Exposure to radiation in an underground NORM repository

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NORSE DECOM

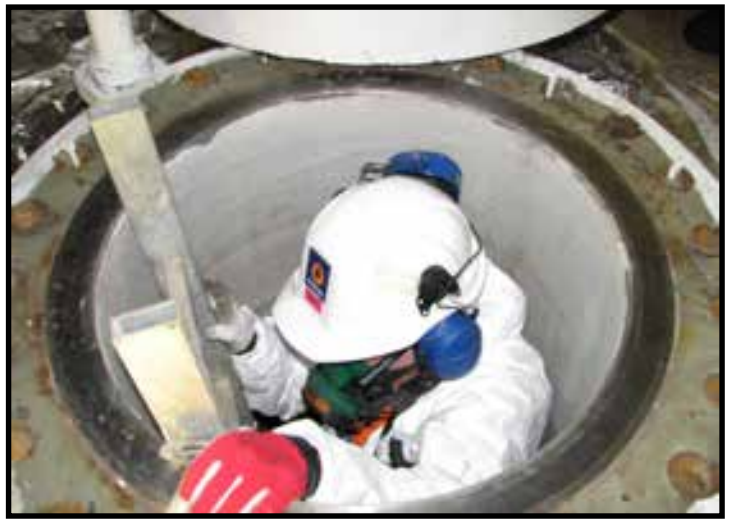
Where to find NORM
(in the petroleum industry)

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

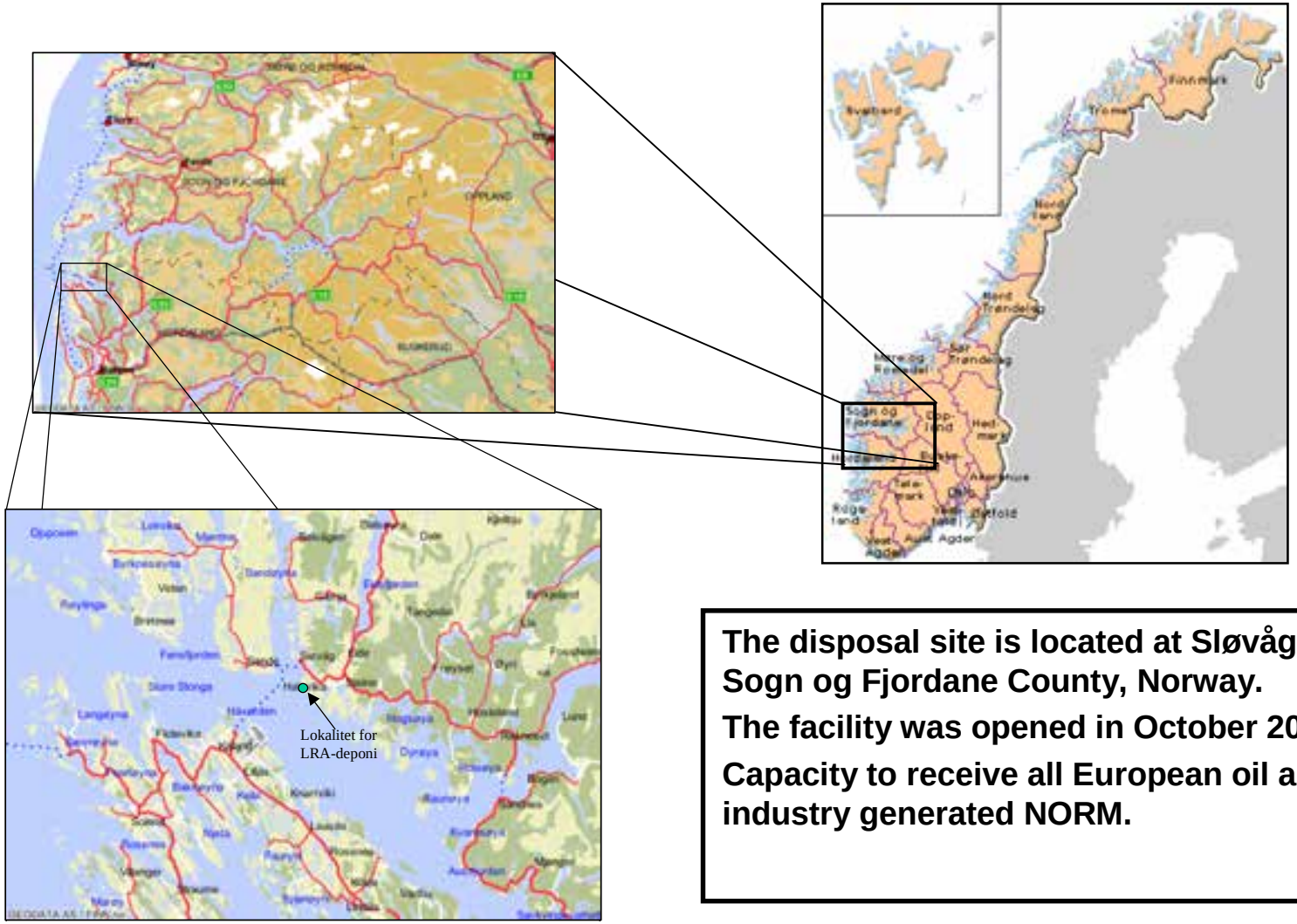
HPWJ (> 2000 bar) has been the preferred NORM decontamination method in Norway since 1995.

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



The disposal site is located at Sløvåg in Sogn og Fjordane County, Norway.

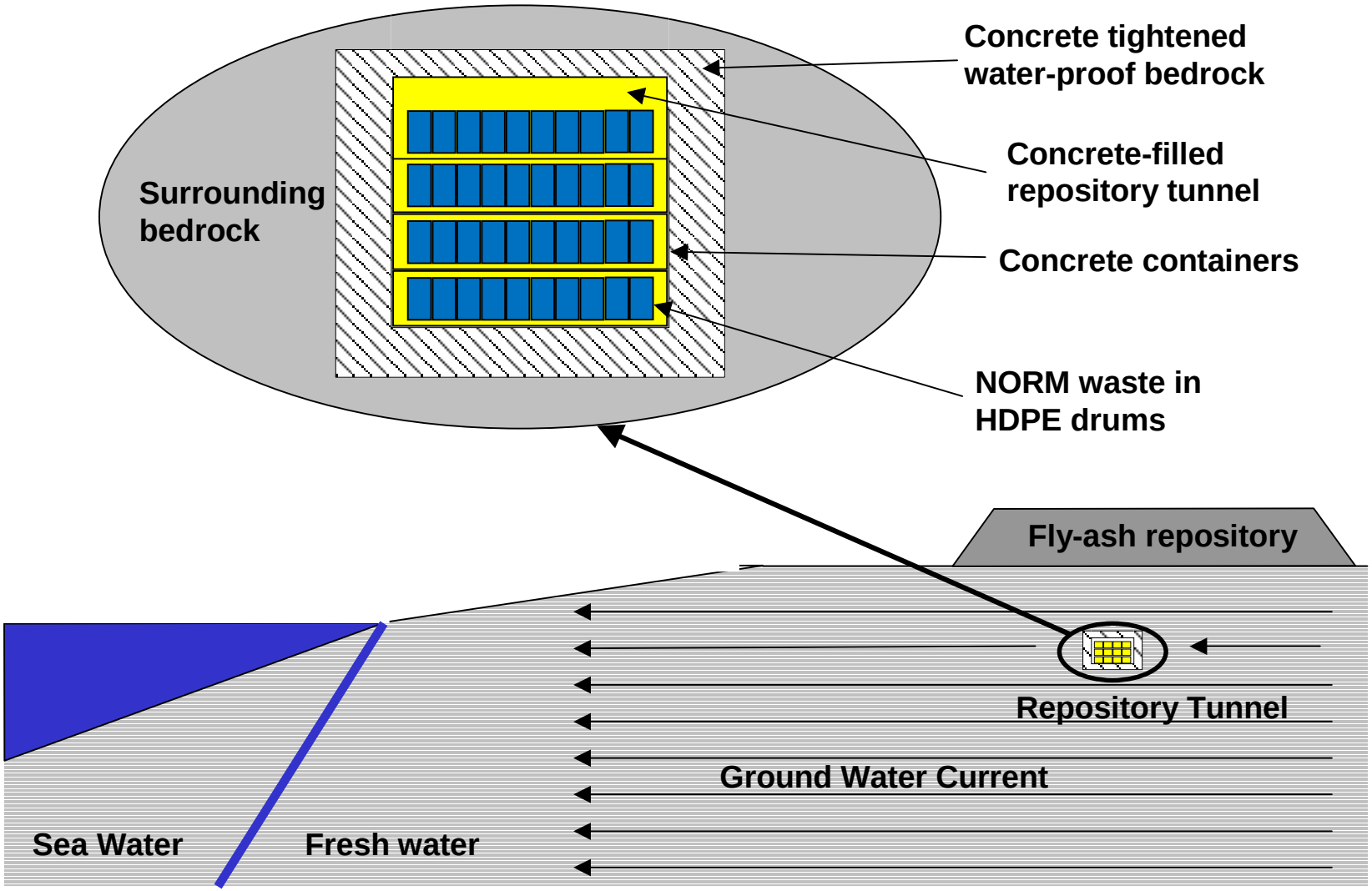
The facility was opened in October 2008.

Capacity to receive all European oil and gas industry generated NORM.

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

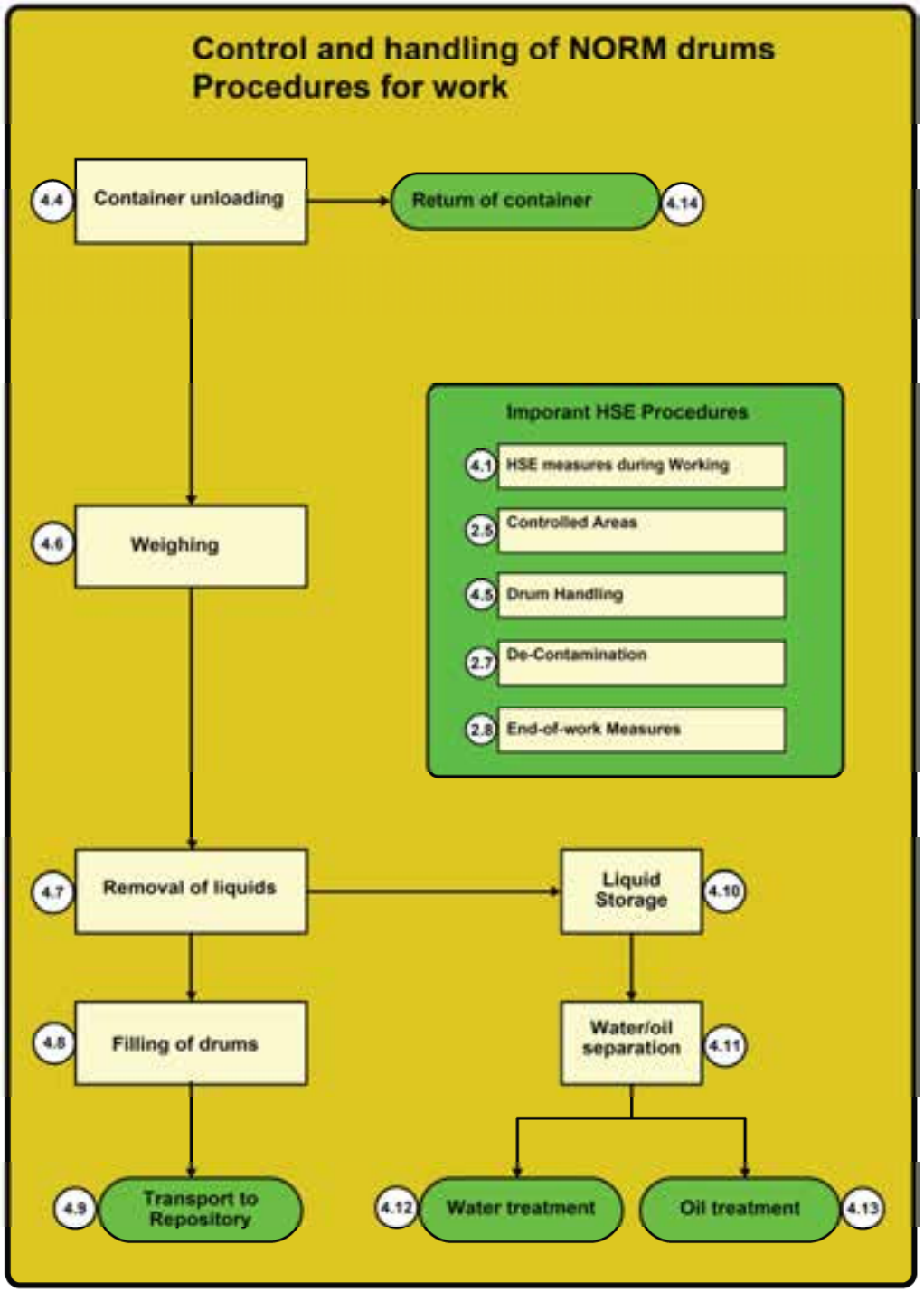

Concrete tightened
water-proof bedrock
Concrete-filled
repository tunnel
Concrete containers
NORM waste in
HDPE drums
Surrounding
bedrock
Fly-ash repository
Repository Tunnel
Ground Water Current
Sea Water
Fresh water

Work Flow

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

The drums are registred, weighed and conditioned.

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



Ship unloading

First container recived midnight 31 October 2008

Containers (5 tons each) handled by fork lift

Loading on trailer

Transport to Facility

Container unloading

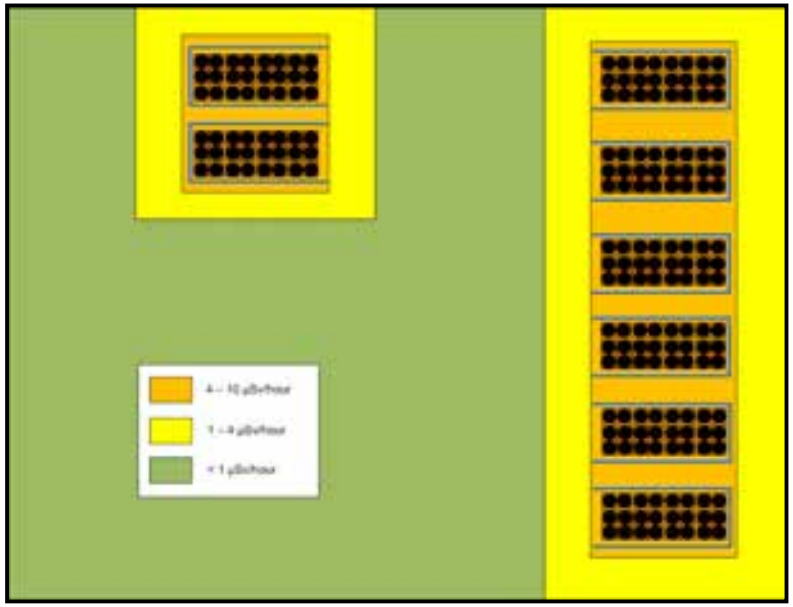
Container unloading area

First pallets unloaded with fork lift

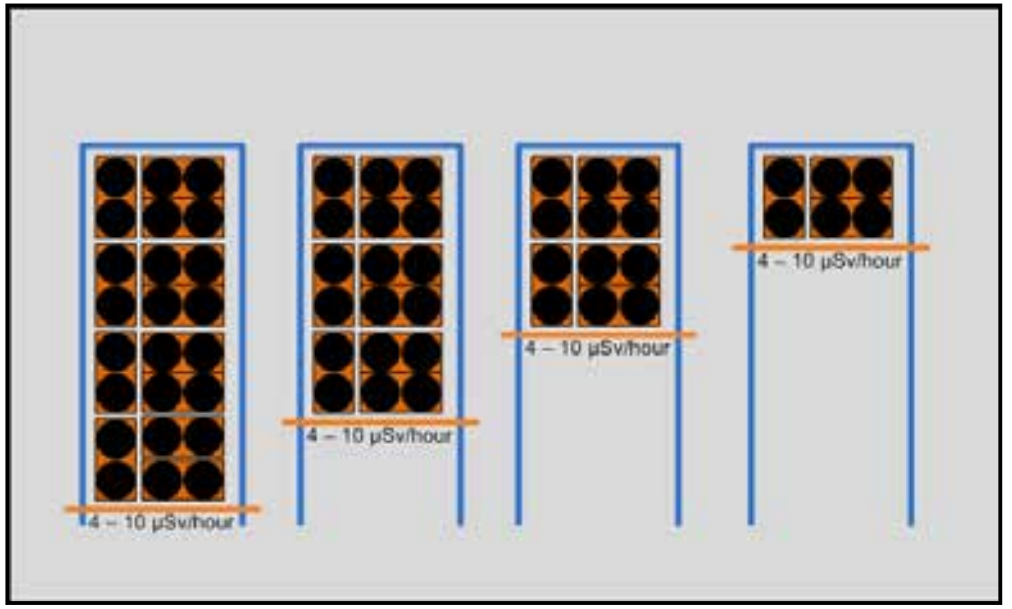
Pallets manually moved to container opening

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

Pallet removal

Handling of drums

Weighing of individual drums

Ready for conditioning

Final Disposal

Ready for grouting

Filling of concrete basket

Grouting

Final disposal

Doses

- Low radon levels (~ 100 Bq/m^3).
- 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 µSv/hour	Unit	Duration min/unit	Unit Dose µSv/unit	# of Units	Dose 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