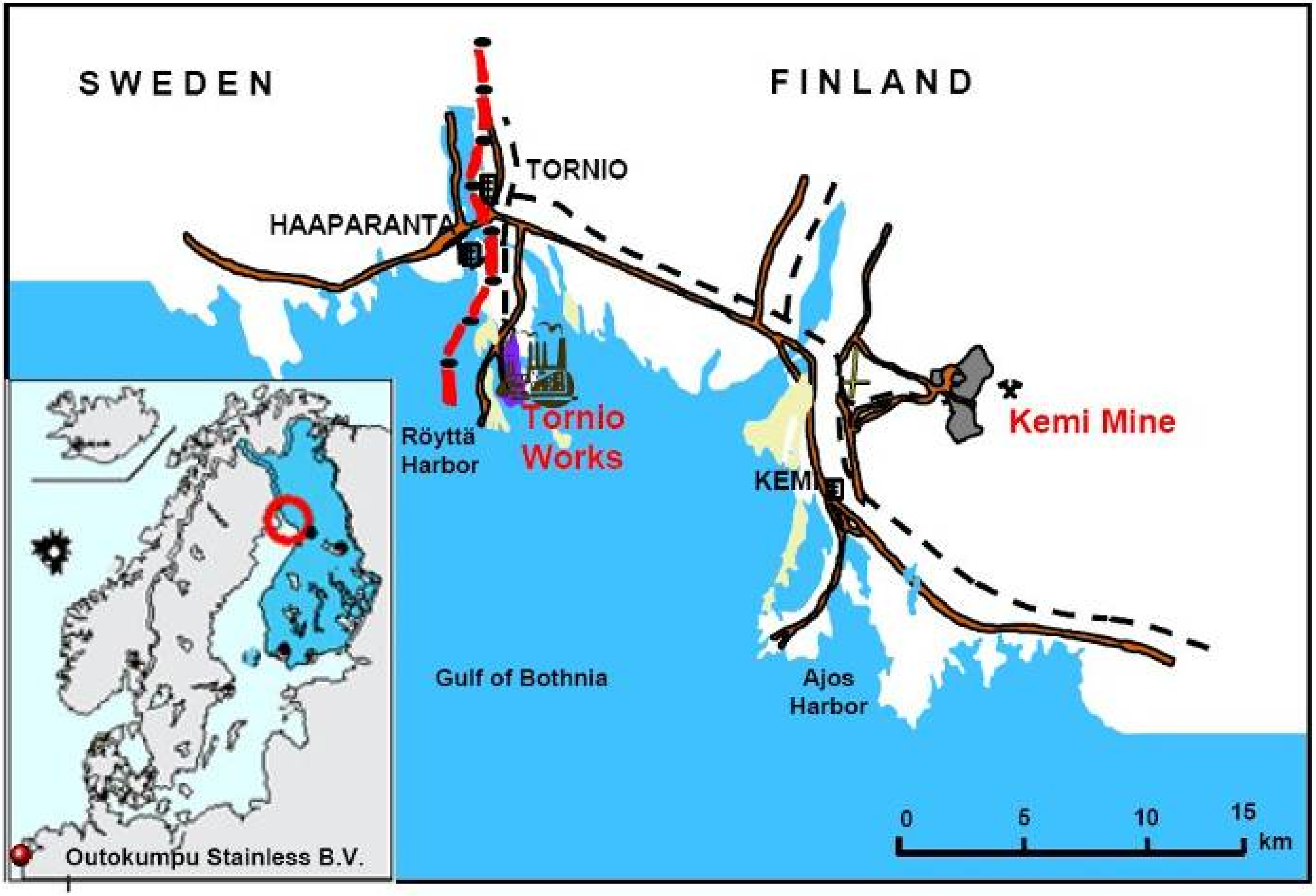
Experiences in Monitoring and Dealing with Radioactivity in Recycling Steel at Outokumpu Tornio Works

Hot Rolling Mill, Eero Huhtalo, January 7, 2009

Content

- Introduction
- Radiation detection before smelting
- Radiation detection after smelting
- Handheld instruments
- Where and how radiation is detected after smelting
- Procedures after melting of a radiation source
- Final placement for radioactive waste

1. Introduction



OUTOKUMPU

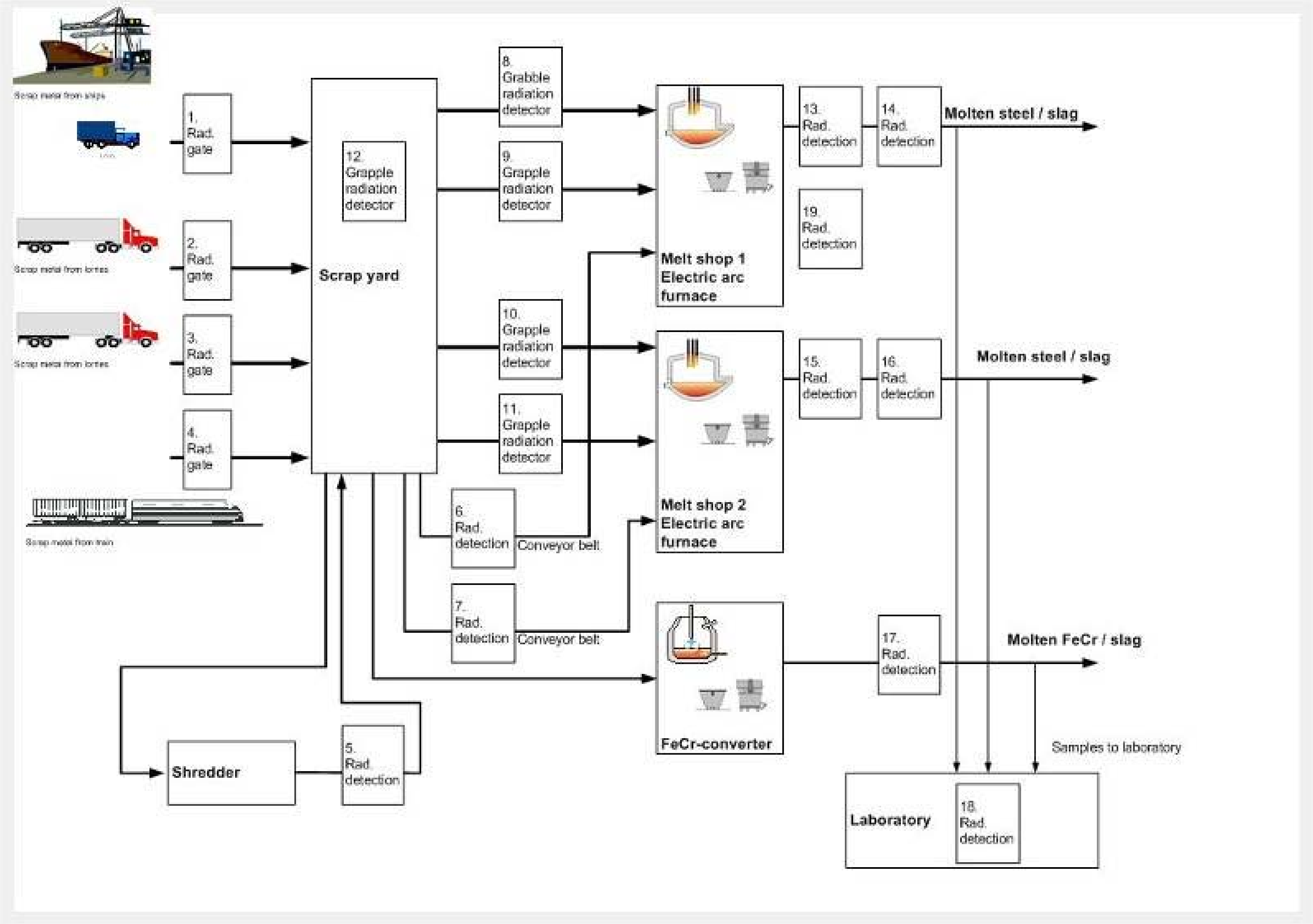
Outokumpu Tornio Works

- Full capacity after latest expansion:

FeCr	270 000 tons
Slabs	1 650 000 tons
Coil products	1 200 000 tons
of which:	
White hot rolled	300 000 tons
Semi-cold rolled	150 000 tons
Cold rolled	750 000 tons

- Specialized in:
  - Custom-made mass production in selected product areas
  - Supplying cost efficiently high quality volume products
  - Using best available technology
  - New products from RAP line
- About 2 400 employees

Radiation detection systems at Tornio works



2. Radiation detection before smelting

Ref	Type	Location
1	5x 50 l plast	Harbour portal monitor
2	6x 25 l plast	Weighing station portal monitor
3	12x CsI scintillators	Weighing station portal monitor
4	5x 25 l plast	Train Weighing station portal monitor
5	1x 25 l plast	Shredder monitoring station, conveyor belt
6	1x 33 l plast	Alloy transfer monitor 1, conveyor belt
7	1x 33 l plast	Alloy transfer monitor 2, conveyor belt
8	2x 3 l plast	Grapple monitor
9	2x 3 l plastic	Grapple monitor
10	2x 3 l plastic	Grapple monitor
11	2x 3 l plastic	Grapple monitor
12	1x NaI scintillator	Grapple monitor

1


2


3


4


5


6,7


8-11

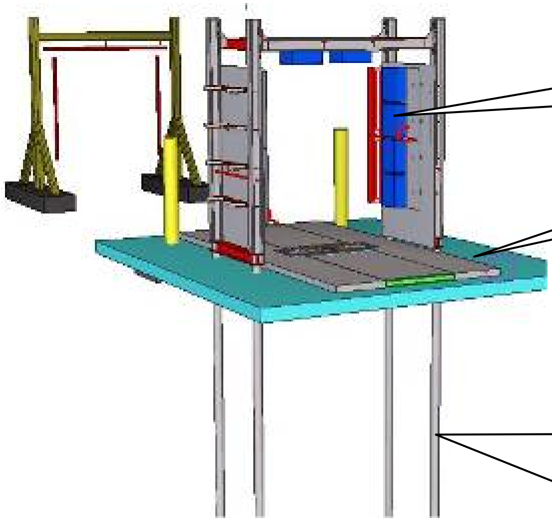

OUTO KUMPU

Ref 3. Weighing station portal monitor / limitation of background radiation

2 detectors at roof
Background count rate about 250CPS

4 detectors at each side
Background count rate about 100 - 200CPS

2 detectors at bottom
Background count rate about 50CPS



Detectors
boxes (blue)

Steel plates.

Steel pole
Cement, concrete and asphalt
has been replaced with
steel poles, steel scrap and steel
plates.

Foundations for the new weighing station portal monitor

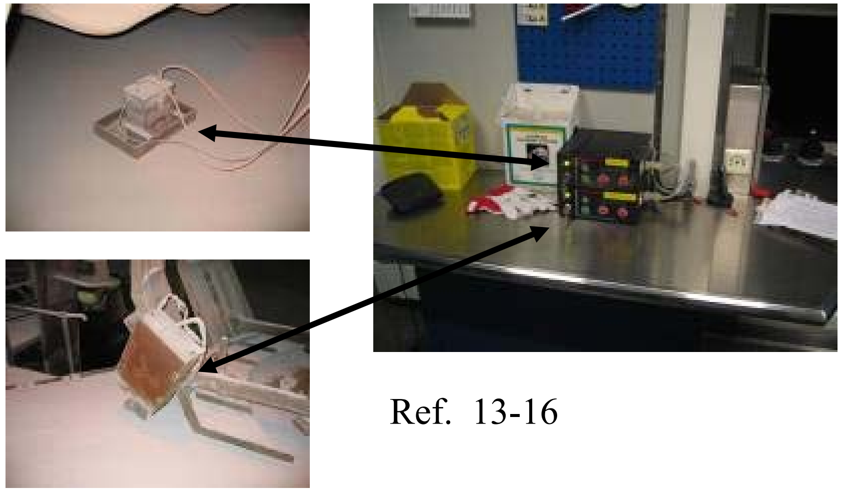
Steel pole

Steel scrap to decrease background radiation as much as possible.

Steel plates.

3. Radiation detection after smelting

Ref	Type of monitor	Location
13	1x NaI scintillator	Line 1, molten steel and slag monitoring, redundant with 14
14	1x NaI scintillator	Line 1, molten steel and slag monitoring, redundant with 13
15	1x NaI scintillator	Line 2, molten steel and slag monitoring, redundant with 16
16	1x NaI scintillator	Line 2, molten steel and slag monitoring, redundant with 15
17	2x NaI scintillators	FeCr-converter, molten FeCr and slag monitoring
18	1x NaI scintillator	Automatic slag sample measurement in laboratory
19	1x CsI scintillator	Line 1, slag sample measurement



Ref. 13-16

Ref. 17

4. Handheld instruments

Ref	Type of monitor	Purpose of use
1	GR-110 Telescope arm NaI-detector	To establish the radiation : - in scrap yard - ladles after the radiation incidence has been happened - all over the melting shop after the radiation incidence has been happened
2	GR-135	Spectral analyzer to clarify the radionuclide after the incidence has been happened
3	TSA PRM-470B	To establish the radiation in scrap yard
4	RD-110	To check the dose rate value [µSv/h]

Ref. 1

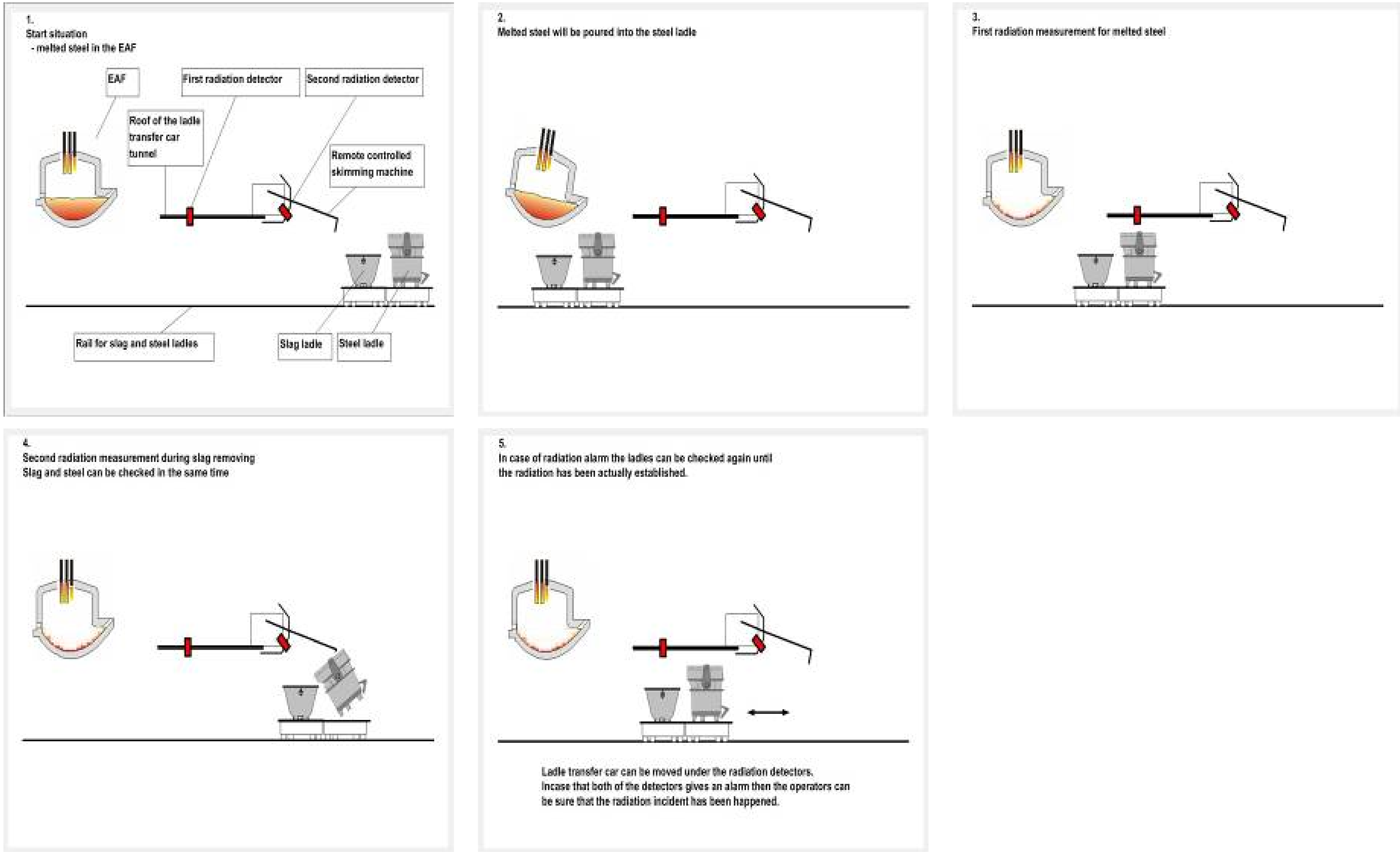
Ref. 2

Ref. 3

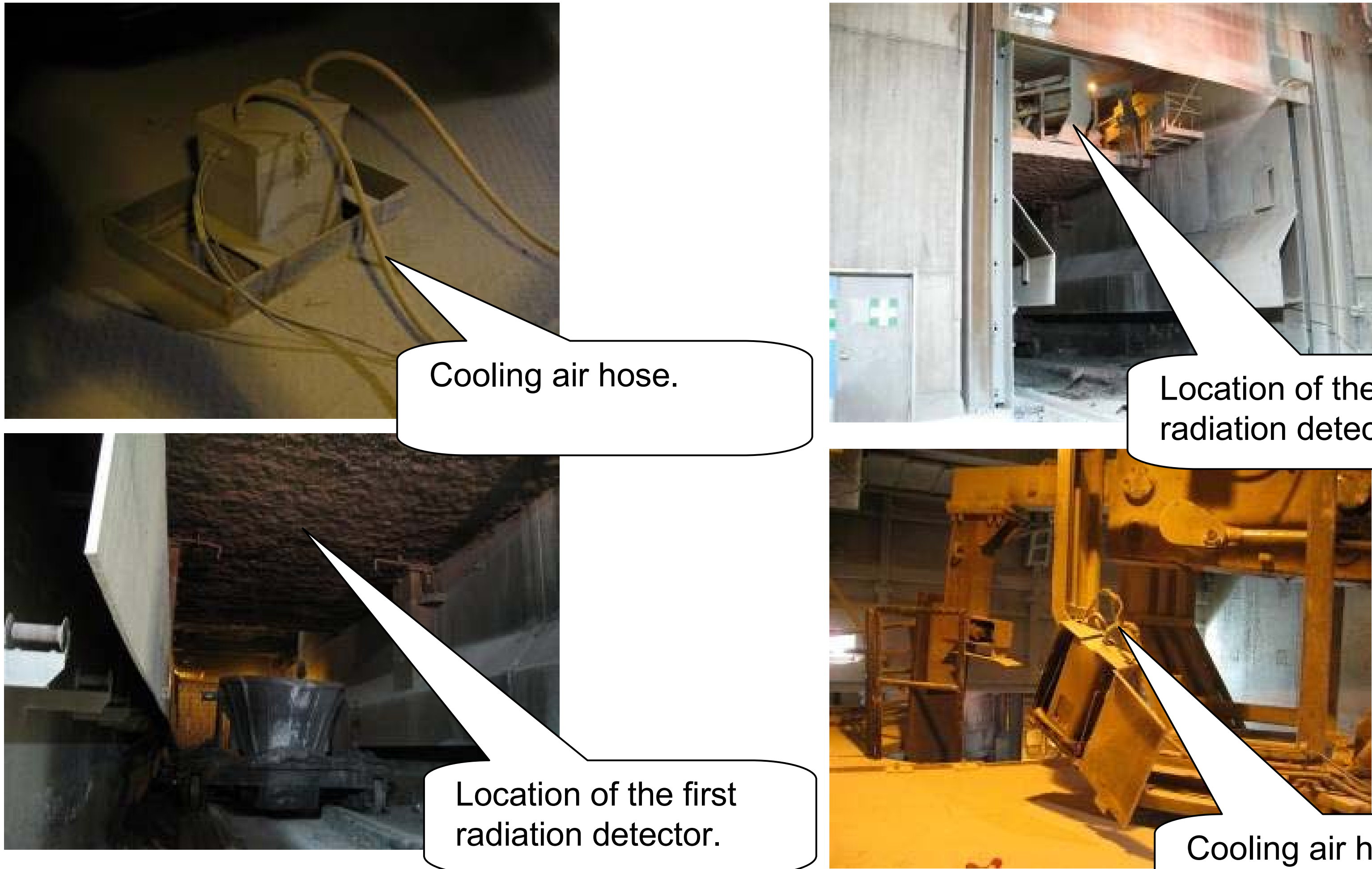
Ref. 4

OUTOKUMPU

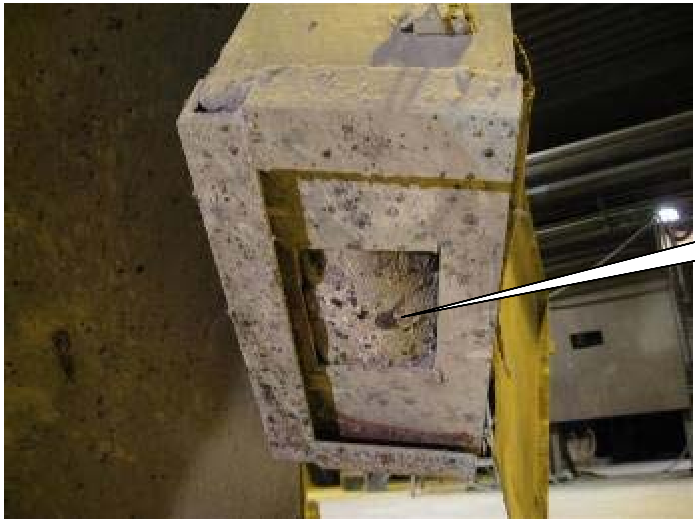
5. Where and how radiation is detected after smelting



Locations and cooling of the radiation detector installations



Detector head installation and measuring window temperature protection



Measuring window covered with temperature resistant textile.

6. Procedures after melting of a radiation source

1	Immediate works after a radiation incidence at the melt shop
2	Works at the smoke and dust filter plant: - Stop the smoke and dust filter - Planning how to minimize the amount of contaminated material - Stopping the transport of contaminated dust to recycling plant - Determine the moment when the transport to recycling plant can be started again
3	Works at masonry work shop: - Plans for the special dismantling works for contaminated furnaces and ladles - Dismantling for the contaminated furnace and ladles - Taking care for the contaminated material
4	Finding the final placement for the contaminated waste

Immediate works after radiation incidence at melt shop

1.Innitiate respirator usage:
- The workers inside the melt shop must use respirators.
- This rule affects all people, who are working inside the factory hall where the contaminated dust can spread to.
- The respirators have to be used until air purity can be established.
- During the last Am-241 incidence on 18.10.2008 respirators were used for about 24 hours.
- For Am-241 the respirators must meet the minimum P3 requirements of the EN140 standard.

2. Give an overall radiation alarm for melt hall.
- Check for individuals with the possibility of internal contamination (i.e. persons in the factory hall during the melt)

3. Limitation of the works inside the factory hall:
- All work inside the factory hall has to be minimized until air purity has been established and the factory hall is cleaned.
- Only the most important process work and emergency work are allowed.

OUTOKUMPU

...continued

4. Investigate the radionuclide:
    - The incidence handling depends a lot of melted radionuclide.
    - At Tornio Works we have been able to determine the Am-241 radionuclide immediately after the radiation alarm.
5. Notification to Finnish authorities:
    - The notification to authorities has been given about 30 minutes after radiation alarm.
    - Together with authorities we have planned the cleaning methods and other works with special radiation considerations.
6. Limitation of contaminated dust dispersal:
    - All slag ladles and other contaminated material are carried outside the factory hall.
    - The slag ladles are coated with sand.
7. Start to organise the works at smoke dust filter plant.
8. Start to organise the factory hall cleaning work
9. Installation of the air samplers for radiation detection.

Into action...

Checking measurements from slag and steel ladle

Installation of air samplers for dust collection

Maximum measured values for air activity in the 18.10.2008 event were 1,5 and 3,5mBq/m3

OUTOKUMPU

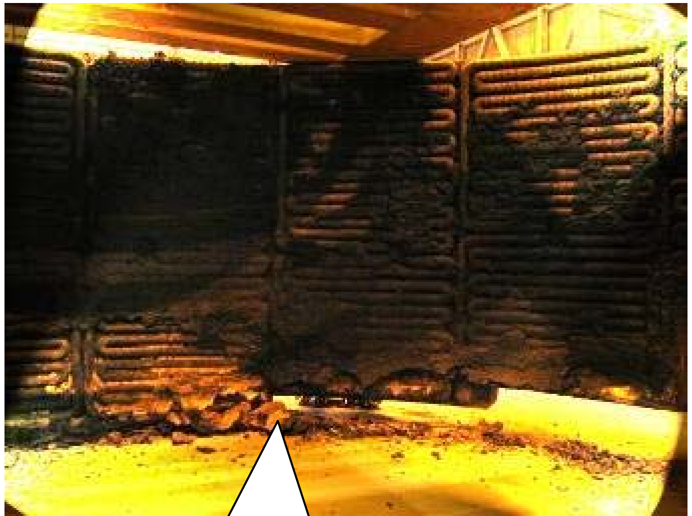
Works at masonry work shop

Ladle dismantling work at masonry work shop

EAF preliminary cleaning with
high pressure water.

EAF water cooling section
waiting for cleaning.

EAF dismantling work



Seacontainer for radioactive waste. Open roof.

Contaminated EAF water cooling elements.

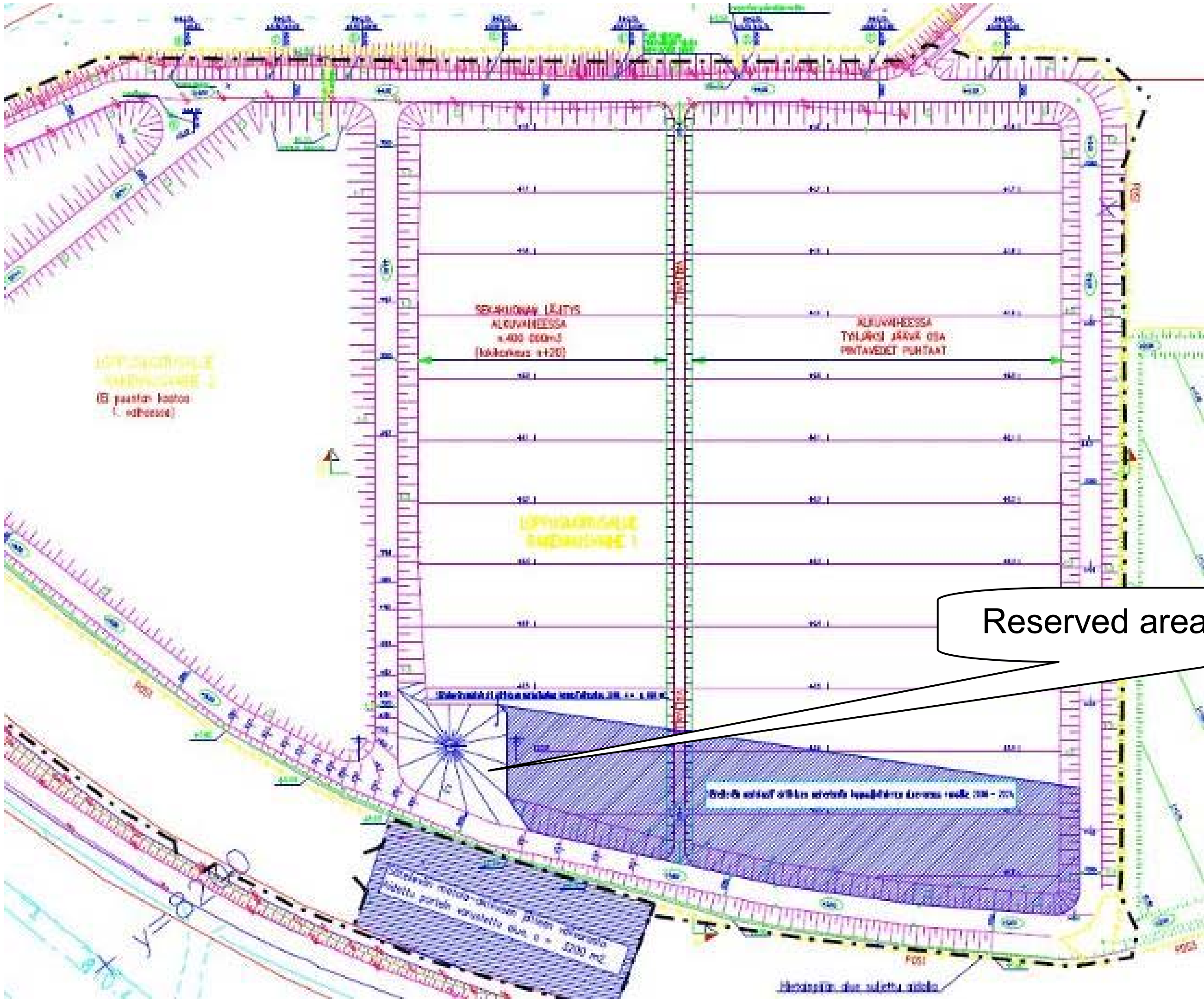
7. Final placement for radioactive waste

	Date of incidence	Maximum measured values for air activity	Maximum measured values for dust samples gathered from factory hall floor	Maximum measured values for slag activity / weight	Maximum measured values for steel activity	Maximum measured values for foundry dust activity / weight
		[µBq/m3]	[Bq/kg]	[Bq/kg] / [ton]	[Bq/kg]	[Bq/kg] / [ton]
1	24.11.2006	200	80	230 000 / ~100	0,5	540 / ~400
2	1.11.2007	500	300	100 000 / ~50	4	450 / ~200
3	18.10.2008	3500	290	136 000	0,9	224

Slag ladles and seacontainers containing foundry dust waiting for the final placement

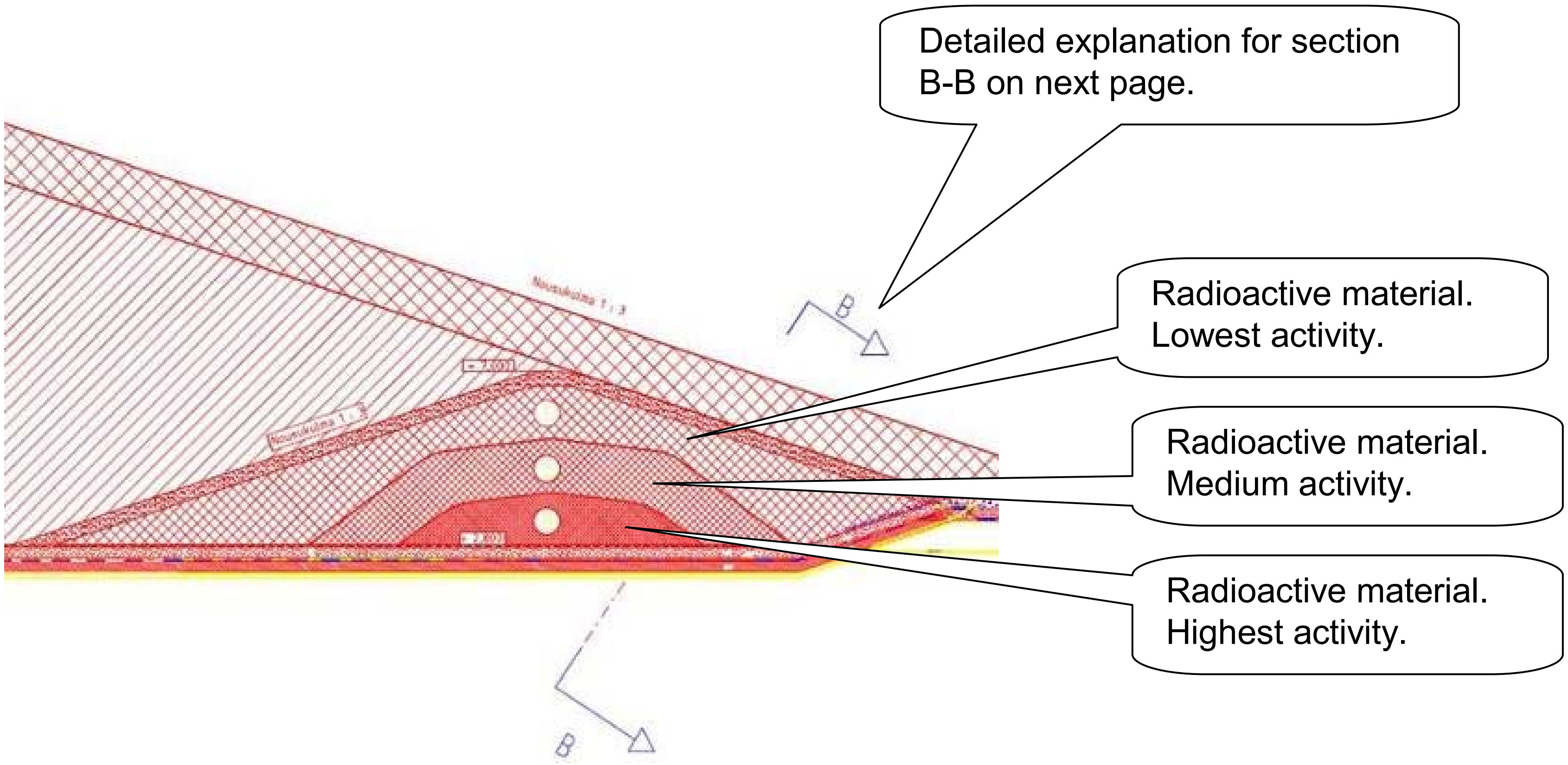
OUTOKUMPU

New waste site



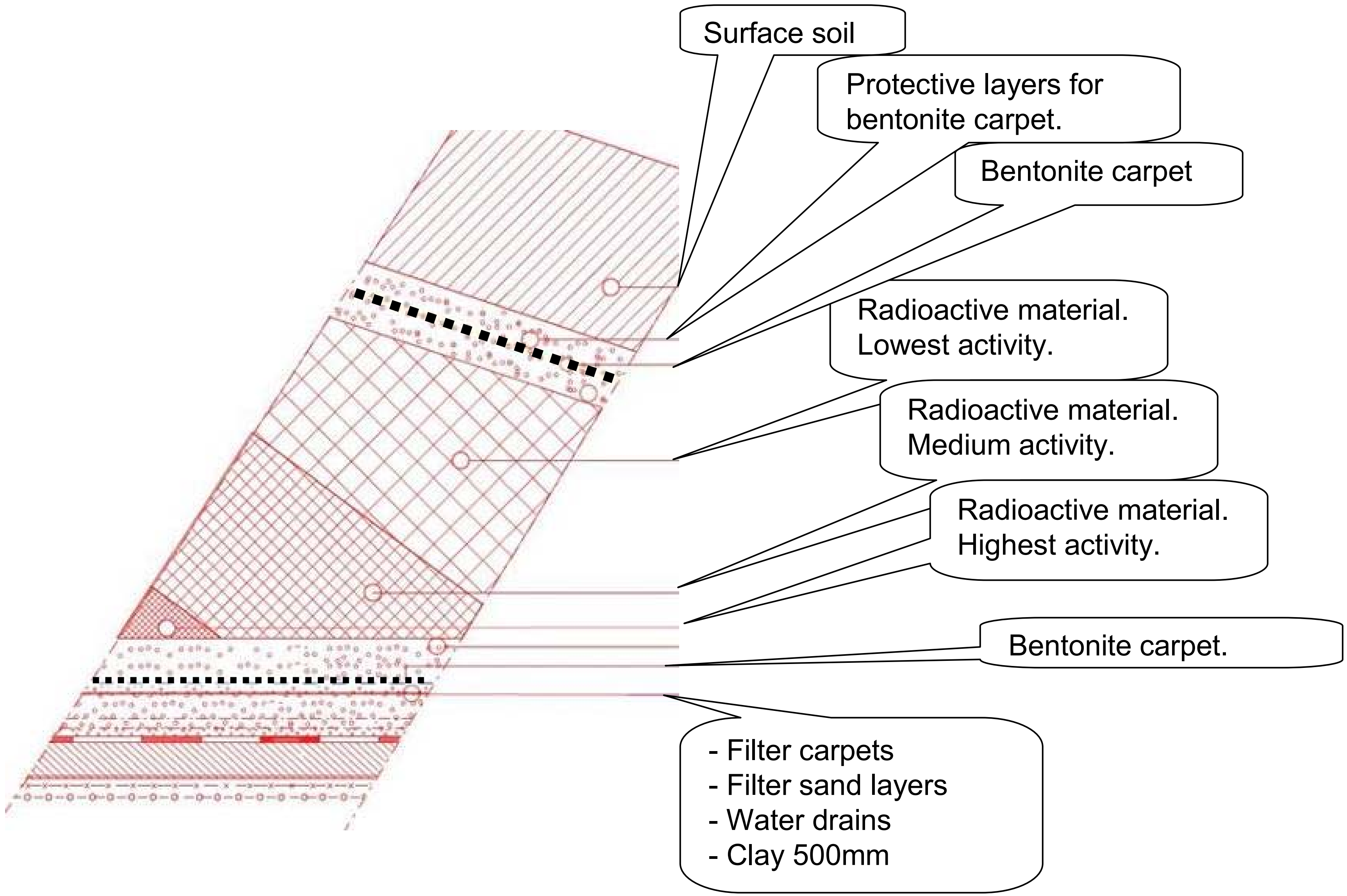
Reserved area for radioactive materials.

Final placement for radioactive material

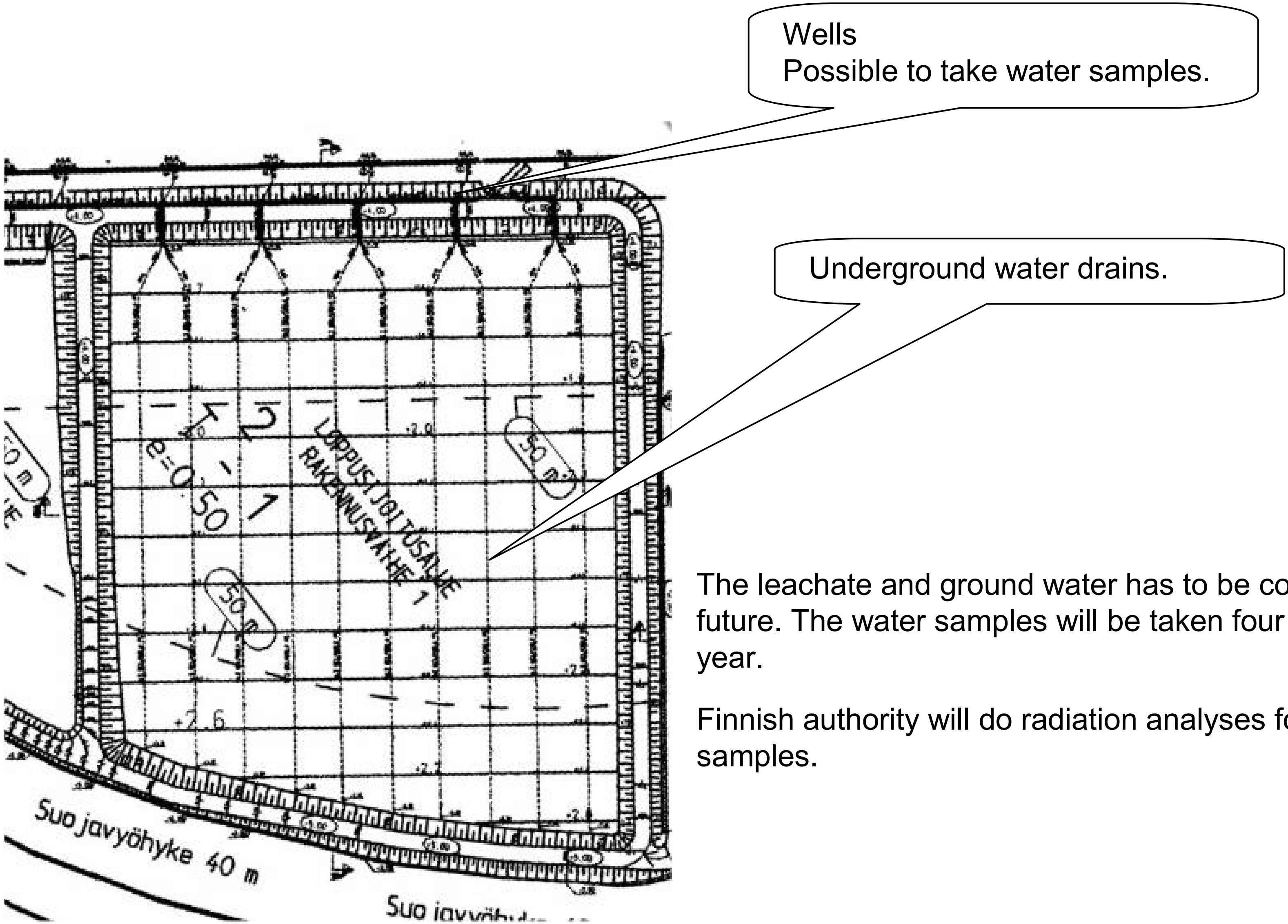


OUTOKUMPU

Previous picture section B-B



Leachate sampling.



The leachate and ground water has to be controlled for future. The water samples will be taken four times per year.

Finnish authority will do radiation analyses for water samples.

Conclusions (my own)

- For good detection results, a defence in depth type of approach for monitoring is required.
- Even with sophisticated defence in depth monitoring arrangement, radioactive sources can get through.
- All parts of the process should be monitored.
- Be prepared.
- Emergency management plans are not enough, training is also required.