



Waste Reduction in Canada

REDUCE • REUSE • RECYCLE

Waste Reduction in Canada

➤ Nuclear Waste Generators – Obligations and Responsibilities

➤ Canadian Rad Waste Reduction

- What waste generators have accomplished in the last 20 years
- Review Waste/Cost Avoidance in Canada – launderable versus single use
- Review Decontamination for Scrap or reuse as non-radioactive
- Improvements with radiation monitoring equipment

➤ Path Forward To Achieve Significant Increases in Rad Waste Reduction

- What needs to change
- Strategies that can be implemented
- Role of Government, Regulators and Industry



Waste Reduction in Canada

What Governments and Regulators require Waste Generators to do:

- Keep the generation of radioactive waste to the minimum possible or practicable;
- Minimize the spread of radioactivity leading to the creation of radioactive waste as much as possible by containing it to the greatest extent possible;
- Optimize possibilities for recycle and reuse of valuable components from existing and potential waste streams;
- Minimize the amount of radioactive waste that has been created by applying adequate treatment technology.



Clothing Decontaminated Waste Avoidance

A Success Story: Anti-C Dress Outs

Historical Quantity Used in Canada

Data is through to March 2020,	Station 1 & 2	Station 3	Station 4	Station 5	Station 6	Total Units Processed	LBS waste saved per	Total LBS Saved	Total M3 saved
DRESS OUT	Each	Each	Each	Each	Each	Each	Each	Each	Each
Anti-C Dress Out									
ProTech Anti-C Coverall	2,007,686	276,129	389,095	688,474	40,539	3,401,923	0.700	2,381,346	9,194.4
Blue Booties	4,015,372	552,258	778,190	1,376,948	81,078	6,803,846	0.110	748,423	2,889.7
Cotton Liners	4,015,372	552,258	778,190	1,376,948	81,078	6,803,846	0.044	299,369	1,155.9
Rubber Gloves	4,015,372	552,258	778,190	1,376,948	81,078	6,803,846	0.110	748,423	2,889.7
						23,813,461		4,177,561	16,129.6
FR Anti-C Dress Out									
Orange/Gray FR Anti-C Cover	-	19,825	4,411	9,935		34,171	0.950	32,462	125.3
Gray Booties	-	60,386	8,822	19,870		89,078	0.110	9,799	37.8
Cotton Liners	-	39,650	8,822	39,740		88,212	0.044	3,881	15.0
Rubber Gloves	-	39,650	8,822	79,480		127,952	0.110	14,075	54.3
						339,413		60,217	232.5
						24,152,874		4,237,779	16,362

On January 15, 2014, the 1,000,000th Anti-C coverall from one CDN NPP was laundered. 9,194 M3 of radioactive solid waste has been diverted on this single item.



At 259 pounds per M3, Anti-C's avoided filling 226 each, 40'sealands with radioactive waste



Clothing Decontaminated Waste Avoidance

A Success Story: Plastic Suit Dress Outs



Data is through to March 2020,	Station 1 & 2	Station 3	Station 4	Station 5	Station 6	Total Units Processed	LBS waste saved per	Total LBS Saved	Total M3 saved
Dress Out	Each	Each	Each	Each	Each	Each	Each	Each	Each
Plastic Suit	1,067,627	222,863	4,117	167,131		1,461,738			
Blue ProTech Oversuit	209,853	25,855	1,857	123,202		360,767	0.950	342,729	1,323.3
Blue Booties	1,831,938	497,935	91,114	585,119		3,006,106	0.110	330,672	1,276.7
Cotton Liners	5,129,953	1,171,100	71,912	376,628		6,749,593	0.044	296,982	1,146.6
Rubber Gloves	9,475,151	3,128,559	76,093	1,603,394		14,283,197	0.110	1,571,152	6,066.2
Black Booties	4,525,257	989,507	12,410	1,440,583		6,967,757	0.040	278,710	1,076.1
						31,367,420		2,820,244	10,889.0
FR Plastic suit Dress Out									
Gray FR Anti-C Oversuit	-			35,902		35,902	0.950	34,107	131.7
Gray Booties	-			160,509		160,509	0.110	17,656	68.2
Cotton Liners	-			71,804		71,804	0.044	3,159	12.2
Rubber Gloves	-			71,804		71,804	0.110	7,898	30.5
Black Booties	-			71,804		71,804	0.040	2,872	11.1
						411,823		65,693	253.6
						31,779,243		2,885,937	11,142.6



- Design clothing at the fiber level
- Complete line of Canadian launderable RPPE to maximize garment life to reduce cost/improve worker efficiency. All 35 Canadian products are custom designed.



At 259 pounds per M3, Launderable items avoided filling 154 each, 40' sealands with radioactive waste



Clothing Decontaminated

Custom Bags – Reduce Waste - Save Time/Dose



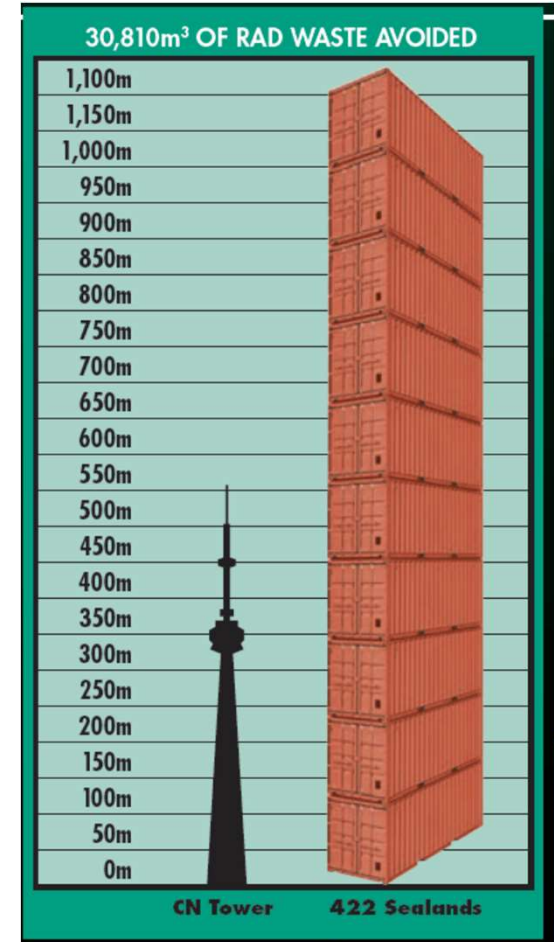
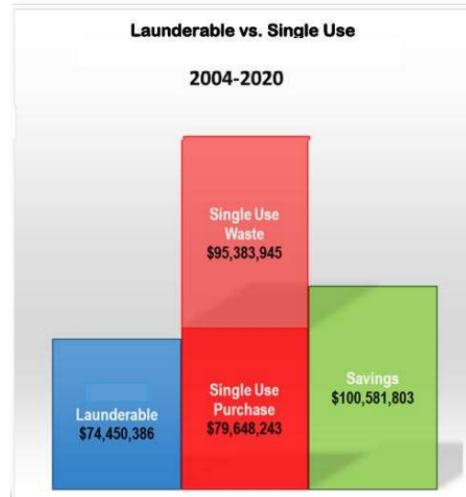
Data is through to March 2020,	Station 1 & 2	Station 3	Station 4	Station 5	Station 6	Total Units Processed	LBS waste saved per	Total LBS Saved	Total M3 saved
Bags	Each	Each	Each	Each	Each	Each	Each	Each	Each
Laundry Bag	919,418	281,934	49,648	131,158		1,382,158	0.390	539,042	2,081.2
Clean RPE Bag	195,039	23,772		312,448	4,739	535,998	0.195	104,520	403.6
Silo Liner Bag	76,971	6,355				83,326	1.000	83,326	321.7
Scaffold Bag	7,913	812				8,725	7.000	61,075	235.8
Insulation Bag	20,905	2,385				23,290	1.500	34,935	134.9
Storage Bag 400D	55,768	154				55,922	0.390	21,810	84.2
Tool & Equipment Bags Yello	160,782	2,611				163,393	0.040	6,536	25.2
Cage Bag	2,280	202				2,482	1.000	2,482	9.6
Lead Blanket Bags 22/32 lb	5,189					5,189	0.450	2,335	9.0
Tool & Equipment Bags Yello	160,782	2,611				163,393	0.040	6,536	25.2
						2,423,876		862,595	3,330.5



Each bag/item has a labour or process saving feature to save time and dose over single use.

Clothing Decontaminated

March 2020 historical use	Station 1 & 2	Station 3	Station 4	Station 5	Station 6	Total Units Processed	LBS waste saved/use	Total LBS Saved	Total M3 saved
Total By Item	Each	Each	Each	Each	Each	Each	Each	Each	Each
ProTech Anti-C Coverall	2,007,686	276,129	389,095	688,474	40,539	3,401,923	0.700	2,381,346	9,194
Rubber Gloves	13,490,523	3,720,467	863,105	3,131,626	81,078	21,286,799	0.110	2,341,548	9,041
Blue Booties	5,847,310	1,050,193	869,304	1,962,067	81,078	9,809,952	0.110	1,079,095	4,166
Cotton Liners	9,145,325	1,763,008	858,924	1,865,120	81,078	13,713,455	0.044	603,392	2,330
Laundry Bag	919,418	281,934	49,648	131,158	-	1,382,158	0.390	539,042	2,081
Blue ProTech Oversuit	209,853	25,855	1,857	123,202	-	360,767	0.950	342,729	1,323
Black Booties	4,525,257	989,507	12,410	1,512,387	-	7,039,561	0.040	281,582	1,087
Clean RPE Bag	195,039	23,772	-	312,448	4,739	535,998	0.195	104,520	404
Silo Liner Bag	76,971	6,355	-	-	-	83,326	1.000	83,326	322
Scaffold Bag	7,913	812	-	-	-	8,725	7.000	61,075	236
FR Anti-C/Oversuit	-	19,825	4,411	45,837	-	70,073	0.950	66,569	257
Insulation Bag	20,905	2,385	-	-	-	23,290	1.500	34,935	135
Gray Booties	-	60,386	8,822	180,379	-	249,587	0.110	27,455	106
Storage Bag 400D	55,768	154	-	-	-	55,922	0.390	21,810	84
Tool & Equipment Bags	160,782	2,611	-	-	-	163,393	0.040	6,536	25
Cage Bag	2,280	202	-	-	-	2,482	1.000	2,482	10
Lead Blanket Bags	5,189	-	-	-	-	5,189	0.450	2,335	9
Total:						58,192,600		7,979,775	30,810



Materials Decontaminated

Materials surveyed or decontaminated/surveyed to reduce waste volume and cost.

Pipe hangers	Ladders	Scissor lifts
Electrical Cables	Hand Tools	Scaffolding
Structural Steel	Electric tools	Chain Falls
Refuel drive motors	Extension cords	Computers
Instrument Cable	Welders	HX Plates
Vent Fans	Drill Presses	Machine tools
Power Panels	Fork lifts	Transformers
	PHT Motor	Air Hoses



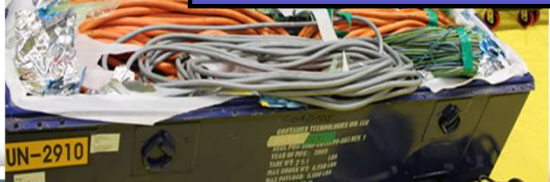
Materials Decontaminated

Candu 6 mid cycle refurbishment tool set

- 70 shipments – 2.5M lbs.
- Decontaminated and scrapped/recycled 2.45M lbs.



5M pounds of contaminated scaffolding and equipment from Canadian facilities has been decontaminated, surveyed and released



Monitoring Criteria and Risk

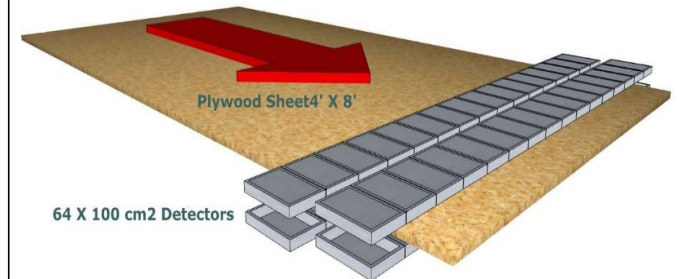
Human Factors associated with Hand Frisking increase risk due to:

- inconsistent detector to item distance
- difficult to obtain 100% item coverage
- difficult to maintain consistent scan speed
- difficult to determine if “clicks” could be at alarm limit
- difficult to determine optimum alarm limit in fluctuating background



Automated monitors significantly reduce risk due to:

- Fixed detector to item distance
- 100% item coverage w/detector overlap
- Computer controlled belt speed
- Computer controlled/calculated MDA
- User selectable confidence levels and isotopic relative efficiency



Who cares if you can get it clean. If you can't properly monitor to verify the absence of radioactivity, then it just doesn't matter.

Monitoring Criteria and Risk

(state-of-the-art alpha/beta monitoring)

Minimize Human Factors w/Hand frisking

- Computer controlled alarm points
- Fixed detector to surface distance
- Scan speed calculated by computer
- Ensures 100% item coverage
- Engineered detector to item coverage
- Designed to meet project needs

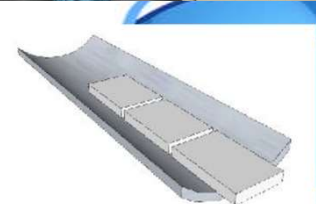
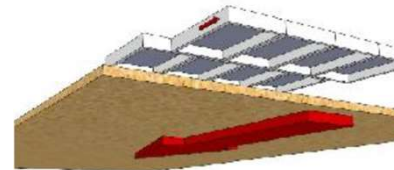
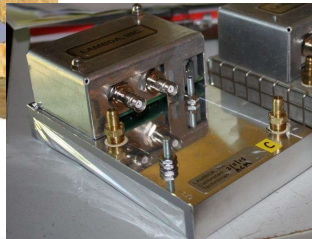
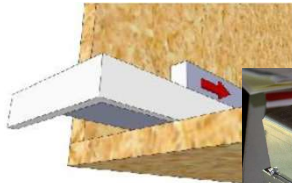
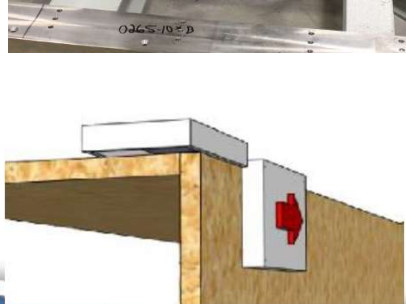


Monitoring Criteria and Risk

- Heavy and odd shaped items
- 2500 dpm, Cs-137, point source geometry, 95% confidence level, beta

Minimize Human Factors:

- Computer controlled alarm points
- Fixed detector to surface distance
- Scan speed calculated by computer
- Ensures 100% item coverage



Waste Reduction in Canada

What Needs to Change:

- Waste minimization has many meanings. The definition used for Canada focuses on reducing the final volumes that require storage, and, ultimately, long-term disposal.
- From the organizational level, the departments and budgets within Canadian waste generators are not aligned to maximize Rad Waste Reduction.
- There is no specific group assigned the responsibility of coordinating the various aspects of waste reduction/avoidance and significant opportunities are being missed.



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Strategies that can be implemented:

- A key missing element in current waste avoidance planning is **Waste Avoidance/Process Improvement** (not making the waste).
- No Canadian organization has implemented this element.
- Waste Avoidance/Process Improvement can include:
 - Using launderable items to replace single use RPPE,
 - Reusable bags and floor coverings,
 - Many building maintenance activities (dry/wet mops, and microfiber towels), and
 - Decontaminating tools and equipment for scrap or non-radioactive reuse.



Waste Reduction in Canada

Organizational Changes Required:

There are typically 3 Budget groups and 2 Technical groups in control of areas that play key roles in ensuring the success of a **Waste Avoidance/Process Improvement Program**, but they are not aligned:

Budget Groups:

1. The group that purchases/pays for single use clothing, floor coverings, mops, wipers, packaging materials, etc.
2. The laundry group that pays for reusable items to be decontaminated and reused,
3. The waste/environment group that processes and pays for the radwaste generated.

Technical Groups:

1. Health Physics that prescribes clothing use
2. Maintenance/Operations/Outage Groups

Budget groups are not aligned. For example, if a launderable bag, cover, or clothing is put into service the laundry bill goes up and commodity spend and waste volumes go down.

- Without budget adjustment/alignment these numbers can get significant.
- These budgets need to have common control or a structural way to allocate/reallocate budgets to keep a company-wide focus on Waste Avoidance/Process Improvement.
- Not making the waste is the best possible outcome, yet it is not required by regulation.



Waste Reduction in Canada

- We have seen significant labor-saving/dose saving items be implemented, but because there is no mechanism in place to evaluate, track, and then celebrate the benefits of a given item, it can be undone, and possibly more importantly, only one group at one station is benefiting while other stations continue to work “old method” or inefficiently which needlessly generates radioactive waste or increases time spent on a given task that adds employee dose and overall cost.
- Health Physics have several groups that get together and measure metrics and share successes (ALARA, RHP’s, etc.). The ALARA program drives dose reduction concepts and highlights opportunities for improvement from the top to the bottom of the organization.
- If this level of focus was added to a Waste Avoidance/Process Improvement program, significant volumes of radioactive waste, worker dose, and cost could be avoided. There simply is not enough focus. Groups like the Environment or Waste groups do not have the visibility or authority of an ALARA group. Further, for waste avoidance, they are cheerleaders at best and do not have the means to drive progress – they try to sell it without authority or budgets.
- Their role is to simply ensure generated waste is packaged efficiently. However, all the pieces are already in place, and if this became a regulatory requirement, waste generators could make some organizational changes that could turn this on almost overnight. If you could get these concepts built into every worker and every evolution – significant benefits would be realized by the waste generator, their employees, and the environment.



Waste Reduction in Canada

Role of the Government and Regulators:

- Regulations need to be implemented that would add a requirement for all waste generators to evaluate, track, and then celebrate the benefits of not making radioactive waste
- The ALARA model concepts, which have been successfully implemented in the nuclear industry, could be used as a framework for new waste reduction regulations.
- This would provide the focus and clarity required by the waste generators (and by the nuclear industry supporting them) to drive the necessary changes to implement

Waste Avoidance/Process Improvement Programs

- The organizational changes required to realize improved rad waste reduction could be implemented relatively quickly and could be built into every worker and every evolution producing significant financial benefits to the waste generator, their employees, the industry, and the environment.



Waste Reduction in Canada

Summary

- Even though there were no formal government programs/regulations in place, there are significant examples of the reduction in rad waste that has been realized by working together with the major Canadian generators over the last 20 years
- The specific waste reduction strategies that have been employed are well proven, not complex, cost effective and could be implemented by all generators relatively quickly
- Additional benefits of worker protection (reduced dose) and safety have also been realized as part of the waste reduction process
- However, if this process was clarified and focused, the benefits would be significantly more than 8 million pounds of waste avoided with clothing and 5 million pounds of waste avoided with decontamination and survey of metals for recycling, scrap, and reuse.
- If new waste reduction regulations were implemented that added a requirement for waste generators to evaluate, track, and then celebrate the benefits of not making radioactive waste, much like the focus of the ALARA regulations, these concepts could be built into every worker and every evolution producing significant financial benefits to the waste generator, their employees, the industry, and the environment.

