"SPECIFICATION PACKAGINGS - PROGRESS AND POTENTIAL"

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SPECIFICATION PACKAGINGS - PROGRESS AND POTENTIAL

1) INTRODUCTION

Transportation is an important component of nuclear materials management. Nuclear materials may be transported many times between their origin as a raw material, through their various stages of processing and fabrication, and finally through their use and reuse.

Transportation of nuclear materials is a regulated activity. Many of you will be familiar with the regulatory agencies and their regulations - the Department of Transportation (DOT) and the corresponding Canadian regulatory bodies. The past several years have seen significant changes in the regulations for the transportation of nuclear materials. These changes have originated with the publication of the International Atomic Energy Agency, "Regulations for the Safe Transport of Radioactive Materials, 1967 Edition", which have now been adopted by most nations of the world, including United States and Canada.

The new regulations, which provide intermodal and international uniformity, prescribe packaging performance standards commensurate with the hazard potential of the nuclear material being shipped. To assure that the packaging performance standards are met for materials of significant hazard potential, the packaging design must be approved by the regulatory authority. The approval may take the form of either a special permit or a specification packaging.
Specification packaging is a packaging design whose physical details and allowable nuclear material loadings are published in the regulations. The design is available for use by all shippers without further approval of the transportation regulatory authority. Many of you will be familiar with some of the existing specification packagings—particularly Specifications 6L, 6M, and 7A.

Specification packagings provide significant advantages to both shipper and regulatory authority.

The primary advantage to the shipper is that specification packagings provide a readily-available, fully-approved packaging design. The dollar and time significance of this advantage may be better appreciated when it is realized that the design, regulatory compliance demonstration, and approval of a nuclear materials packaging design may cost from $5,000 to $10,000 and may require 8 to 12 weeks to complete. Specification packagings also provide a convenient basis for estimating the packaging and shipment costs for nuclear materials.

Specification packagings are a standardized design and provide the availability and interchangeability advantages inherent in standardization. Specification packagings may be available as off-the-shelf hardware or on a rental basis. Specification packagings may be exchanged with a nuclear materials shipper's suppliers and customers, thereby eliminating the shipping cost and packaging inventory disadvantages of returning empty packagings. Specification packagings may more readily correspond to the consignee's receiving and handling procedures and limitations.

Specification packagings may also be advantageous to the shipper because they are more readily acceptable to various national authorities who must approve international shipments. Specification packagings would also appear to be the solution to the apparent reduced willingness of the United States
within a Specification 6J or equivalent outer drum. The interspace between drum and pipe is packed with vermiculite which serves as a shock and thermal insulant. The Specification 6L packaging is authorized for not more than 14 kg of U-235 as Fissile Class II with a transport index of 1.3 (allowable number of packages per shipment is 38). The contained fissile and packing material must have an H/U-235 atomic ratio not exceeding 3 and must not decompose at 750°F.

The Specification 6M packaging was developed at Rocky Flats and was originally authorized by DOT Special Permit No. 5000 prior to its becoming a specification packaging. The 6M packaging consists of a 5 1/4 inch maximum diameter by 60 inch maximum length (approximate) Specification 2R inner container fixed centrally within a Specification 6C or 17C outer drum by a laminated fibreboard ("Celotex" or equivalent) filler which provides shock and thermal insulation for the inner container. This packaging is authorized for various quantities of U-235 and plutonium metals, alloys and compounds as a Fissile Class II or III packaging.

The Specification 7A packaging corresponds to the Type A packaging of the IAEA Regulations. This packaging must maintain its containment and shielding capabilities under defined "normal conditions of transport" but is not expected to survive "accident conditions of transport". The general Specification 7A includes other types of specification packagings including metal and fibre drums, wooden and fibre boxes, etc. Specification 7A packagings may be used as Fissile Class II packagings for up to 40 gm U-235 with a transport index of up to 10 or as a Fissile Class III packaging for up to 500 gm U-235.

Pending and potential specification packagings include a protective outer packaging for enriched UF₆ cylinders, a "wooden overcoat" overpack, and a steel-encased corrugated-fibreboard overpack for 55 gallon drums.
Longer range future specification packaging requirements include Type B quantities of radionuclides (a "Specification 56" packaging has been mentioned), for radioactive wastes (the "paper tiger" overpack may fill immediate needs in this area), and for reactor fuels (particularly as fuel designs reach a higher degree of standardization).

The procedure for development and publication of specification-packagings includes the stages of identification of need, design and regulatory compliance demonstration, regulatory approval-in-principle, utility review, final review and approval, and publication.

Identification of need for a specification packaging may come from industry (or, more probably, an industrial association) or from the regulatory authority (who may recognize a need from the similarity of a number of special permit applications). It is important that the need be identified as early as possible — and before various industrial organizations accumulate an inventory of different packaging designs which are intended to fulfill the same function.

The design and regulatory compliance demonstration includes the identification and optimization of functional, economic, and safety factors into a packaging design and the demonstration to the satisfaction of the regulatory authority (either by tests, analysis, reference, or combination of these methods) that this packaging design fulfills all of the regulatory requirements for its proposed nuclear material loading. Drawings and compliance report must be prepared. One or more prototype packagings may also be built at this stage. This work may best be executed by the design — development group of a single corporation or by a small group of experts from an industrial organization.

If the packaging design is acceptable to the regulatory authority, he will approve it — usually by the issuance of a special permit. This authorizes use of the proposed specification packaging design and provides an opportunity to
The steel-encased corrugated-fibreboard overpack was developed by Mechanics Research Inc., and is currently authorized by DOT Special Permit 6000. This packaging consists of an outer steel shell filled with an annular 4 inch thick corrugated fibreboard packing. This overpack has been demonstrated to provide impact- and fire-resistance adequate to convert a 55-gallon drum with gross loaded weight of 500 lb into a Type B packaging. This overpack is expected to see broad utilization - particularly for radioactive liquids (eg., tritiated heavy water with specific activity greater than 5 Ci/l) and radioactive wastes. This overpack is identified by the nickname "paper tiger".

Future specification packaging needs include packaging for low-enrichment bulk fissile materials, for liquid fissile materials, for high-density low-enrichment metals, for Type B quantities of radioisotopes, for radioactive wastes, and for unirradiated reactor fuels.

The packaging for low-enrichment bulk fissile materials (eg., UO₂ powder with U-235 in total U not exceeding 5 percent) would likely have the configuration of a 5-gallon pail centrally spaced within a 55-gallon outer drum by a steel-spider-and-vermiculite or a fibreboard filler arrangement. The packaging will likely be a moderation-controlled, Fissile Class II packaging.

- The specification packaging for liquids will be primarily for enriched uranyl- and plutonium-nitrate and may have a configuration similar to existing Fissile Class II packagings of this type which are currently authorized by Special Permit.

A wooden-box-type specification packaging is required for low-enrichment, high-density metals such as fuel cores. This design should be of a high-integrity, low-cost, non-returnable type.

The primary advantage of specification packagings to the regulatory authority is that they reduce the number of special permit applications which he must evaluate and authorize - thereby permitting him to more efficiently and effectively administer and update the general regulations.

Specification packagings currently in use in North America have been developed largely as a result of efforts by the Department of Transportation and the Atomic Energy Commission. Mr. Bill Brobst of the Department of Transportation will be addressing you tomorrow. The Traffic Management Branch (Bob Kay and Jim Sisler) of the Division of Construction of Atomic Energy Commission Headquarters have been responsible for coordinating the Atomic Energy Commission effort in the specification packaging program. Some of you will be familiar with the "Information Brochure on DOT Specification Shipping Containers and Guidelines for the Preparation of Proposals for DOT Specifications for Radioactive and Fissile Material Shipping Containers" which this Branch has published.

2) PROGRESS

Let us now examine current specification packagings, pending and potential specification packagings, future needs in specification packagings, and procedure and problems in developing specification packagings.

There are currently three specification packagings in widespread use for nuclear materials - Specifications 6L, 6M, and 7A.

The Specification 6L packaging was developed at Los Alamos and was originally authorized by Bureau of Explosives Special Permit 1736. This packaging consists of a 5 1/4 inch maximum inside diameter by 50 inch maximum length Specification 2R inner container fixed centrally by spider frames
The protective outer packaging for enriched UF₆ cylinders was developed at Oak Ridge and is currently authorized by DOT Special Permit 4909. This packaging consists of a fire-resistant, fibreglass-and-wood-reinforced, rigid foam insulant contained within inner and outer steel shells. There are four different sizes of this packaging with the inner cavities being sized to receive 5, 8, 12, and 30 inch diameter UF₆ cylinders. The packaging assemblies are authorized as Fissile Class II, with maximum enrichment limit and transport index assigned on the basis of cylinder diameter. These outer packagings also have a use potential for inner packagings other than UF₆ cylinders.

The Specification 20WC wooden protective jacket was developed by Sandia Corporation and was originally authorized by DOT Special Permit 5800. This packaging design was published as an interim DOT Specification on 1 January 1969. This overpack consists of a hollow cylindrical shell made up of discs and rings of plywood or hardwood, adhesive-laminated and reinforced by axial steel rods. The wooden shell thickness varies from 3 to 6 inches depending upon the weight of the inner packaging and upon whether an outer steel shell is used. There are five different configurations of this packaging (numbered 20WC-1 to 20WC-5) with a range of maximum authorized gross weights of jacket and contents between 500 and 4,000 lb. This specification packaging will prove most useful for uprating existing packagings (e.g., Specification 55) to a Type B packaging category. Since this outer packaging provides good thermal insulation, and since it is desired that inner package temperatures be limited to a safe value, the maximum heat output of the radioactive contents of the package assembly is limited.
accumulate some actual experience with it.

After the packaging design is approved in principle, a "utility review" is conducted. The "utility review" consists of distributing the design details and compliance evaluation of the packaging to a large number of prospective users. The purpose of the utility review is to broaden the scope of the proposed specification packaging design - both in terms of generalizing and standardizing design details and also in terms of the types, forms, and quantities of materials for which it will be authorized. Utility review feedback is normally sent for review to the packaging design sponsor or to the regulatory authority or his adviser.

A final review of the utility review feedback, service experience, etc., is conducted before the specification packaging design is published in the regulations.

3) POTENTIAL

To date, the potential of specification packagings has been utilized to only a small degree. It is the purpose of this section to examine some of the methods by which specification packagings may be utilized to a greater degree. The methods considered are improvement of the procedure for development and publication of specification packagings, the general special permit approach, form of publication of specification packagings, and international specification packagings.

The specification packaging procedure may be improved by an earlier anticipation of need, and by an improved and better-coordinated industry input both during the initial submission and the utility review. It was mentioned earlier that both industry and regulatory authority benefit from the use of specification packagings. The regulatory authority's responsibility is safety - that is, he is responsible for assuring that specification
packagings meet the regulatory requirements. The functional and economic aspects of specification packagings are industry's responsibility — and thus the major responsibility for improving the specification packaging procedure rests with industry.

An industrial association is the best instrument for dealing with specification packagings. All of the nuclear industry associations which come to mind — the Institute of Nuclear Materials Management (INMM), Atomic Industrial Forum (AIF), American Nuclear Society (ANS), United States of America Standards Institute (USASI), etc., all have standards committees of various types. The association which would appear to be best equipped for this role is the United States of America Standards Institute (USASI) — particularly within the Committee N14 which deals with the transportation of all types of radioactive materials. The USASI N14 Committee is best suited for this role because it has a broad representation (packaging designers, shippers, carriers, AEC and contractors, Department of Transportation; representatives from INMM, AIF, ANS, etc), has commodity-based sub-committees (fissile and reactor feed materials, irradiated-fuel, waste and low specific activity materials, Type A shipments, radioactive devices, etc); has the capability to publish specification packagings in the form of standards, and has (through the Committee on International Nuclear Standards) contact with international standards organizations. USASI N14 Committee can do much to further the exploitation of specification packagings by early anticipation of need (by examining future requirements — say five years hence), by proposing specification packagings (which could be designed and submitted by a small group of packaging designers and shippers from potential-user-corporations), and by contributing to and coordinating
utility reviews. The last point is important to efficient and effective utility reviews. The reason why utility reviews have not been completely successful to date is that a single organization (either the regulatory authority, his adviser, or the packaging design submitter) must review a large number of uncoordinated responses to the request for utility review. An organization such as a USASI N14 subcommittee could discuss and review utility review feedback and make a single recommendation which represented the consensus view of industry.

Another basic method of developing the potential of specification packagings is through the greater use of the general special permit which does not name an authorized user but rather requires that each potential user, before his first use of the packaging, register his identity with the regulatory authority. Thus, when the regulatory authority receives an application for a special permit for a packaging design with broad scope application, he may issue a general special permit for the packaging and make it available for use by all interested organizations. The financial investment of the organization submitting the packaging design is protected because the design is not described in detail on the special permit - thus interested users are required to contact the submitter organization (which is identified on the special permit) and to make the necessary arrangements to acquire packaging design or hardware. Since special permits are normally issued for a two-year term, this period may be used to gain experience which may be useful in the utility review of the packaging design prior to its publication as a specification packaging. The general special permit is also advantageous to the regulatory authority, since frequent revisions to include additional authorized users are not required. The potential of the packaging design as a specification packaging may be indicated by the number of users who
register their identity with the regulatory authority.

The form of publication of specification packagings has, in some cases, inhibited the use of specification packaging. Regulatory format, at the present time, requires that the packaging design be described in words. When a shipper wishes to have a specification packaging fabricated, the fabricator requires drawings. The production of drawings imposes an additional cost to the supply of the packagings and provides an opportunity for variances from the specification - either through error or misinterpretation. A solution would appear to be publication of specification packagings in the form of both written description and drawings. If the regulatory format or printing requirements prevent the publication of drawings, then a reference to the source of drawings should be given. Perhaps the drawings and relevant description could be published as a USASI standard which could then be referenced in the regulations.

So far, we have discussed specification packagings in a North American context. For export and import shippers, a great potential for use of specification packagings exists in an international context. At the present time, most fissile and large quantity packaging designs require the approval of each national regulatory authority through whose jurisdiction the export/import shipment is transitted. Ocean-going vessels and aircraft are considered to be extensions of their country of registry and require the approval of that regulatory authority. The International Atomic Energy Agency, in Annexes III and V of its "Regulations for the Safe Transport of Radioactive Materials, 1967 Edition" makes provision for the publication of international specification packages. The procedure for development and publication of international specification packagings is similar to that for national specification packagings except that submissions are made by governments and the
regulatory compliance is evaluated by an international panel of packaging experts. Although no international specification packagings have been published to date, several submissions for evaluation are expected to be made in the near future. International specification packagings are expected to reduce the administrative aspects of international shipments of nuclear materials very significantly.

4) CONCLUSIONS

It is the common objective of the nuclear industry and the regulatory authority to make the transportation of nuclear materials as safe, efficient, and economic as possible.

The first major step toward the achievement of this objective was the development, promulgation, and application of the new regulations which have a rational basis of specifying packaging requirements in terms of the hazard potential of the material being shipped and which provide intermodal and international uniformity.

The second major step toward the achievement of the common objective is the optimal use of specification packagings. The increased use of specification packagings may be stimulated by improved industrial support and coordination, by the greater use of general special permits, by improved methods of publication, and by accelerated publication of international specification packagings.

As a regulatory authority (and I am sure that I may also speak for Mr. Brobst in this respect), I look forward to the cooperation and assistance from the Institute of Nuclear Materials Management and other nuclear industry associations such as the N14 Committee of the United States of American Standards Institute in achieving our mutual objective of safe, economic, and efficient transportation of nuclear materials.