

NORM Waste Streams in the Norwegian petroleum Industry

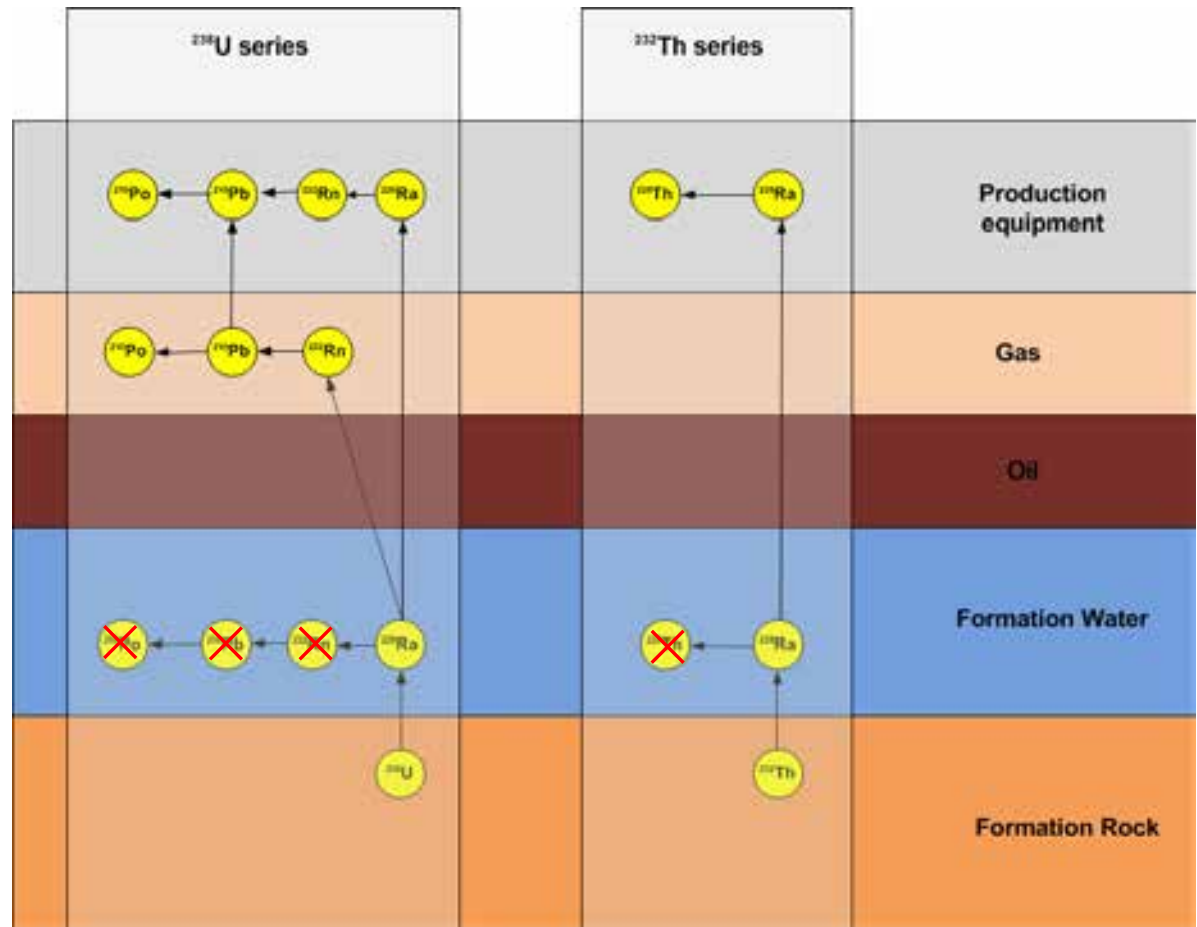
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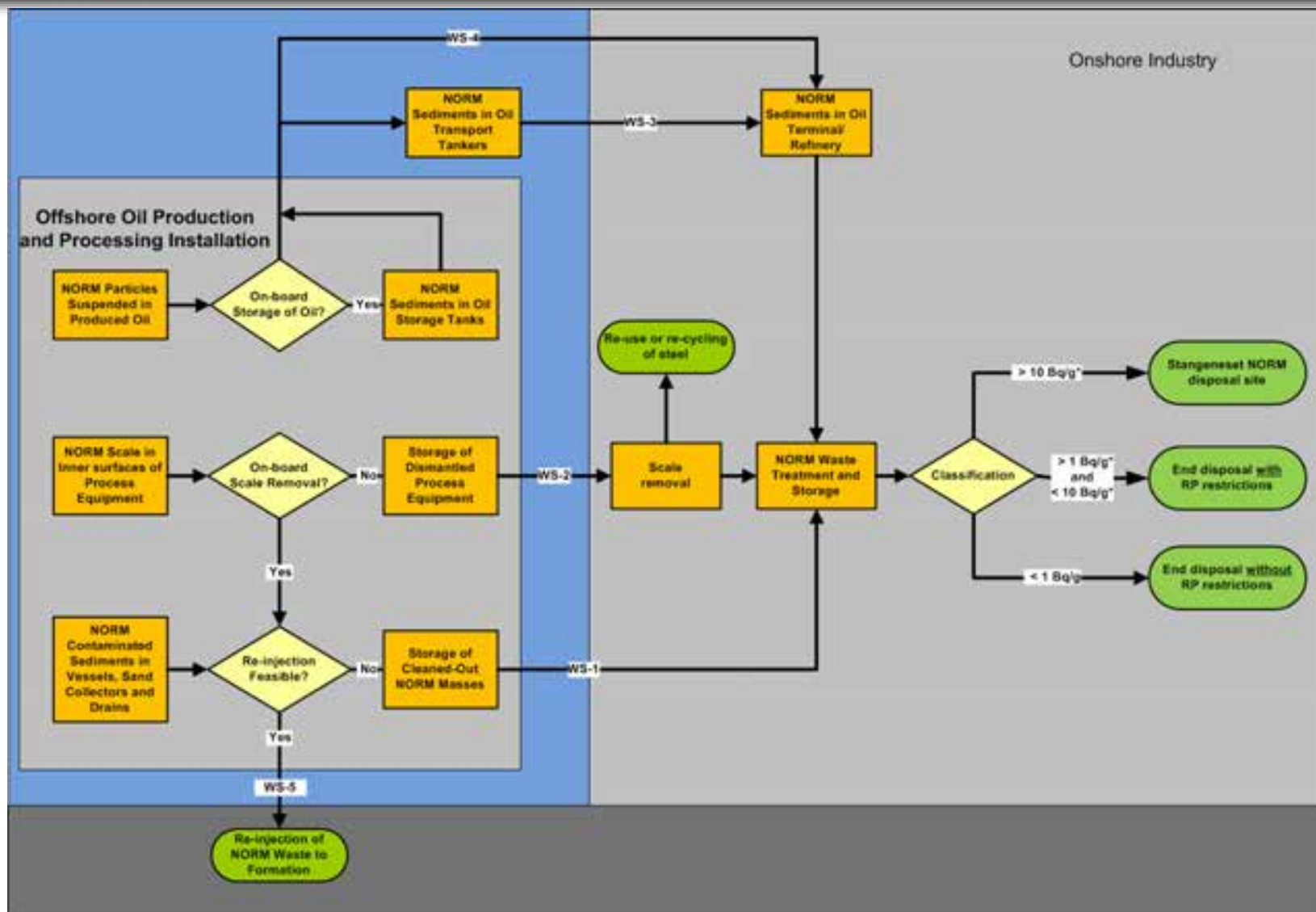
Dresden, 07 December 2012

Presence of NORM Nuclides in Petroleum Production

- U and Th have low solubility and is retained in the formation rock.
- Ra is dissolved and stabilised in the formation water.
- ^{222}Rn ($t_{1/2} = 3.8$ days) a non-polar noble gas is dissolved and stabilised in the oil and gas phase.
- Ra-isotopes and sometimes ^{210}Pb are co-precipitated onto the inner surfaces of the production equipment forming radioactive scales or corrosion products.



Overview of Waste Streams



WS-1: NORM as sediment and sludge



Waste containers (115) with separator sediments assessed at base with respect to NORM



Tanks with NORM contaminated sludge



NORM contaminated plastic plates from separator

Occurrence: Tanks and drains in the production system
Composition: Sand, Heavy oil components, Scale, Water
Activity: typically 0.1 – 20 Bq/g



Sediment NORM material

WS-2: NORM as scale



NORM contaminated valves



Measurement of NORM-Infected tube



Separator tank entry (observe the scaling)

Occurrence: Inner surfaces in the production system

Composition: Scale – Ba/Sr Sulphate with radium

Activity: typically 10 – 300 Bq/g

Scale decontamination



Tubular cleaning at Chemtech's facility outside Stavanger



Water jetting at 2 000 – 3 000 bars

Methods:

- High Pressure Water Jetting
- Chemical treatment
- Sand/Salt blasting
- Melting

HPWP is by far the most preferred method due to its cost efficiency and that it does not generate secondary waste.

NORM Intermediate storage



Book-keeping at NORM storage



NORM storage

NORM waste is stored at the supply bases awaiting final disposal.

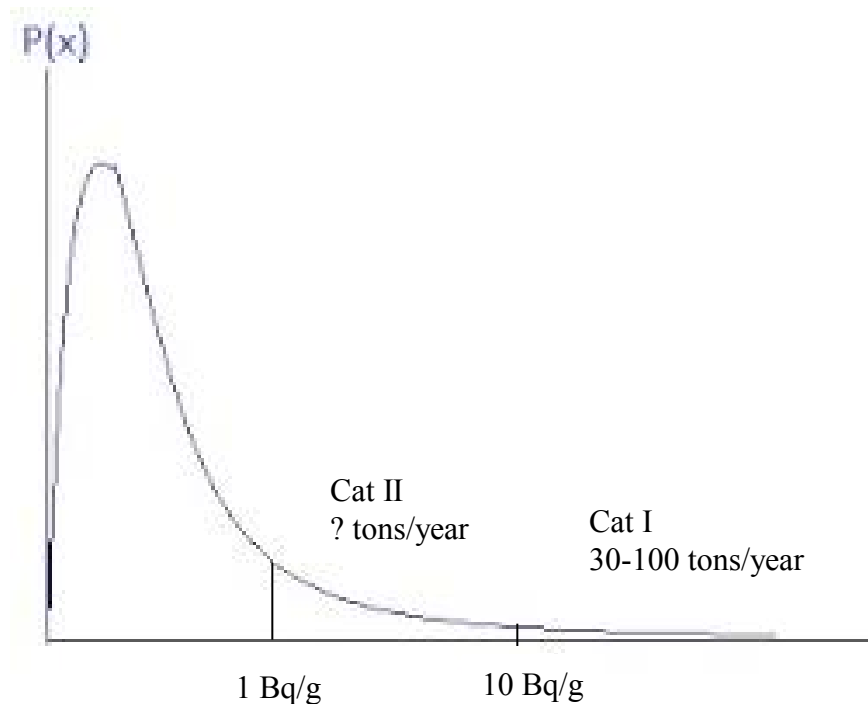
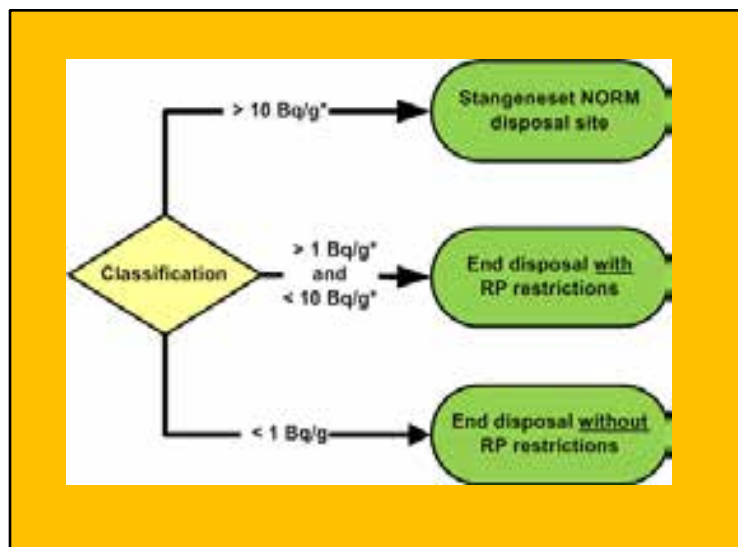
Typically the NORM is packed in HDPE drums placed in steel containers.

Shipment to final disposal usually once a year.

Classification of NORM Waste

NORM Category I: $^{226}\text{Ra} + ^{228}\text{Ra} + ^{210}\text{Pb} > 10 \text{ Bq/g}$

NORM Category II: $^{226}\text{Ra} + ^{228}\text{Ra} + ^{210}\text{Pb} > 1 \text{ Bq/g}$



Disposal sites for NORM in Norway:

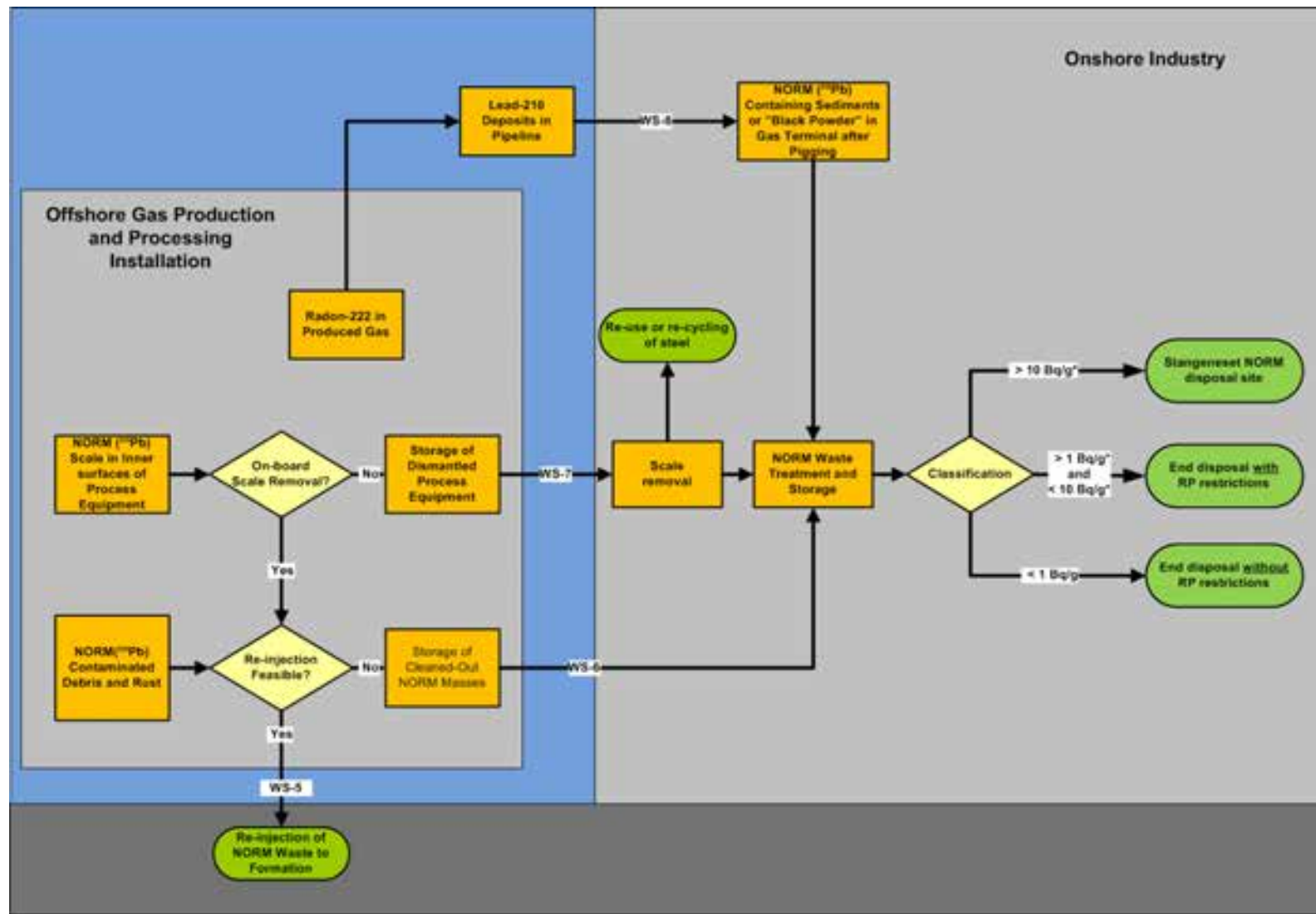
Stangeneset NORM Disposal Site: Cat 1&2

NOAH Langøya: Cat 2, low oil content

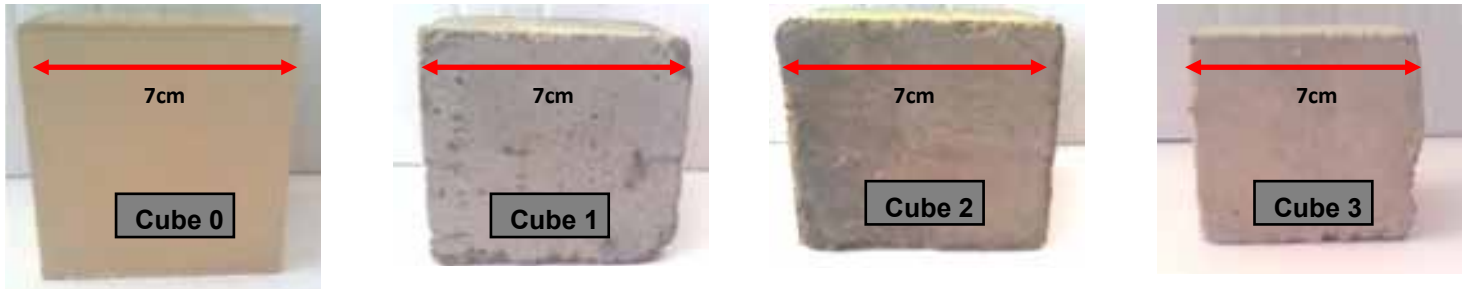
By regulation any site with license for disposal of Haz.

Waste can receive NORM Cat II for disposal.

NORM in Gas Production



Black Dust



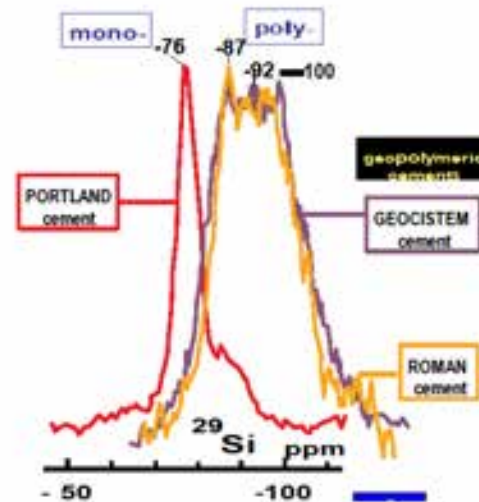
Black Dust is the waste that occurs after pigging of gas pipes.

Composition: FeS most often with ^{210}Pb and Hg.

Black dust is pyrophoric and therefore has to be stabilised prior to disposal.

Chemical stabilisation: oxidation of Fe and S

Immobilisation: use of e.g. geopolymer

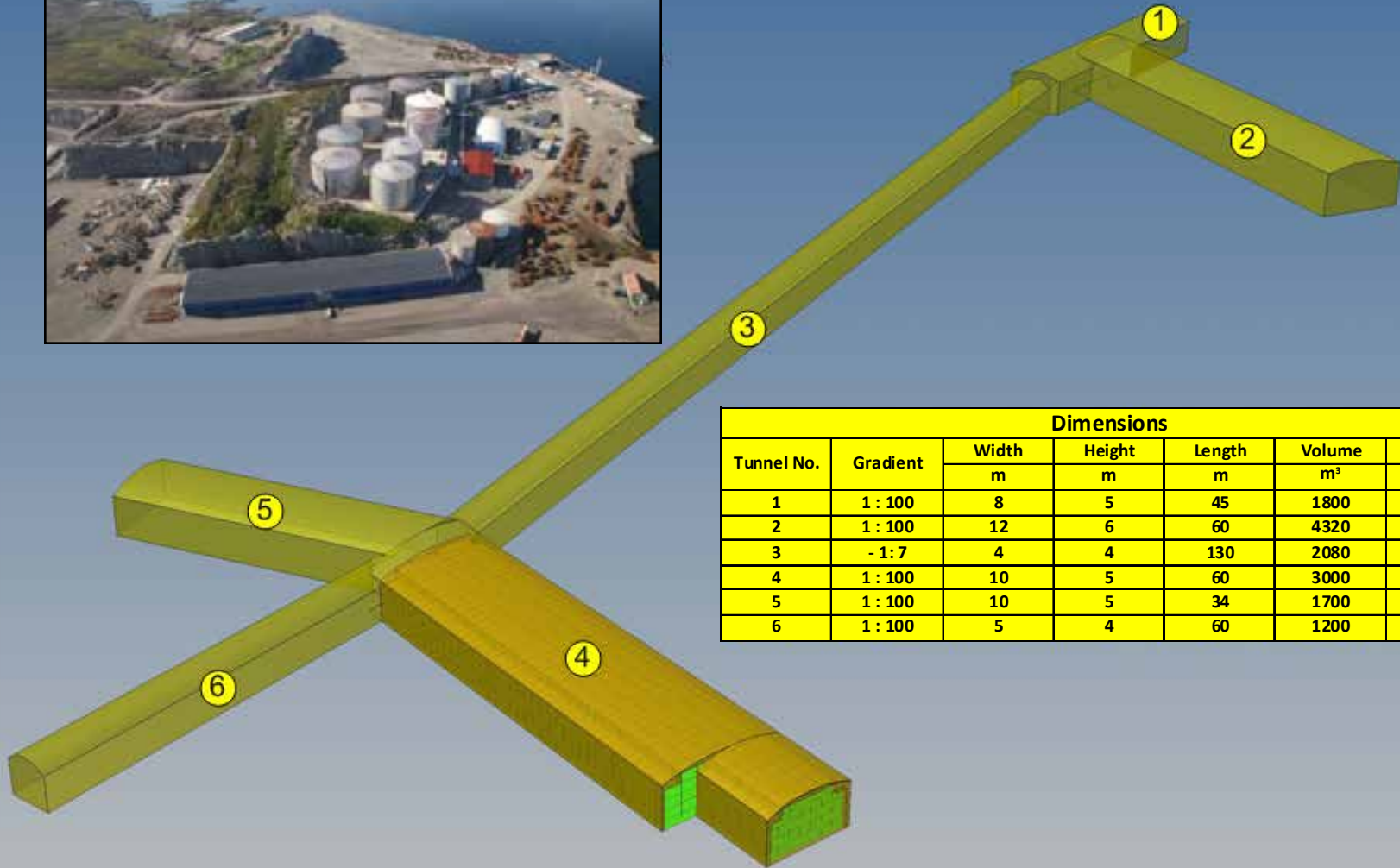


Location



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	

Drums for Disposal



Work in Conditioning Tunnel Weighing (closed drums)



Disposal

