

Detailed course contents:

| | <i>Title/topics</i> | <i>hours</i> | <i>class type: lecture/exercise</i> |
|------------|--|--------------|---|
| I | <i>NORM and radon body of knowledge</i> | 10 | 10 |
| 1 | <i>The set of accepted and agreed upon standards and nomenclatures pertaining to the field of NORM and related activities: definitions and terminology, natural radionuclides occurrence and sources of NORM, sequential decay and disequilibrium in natural decay series, differences between NORM and TENORM; NORM vs. natural background, HBRA (high background radiation area)</i> | 3 | L |
| 2 | <i>Legal context of NORM - radiation protection and mutual interconnections with regulation dealing with non-radioactive waste, features of occupational exposure, protection of environment in the light of recent ICRP recommendations, clearance and exemption levels, liquid NORM, authority control - notification, graded approach.</i> | 2 | L |
| 3 | <i>Radon isotopes - sources and migration in human environment, exposure scenarios, decay product and derived effective dose evaluation.</i> | 2 | L |
| 4 | <i>Typical scenarios of environmental exposure caused by (liquid, gaseous and solid NORM) and natural radionuclides migration in environment, radionuclides fractionation, fragmented decay series, key parameters used for exposure evaluation, associated pollution.</i> | 2 | L |
| 5 | <i>NORM affected legacy sites characterisation</i> | 1 | L |
| II | <i>Rudiments of the methodology and tools for systematic identification and characterization of potential NORM exposure situations</i> | 9 | 5/4 |
| 1 | <i>The systematic approach to identification of NORM involving industries and processes – four tiers method - mineral resources classification, analysis of industrial processes, commodities, products, and waste streams characterisation</i> | 2 | L |
| 2 | <i>Systematic identification and characterization of potential NORM exposure situations and following data collection using predefined templates/registers</i> | 2 | L |
| 3 | <i>NORM survey - dedicated to naturally occurring radioactive materials (NORM) questionnaire as a supporting tool for NORM exposure situation identification</i> | 1 | L |
| 4 | <i>Multiple choice test and discussion (Block I & II)</i> | 1 | E |
| 5 | <i>Preparation of a country specific NORM inventory – group exercise</i> | 3 | E |
| III | <i>NORM and radon monitoring rudiments</i> | 11 | 11 |
| 1 | <i>NORM characterisation: crucial radionuclides identification, disequilibrium in natural decay series, measurement technique selection, interpretation of results obtained in the light of sequential decay, natural background subtraction.</i> | 2 | L |
| 2 | <i>Overview of laboratory and field measurements methods</i> | 1 | L |
| 3 | <i>Dosimetry - applied measurement techniques and measurement strategies</i> | 2 | L |
| 4 | <i>Introduction to Radon and RP measurement, free fraction and aerosols, equilibrium between radon and radon progeny, radon measurements vs. radon progeny (PAEC) measurements, dose conversion factors</i> | 2 | L |
| 5 | <i>Modelling: simulation of radionuclides behaviour under different conditions for dose/risk evaluation</i> | 2 | L |
| 6 | <i>Monitoring and sampling strategies - identification of sampling units, preparation sampling plan, data interpolation/evaluation</i> | 2 | L |

| | | | |
|-----------|--|-----------|--------------|
| IV | Special considerations of NORM | 5 | 4/1 |
| 1 | <i>NORM in building materials</i> | 2 | L |
| 2 | <i>Naturally occurring radionuclides (NOR) in drinking water</i> | 2 | L |
| 3 | <i>Committed dose calculation cause by intake via water consumption derived radionuclides activity concentration limits – individual exercise</i> | 1 | E |
| V | Occupational exposure and exposure of members of the public caused by NORM | 13 | 8/5 |
| 1 | <i>External exposure: identification of exposure sources and typical exposure scenarios for members of the public and in NORM involving industries, identification of most sensitive groups</i> | 2 | L |
| 2 | <i>Intake and internal exposure - important natural radionuclides, committed effective dose, uranium, and thorium vs their decay product</i> | 2 | L |
| 3 | <i>Exposure to radon and radioactive aerosols and decay products fractions: identification of exposure sources and typical exposure scenarios for members of the public and in NORM involving industries, identification of most sensitive groups - underground workplaces</i> | 2 | L |
| 4 | <i>Modelling of radon and thoron dispersion in systems (working/living environment) with enforced ventilation: application of Ventgraph symulation system</i> | 2 | L/E |
| 5 | <i>Dose evaluation and workplaces/workers classification - graded approach to occupational exposure monitoring and evaluation, work places classification and reporting, communication.</i> | 1 | L |
| 6 | <i>Multiple choice test and discussion (Blocks III, IV and V)</i> | 1 | E |
| 7 | <i>Effective dose evaluation for multi-source exposure situations (typical for NORM) – group exercise</i> | 3 | E |
| VI | Exercises - application of gathered knowledge - real example evaluation and proposed solutions discussion | 12 | 1/11 |
| 1 | <i>A company reprocessing NORM residues (tin and lead re-melting processes)</i> | 3 | E |
| 2 | <i>Natural lake contaminated by radium rich brines</i> | 3 | E |
| 3 | <i>The old silver mine</i> | 3 | E |
| 4 | <i>Examples of practical solutions applied in cases of planned and existing exposure situations monitoring based on coal mining - exposure to NORM and radon/radon progeny</i> | 3 | E2/L1 |
| | in total | 60 | 39/21 |