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Waste characterisation in a Swedish uranium facility during decommissioning using nuclide vectors and nuclide specific measurements

IFE/HRP/IAEA/NEA Decom workshop

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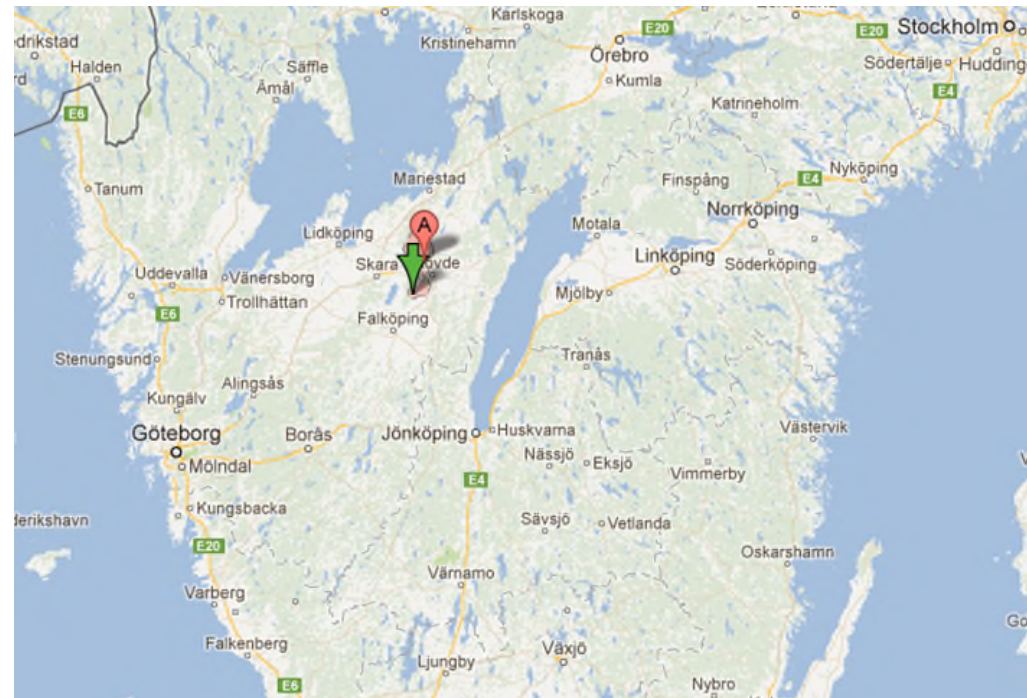
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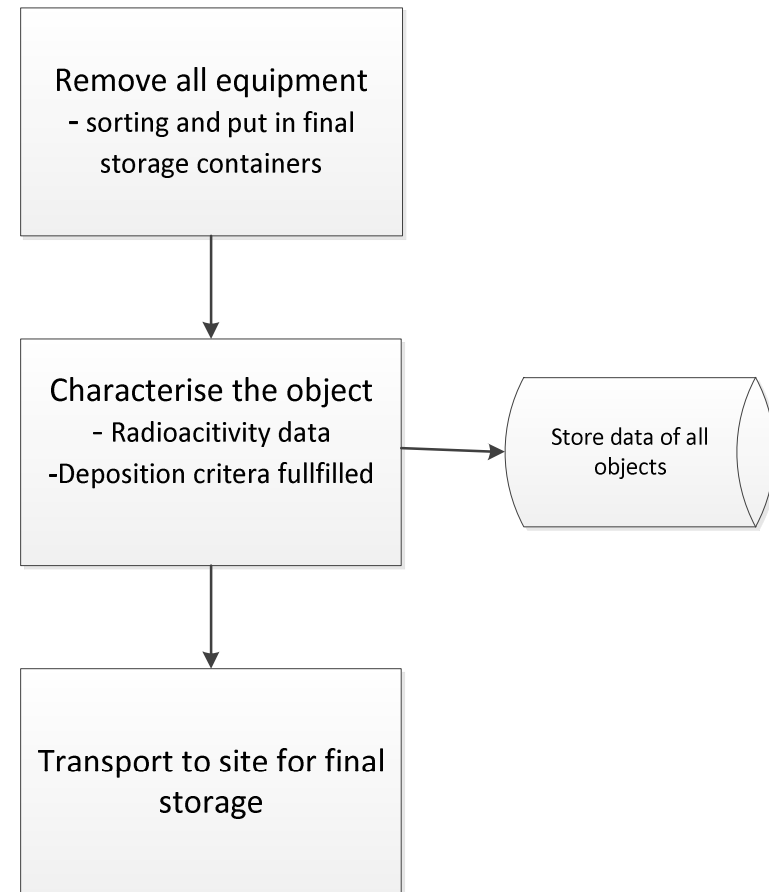
Ranstad – short background

- Former site for uranium extraction and recycling of uranium contaminated waste
- Located near Skövde in the south of Sweden – a uranium rich landscape
- Under decommissioning during the last decade



Clear out the buildings – important for all decom projects

- Control programme
 - Describing the procedure
 - Conditional clearance criterias



Clear out the buildings #housekeeping

- Many objects
 - 1200 containers, 140 tonnes
- Different materials
- Mixture of uranium isotopes
 - Broken chains –unknown relationships
 - Poor gamma yield, low energies



Characterisation of waste can be time consuming

- *"If you have endless of time (and money) you can produce radiation measurements with a very good precision and get a very nice characterisation of the radioactivity contents"*
- Optimize the procedure (get characterisation info that is good enough)
- How can you decrease the characterisation/measurement time?
- "Pack big, measure small"



Characterisation – what needs to be determined

- Enrichment of U-235 – natural or enriched
- Uranium concentration and total amount of uranium in grams
- Nuclide specific limits

=> Gamma nuclide specific measurements

	Conditional free release limits
	kBq/kg
U-238+	100
U-234	100
Th-230	10
Ra-226+	100
Pb-210+	100
U-235+	100
Pa-231	10
Ac-227	10
Th-227	100
Ra-223+	1000
Th-232+	10
K-40	1000

Optimize the time

- How do you handle hard to measure nuclides?
- Th-230 (75380 years)
 - 67,7 keV (0.38%)
- U-234 (245500 years)
 - 53,2 keV (0.12%)
 - 120.9 keV (0.03%)



Sorting – importance for characterisation

- Material sorting in categories of burnable waste, glas, metal, chemicals etc.
 - Organic waste can not be placed in the repository
 - Better efficiency calibrations
- Pulse rate measurement – 3 levels
 - Improve measurement uncertainties
- Containers
 - High packing grade

Analyze and Report

- Calculate the activity concentration for all isotopes
- Nuclide relationships
- Measured values /detection values

Variabel	Värde
Prov	2014-1363
Mätstart	2014-11-18 13:11
Provvikt kg	517
Mättid s	3029
U ppm	477.8
g Uran	247.0
MDA g Uran	12.6
U-235 anr %	2.28
g U-235	5.63
MDA g U-235	0.06
Int summa	0.85
Akt tot Bq/kg	3.82E+04
Akt tot Bq	1.98E+07
Max kolli (kg)	108

	Mätvärde	MDA	Nuklidspec. Aktivitet (Bq/kg)	Inteckning
U-238 Bq/kg			5.81E+03	0.06
Pa-234m Bq/kg	8.35E+03	3.00E+02	8.35E+03	
Th-234 Bq/kg	3.27E+03	4.67E+02	3.27E+03	
U-234 Bq/kg		1.97E+04	2.08E+04	0.21
Th-230 Bq/kg		4.93E+03	4.93E+03	0.49
Ra-226 Bq/kg		1.38E+02	1.38E+02	0.00
Pb-214 Bq/kg	1.41E+01	8.21E+00	1.41E+01	
Bi-214 Bq/kg	8.86E+00	1.01E+01	8.86E+00	
Pb-210 Bq/kg		5.36E+03	5.36E+03	0.05
U-235 Bq/kg	8.70E+02	8.67E+00	8.70E+02	0.01
Pa-231 Bq/kg		1.25E+02	1.25E+02	0.01
Ac-227 Bq/kg			3.83E+01	0.00
Th-227 Bq/kg		3.36E+01	3.36E+01	
Ra-223 Bq/kg		2.84E+01	2.84E+01	
Rn-219 Bq/kg		3.59E+01	3.59E+01	
Pb-211 Bq/kg		8.57E+01	8.57E+01	
Bi-211 Bq/kg	3.83E+01	2.23E+01	3.83E+01	
Th-232 Bq/kg			9.58E+00	0.00
Ac-228 Bq/kg		1.12E+01	1.12E+01	
Pb-212 Bq/kg		9.58E+00	9.58E+00	
Tl-208 Bq/kg		1.20E+01	1.20E+01	
K-40 Bq/kg		4.11E+01	4.11E+01	0.00
Am-241 Bq/kg		9.01E+01	9.01E+01	0.01
Co-60 Bq/kg		1.94E+00	1.94E+00	0.00
Cs-137 Bq/kg		3.98E+00	3.98E+00	0.00

Conclusions and expericences

- Good procedures increases the throughput of material/waste
- Sorting of material was the key for the characterisation
- Involve people with deep understanding for radioactivity measurements early in the process

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