly spaced between. This would make the end caps 8 inches instead of 6 inches thick. As a result of this added thickness, no harm is done if one of the end rings shears off entirely during a drop test.

Ten 30-foot drop tests have been made to date of the 4000-pound container. Eight units have been dropped; one was dropped three times (one end, on the side, and at 45 degrees on opposite end), accounting for the extra two drops. All containers survived in suitable condition to withstand a 1-hour petroleum fire without repair. The first test unit, utilizing resorcinol-formaldehyde glue, experienced some glue-joint failure, but this condition was corrected in subsequent drops. One 4000-pound container was drop tested following a 1-hour petroleum fire and survived without damage to the inner pig. Three drop tests were of resorcinol-formaldehyde-bonded (no nails used except in end rings), fir-plywood-shell designs. One of the drops took place during the International Symposium. Although there was slightly more delamination evident in this construction than in the nail-reinforced design, there was no damage that would affect the subsequent fire response of the container. It should be mentioned at this time that any wood-insulation design that utilizes an exterior metal shell should not require the use of reinforcing nails in the construction.

A number of smaller containers, ranging in size from 25 to 200 pounds, were dropped from 30 feet and were not noticeably damaged. Most of these were dropped three times (one end, side, and at 45 degrees) in an attempt to detect differences in response. Even with three drops, damage to this size range of container was only superficial.

A tabulation of the drops will be found in Appendix A.

Fire Tests

The results of the first fire test (see Appendix B) were most favorable for the wooden containers. Before the fire test, both the 3-inch and 6-inch wall models survived three drop tests each, while ballasted with a 61-pound steel billet simulating an inner container. The containers were then subjected to the 1-hour petroleum fire at 1850°F. Although there were difficulties with the thermocouple leads, other backup data indicate that the interior temperature in the 6-inch wall container could not have exceeded 300°F and probably was under 150°F (Figure 9). The 3-inch wall, steel jacketed, container had 1 inch of good wood left surrounding the inner billet and temperatures were in the 400° to 500°F range, according to the best estimates based on other test results.

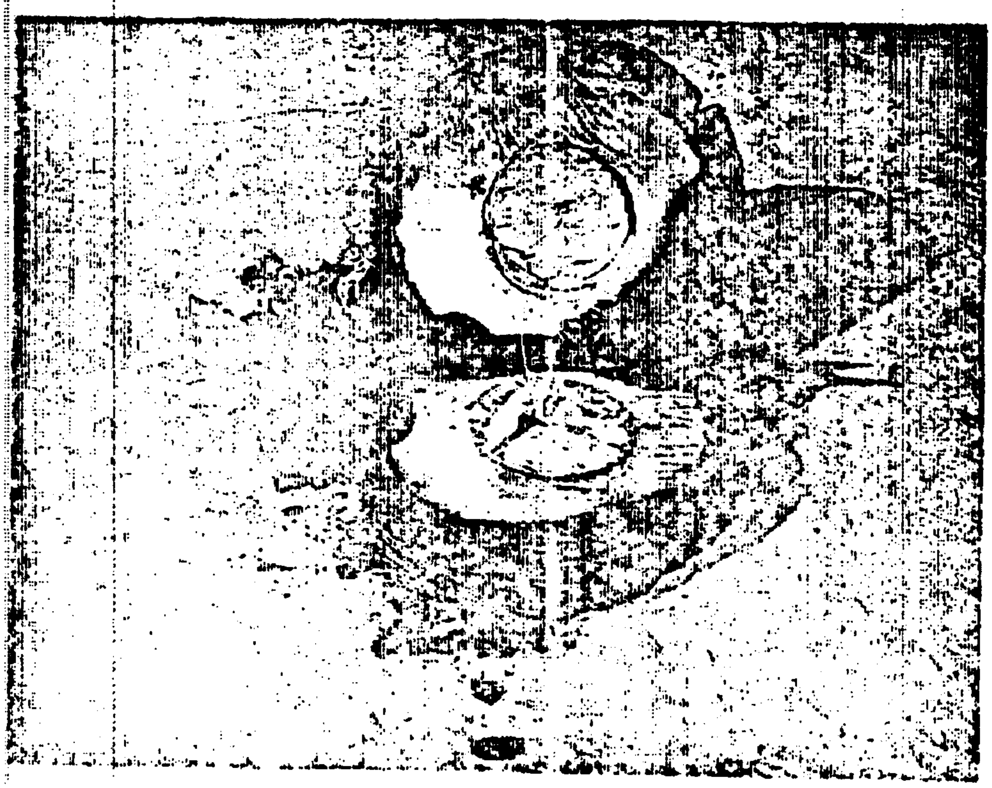

Figure 9. 6-inch wall Douglas-fir plywood unprotected container after Fire Test 1 showing amount of undamaged wood (D63-13141)

Following the first fire test and the excellent performance of wood, an investigation was begun into the thermal insulation properties of several types that were of most interest due to cost and other considerations. The Sandia Corporation Radiant Heat Facility was utilized to supply a simulated fire environment that could be carefully controlled over small areas. Four 8 x 8 x 6-inch thick blocks were made up with small thermocouples imbedded at 1/2-inch intervals all the way through the 6-inch thickness (Figure 10). A quartz lamp radiant heat panel was programmed to provide an 1850°F black-body radiant heat source (a heat rate of 11 BTU/ft^2-sec was actually measured) for 1 hour for each of the four blocks. Sample blocks tested were:

1. Douglas-fir plywood exterior grade, 3/4 inch thick, laminated into a single 6-inch thick block.

2. Douglas-fir lumber, nominal 2 inches thick, laminated into a single 6-inch thick block.

3. Redwood plywood, exterior grade, 3/4 inch thick, laminated into a single 6-inch thick block.

4. Redwood lumber, nominal 2 inches thick, laminated into a single 6-inch thick block.

The plywood blocks were tested so that the heat source was exposed to the maximum end grain. In the solid-wood blocks end grain was 90 degrees to the heat source. For the actual curves obtained from this test series see Appendix C. As can be determined from the curves the solid-wood blocks performed best with plywood blocks close behind. The redwood plywood made the poorest showing. Figure 11 showing the blocks after the tests reveal two things; namely, the char rate in the radiant heat test was twice what it was in an actual fire (it jumped from 2 inches in a fire to 4 inches in the radiant heat test), and there was a definite tendency for the heat to travel down the glue joints. The adhesive used in laminating the blocks was polyvinyl-acetate aqueous emulsion (white glue) fabricated under "box shop" conditions. The resorcinol-formaldehyde used in the fabrication of the plywood did not exhibit such tendencies. It is rather unusual that excessive heat travel, down the glue joints, had not been detected in actual fire tests. It is believed both of the above anomalies can be explained by the strong air blast applied to the face of each block during the test. This air blast is necessary to cool the radiant panel quartz lamps and causes no problem on nonflammable materials. An effort is now underway to construct an analytical model of the heat flow through a wood block from an 1850°F black-body radiant source.

Figure 10. Test setup; radiant heat test of four wood panels (D64-2524)

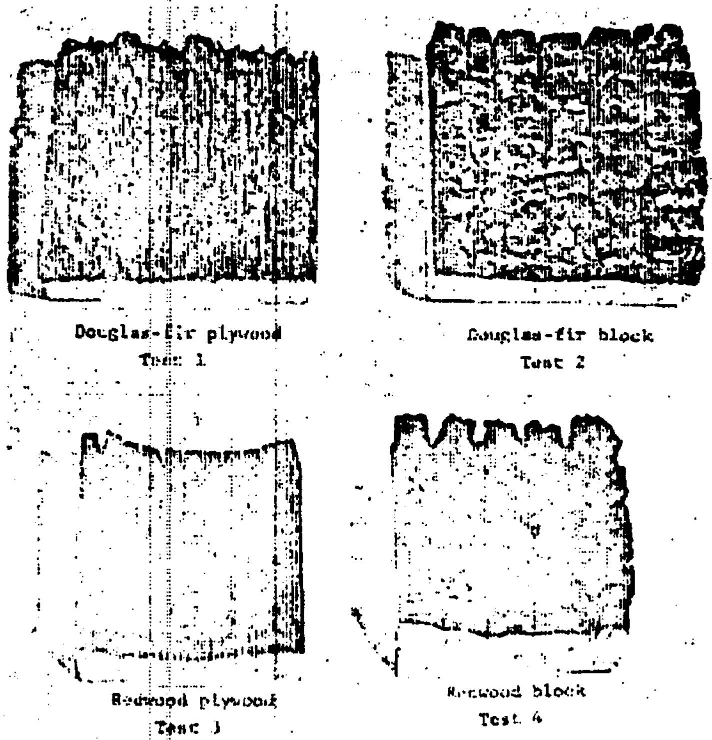

Figure 11.

Appearance of four wood panel after radiant heat test simulating a 1 hour fire (D64-2519)

The second open-pit fire test was similar to the first test, except a 30 x 30-foot pit was used instead of a 20 x 20-foot pit (Figure 12). Eleven instrumented containers were tested (see Appendix B) for 1 hour; 9880 gallons of JP-4 fuel were used, producing the hottest fire in the test series. Some of the high-temperature fiberglass insulation on the thermocouples disintegrated causing shorts. Carbon impregnation of the thermocouple insulation also caused shorts. With partial failure of the thermocouples (which had been successfully used in dozens of other Sandia fire tests) in two fire tests, it was decided to change to stainless-steel sheathed thermocouples in future tests for container instrumentation. Seven of the eleven test objects in Fire Test 2 survived. It had been anticipated that two of the containers would fail, since wall thickness was very minimal. The other two failures were the solid redwood containers which apparently split and burned quite rapidly. The solid Douglas fir also split and cracked, but still survived (Figure 13).

Fire Tests 3, 4, and 5 (see Appendix B) confirmed conclusions drawn earlier regarding the superior performance of fir plywood laminated shells in protecting an inner ICC-55 or similar container from the rigors of a severe accident.

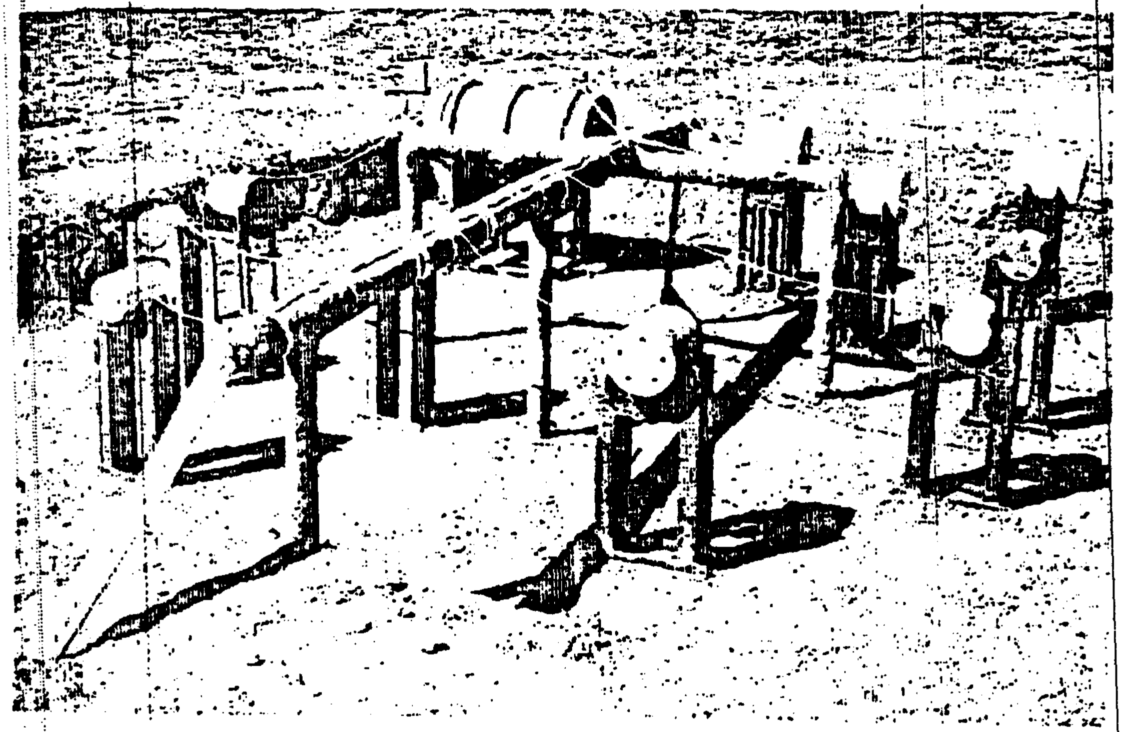

Figure 12. Test array in 30 x 30-foot pit for Fire Test 2 (D64-10016)

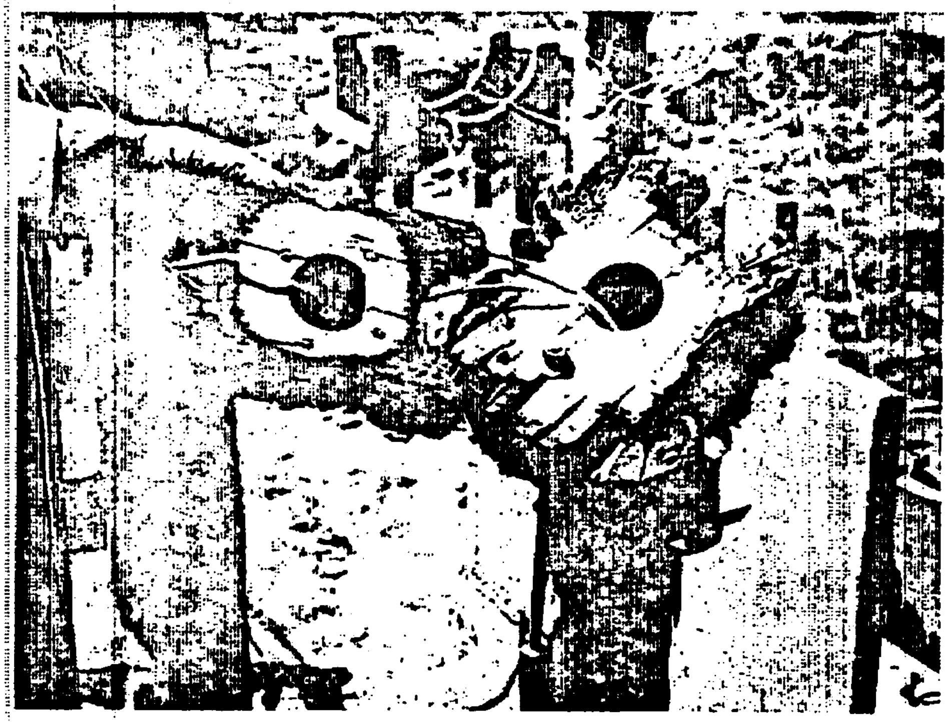

Figure 13. Solid Douglas fir, 4-inch thick wall cylinder showing splitting found to be characteristic of solid wood containers (D64-2616)

Conclusions

The purpose of this study and test effort was to develop a container, for shipping radioactive materials, capable of withstanding the fire and drop test outlined in the proposed regulations.

A laminated plywood shell with a 4-inch minimum wall thickness will provide the necessary protection for an approved ICC inner container against the 1-hour fire environment. However, thicker wood shells may be required for shipment of low-boiling-point liquids. The weight and structural features of the inner container may require a thicker wood shell to survive the drop-test requirements and to ensure that 4 inches of wood surround the container after the drop tests. However, in providing a protective shell for massive containers that contain no liquids or other pressure generating materials that might escape when exposed to temperatures under 500°F, it would not always be necessary for the protective shell to stay completely intact. At least 10 to 15 percent of the outer surface area of most large containers could be exposed to a fire environment for 1 hour and still not be in danger of loss of shielding. Therefore, for some shipping container designs the requirement that the outer protective shell remain 100-percent intact during the 30-foot drop could be relaxed to something more practical.

The early development work for the wooden-shell insulation concept has indicated that the following conditions appear to be true:

1. There is no significant difference in the burn rate between Douglas-fir and redwood plywood; however, redwood seems to incur a greater amount of splitting that could be detrimental in the fire environment.

2. There is no significant difference in the temperature gradient or char rate that can be verified for these two plywoods.

3. Plywood is superior to solid woods because of the tendency of the solid woods to split in the fire environment.

4. A glued and nailed laminate with through bolts for lid closure will produce a container that will survive the drop tests.

Although additional research must be done to refine existing data and establish concise design criteria, sufficient information is available to design an effective, economical container which will meet the rigorous requirements of the regulatory agencies.