The field course on NORM in Poland

Preliminary program

Monday

Time	Title/subject	Type	Lecturer
8:00- 10:00	Source of NORM, NORM industry, NORM vs. natural background, HBRA (high background radiation area)- NORM examples: radium rich brines from coal and oil/gas industry, phosphogypsum piles - implied environmental effects and possible mitigation methods	Lecture	GIG/NMBU
10:00-12:00	Main processes (physical, chemical, biological/ecological) ruling behavior (migration in terrestrial and aquatic environment, atmosphere) of natural radionuclides and metals in environment (abiotic and biotic environment, TF, Kd in particular ecosystems) – and sampling implications	Lecture	SU
12:00 -13:30	Radionuclides speciation, mobility and bioavailability - sequential extraction procedure and fractionation techniques	Lecture	NMBU
13:30-14:00	Lunch break		
14:00- 15:30	Features of sampling and sample preparation (soil cores/profiles, soil gas/soil solution, bottom sediments, water , biota – including assumed way of accumulation/concentration – TF, Kd, ingestion, inhalation, foliar interception)	Lecture	GIG
15:30-17:00	Regulation context (requirements resulting from the new European and IAEA BSS) – and overlapping regulation dealing with non-radioactive pollutants, i.e. organic and inorganic chemicals)	Lecture	NRPA

Tuesday (field exercises)

Time	Title/subject	Type	Lecturer
8:00 – 9:00	Drive to the site		
9:00 – 11:00	Soil, soil solution and biota sampling – methodology & statistical rules – records and documentation	Field exercise	SU/GIG/NMBU
11:00 – 13:00	NORM contaminated sites identification - sampling of soil cores/profiles	Field exercise	SU/GIG/NMBU
13:00 – 13:30	Lunch break		
13:30 – 17:00	Bottom sediments sampling (cores/profiles)	Field exercise	SU/NMBU

	and water sampling - water fractionation		
17:00 – 18:00	Return to the lab		

Wednesday (field exercises)

Time	**Title/subject**	**Type**	**Lecturer**
8:00 – 9:00	Drive to the site		
9:00 – 13:00	in situ gamma spectrometry and dose rate mapping	Field exercise	GIG
13:00 – 13:30	Lunch break		
13:30 – 16:00	radon in soil gas measurement and radon exhalation measurement	Field exercise	GIG
16:00 – 17:00	Return to the lab		
19:00	*Joint dinner*		

Thursday

Time	**Title/subject**	**Type**	**Lecturer**
8:00- 9:00	Radium measurement – the first stage of radiochemical procedure	Laboratory exercise	GIG
9:00-10:00	NORM metrology rudiments (alpha and gamma spectrometry, liquid scintillation spectrometry (LSC), radiochemistry , mass spectroscopy, track and TL detectors)	Lecture/laboratory exercise	GIG
10:00-11:00	Radium measurement - radiochemical procedure - continuation	Laboratory exercise	GIG
11:00-12:00	High resolution gamma spectrometry - direct measurement of radium 226, correction for lead 210, disequilibrium effects	Lecture/laboratory exercise	GIG
12:00-13:30	Biota samples preparation	Lecture/laboratory exercise	GIG
13:30-14:00	Lunch break		
14:00- 15:00	Radium measurement by LSC	laboratory exercise	GIG
15:00- 17:00	Dose (external ,internal) to biota/humans calculation/assessment (ERICA, RESRAD)	Lecture/ computational exercise	NRPA