

Evaluation and Survey of a Thorium Contaminated Legacy Site in Austria



Fabian Rechberger
Department of Technical Radiation Protection

Historical Usage of Uranium

- Discovery of radioactivity → uranium ore/pitchblende residues
- Austria: Joachimsthal mine (CZ)
- Marie Skłodowska Curie: discovery of radium and polonium in the tailings of the uranium colour production in Joachimsthal
- Pitchblende → production of Radium
- Ra-226 + progeny
 - Rn-222
 - Pb-210 and Po-210

Historical Usage of Thorium

- Monazite sands → production of Thorium
- Carl Auer von Welsbach inventor of the incandescent light mantle
 - also called the 'Welsbach mantle'
- Th-232 + progeny
 - Ra-228
 - Rn-220 (Thoron)
- Several production sites in Austria (Vienna)



<http://creativecommons.org/licenses/by-sa/3.0/>
Anton on wikipedia.de

Initial Situation in Austria

- Bullet points according to EU-BSS
(Section 6, Art. 100/101/102)
- Member States shall assign responsibilities for:
 - Implementation of strategies for the management of existing exposures
 - Coordination between relevant parties
 - Evaluation of remedial and protective measures
 - Provide information to exposed populations on potential health risks

Regulatory Limits in Austria

Dose limits:

Individual members of the public: 1 mSv/a

Occupationally exposed worker category A: 20 mSv/a

Occupationally exposed worker category B: 6 mSv/a

- Guidance Level for natural sources of radiation

<1 Bq/g for all radionuclides:
dosage for public <1 mSv/a

>1 Bq/g for any radionuclide
→ exposure scenario

Plan of Action



1. Identification of NORM legacy sites
2. Characterization of the legacy sites
3. Secure/decontaminate the site
4. Waste management strategy

Identification



- Competent authority: BMLFUW (Austrian Federal Ministry for Agriculture, Forestry, Environment and Water Management)
- Identification of legacy sites (research) → legacy catalogue
- Prioritizing based on radiological risk for population
- Confirmation of contamination and evaluation of its extent (AGES)

Characterisation

- Characterization
 - Nuclides (Th/U)
 - Spatial Distribution
 - Exposure scenario (if necessary: simulations)
- Cooperation with specialists for chemical legacy sites
- Correlation between chemical and radiological contamination?

Remediation of Contaminated Sites

- Secure \longleftrightarrow Decontaminate
- Indoor /outdoor, size of the area, solubility of material, etc.
- Secure: preservation of evidence (continuous sampling), stable contamination profile



- Dose assessment (risk based)
- Ensuring radiation protection for workers/participants of the public during remediation actions
- Continuous monitoring of the contamination status (wipe tests)
- Cooperation with decontamination experts
- Confirming success of remediation (comprehensive sampling: soil, water, air, etc.)
- Waste disposal

Soft Skills During Remediation



- Coordination of all relevant parties (competent authorities, special companies, owner, etc.)
- Information of local residents/workers
- Documentation
- Preservation of Evidence (e.g. photos)

Waste Disposal

- Activity concentration $>1 \text{ Bq/g}$ →
- Dose assessment
- NORM waste (disposable) ↔ radioactive material
- Case by case decision → finding a suitable landfill for NORM
- Adopted NORM waste strategy for existing exposure will be developed (EU-BSS Art. 102)
- Necessity of a NORM landfill / use of existing landfills

Characterisation



Characterisation



Characterisation

Room ID	Description	Radon		Thoron		Dose ¹
		(Bq/m ³)	(%)	(Bq/m ³)	(%)	(mSv/a)
A2	Work place	23	26%	164	17%	2,62
A3	Work place	<21		33	45%	0,52
A4	Work place	35	20%	98	26%	1,57
A7	Work place	22	24%	41	42%	0,66
B3	Storage Room	<21		40	30%	0,64
B5	Contaminated Wall (5 cm)	32	311%	9187	9%	146,99
B5	Storage Room	<21		57	24%	0,92
D1	Work place	<21		67	26%	1,08
D2	Work place	<21		16	85%	0,26
D2	Work place	26	21%	<9		<0,15
D3	Work place	26	21%	13	117%	0,22
D3	Work place	28	20%	<9		<0,15
D4	Work place	36	19%	12	155%	0,19
D4	Work place	63	15%	<9		<0,15

¹Dose calculation according to UNSCEAR 2006

Characterisation



Characterisation/Decontamination



Decontamination



Decontamination



Preservation of Evidence



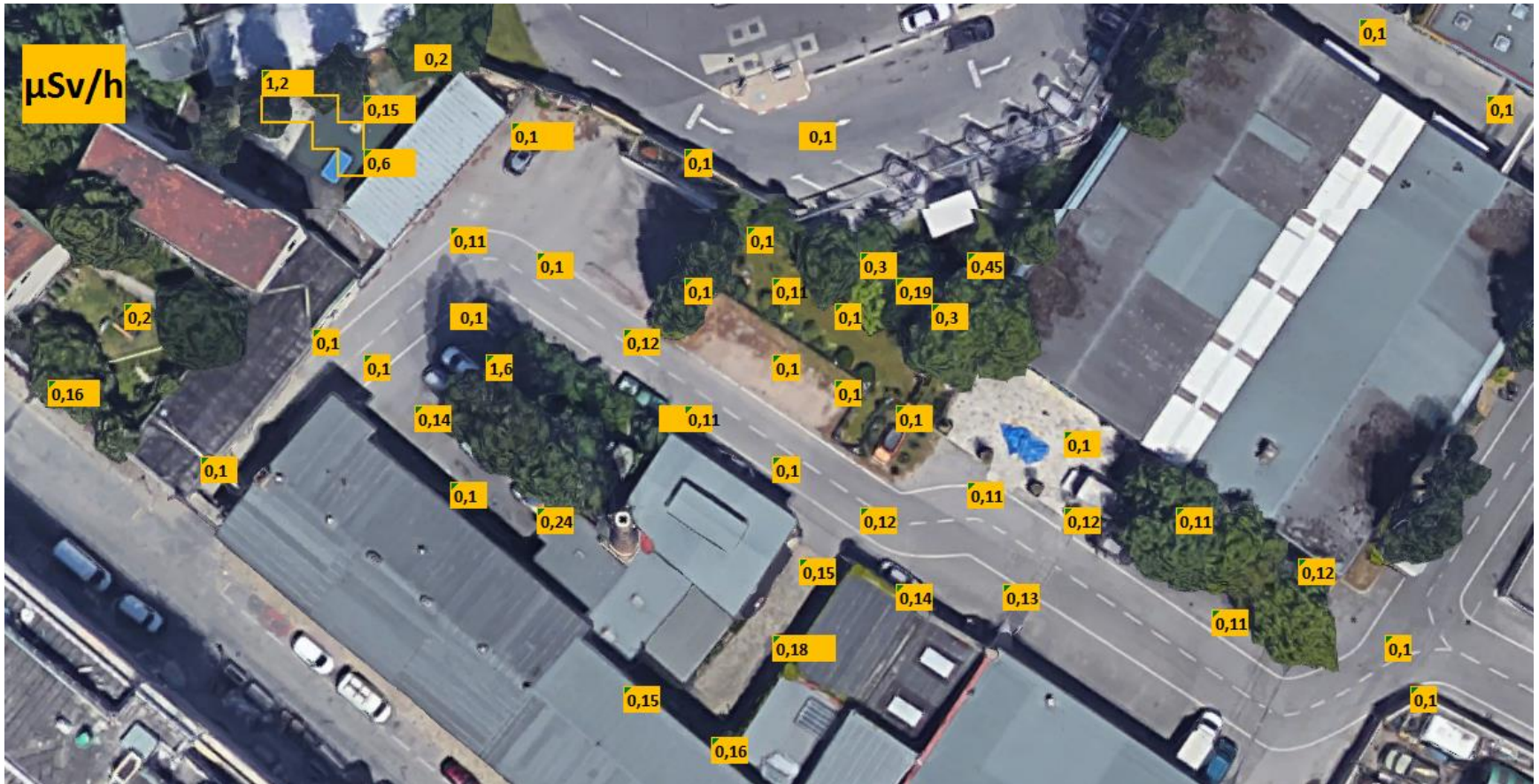
Waste Classification



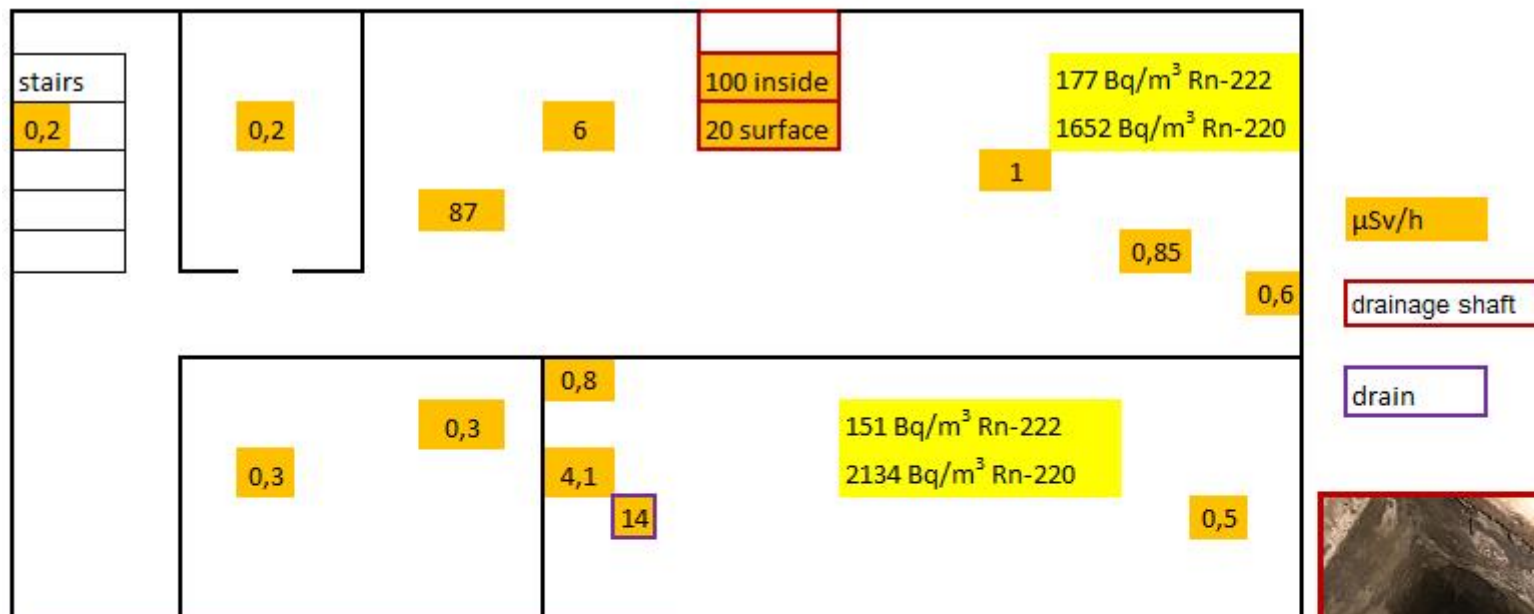
Waste Disposal

- Dose assessment/estimation
- NORM waste (disposable) ↔ radioactive material
- Suitable criteria: activity concentration
- Decision via In-situ measurement (measurement time ~500 s)
- 5 % radioactive waste (>20 Bq/g)
- 10 tons disposable waste (NORM) (avg. 2,4 Bq/g)

Forecast



Forecast



Challenges

- No documentation of usage of radioactive material
- Th-232 was found in a cellar
 - Material was deposed
 - Contaminated spots found in different buildings
 - Contamination distributed through bombing in WWII?
- Contamination in drainage shaft
 - Is the ground water contaminated?
- High Rn-222 activity concentration inside one building

Summary

- How does the survey of legacy sites work in Austria?

