

Exposure to radiation in an underground NORM repository

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Where to find NORM (in the petroleum industry)



Oil production

Production tubulars

Christmas trees

Risers

Oil-water separators

Topside tubes before
oil-water separation

Water discharge system

Gas production

Anywhere in the system
from risers to flares



Ultra High-Pressure Water-Jetting



HPWJ (> 2000 bar) has been the preferred NORM decontamination method in Norway since 1995.

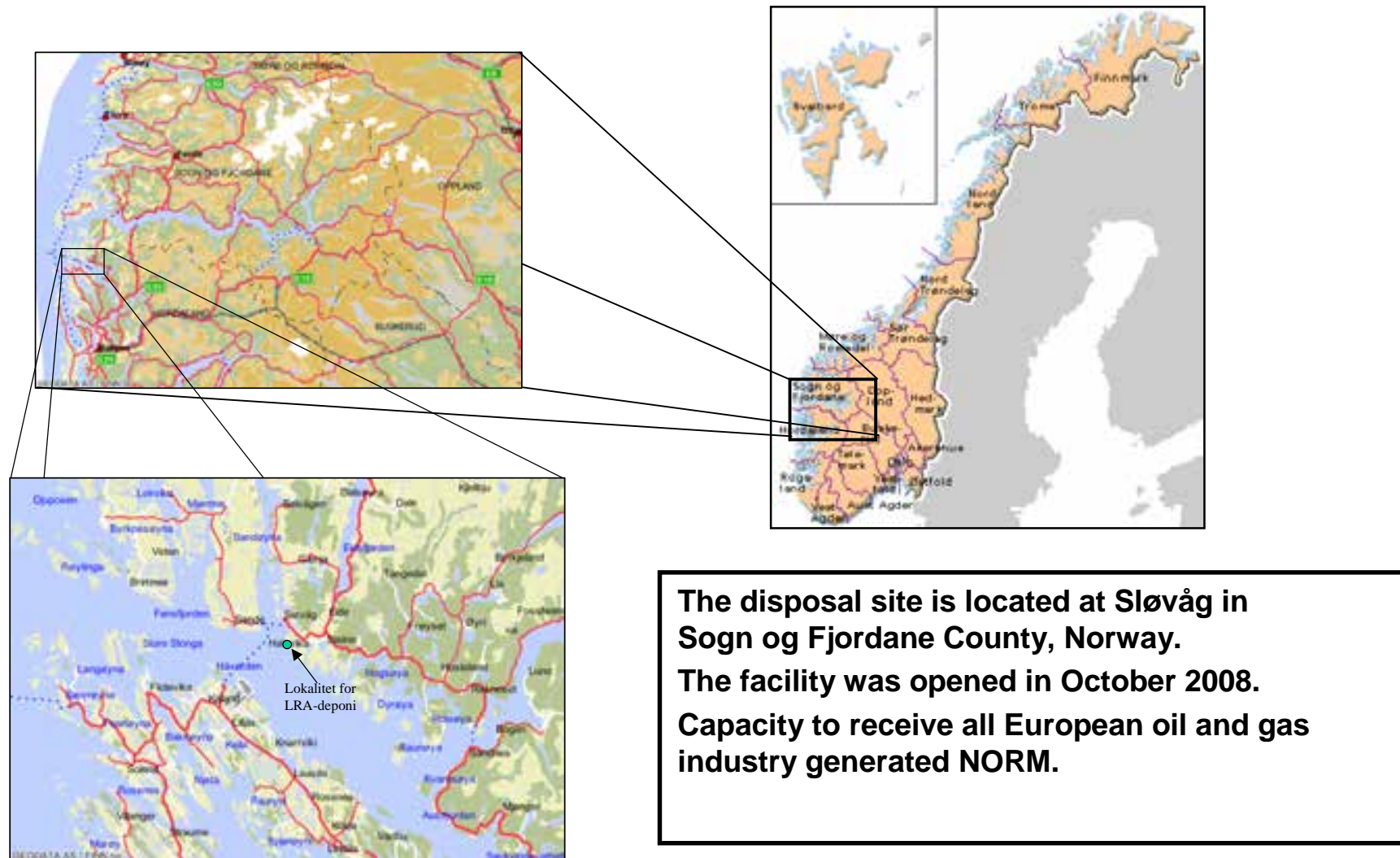
Several specially designed plants perform decontamination on a routine basis.

The used water (with NORM) is collected in settling tanks before emission. The NORM is retrieved and stored.

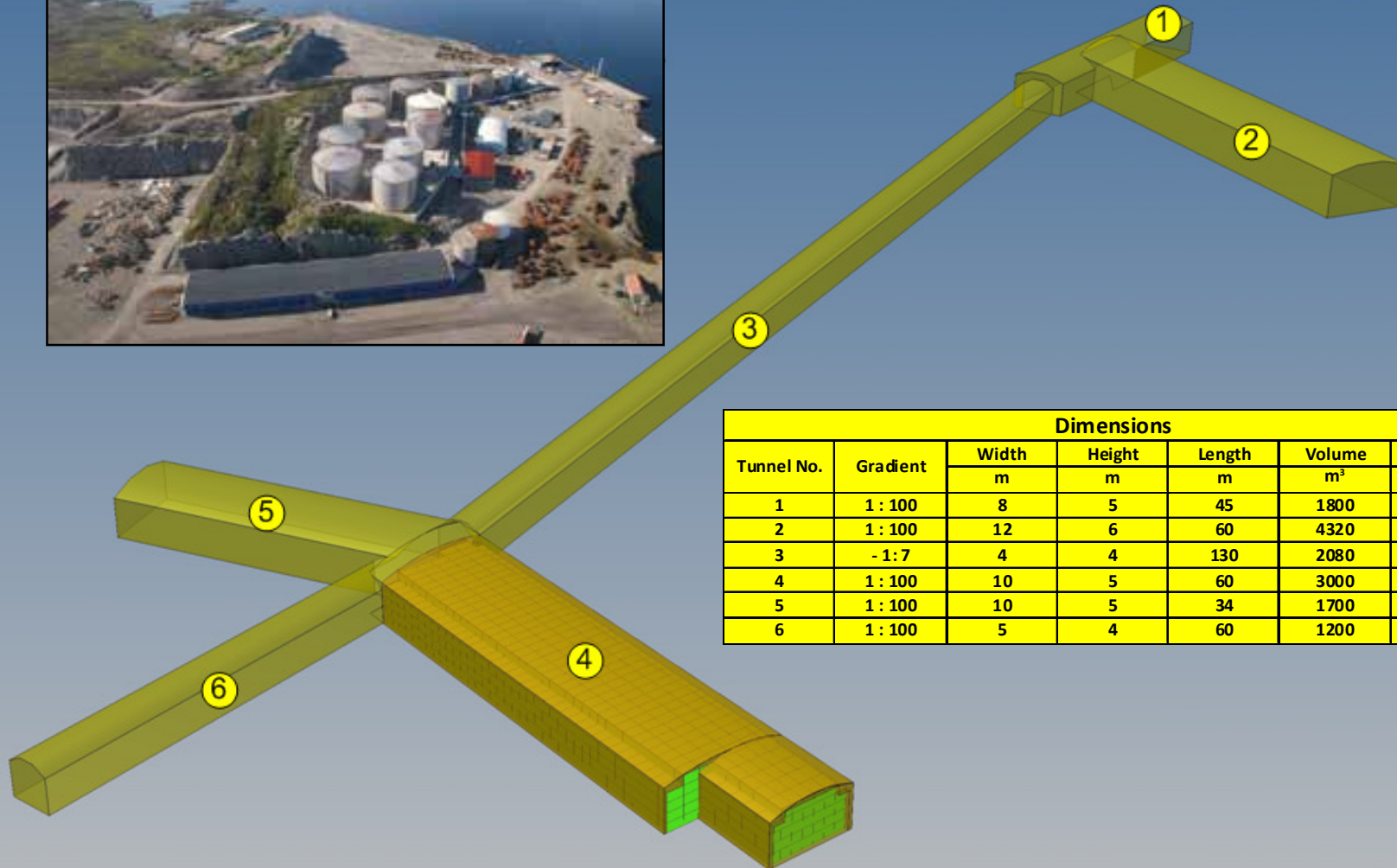
The method works very well on easily accessible components, e.g. production tubulars. HPWJ does not create secondary waste.



Location

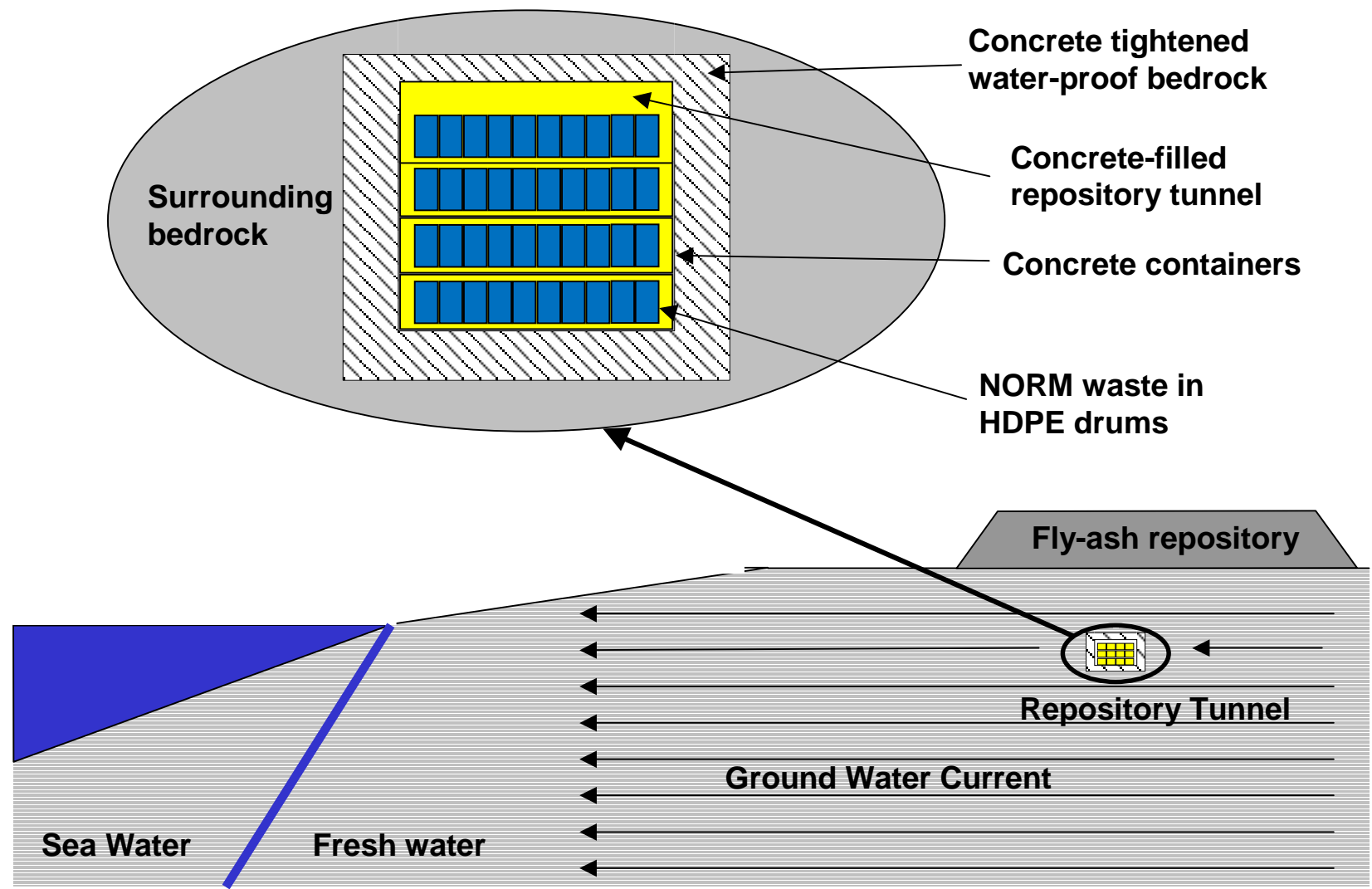


Stangeneset NORM Disposal Site



Dimensions						
Tunnel No.	Gradient	Width	Height	Length	Volume	Capacity
		m	m	m	m ³	tons
1	1 : 100	8	5	45	1800	
2	1 : 100	12	6	60	4320	
3	- 1 : 7	4	4	130	2080	
4	1 : 100	10	5	60	3000	4500
5	1 : 100	10	5	34	1700	2550
6	1 : 100	5	4	60	1200	

Design

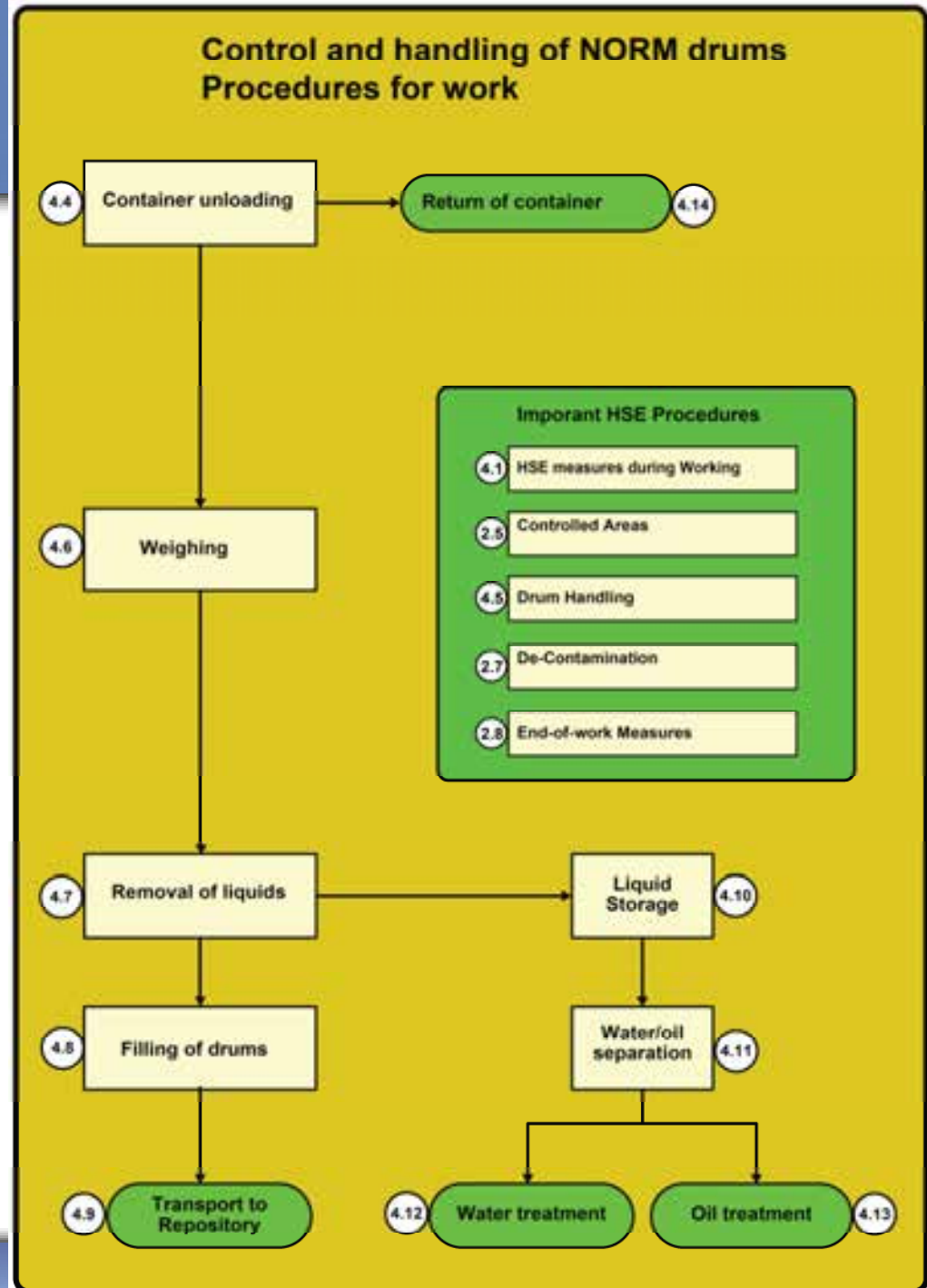


Work Flow

Containers with NORM drums are received at quayside and transported unopened to the Storage & Conditioning Tunnel.

The drums are registered, weighed and conditioned.

Disposal-ready drums are transferred to the Repository Tunnel and grouted into concrete blocks (30 – 100 drums per block).



Ship unloading



Container unloading



Container unloading area



First pallets unloaded with fork lift

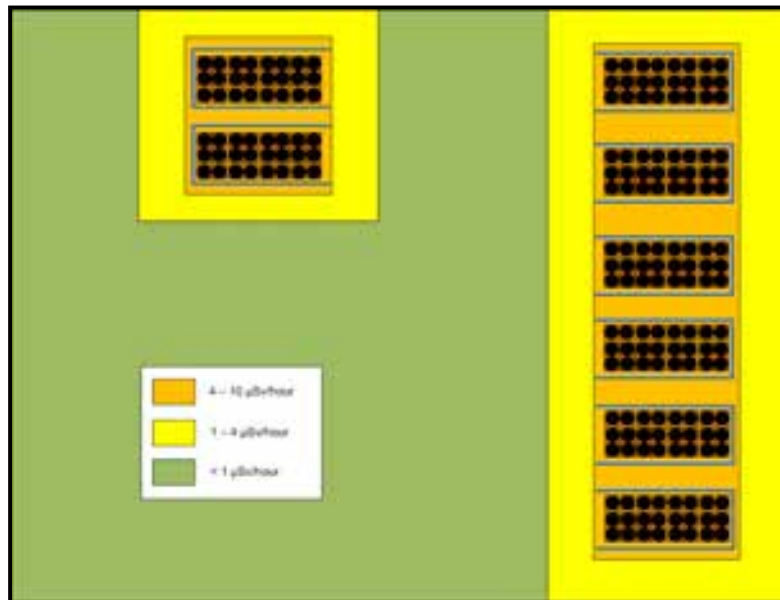


Pallets manually moved to container opening

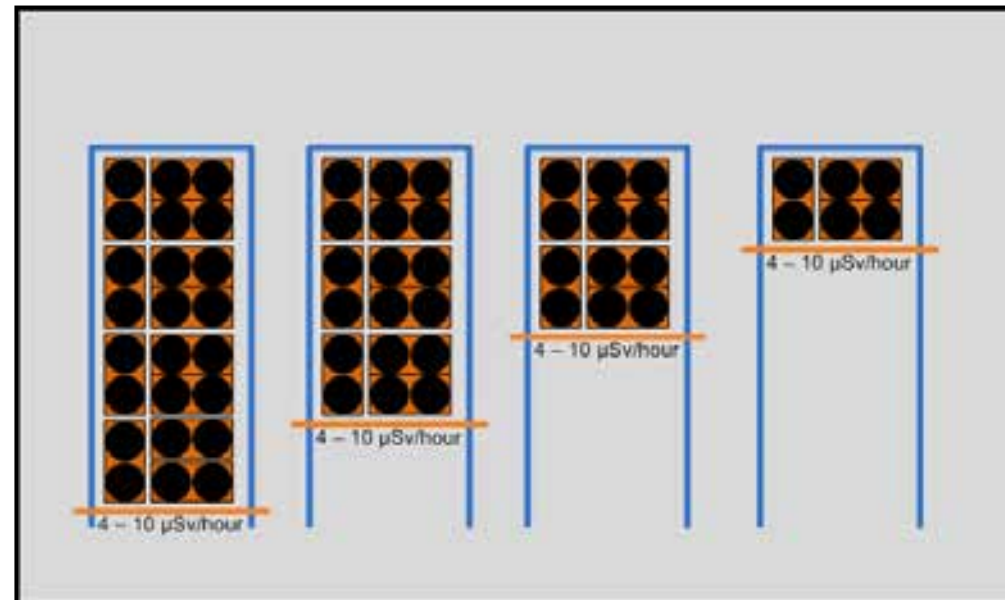


Innermost pallets

Dose rates - Container unloading



Container unloading area: only work inside containers involves exposure to radiation.



Container unloading: due to self-shielding in the barium-rich NORM only the outermost drums contribute to the dose rate.

Work in Storage and Conditioning tunnel



Final Disposal



Doses

- Low radon levels (~ 100 Bq/m³).
- Drums are closed at all times except during water removal and topping.
- Only gamma radiation contributes to dose.
- Dose rate at drums between 4 µSv/hour and 10 µSv/hour – decreases rapidly with distance.
- Work with drums performed in concentrated work sessions.
- Normal total process time for 1 shipload is 1-2 weeks.

Work Activity	Average Dose Rate	Unit	Duration	Unit Dose	# of Units	Dose
	µSv/hour		min/unit	µSv/unit		µSv
Ship unloading	5	Container	2	0,2	8	1,3
Transport to Facility	insignificant	Container	na	na	na	na
Emptying of Container	10	Container	15	2,5	8	20,0
Unpacking of drums from Pallet	10	Drum	1	0,2	170	28,3
Weighing	10	Drum	0,5	0,1	170	14,2
Liquid removal (drums)	10	Drum	1,4	0,2	170	40,0
Backfilling of drums	10	Drum	0,4	0,1	170	10,0
Drum Uploading	insignificant	Drum	na	na	na	na
Total Dose Shipment #7						113,8

Thank you for the attention



Safe disposal of NORM