THE EFFECT OF PROPOSED CHANGES TO THE IAEA TRANSPORT REGULATIONS ON DECOMMISSIONING AND OTHER LOW LEVEL WASTE TRANSPORTATION

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ABSTRACT

Ontario Hydro has studied the proposed changes to the IAEA Transport Regulations contained in the 1985 4th draft edition. The study shows that these proposed changes will have significant strategic and economic effects on the transportation of radioactive decommissioning and other low level wastes.

Under the 1985 4th draft edition, the definition of Low Specific Activity (LSA) material is revised and a new regulation is proposed which restricts the quantity of LSA material or Surface Contaminated Object (SCO) in a single package to that which would have an unshielded dose rate of 10 mSv/h (1 rem/h) at 3 m.

The objective of this paper is to highlight the implications of the proposed regulatory changes. An example of the impact of these changes is presented by considering the transportation of typical CANDU decommissioning wastes which arise through piece-by-piece removal of a reactor assembly.

The potential effect of the changes is that less decommissioning waste can be shipped in a single low level waste package. This results in the requirement for so many small, low level waste packages that Type B shipments are strategically and economically more attractive. However, use of Type B shipments would also result in higher dose uptake and waste management costs than under the 1973 Regulations.

INTRODUCTION

The 1985 4th draft edition of the IAEA's "Regulations for the Safe Transport of Radioactive Materials" proposes several major changes in the area of Low Specific Activity (LSA) material. The objective of this paper is to highlight the strategic and economic effects that these proposed changes may have on the packaging and transportation of low level radioactive wastes.

The volume and rate of low level waste production during nuclear power station decommissioning operations is large compared to routine station waste arisings. Therefore, the impact of the proposed Transport Regulation changes is more evident when considering the management of decommissioning wastes. In this paper, the differences between packaging, handling and transporting typical activated CANDU reactor core decommissioning wastes under the "old" (1973) and "new" (1985) Regulations are presented.

Since most utilities having nuclear generation are faced with the *eventual* transportation of decommissioning wastes, the regulatory changes could have far-reaching effects. The implications highlighted in this paper via the CANDU reactor example, apply to other types of nuclear power reactors and to other types of waste such as activated and contaminated routine operating wastes and reactor rehabilitation wastes. For most utilities, the new Regulations would have more immediate impact in the management of these latter waste types. Furthermore, manufacturers of transport packages for low level radioactive wastes may find that, under the proposed regulations, some of their existing packages may be of limited use. It may be prudent for utilities and manufacturers of low level waste packages to review the impact that the new Regulations will have on them if adopted by their Regulatory body.

REGULATORY CONSIDERATIONS

The International Atomic Energy Agency (IAEA) "Regulations for the Safe Transport of Radioactive Materials"[1] have been adopted by or used as a basis for radioactive materials transport regulations in most countries.

In Canada, the nuclear industry is regulated by the Atomic Energy Control Board (AECB). Traditionally, the AECB adopts regulations developed by international expert bodies such as the IAEA. It is expected that, if revisions are made to the "Regulations for the Safe Transport of Radioactive Materials - 1973 edition", these revisions will also be adopted by the AECB unless there is good reason to show that the new regulations are not appropriate in whole or in part.

Although many small changes have been noted between the fourth draft revision of the 1985 edition[2] and the existing 1973 edition, only the following changes are considered in this paper:

1. The definition of LSA and Low Level Solid (LLS) material has changed significantly. Under the proposed regulations, the material is divided as follows:

Waste Category (1973 Regulations)	Waste Category (1985 Regulations)
LSA	LSA-I LSA-II SCO-I SCO-II
LLS	LSA-III

2. Under the 1973 edition of the Regulations, the quantity of LSA material of a given specific activity allowed in a single package was determined only by external package dose rates. Under the 1985 edition, the quantity of LSA material of a given specific activity allowed per package is also restricted such that the external radiation level at 3 m from the unshielded material does not exceed 10 mSv/h (1 rem/h).

The general transport restrictions of .1 mSv/h (10 mrem/h) at 2 m from the vehicle and 2 mSv/h (200 mrem/h) at any point on the surface of the vehicle have not been changed and would apply in the transportation of low level wastes under either edition of the Regulations.

Both the "old" and "new" Regulations also specify 74 MBq/Mg (2 µCi/kg) as the specific activity of waste material below which the material is considered "non-active" for transportation.

DECOMMISSIONING STRATEGY AND ASSUMPTIONS

Decommissioning strategies for nuclear stations are based on many assumptions. In this paper, the assumptions affecting the transportation of CANDU decommissioning wastes to a disposal facility are listed as follows:

1. Nuclear units are mothballed for 30 years following shutdown to permit activated and contaminated components to become less radioactive. Removal of equipment and buildings then begins.

2. A decontamination stage immediately after shutdown will remove most non-fixed contamination. The remaining fixed contamination is assumed to be low enough that all materials which are only surface contaminated can be considered "non-active" for transportation purposes (i.e. less than 74 MBq/Mg (2 µCi/kg)) at the time of removal. As a result, only activated reactor core components need to be considered in this paper.

3. Since the definition of "non-active" waste for transportation purposes has not been changed in the new Regulations, the strategy for managing wastes less than 74 MBq/Mg (2 µCi/kg) would be the same under both sets of Regulations.

4. A low level waste disposal facility for wastes of specific activity greater than 3.7 MBq/Mg (.1 µCi/kg) is assumed available and operating at the time of reactor dismantling.

5. Non-active disposal wastes (less than 3.7 MBq/Mg (.1 µCi/kg)) are taken to local landfill sites near the reactor site.

6. Note that some wastes, deemed non-active under the transport Regulations must still be shipped "in bulk" to the disposal facility (i.e., those wastes with specific activities in the range 3.7-74 MBq/Mg (.1-2 µCi/kg)).

Waste Characterization

The quantity and activity of the CANDU decommissioning wastes to be considered in this paper are presented in Table I, which has been produced from existing information.[4] The specific activities of the waste materials are based on neutron activation calculations performed by the ORIGEN computer code.

The reactor core is assumed to be dismantled in a piece-by-piece removal technique using remote cutting and handling equipment. The basic CANDU reactor assembly is shown in Fig. 1. Figure 2 shows the general layout and equipment for core dismantlement.

The following assumptions, made in preparing Table I, should be identified:

1. The study assumes that the total activity in each component is evenly distributed throughout the entire component.

2. The specific activities of components are restricted to the significant gamma emitters present in the waste item (e.g. Co-60, Fe-55), since these affect external radiation fields and are important for package design.

It is assumed in this study that all waste material is volume reduced if required after dismantlement to achieve an average density of 4 Mg/m^3 (approximately 1/2 the density of steel). This is reasonable for packaged steel plate, steel shielding balls and volume reduced steel piping, which describes the waste material obtained from a CANDU reactor.

WASTE PACKAGING

The "active" components for transport purposes listed in Table I range in specific activity from 1.94x10^{-3} TBq/Mg (5.24x10^{-5} Ci/kg) Co-60 to 57.5 TBq/Mg (1.552 Ci/kg) Co-60. Thus, shielded packages would be required in transporting these materials to reduce external dose rates to regulatory limits. Table II organizes the active waste items from Table I in order from most to least active. To package these materials, the regulatory limits on package and material dose rates identified previously must be applied for each waste item of Table II.

The waste category and minimum packaging type requirement for all active waste items under each revision of the Regulations is summarized as follows:

	1973 Regulations		1985 Regulations	
Waste Item No.	Waste Category	Packaging Type	Waste Category	Packaging Type
18	LLS	Strong Industrial Package	LSA-III	IP-3 (Type A for Solid Wastes)
Remaining Items	LSA	LSA Package (Meets General Packaging Requirements 201-208, 210)	LSA-II	IP-2 (Strong Industrial Package)

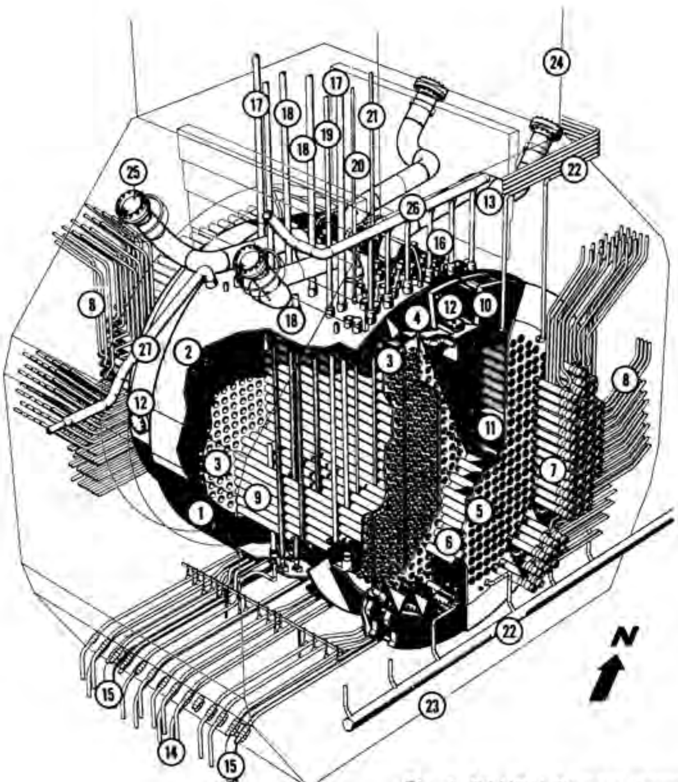
To satisfy the above packaging requirements, two basic packaging options are considered for managing the volume reduced reactor wastes:

1. Waste could be remotely loaded into disposable steel liners which are placed inside a reuseable shielding overpack constructed of lead, steel or concrete. The overpack (containing the liner) could be designed to satisfy the regulatory requirements for an LSA, Strong Industrial (IP-2), Type A (IP-3) or Type B package. Type B packages meet more stringent test requirements than the packages tabled above and have no regulatory limit on the quantity of waste carried.

Table I

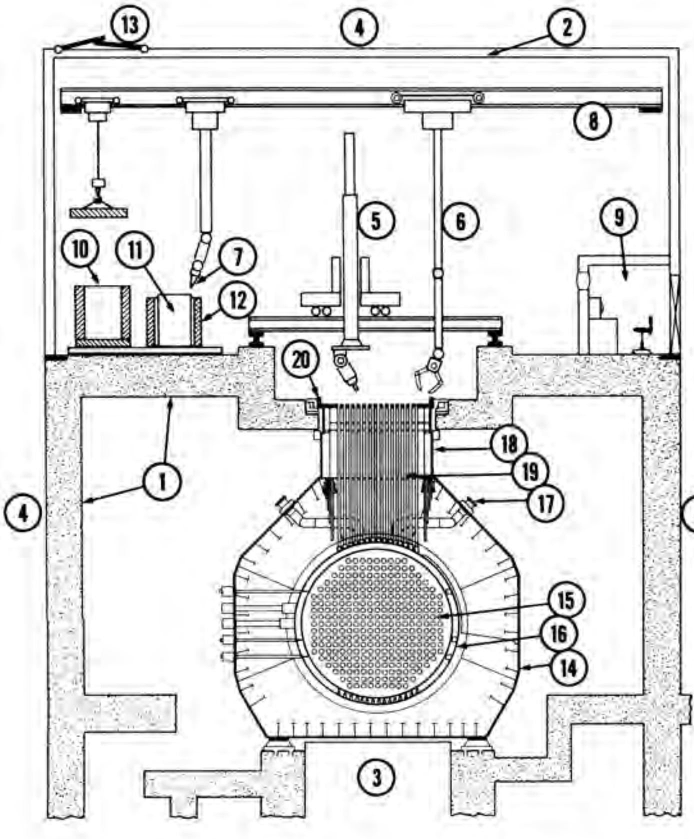
CANDU Reactor Waste Components

Waste Item Nos.	Component Name(s)	Weight of Waste Material Per Reactor Unit (Mg)	Activity 30 Years After Reactor Shutdown (TBq)	Specific Activity of Waste at Time of Dismantling TBq/Mg (Ci/kg)	Comments
1	Drives for Control Rods	51.4	Non-active		Shipped in bulk to landfill site
2	Shut-off Rods	1.25	Co-60 1.44×10^{-5} Fe-55 2.32×10^{-6}	1.15×10^{-5} ($.31\times10^{-6}$) 1.86×10^{-6} ($.05\times10^{-6}$)	Non-active for transport: Shipped in bulk to disposal
3	Liquid Zone Control Tubes	.4	Co-60 .345	.863 (.0233)	LSA Material
4	Flux Monitors	2	Co-60 1.73	.863 (.0233)	LSA Material
5	Booster Rod Guide Tubes	1	Co-60 .863	.863 (.0233)	LSA Material
6	Shut-off Rod Guide Tubes	2	Co-60 1.73	.863 (.0233)	LSA Material
7	Feeder Cabinet	1.81	Non-active	–	Shipped in bulk to landfill site
8	Feeders	117.6	Non-active	–	
9	External Piping (end shield cooling, moderator, shield tank cooling)	6.8	Non-active	–	
10	End Fittings (including closure plug and gray lock fittings, liner tube & latch)	205.6	Co-60 323.4 Fe-55 53.7	1.57 (.0425) .261 (.0071)	LSA Material
11	Pressure Tubes and Shield Plugs	30 P/T 70 SP	Co-60 19.5 P/T Co-60 20.1 SP Fe-55 5.19 SP	.65 (.0175) .287 (.0078) .074 (.002)	LSA Material
12	Calandria Tubes with Inserts	11.4	Co-60 7.9	.693 (.019)	LSA Material
13	Feeder Tube Supports and Hangers	3.9	Non-active	–	Shipped in bulk to landfill site
14	Reactivity Mechanism Deck Including Steel Structure, Cover Plates, Shielding Plugs, Lead Shielding (zone troughs)	72.3	Non-active	–	as for item 13.
15	Internal Piping-Shield Tank to Calandria (include moderator outlet piping-removed after item 17)	7.2	Co-60 1.4 Fe-55 .23	.194 (.00524) .032 (.00086)	LSA Material
16	Curtain-Type Shielding Slabs	53.6	Co-60 10.4 Fe-55 1.71	.194 (.00524) .032 (.00086)	LSA Material
17	Calandria Shell with Fittings	39	Co-60 84.1 Fe-55 13.7	2.16 (.0582) .351 (.0095)	LSA Material
18	Calandria Side Tube Sheets	17.5	Co-60 1006 Fe-55 164.2	57.5 (1.552) 9.38 (.2533)	LLS (Old Regs) or LSA-III (New Regs)
19	Baffle Plates	26.3	Co-60 253.3 Fe-55 41.9	9.63 (.26) 1.59 (.043)	LSA Material
20	Annular Shielding Slabs	92.1	Co-60 17.9 Fe-55 2.93	.194 (.00524) .032 (.00086)	LSA Material
21	Lattice Tubes	33.1	Co-60 50.3 Fe-55 8.34	1.52 (.041) .252 (.0068)	LSA Material
22	End Shield Shielding Balls	231.33	Co-60 39.9 Fe-55 10.3	.172 (.0047) .045 (.0012)	LSA Material
23	Shield Tank Extension	42.8	Co-60 8.3×10^{-5} Fe-55 2.16×10^{-4}	1.94×10^{-6} ($.0524\times10^{-6}$) 5.05×10^{-6} ($.136\times10^{-6}$)	Non-active for transport: Shipped in bulk to disposal
24	Extension Shielding Balls	129.5	Co-60 .756 Fe-55 2.02	5.84×10^{-3} (1.57×10^{-4}) 1.56×10^{-2} (4.2×10^{-4})	LSA Material
25	Gap Shielding Between Extension and Concrete	16.8	Non-active	–	Shipped in bulk to landfill site
26	Shield Tank (with slot retaining plates)	316.33	Co-60 6.3×10^{-4} Fe-55 1.59×10^{-3}	2×10^{-6} ($.0524\times10^{-6}$) 5.03×10^{-6} ($.136\times10^{-6}$)	Non-active for transport: Shipped in bulk to disposal
27	Shield Tank Shielding Balls	193.5	Co-60 1.13 Fe-55 3.01	5.84×10^{-3} (1.57×10^{-4}) 1.56×10^{-2} (4.2×10^{-4})	LSA Material
28	F/M Side Tubesheet	37.5	Co-60 2.16×10^{-4} Fe-55 3.52×10^{-6}	5.76×10^{-6} ($.1552\times10^{-6}$) 9.4×10^{-8} (2.53×10^{-9})	Non-active for transport: Shipped in bulk to disposal
29	End Shield Shell	10	Co-60 1.94×10^{-2} Fe-55 3.19×10^{-3}	1.94×10^{-3} (5.24×10^{-5}) 3.19×10^{-4} (8.6×10^{-6})	LSA Material
30	Shield Tank Support Bearings	8.71	Non-active	–	Shipped in bulk to landfill site
31	Shield Tank Base Plates	21	Non-active	–	as for item 30.
	Total Waste Mass Per Unit	1853.7 Mg			



1. Calandria
2. Calandria Shell
3. Calandria Side Tube Sheet
4. Baffle Plate
5. Fuelling Machine Side Tube Sheet
6. Lattice Tube
7. End Fittings
8. Feeders
9. Calandria Tubes
10. Shield Tank Solid Shielding
11. Steel Ball Shielding (End Shield)
12. Manhole
13. Pressure Relief Pipes
14. Moderator Inlets
15. Moderator Outlets
16. Reactivity Control Rod Nozzles
17. Booster Rod
18. Shut-Off Rod
19. Zone Control Rod
20. Flux Monitor
21. Flux Monitor and Poison Injection
22. End Shield Cooling Piping
23. Shield Tank
24. Shield Tank Extension
25. Rupture Disc Assembly
26. Moderator Inlet Header
27. Moderator Overflow

Fig. 1. CANDU Reactor Assembly



1. Reactor Vault
2. Temporary Containment Envelope
3. Fuelling Machine Duct
4. Reactor Building
5. Remote Underwater Plasma Arc Cutter
6. Remote Manipulator
7. Remote Welder/Maintenance Tool For Remote Cutter & Manipulator
8. Bridge
9. Shield Control Room
10. Shielded Transportation Cask
11. Cask
11. Cask Liner
12. Liner Shield
13. Sealed Hatch
14. Shield Tank
15. End Shield Plugs
16. Calandria Shell
17. Capped Connections
18. Shield Tank Extension
19. Thimble
20. Reactivity Mechanism Deck

Fig. 2. General Layout and Equipment for Reactor Dismantlement

TABLE II

Waste Characterization for Packaging

Waste Item Nos.	Specific Activity of Removed Mass (TBq/Mg Co-60)	Approximate Shielding Thickness to Obtain .1 mSv/h (10 mrem/h) @ 2 m	Allowable Mass of Material per LSA Package (1985 Regulations) (kg)	Allowable Mass of Material per Type A Package (1985 Regulations) (kg)	Mass of Waste per Type B Package[3] (1985 Regulations) (kg)	Mass of Waste per LSA Package[3] (1973 Regulations) (kg)
18	57.5	825 mm h.c.[1] or 370 mm Steel	9.2	6.44	15,700	27,760
19	9.63	700 mm h.c. or 310 mm Steel	54	38.5	15,700	43,000
17	2.16	560 mm h.c. or 250 mm Steel	240	170.	26,850	43,000
10	1.57	530 mm h.c. or 240 mm Steel	330	235.	26,850	66,800
21	1.52	530 mm h.c. or 240 mm Steel	340	240.	26,850	66,800
3 to 6	.863	485 mm h.c. or 220 mm Steel	600	429.	26,850	66,800
12	.693	470 mm h.c. or 210 mm Steel	740	530.	26,850	75,000
11 P/T	.65	460 mm h.c. or 205 mm Steel	800	570.	26,850	75,000
11 SP	.287	410 mm h.c. or 185 mm Steel	1,800	1,280.	26,850	75,000
15, 16, 20	.194	390 mm h.c. or 175 mm Steel	2,670	1,900.	37,900	90,600
22	.172	385 mm h.c. or 170 mm Steel	2,980	2,130.	37,900	90,600
24, 27	.00584	270 mm l.c.[2]	89,170	60,000.	-	135,000
29	1.94×10^{-3}	175 mm l.c.	267,170	190,000.	-	135,000

1. h.c. = heavy concrete (3.5 Mg/m^3); 2. l.c. = light concrete (2.5 Mg/m^3)
3. To reduce the number of package sizes required, waste items are combined to make an efficient packaging strategy.

2. Waste could be put in disposable concrete-shielded modules suitable for transport and disposal of the wastes. These packages could also be LSA, or modified and tested to satisfy Strong Industrial Package and Type A requirements at an additional cost. The concrete modules could be made any size desired.

Economic and occupational dose savings are associated with the use of multi-function (e.g. transportation, disposal) packages since packaging, handling and transportation operations are minimized for the system. Because of this, it is assumed that Option 2 is used where possible. A reuseable steel shielding overpack is assumed for Type B packages where required.

The 1973 regulations determine allowable combinations of shielding thickness and payload activity by limiting dose rates to a maximum of 2 mSv/h (200 mrem/h) on contact with the package and .1 mSv/h (10 mrem/h) at 2 m from the vehicle. Calculations have shown that external package dose rates are relatively insensitive to the quantity of waste material carried (of a given specific activity) when large, shielded packages are considered. Therefore, the largest possible packages can be used to take full advantage of volumetric efficiency and payload self-shielding to reduce the number of shipments. Overall package size and weight are determined by other modal considerations.

Further justification for the use of large packages is obtained from Ref. 5. "Radioactive waste resulting from the dismantling of major nuclear reactor components must be transported in larger units than those used at present for other types of waste, in order to reduce the amount of cutting required and consequently the radiation exposure of personnel and the costs of decommissioning."

Table II summarizes, for each waste item, the approximate shielding thickness required to obtain .1 mSv/h (10 mrem/h) @ 2 m for both steel and concrete shielding materials. In addition, the maximum quantity of material shippable in a single LSA package under the proposed 1985 Regulations is listed. The maximum quantity of each waste material allowed in a Type A package is also presented in Table II for comparison to LSA quantities.

Possible Packaging Options

Based on the discussions above and the information presented in Table II, the most effective packages for managing the decommissioning wastes of Table I can now be considered for each set of Regulations.

Under the 1973 Regulations, large concrete-shielded modules as shown in Fig. 3 are assumed for both transporting and disposing of the waste. These modules are of a similar size and design to the Dry Storage Modules (DSM) presently in use at Ontario Hydro for managing rehabilitation wastes (pressure tubes).

Under the 1985 Regulations, large concrete-shielded modules would not be used for the majority of waste items since the quantity of waste per package is limited to the amount listed in Table II. Therefore, a smaller, disposable concrete package would have to be considered, such as the Radblocks of Fig 4. Radblocks are considered for the management of all waste items except 24, 27 and 29 which can be transported in a large concrete module. Radblocks are essentially small concrete-shielded modules. Prototype Radblocks have been constructed at Ontario Hydro to assess their practicality in managing low and medium level radwastes.

Calculations show that the new 10 mSv/h (1 rem/h) @ 3 m restriction limits the quantity of material shippable per Radblock to such a small amount that a very large number of LSA packages and shipments would be required. In addition, extra cutting equipment and labour would be required after reactor component removal to get pieces small enough to fit into the small Radblock cavities. The extra cutting would be costly since it must be done remotely.

Consequently, a second case for the new Regulations is considered (as opposed to the LSA Radblocks discussed above). Since a Type A package cannot carry as much decommissioning waste material as an LSA package (see Table II), Type B shipments are considered (i.e., waste in a steel liner, shipped in reuseable overpack). The quantity of material that can be transported in a Type B package is restricted only by the size and weight of the loaded package. The .1 mSv/h (10 mrem/h) @ 2 m criteria would establish package shielding thickness. The package shown in Fig. 5 would be used for Type B shipments of the waste.

Maximum loaded weights of 200 Mg and 85 Mg are assumed for the large concrete modules and Type B packages respectively. The approximate masses of waste material per package, listed in Table II, are based on these maximum loaded weights.

Table III summarizes the package type used for each waste item under both sets of Regulations. The quantity of each type of package and the number of shipments required are also presented in Table III for comparison. Table III is based on the management of reactor core component wastes arising from a typical 4-unit CANDU nuclear generating station.

TRANSPORTATION AND HANDLING OF WASTE PACKAGES

Transportation

The packages considered above and shown in Figs. 3, 4 and 5, have been evaluated for managing the volume reduced wastes. The large concrete modules are assumed to be transported on a special rail car. Rail cars capable of transporting this load are available and could be rented or purchased as required. The Radblocks would be transported by road using a 4-axle trailer arrangement which would permit the movement of from one to three Radblocks (maximum 40 Mg) per trip, depending on loaded weight. Radblocks and concrete modules would be transported one-way to disposal. Type B packages would be shipped by standard rail cars adapted for tiedown of packages, since loaded package weight has been limited to less than 85 Mg. It is assumed that all reactor sites are serviced by a well-maintained railhead capable of supporting the total package and rail car loads.

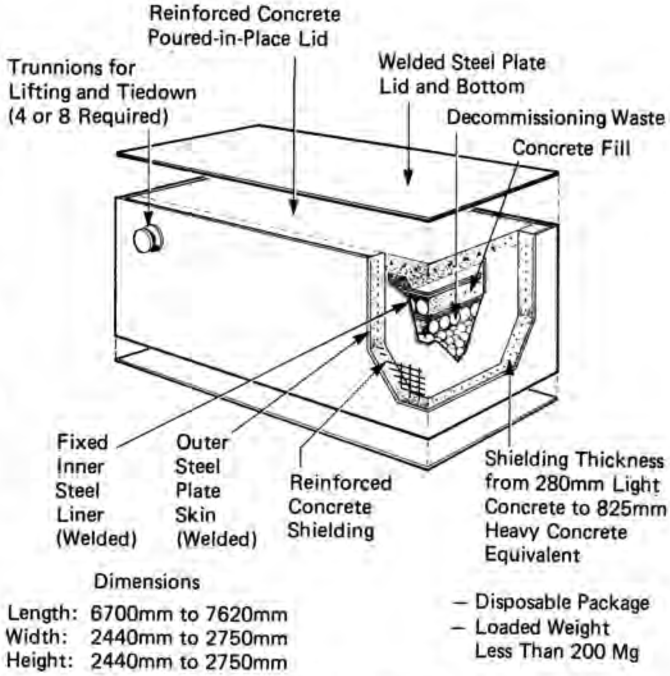


Fig. 3. Large Concrete-Shielded Modules

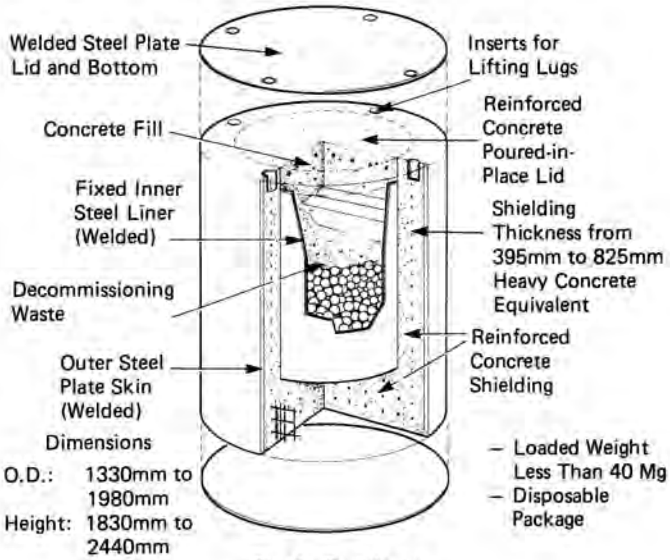


Fig. 4. Radblocks

Therefore, only a short on-site movement of all heavy packages is required prior to the rail shipment. Type B packages are reuseable and are therefore subject to two-way transport.

The Type B packages and large concrete modules might also be transported by water vessel. However, the water mode is slower and requires transhipment of the waste packages (i.e., double handling) and has not been studied for the purposes of this paper.

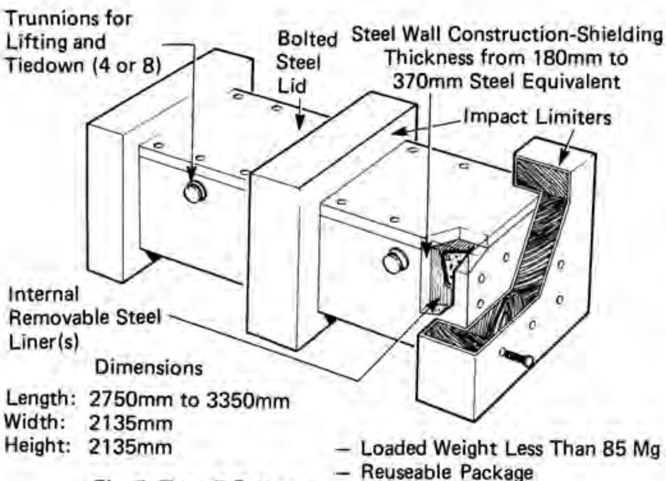


Fig. 5 Type B Package

Handling

The large concrete modules and Type B packages require special handling considerations due to their size and weight. A jacking system or large crane would be used to lift them onto a multi-wheeled, on-site transporter and from the transporter onto the rail car. At the disposal end, system design is assumed to permit simpler unloading of the packages for disposal.

Type B packages, due to their reuseable nature, require extra handling operations. The waste is emplaced in a disposable steel liner which is remotely welded closed and put in the steel shielding overpack for transportation to disposal. Both liner and cask must be double-handled at each end of the system. Handling of the waste liner outside the cask

Table III

Package Selection

1973 Regulations			1985 Regulations		
Waste Item Nos.	Package Type and Shielding	No. of Packages and Shipments Required	Waste Item Nos.	Package Type and Shielding	No. of Packages and Shipments Required
18	CM[1], (825 mm h.c.[2]) (Strong Industrial Package)	3	18, 19	a. Radblock (825 mm h.c.) or b. Type B (370 mm Steel)	9557 Packages 9557 Shipments (1 per truck) 12
19, 17	CM, (700 mm h.c.)	6	17, 10 21, 3-6	a. Radblock (560 mm h.c.) or b. Type B (255 mm Steel)	4719 Packages 1573 Shipments (3 per truck) 43
10, 21, 3-6	CM, (535 mm h.c.)	15			
12, 11 P/T 11 SP	CM, (470 mm h.c.)	6	12, 11 P/T	a. Radblock (470 mm h.c.) or b. Type B (255 mm Steel)	244 Packages 82 Shipments (3 per truck) 6
			11 SP	a. Radblock (420 mm h.c.) or b. Type B (255 mm Steel)	156 Packages 52 Shipments (3 per truck) 10
15, 16, 20, 22	CM, (395 cm h.c.)	17	15, 16, 20, 22	a. Radblock (395 mm h.c.) or b. Type B (180 mm Steel)	586 Packages 293 Shipments (2 per truck) 41
24, 27, 29	CM, (280 mm l.c.[3])	10	24, 27 29	CM (280 mm l.c.)	15
Total Number of Shipments Required		57		127 to 11,572 (CM and Type B) (CM and Radblock)	

1. CM = Concrete Module; 2. h.c. = heavy concrete (3.5 Mg/m^3); 3. l.c. = light concrete (2.5 Mg/m^3)

requires remote or shielded operation to avoid high dose uptake. These operations are costly in equipment and manpower.

The large concrete modules and Type B packages, because of their great size and weight, cannot be moved within the reactor buildings. These packages would be remotely loaded and sealed at grade level to minimize their movement.

Radblocks are considerably lighter than the other two package types and therefore require less handling effort. Because of their small size and light weight, Radblocks would be moved within the station close to the area of waste removal and processing. This provides operational advantages in remote waste loading and package sealing. The costs associated with these packages would largely be incurred during their loading, unloading and tiedown to the transport vehicle.

CONCLUSIONS

1. Although it is desirable to use large, multi-purpose disposable packages for the management of decommissioning wastes, the use of such packages is not practical under the proposed 1985 Regulations. The limitation placed on the waste quantity allowed per low level waste package results in a requirement for so many small, disposable packages that Type B shipments are far more economic.

2. Using Type B shipments rather than LSA shipments results in additional conventional public hazard and occupational dose uptake due to two-way shipping of the shielding overpack and double-handling of the waste liners used to contain the wastes within the Type B package.

3. Based on the conclusions above, it is apparent that the proposed regulations would have a significant effect on the strategy and costs for managing decommissioning wastes. The type of package used will impact on transportation, handling, disposal and possibly the method and degree of component removal and volume reduction.

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